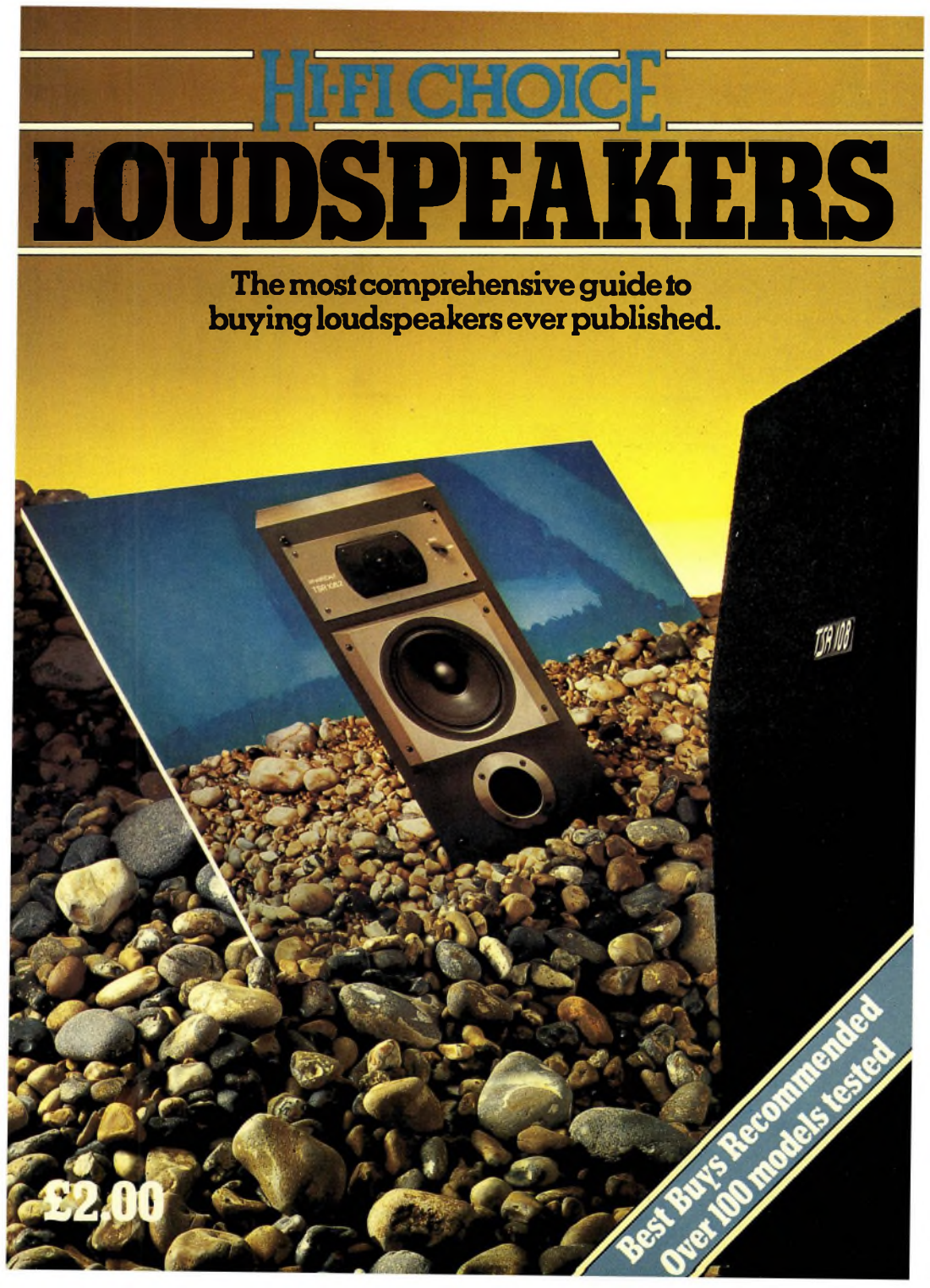
HI-FI CHOICE

LOUDSPEAKERS

The most comprehensive guide to buying loudspeakers ever published.



the beginning!

The beginning of a record playing chain is the record. If the turntable does not extract the musical information from the record, it is lost for ever. No amount of money spent further along the chain, on speakers for example, will recreate a signal which is lost at the beginning. In fact, you may only amplify original deficiencies by reproducing them more faithfully.

The Linn Sondek LP12 transcription turntable is designed and manufactured to extract as much information as possible from the modern long playing record. It is, quite simply, the link missing in so many play-back systems between your ear and the recorded performance.

If you can appreciate the differences between listening to a record on a good system and hearing something that approaches live music, then the logical place to start is with the Linn Sondek LP12.

A product of integrity which offers proven value and performance.

LP12 LINN SONDEK

simply better!

Linn Products Ltd., Sondek Division, 235 Drakemire Drive, GLASGOW G45 9SZ. Tel: 041-634 0371 (10 lines)
Telex: 77301. ANS. BK. Sondek G. Cables Eurodeck.

HI-FI CHOICE No. 26
LOUDSPEAKERS BY MARTIN COLLOMS

CONTENTS

Author: Martin Colloms
Editor: Paul Messenger

Advertisement Director: Judith Elliott
Group Ad. Director: Stephen England
Art Director: Paul Carpenter
Production Manager: Steve Rowe
Cover Photography by Chris Stevens
Product photography by Trevor Attewell

Typesetting and makeup arranged through Time Brokers, Upper Nordens, High Hurstwood, Near Uckfield, Sussex. Tel: Buxted 3168
Printed by H. E. Warne Ltd., London and St. Austell
Published by Sportscene Publishers Ltd., 14 Rathbone Place, London, W1. Tel: 01-631 1433
Distributed by Argus Distribution Ltd., 12–18 Paul Street, London, EC2
Hi-Fi Choice Series, Sportscene Publishers Ltd.

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

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

If you're going to put speakers in a dustbin you can't use rubbish!

But Kitty wanted speakers that would appeal to the sensitive ears of the other cats in her alley. Tricky, but we met her requirements. She lapped it up and so will you.

No matter what your market our high quality speakers are the cats whiskers and in your cabinets will make the purrfect combination.

We offer a wide range of systems and units plus an unrivalled depth of technical know-how which can produce designs that are right up your alley.

For further details, write to us on company headed paper at the address below.

For the technically minded

SPEAKER SPEC
Power Handling Capacity 80W
Maximum Power 140W
Operating Power 5W
Frequency Range
(DIN) 35-20,000 Hz

Mullard

MULLARD LIMITED, MULLARD HOUSE, TORRINGTON PLACE, LONDON WC1E 7HD TELEPHONE 01-580 6633 TELEX 264341

HOW TO USE THIS BOOK

Each edition of *Hi-Fi Choice* tries to provide a comprehensive guide to a particular link in the hi-fi chain. It is designed to be useful to both the novice and the professional, and can serve as a simple 'buyers guide' or a valuable reference to the product currently available.

The *Editorial Introduction* sets the scene for the project as a whole, giving some of the reasons for decisions that had to be taken, and some warnings concerning interpreting the results.

The *Consumer Introduction* is written mainly for the layman with little knowledge of the whys and wherefores of loudspeakers. It explains in simple terms what a loudspeaker is required to do, and goes on to describe how this is normally attempted, explaining some of the different approaches designers take to the problems. It then discusses the methods we have used to examine the loudspeakers, and explains in general terms the reasons why we have chosen to use these techniques.

The *Technical Introduction* goes into the testing methods in more specific detail, explaining as precisely as possible the test conditions, and giving information which is essential to anyone attempting to interpret the laboratory data. Loudspeaker evaluation is a far from exact science, and while we have aimed to follow internationally recognised standard procedures as much as possible, there are a number of interesting and pertinent areas for which no such standards exist. Consequently some of the data has been derived in an arbitrary and commonsense way, and the reader should understand the assumptions that have been made before making any interpretations.

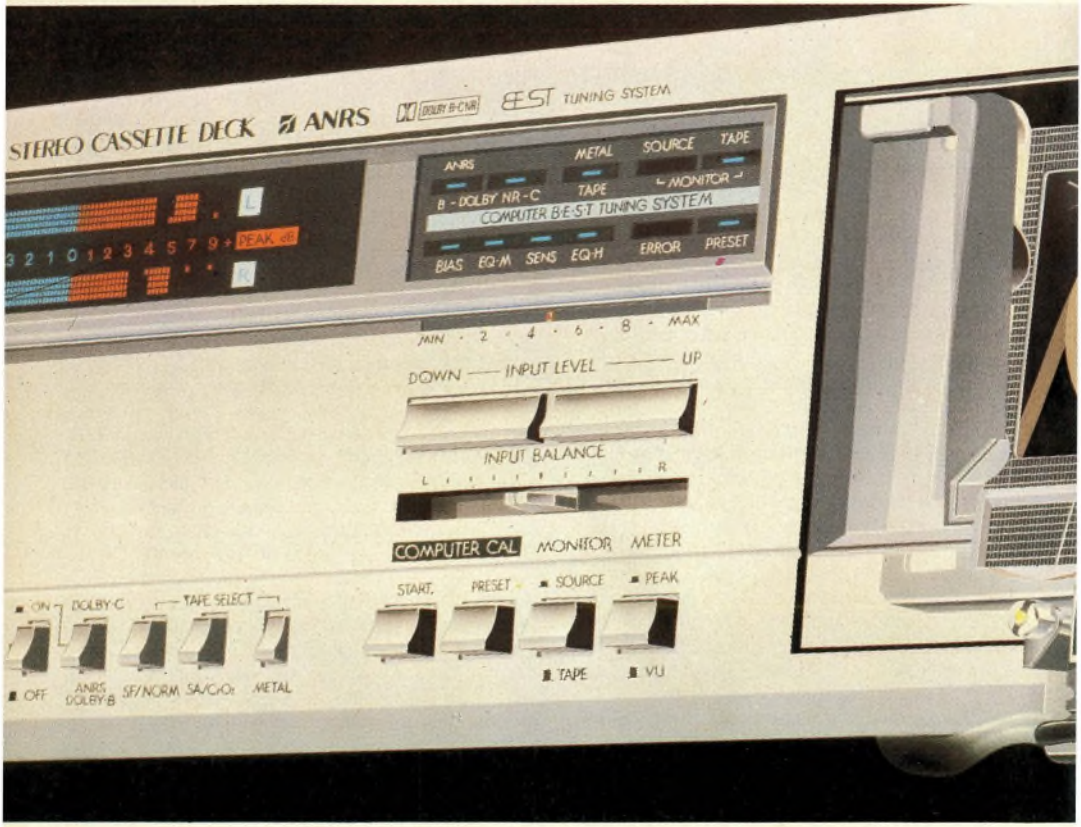
The *Loudspeaker Review* section, some 149 pages in all, gives all the basic data on the 73 different models, plus design details, comments on the panel listening sessions, interpretations of some of the test results, recommendations for achieving optimum performance, and a brief summary on the strengths and weaknesses of the particular designs. Pressure on editorial space has meant that many reviews from the previous projects have had to be summarised to make way for new models. The 37 additional *Summary Reviews* may be found at the end of the alphabetically ordered full reviews.

The *Conclusions* gives the reviewer an opportunity to take a wider view of the test programme results, picking out common factors and trends which a survey of this kind is uniquely able to point out. The *Best Buys and Recommendations* section examines the strengths and weaknesses of the loudspeakers in relation to their typical prices, giving appropriate 'value for money' recommendations and pointing out the inevitable 'trade-offs' that should be taken into account by prospective purchasers.

The *Comparison Chart* is an attempt to collect together all the important information on all the models, which enables their performance to be compared in any particular area. Naturally this 'shorthand' method of presentation inevitably over-simplifies some results, and the reader is advised to refer back to the main text for fuller information. In addition, the chart can provide hours of fun for the amateur statistician! Keeping in mind the maxim that there are 'lies, damned lies, and statistics', it is possible to derive a marking scale for any or all of the parameters. For example, the 'value judgement' factors fall into six categories: poor, acceptable, average, good, very good and excellent; so one could ascribe an appropriate mark between one and six. Likewise, the measured results could also be given a six-point scale by making categories with equal graduations between the 'best' and 'worst' results. Each parameter can then be 'weighted' by a multiplication factor, according to the importance ascribed to that factor by the individual concerned, and when these are all added up, a 'factor of goodness' can be derived according to the individual's chosen weighting. Thus the individual can short-list a number of speakers that best suit his requirements.

One of the great strengths of *Hi-Fi Choice*'s scale of reviewing is that all the items are assessed under the same conditions, so direct comparisons are valid. We should point out, however, that standards and conditions vary so much within the industry that it is thoroughly misleading to try to compare these results with those quoted by manufacturers, or indeed to try and compare one manufacturer's quoted performance with another's, or perhaps another reviewer's.

No cogs, no w



The JVC guide to genuine reel-to-reel quality from a cassette deck.

If you thought that wow and flutter were inevitable on a cassette deck, think again.

The wow and flutter on JVC's new DD-9 cassette deck is a minuscule 0.019% (WRMS)

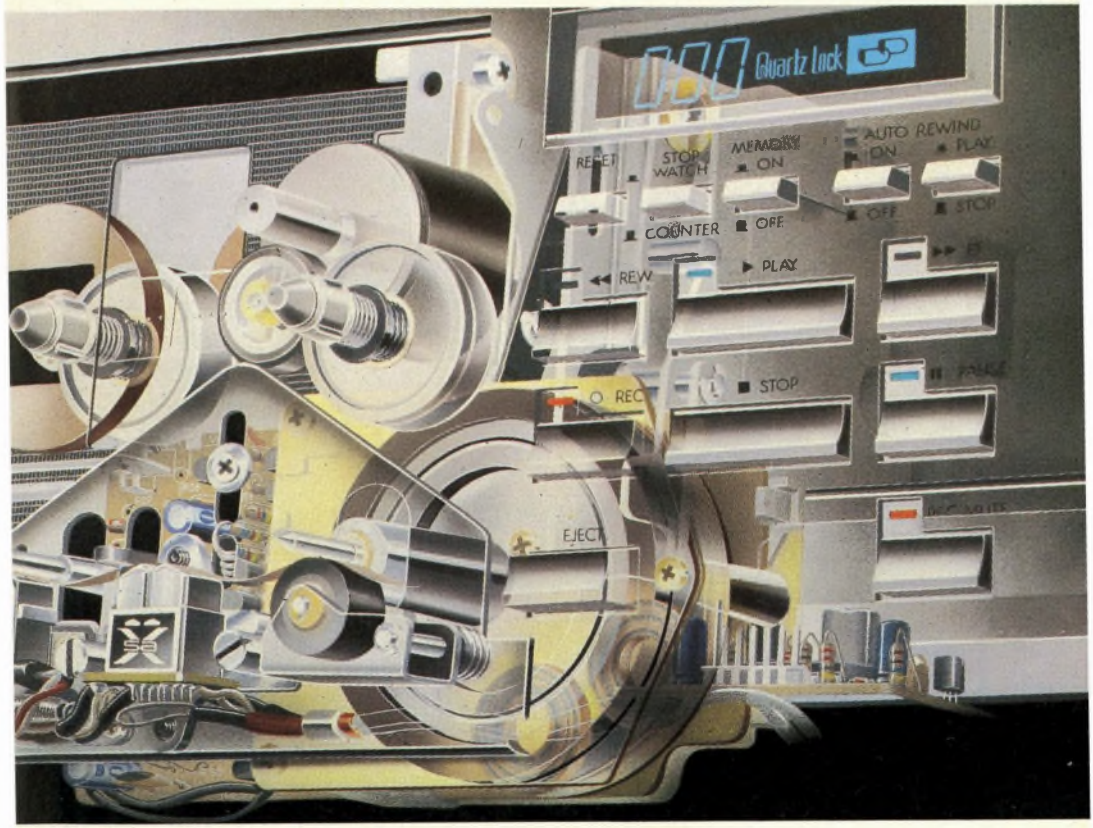
This amazingly low figure is only possible because of the revolutionary new tape transport system JVC has developed. (You don't need us to tell you that it is the tape transport that is responsible for smooth, wow-and-flutter-free travel of the cassette tape past the heads).

At the heart of the transport system is an extraordinary new motor that drives the capstan of the DD-9 directly. It's a coreless Pulse Servo motor with Hall-effect elements for polarity switching. JVC has done away with the wear-prone, drag-inducing brushes and commutators of conventional motors. Rotational fits and starts – cogging – are non-existent. Better still, the motor has a Frequency Generator servo system built-in. Even the most minute speed error is detected and corrected instantaneously. And that's why you've heard the last of wow and flutter.

The only thing this motor doesn't do is drive the take-up and supply reels. The DD-9 has a completely separate DC motor to do that.

Everything else on the DD-9 lives up to the high standards of the

ow, no flutter?



transport system. It has a computer B.E.S.T. tuning system to give you the ideal balance of Bias, Equalization and Sensitivity for any tape.

The 3 heads of the DD-9 are all SA (Sen-Alloy) types – another JVC invention.

The DD-9 has the very latest in noise reduction systems – Dolby* C type. This system gives a full 20 dB of noise reduction at high frequencies.

For easier recording the electronic digital level meter operates in with the VU or peak-hold modes. The choice is yours.

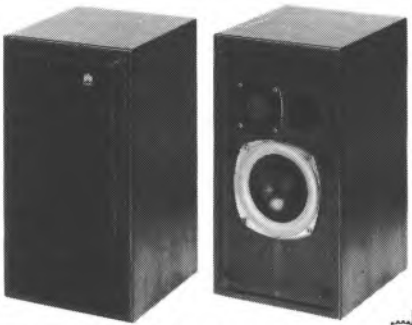
In fact, the DD-9 has everything you want in a cassette deck. Hear it soon at your JVC dealer or write for further details, enclosing a large stamped and addressed envelope, to JVC (UK) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2 7AF.

JVC

your guide to the best in hi-fi.

THE CASTLE RANGE OF SPEAKER SYSTEMS

RICHMOND II



KENDAL II

CONWAY IIA

HOWARD II

The Castle Range of Speakers gives fatigue free listening over the full audio range whilst covering the entire variety of musical and speech selection.

Built completely in our own factory, Castle speakers blend modern technology with the traditional values of beauty and craft, and are available in a variety of genuine wood veneers.

RICHMOND II	KENDAL II	CONWAY II A	HOWARD II
2 SPEAKER SYSTEM	2 SPEAKER SYSTEM	3 SPEAKER SYSTEM	4 SPEAKER SYSTEM
2 WAY	2 WAY	3 WAY	3 WAY
4–8 OHMS	4–8 OHMS	4–8 OHMS	4–8 OHMS
8–30 WATTS	8–40 WATTS	15–100 WATTS	15–150 WATTS

For detailed specifications write to:

Castle Acoustics Limited

SHORTBANK ROAD, SKIPTON
NORTH YORKSHIRE, ENGLAND
TELE: (0756) 5333
TELEX 517618 CASTLE G.

EDITORIAL INTRODUCTION

This is likely to be the last editorial that I shall write for *Hi-Fi Choice*, as I am moving on forthwith to pastures not-so-new. I should therefore like to take this opportunity to thank all those who have helped towards our success over the last few years: manufacturers, distributors and advertisers, dealers, contributors and of course readers. Be assured that *Choice* will get better and better, under the watchful and capable guidance of Steve Harris (*ex What Hi-Fi?*).

On to specifics, this is the fourth *Loudspeaker* book that Martin Colloms has undertaken, so although we only have the space to print seventy or so reviews in full, there are a further fortyish reviews in summary form, while the accumulated comparative knowledge and data must by now cover something like 150 models. By re-reviewing certain key models from each issue to the next we can ensure that consistency is maintained, and even though some models do undergo development and improvement from time to time, the essential character usually remains. One almost embarassing result of carefully selecting the reviews to re-print, and indeed the new models to include, is that we are ending up with a very high percentage of recommended models. Looked at in the context of the printed reviews, we appear to have been negligent in applying discrimination between the models; looked at in the context of the total number of models we have covered, plus the careful screening of new models to try and find the most promising ones rather than the 'lemons', this deluge of recommendation is more easily justified. One could argue that standards should be tightened to improve selectivity. But at the same time there is much variety amongst loudspeakers – if only due to the differences in size and correspondingly price. So there exists a much wider range of valid compromises for the designer, and it is this validity which we are trying to establish.

While pointing out the reasons behind the large number of recommended models, I must admit to a slight disquiet about our level of discrimination. I am inclined to feel that there are a few more layers of the loudspeaker onion to peel off before we will get much deeper, and the room responses published with the latest series of tests are one very interesting step in the right direction. Certainly the measurements were as rigorous and the listening tests as consistent as usual. Indeed my only minor misgiving is in the use of the Carver 'Cube' power amplifier: not because I think it sounds bad or anything like that, but because I don't know what it *does* sound like – it is very new to the UK (and took a fair amount of effort to get it to work on 50 Hz mains), and it is also a somewhat unusual design; consequently at the present time it has no 'subjective track record', which leaves me a trifle apprehensive.

The really impressive development has been the response to increased competition within the loudspeaker market, which has led to a very noticeable raising of standards accompanied by a general lowering (or at any rate stabilising) of prices. Speakers are a significantly better deal in real terms than they were a year ago.

The toughest part of any *Loudspeaker* project is deciding which models should or should not be included. A brief *rationale* is that we try to give as many manufacturers as possible a chance, but recognise that our selection must be related to availability, with the major manufacturers receiving the most attention. At the same time we feel that it is more useful to search out the better products than winkle out the lemons for the sake of sensationalist prose. And past experience enables us to make a pretty coarse prior assessment of which models are likely to perform well against our criteria. We try to include a good sprinkling of budget models, because this is the part of the market where manufacturers really move the chipboard, where design/cost constraints loom largest, and where the biggest differences between similarly priced components are to be found. Finally there is something of a priority on unusual or interesting designs, including a number of established 'classics' for their own sakes. Our exploration of the 'outer limits' this time has included a couple of electrostatic designs: their 'differentness' means that they have to be handled with kid gloves, yet their inclusion helps to broaden the total context within or against which all the models are assessed.

A word of warning: our value judgements and priorities may not be the same as your own, so the reader should always try to audition an intended loudspeaker purchase himself, preferably at home in his own system. Because our judgements are the synthesis of a panel of listeners, they naturally represent an extremely 'balanced' set of criteria. Yet speaker design does involve considerable compromise based on personal taste, as should the choosing. Different listeners will place different emphases upon the relative importance of colorations, stereo imagery or dynamic range, for example, so our 'averaged' responses should only be a guideline for the reader, not a yardstick or substitute for his own taste.

Paul Messenger


A head of our time.
The KEF Reference Series.
Unchallenged. Unequalled.
Speaker systems to match the highest demands of digital techniques.
Models 101, 103.2, 105.2 and 105.4.
Great speakers of our time.
Hear them.
KEF
If you're serious about sound
KEF Electronics Limited, Tovil. Maidstone. Kent ME15 6QP. Telephone: Maidstone (0622) 672261.

THE DEVELOPMENT OF THE LOUDSPEAKER

In the early days of hi-fi, the term loudspeaker usually referred to what we now call a drive unit. The enthusiast (and in those days some enthusiasm was required) would purchase drive units, crossovers, and cabinets from different sources (quite possibly constructing the latter). These systems were usually bulky, and had a fairly uneven frequency response (*ie* notes of one pitch would come out louder than notes of another pitch despite inputs at a similar level), but to some extent these sacrifices were necessary to give adequate loudness from the low-powered valve amps that were available.

The introduction of stereo doubled the problems), so designers started to trade some efficiency (*ie* the volume level of sound produced for a given power input) in the interest of smoothing the frequency response. New plastics materials were used to try and improve drive unit consistency and reduce colorations, and these also tended to reduce efficiency. Likewise the move towards smaller sizes also reduced efficiency, because any model which reduces its volume but keeps the same bass extension ('deepness') and overall balance must sacrifice some midband relative loudness.

By the standards of twenty years or more ago (excepting one or two notable designs), today's available (though not without some attendant problems); designers started to trade some efficiency (*ie* the volume level of sound produced for a given power input) in the interest of smoothing the frequency response; new plastics materials were used to try and improve drive unit consistency and reduce colorations, which also tended to reduce efficiency. Similarly the move towards smaller sizes also reduced efficiency, because any model which reduces its volume but keeps the same bass extension ('deepness') and overall balance must sacrifice some midband relative loudness.

By the standards of twenty years or more ago, and with one or two notable exceptions, today's loudspeakers show enormous improvements in reducing distortions of various kinds, while being domestically far more acceptable, albeit at the expense of efficiency. Much of the improvement has resulted from greater technical awareness and improved measurement techniques. However the fact that a limited number of designs have stayed virtually unchanged for ten or twenty years or even longer, and in some instances still set standards, shows that the complexities of the complete system are still beyond total analysis. At the same time there remains a body of opinion which suggests that some of the modern techniques have perhaps inadvertently thrown away some of the benefits of the early designs, and there has been a re-awakening of interest in higher efficiency designs.

THE ROLE OF THE LOUDSPEAKER

The fundamental purpose of the loudspeaker is to convert the electrical energy supplied by the amplifier (corresponding to the audio signal) into an acoustical (sound) energy output. It is therefore a *transducer* system, which means that it converts one form of energy (electrical) into another (acoustical) via an electro-mechanical device. There are a number of reasons why it is not very good at doing this, but to examine them in anything like sufficient detail is beyond the scope of this book (there are a number of text books available, including an up-to-date and quite rigorous treatment by Martin Colloms.) Sound energy is transmitted by vibrations in the air, and the loudspeaker's job is to create those vibrations which correspond to the signal with which it is fed.

These air vibrations vary in frequency (the number of vibrations per second, expressed in Hz), and the frequency of vibration corresponds to the pitch of the sound. The ear is usually reckoned to be capable of responding to vibrations ranging from the deepest bass at 20Hz to the highest treble harmonics at 20,000Hz (20kHz).

The basic problem for the designer is that he needs to use a largish drive unit to move sufficient air to give enough power at the comparatively slow low frequencies (bass), and a smaller lighter drive unit to move fast enough to handle the high frequencies. This division of labour is also necessary to maintain the wide 'spread' or *distribution* of the sound from the loudspeaker drive units, as drive units 'focus' their higher frequencies into a narrow beam, which can have undesirable effects on the frequency response and stereo properties. This is still an area which is by no means fully understood, and the effects of differences in sound distribution patterns may vary depending on the characteristics of the listening

room. Improving and controlling the distribution has been one of the more recent advances in speaker design; defining the optimum distribution pattern is a rather harder task.

In practice many designs use two drive units, known affectionately as the woofer and tweeter (though where only two drivers are used the former is more accurately described as a bass/mid unit); a number of systems use three or even more units, which naturally costs more, but can improve efficiency, bandwidth, and power handling (though such advantages are by no means automatic, and the extra complexity of the design can bring its own drawbacks.) A speaker system therefore normally comprises two or more drive units, each of which is designed to work at its best over a specific range of frequencies, and as a result works rather poorly outside its designed range. So the signal from the amplifier needs to be split up into frequency bands before being fed to the appropriate drive units, and this is accomplished by an electrical filter network known as a *crossover*. While the basic behaviour of a crossover network appears fairly straightforward, there is no doubt that its subtler aspects — which can distinguish between a competant and an excellent design — remain something of a black art. Indeed a highly respected speaker designer, addressing the Audio Engineering Society not long ago, made the following statement: 'In the old days we just used to go into the (anechoic) chamber with the speaker and a bucketful of components, and play around until we got the right result. Nowadays we run complex computer programmes to tell us what we *should* use; then we get a bucketful of components and go into the chamber and play around until we get the *right* result!'

A number of different physical principles can be used to construct a working drive unit, just as there are a number of ways of designing a car engine. But just as most car designers use a reciprocating piston engine, so most speaker designers use the moving-coil drive unit. This involves feeding the amplifier signal into a coil of wire which is sitting in a powerful permanent magnet field; in compliance with the laws of electromagnetics, the current from the amplifier produces movement corresponding to the signal in this so-called *voice coil*. In order to cause the air to vibrate, the voice coil is connected to a cone (bass and midrange units) or dome (some mid and many tweeter units.) A number of other principles are also used, including: the etched film diaphragm tweeters used on some models in this book (eg Infinity, Wharfedale); electrostatic elements, such as those used in the classic Quad design amongst others; piezo electrics, used in the popular Motorola super tweeter; ionisation systems, such as the late (and by many lamented) Ionofane tweeter, and the modulated gas flame used in an exotic American design (not available in the UK). While these remain inherently interesting, the moving-coil drive unit dominates the scene, and seems likely to continue to do so, if only because all drive unit principles have *some* inherent limitations, and much of the skill of good design is learning to make the best of these.

Likewise most commercial designs are so-called 'direct radiators'; that is the cone, dome or diaphragm is in direct contact with the air. The more efficient alternative of horn-loading was popular in the days of low-powered valve amplifiers, and is widely used in high-power public address systems. This does offer some theoretical benefits over the direct radiator, but also some practical disadvantages which outweigh these; for example one basic disadvantage of the full frequency range horn is its enormous size (examples sometimes being built into a room as part of the architecture!) For full-range work the horn naturally becomes very expensive, though direct-radiator designs which are aiming towards high efficiency quite often use horn-loaded tweeters.

Sticking with the conventional direct radiator moving-coil driver speaker, there nevertheless remain numerous differences between designs. It is not really possible to say that certain approaches are inherently 'right' or 'wrong', though it is often possible to examine how effectively a principle has been put into practice. One could spend many pages discussing the pros and cons of paper versus plastics cones, the subtleties of surround design, the manifold different techniques of bass loading, the virtues of thin-wall over ultra-rigid cabinetry and *vice-versa*, the importance of component type and tolerances in crossover design — the list is probably endless, and is undoubtedly one of the most fertile sources of

hot air amongst enthusiasts and the specialist press. It is also extremely dangerous to assume that because a design uses a particular technique, somewhere along the line this confers either some sort of inherent superiority or a similarity to other kindred designs; indeed the design that is carried to an extreme in one direction is frequently found to have its Achilles heel in a completely different area, overlooked in pursuance of the prime techno-goal. The proof of the pudding must remain in the eating, and listening is still the soundest way to assess the performance of the total system.

Unfortunately this still leaves two areas which have yet to be considered: the interface with the driving amp on the one hand, and with the room that the speaker has to drive on the other. Not a great deal is known about speaker/room interactions, which is why commentators persistently advise and shops increasingly offer home demonstrations or a 'period of grace' during which unsuitable speakers may be changed. Unhappily this is an area over which the reviewer has little control, and yet it is of no little importance; for example I have tried my personal speakers and another high quality design in both my own and Martin Colloms room, and there was no doubt that one type worked better in my room, the other in Mr Colloms', yet both these were designs costing in excess of £500. The amplifier interface is currently an area of some controversy, and will be examined more closely later, in the section on speaker impedance.

REVIEWING LOUDSPEAKERS

Reviewing loudspeakers is both a difficult and necessarily imperfect task. 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 rather limited conditions (a comparatively brief time span with one set of ancillaries in the one room.) One should also note that even 'facts' are subject to process of selection and editing which is based on opinion, and this is perhaps particularly relevant when considering advertising claims.

One could argue that the only way to assess speakers subjectively is to do so over a period of time 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. In my view the long-term 'living with' assessment is the best way to deal with the more unusual or extreme designs, though there remain significant weaknesses nonetheless, not least because of the ear's unusual capacity for self-deception. However the majority of speakers available at popular prices have a lot in common, and the comparative multiple assessment invariably seems to give the sense of perspective that assists reliable judgement in a realistic context.

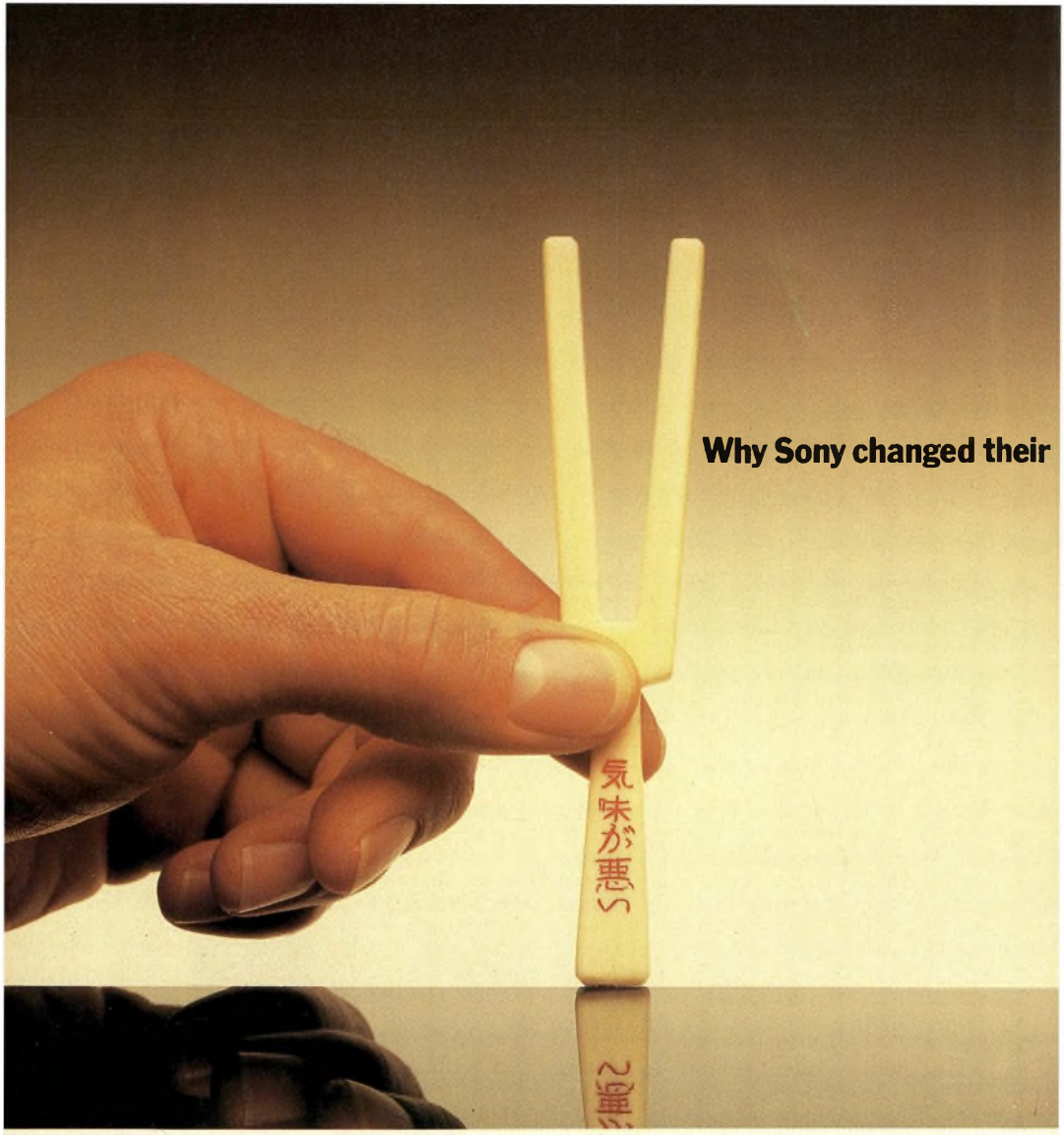
When it comes to facts rather than opinions, the multiple review is without equal. The problem with the performance measurements taken by manufacturers is that they are rarely comparable with one another because of differences in standards or techniques. By adopting the same standards throughout, there 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. Certainly there is bound to be some disagreement in the value judgements which may arise from listening tests, or even in the interpretation of data, but to ignore these factors in a publication aimed at the uninitiated is clearly unrealistic. Opinion, appropriately qualified, is an essential part of reviewing, but the reviewer's opinions should not be 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 inspection of the quality and engineering of the loudspeakers, a considerable number of measurements are taken. This section will try to explain some of the jargon in non-technical terms, while greater detail concerning review technique and interpretation will be found in the *Technical Introduction*.

Frequency Response

Strictly speaking frequency/amplitude responses, these measurements show how the relative loudness of the speaker changes when a similar level signal is fed in at different



Why Sony changed their

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

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

Which is why Sony have taken the rather unusual step of building their loudspeakers in Europe and tuning them to the ears of a European listening panel, rather than those of a Japanese engineer.

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

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

tune about loudspeakers.

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

An acoustic grooved baffle removes unwanted waves and gives a clearer, cleaner sound, while specially designed stands reduce "floor boom," and position the high frequency units at their ideal level, ear height.

The true test of our loudspeakers, however, is to listen to them yourself. That way, we think you'll find they're playing your tune.

Sony SSG1 Mk II loudspeakers.
Price around £215 (inc. stands)

SONY.

Tuned to European ears.

Demonstrations from Sony Showroom, 134 Regent Street, W1.
Further information: Sony (UK) Ltd., Pyrene House, Sunbury on Thames, Middx. TW16 7AT.

frequencies, and thus gives an indication of the tonal balance of the speaker, or indeed 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 the how 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 very different from a listening room. And the room certainly can influence the total tonal 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', 'tubey', '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 is 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 program 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 mid band. 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

CHOICE HI-FI.

The Esotec Series PM6.

Esotec is the crème de la crème.

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

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

It is of course designed to drive difficult speaker loads.

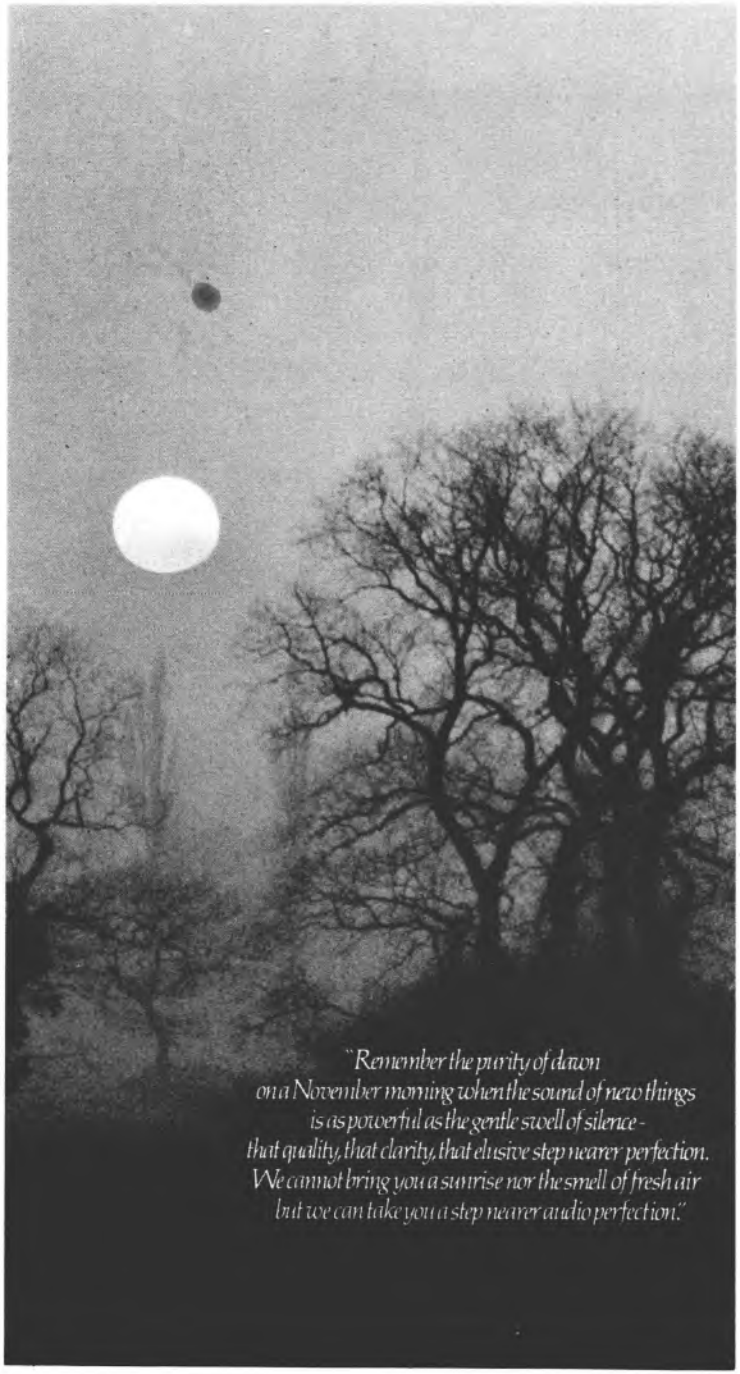
The control amp section includes a high quality MC head amp designed to complement the best cartridges available today.

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

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

ESOTEC SERIES
marantz.

Marantz Audio (UK) Ltd., Debmarc House, 193 London Road, Staines, Middlesex. Freefone 2347.



Ask your nearest Rogers Dealer for a demonstration of the excellence of both our loudspeaker and amplifier range. Expert advice on compatibility with your existing or proposed ancilliary equipment is available from any of our selected network of Franchised Dealers:–

BATH Avon Paul Green Hi-Fi · BECKENHAM Kent Hi-Fi Connections · BIRMINGHAM Fiveways Hi-Fi Ltd · BOLTON Greater Manchester Cleartone Ltd · BRIGHTON Sussex Brighton Cassette & Hi-Fi Centre · BRISTOL Avon Audio Bristol · BRISTOL Avon Radford Hi-Fi Ltd · BROMLEY Kent Halcyon Electronics · BURY ST EDMUNDS Suffolk Anglia Audio · CAMBRIDGE Cambs Renbro Ltd · CANTERBURY Kent John Marley Hi-Fi Centre Ltd · CASTLEFORD Yorks Eric Wiley Ltd · CHANDLERS FORD Hants Hampshire Audio Ltd · CHRISTCHURCH Dorset H A T V · CIRENCESTER Glos T V & Hi-Fi Centre · CROYDON Surrey Spalding Electrical Ltd · DARLINGTON Durham Gilson Audio · DEVIZES Wilts Louis J Rutter Ltd · DOVER Kent John Marley Hi-Fi Centre Ltd · EASTBOURNE Sussex Jeffries Hi-Fi Ltd · ENFIELD Middx A T Labs · EPPING Essex Chew & Osborne · EXETER Exon Audio · FLEET Hampshire Ken Rose Audio Ltd · GUILDFORD Surrey P J Equipment · ILFORD Essex A T Labs · IPSWICH Suffolk Eastern Audio (Ipswich) Ltd · KINGSTON Surrey Surbiton Park Radio · KING'S LYNN Norfolk Martins · LEEDS Yorks Superfi · GATESHEAD Tyne & Wear Linlone Audio · LIVERPOOL Merseyside W A Brady & Son · LONDON N W 5 Audio T · LONDON E 10 D & J Electronics Hi-Fi Centre · LONDON N 1 Grahams Electrical (City) Ltd · LONDON N 15 Martins Hi-Fi Centre · LONDON W 2 Thomas Heinitz · LONDON W C 1 Imbols · LONDON W 2 Nandos Radio · LONDON W 2 NU Sound Edgware Rd · LONDON W C 1 NU Sound High Holborn · LONDON S W 19 M O Brien · LONDON W 1 Telesonic · MAIDSTONE Kent John Marley Hi-Fi Centre Ltd · ISLE OF MAN Manx Audio · MANSFIELD Notts Syd Booth · MIDDLESBROUGH Cleveland Gilson Audio · NEWBURY Berks Donnington Audio · NEWCASTLE UNDER LYME Staffs Clement Wain · NUNTHAMPTON Richard Reeves · NORWICH Norfolk Martins Ltd · NOTTINGHAM Notts Superfi Ltd · ORPINGTON Kent John Marley Hi-Fi Centre Ltd · OXFORD Oxon Absolute Sound & Video · PETERBOROUGH Hunts Soundsense · PLYMOUTH Devon Framptons · PLYMOUTH Devon Peter Russells Hi-Fi Attic · RAYLEIGH Essex Rayleigh Hi-Fi Ltd · READING Berks Reading Cassette & Hi-Fi Centre · RIPLEY Derbyshire J H Hurst Ltd · SAFFRON WALDEN Essex Chew & Osborne · SHEFFIELD Yorks Sheffield Sound Centre · SOMERTON Somerset Wallis Radio · SWINDON Wilts Absolute Sound & Video · TELFORD Salop Sound Services Ltd · TONBRIDGE Kent Saunders Ltd · TRURO Cornwall E T S · URMSTON Manchester Lloyd Paton Ltd · WELLING Kent H C & C Coppins Ltd · WHITEHAVEN Cumbria H L Elliot · WILMSLOW Cheshire Swift of Wilmslow · WINDSOR Berks Radford Hi-Fi Ltd · WOLVERHAMPTON W Midlands Midland Hi-Fi Studio · WORTHING Sussex Thwaites & Wilkins Ltd

ABERDEEN Scotland Holburn Hi-Fi · AYR Scotland Vennal Audio Visual Ltd · EDINBURGH Scotland Audio Aids · EDINBURGH Scotland Hi-Fi Corner · GLASGOW Scotland The Music Room · INVERNESS Scotland Nairn Music Shop

CARDIFF S Wales Houlden Hi-Fi · PORT TALBOT S Wales Electrophonic Ltd · SWANSEA S Wales Holl Hi Fidelity Ltd

Rogers range of Electronics
A100 Amplifier.
T100 FM Preset Digital Tuner.
A75 Series 3 Amplifier.
T75 Series 2 FM Tuner.

Rogers range of Loudspeakers
LS3/5A BBC – licensed Monitor.
Compact Monitor Loudspeaker.
Studio 1 Loudspeaker.
Reference Monitor System.
LS5/8 BBC-licensed Studio Monitoring Loudspeaker.

Send a large stamped addressed envelope now for our latest literature and review reprints.

Rogers
BRITISH HIGH-FIDELITY
4/14 Barmeston Rd. London SE6 3BN.
Telephone: 01-697 8511
Telex: 893980 SWISST

considered more important than low midrange coloration, consequently quite different speakers like 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 being driven. To explain this in simple everyday terms is not easy: a starting point is that the (power) amp is presenting a varying voltage at its loudspeaker terminals which models the audio signal. The loudspeaker is a motor of sorts, which requires energy to give movement and hence sound, so it draws current from the amplifier, and the amount of current drawn for a fixed voltage will be directly dependant on the impedance of the speaker, the lower the impedance the greater the current drawn. (This is an oversimplification of the complexities of AC operation, but nevertheless has some relevance.) The power taken from the amp is the product of the volts and current supplied, measured in watts, and the impedance determines the ratio of volts to amps that the speaker draws, which can be important when choosing speakers to match an amplifier or *vice versa*.

One of the decisions an amplifier designer must 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 these, which can only be obtained into one particular impedance value. If one assumed that loudspeakers were a simple constant load such as an 8ohm resistor, then it would be easy to design an amp capable of supplying the right amounts of voltage and current to achieve maximum power into that impedance without any wasted capability. Unfortunately loudspeakers present a rather complex load, due to inherent characteristics of drive units and crossovers. The load changes with frequency, and may also require the voltage and current to be provided slightly out of step (out of phase) with each other, so the speaker designer has to make certain that his model is capable of being driven by the majority of amps without difficulty, while the amp designer should include sufficient flexibility to cope with the majority of speaker designs without problems. In practice both groups at least acknowledge each others existence with International Standards committees and the like; consequently most amps are quite happy driving impedances significantly below the 'nominal' 8ohm 'target', while speaker designers try to ensure that their designs do not drop too far below this nominal level and avoid offering 'nasty' out of phase conditions at the points of minimum impedance.

When discussing the impedance of the speakers in the reviews, an assessment is made of how easy or difficult the model is to drive, based on the impedance curve and spot checks on phase angles. This could cause ambiguous interpretation, as a 'difficult' load will not be 'difficult' for 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, though these tend to be the more expensive models, while other examples may not be able to realise their full output potential when connected to a 'difficult' type of load. In point of fact, the *raison d'etre* for many of these more expensive amplifiers with their relative imperviousness to loudspeaker load changes, is the view held by a number of designers that the loudspeaker, driven under music signal conditions, does in fact present a considerably more complex and awkward load than is generally acknowledged (due to effects related to mechanical inertia and back e.m.f.) However at present there is little or no published evidence concerning the practical significance of such possible mechanisms.

Sensitivity and efficiency

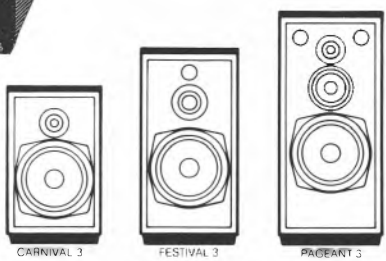
These two characteristics are frequently confused or mis-applied. *Efficiency* is an attempt to measure the actual conversion efficiency of the loudspeaker from electrical input to acoustic output; it is therefore scaled to a constant electrical input, and requires some account to be taken of the distribution pattern of the design. More useful from the consumer's point of view, we believe, is a measure of

Truth...

Since their introduction in 1976, the Series 2 CARNIVAL, FESTIVAL and PAGEANT loudspeaker systems from Mordaunt-Short Ltd. have won acclaim and given pleasure not only in the United Kingdom but also in some 40 other countries throughout the world. Now, this small, specialist Company takes pride in presenting a new, successive generation of advanced and outstanding products.

As with their predecessors, the fundamental design objective of these new speakers has been to achieve sound reproduction of the highest quality from enclosures attractively styled and craftsman-finished – yet at costs that will enable these benefits to be accessible to the widest possible audience of music-lovers, high-fidelity enthusiasts and home-entertainment seekers world-wide. Appropriately, therefore, the new models are to be known as **CARNIVAL 3**, **FESTIVAL 3** and **PAGEANT 3.**

In the present economic conditions, the actual function and performance of any product are increasingly important in relation to its cost and presentation. Consequently, for the **CARNIVAL 3**, **FESTIVAL 3** and **PAGEANT 3**, Mordaunt-Short has departed from the conventional veneered cabinet and has evolved an elegant design, predominantly



CARNIVAL 3 FESTIVAL 3 PAGEANT 3

finished in fabric, yet which still retains in attractive proportion the real wood veneers traditionally associated with quality furniture. This has permitted full and appropriate emphasis to be placed upon the essentials of advanced acoustic design within a highly cost-effective format. The **CARNIVAL 3**, **FESTIVAL 3** and **PAGEANT 3** offer in consequence exemplary sound reproduction, pleasing, tasteful appearance and unrivalled value for money. And that's the truth.

CARNIVAL 3
£128.80
per pair
Inc. V.A.T.

PAGEANT 3
£296.70
per pair
Inc. V.A.T.

...unvarnished.

FESTIVAL 3
£197.80
per pair
Inc. V.A.T.

Stands
£34.50
per pair
Inc. V.A.T.

Mordaunt-Short Ltd
High-Fidelity Loudspeaker Systems
Durford Mill, Petersfield, Hampshire, GU31 5AZ
Telephone: Rogate (S.T.D. 073 080) 721/2
Telex: 86443 MSHIFI

sensitivity, which is based on a fixed amplifier gain (*ie* output voltage), and is averaged from the midband output obtained from a mike at a fixed distance from the front of the speaker. Lower impedance designs will naturally draw more current and therefore use more power than higher impedance models, so they can be expected to show a slightly greater sensitivity; however the selection of an accompanying amplifier will naturally have to be made with correspondingly more care.

Sensitivity is very useful in attempting to assess how loud a speaker system will sound under practical conditions, though it must not be taken in isolation from other design considerations. For example some speaker designs may have a high midrange sensitivity, but at the expense of the bass extension level or achieve a comparatively high level due to a low impedance; moreover to achieve high loudness good sensitivity must be accompanied by good power handling, or the result will merely be to save amplifier power rather than to achieve higher levels. Nevertheless it is a sobering thought that a difference of 6dB in sensitivity (say between the similarly priced Audiomaster *MLS1* and the Castle Richmond) represents a difference in required amplifier power of ten times; in other words the MLS1s would require a 200 watt amplifier to achieve the same sound level as the Richmond driven by a 20 watt amplifier.

Power requirements and handling

Trying to estimate the minimum power requirements and the maximum power handling of a speaker is an almost impossible thing to do, for various reasons. First because the size and furnishings of the room and the position of the speakers will affect the loudness perceived by the listener. Secondly, of course, every individual will have his own feelings about required loudness, partly no doubt dependant on his taste in music. Most important perhaps is the type of program being played, because all audio signals of interest require a variable supply of power to cope with soft and loud, peaks and pauses.

The difference between the power required for the peaks and that supplied overall when averaged out can vary significantly according to the programme: a loudspeaker manufacturer found that when a direct-cut disc was registering 100watt peaks, its mean power (averaged over 3 secs) was only 8 watts; in contrast a more compressed pop recording registered some 17 watts mean for 100 watt peaks. From the point of view of causing direct speaker damage, the peak level can usually be ignored, but it is the peaks that determine the size of amplifier required to avoid distortion (and in fact an amplifier which is driven beyond its capability to reproduce peaks cleanly is far more likely to cause speaker damage than a more powerful model producing the same mean power without any strain.) The mean power is really the factor that controls the perceived loudness and provides the heating effect in the loudspeaker voice coil that can cause damage if excessive.

What this really means is that it is the mean power of the program that is important in determining the subjective loudness and safe power handling of the system, but in order to obtain a descent level of mean loudness it is necessary to use an amp which is capable of coping with the much higher peaks that are contained in any programme material, and in fact the more 'dynamic' the programme, the more powerful the amp has to be to achieve the same loudness. (By implication the way in which the amp goes into brief overload, and whether or not it recovers quickly and cleanly is probably a much more significant indicator to the loudness capability under practical conditions than the actual rated power output.)

From the above it should be clear that specifying power handling and the like is extremely difficult in practice, if not downright impossible. What is perhaps needed is a more careful appraisal of the specification standards in relation to actual programme conditions. At the present time the best advice one can probably give is as follows: Make sure to use an amp within its capabilities, so that peaks are not audibly distorting: there is less danger (and possibly some safety) in using a quite powerful amplifier provided it is used intelligently, than one of insufficient power; special care should be taken when using material with a small peak-to-mean ratio, such as electronic music and some compressed pop music; even if peak clipping is avoided, danger could occur under these conditions with a powerful amp. Perhaps the most important thing to remember is that a hi-fi speaker is not designed to operate under

SINCE WE STARTED WE'VE MANAGED TO

Twoyears ago,we stood the hi-fi world on its end with the introduction of our SL-10.

Imagine, a linear tracking turntable just 7.5mm wider than an LP and capable of playing at any angle.

On its side or even upside down.

But always at precisely the angle record grooves are cut.

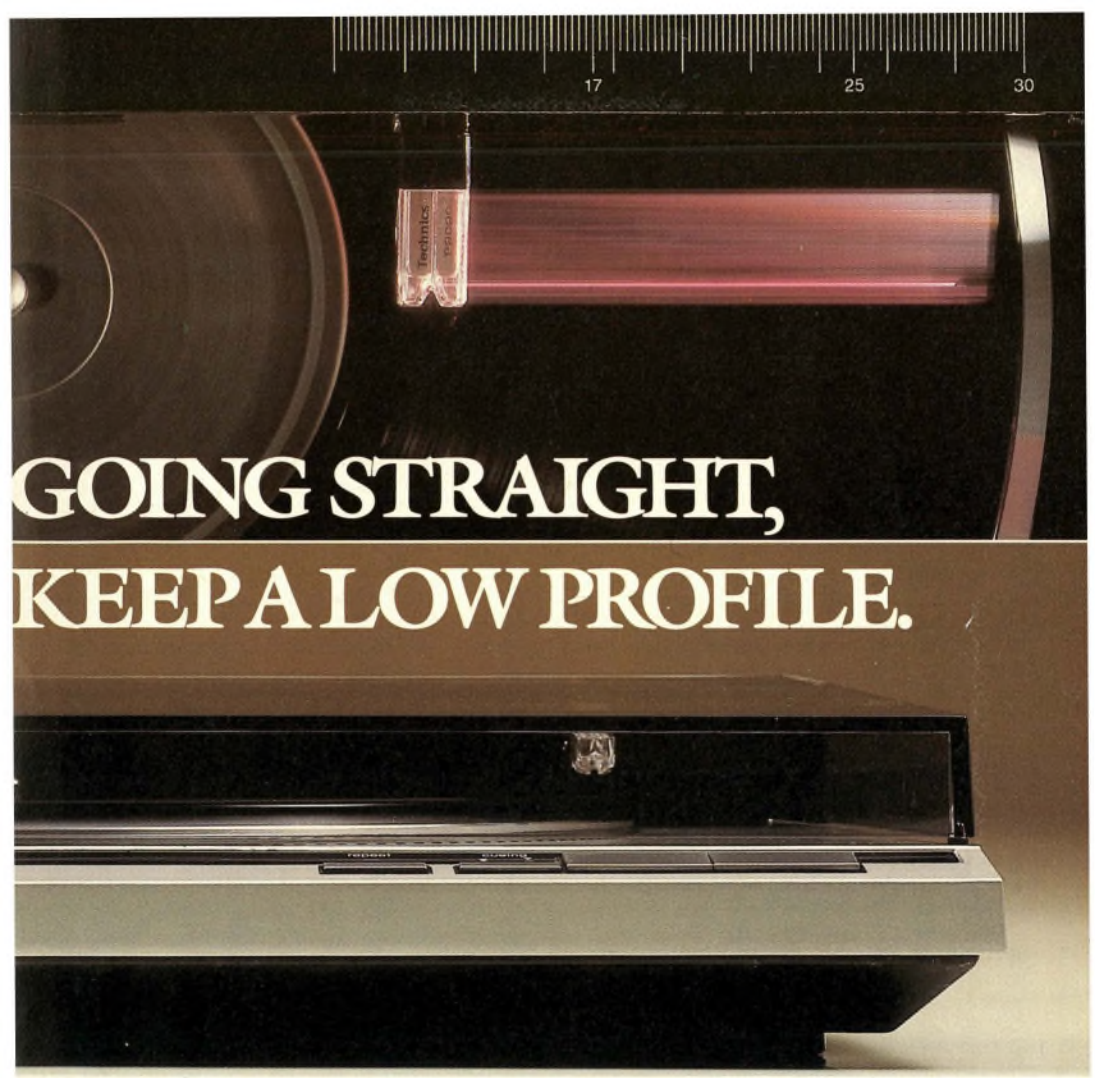
"Revolutionary"and"breakthrough" are the kind of words used to describe the SL-10.

However, no one could ever describe it as cheap.

So we thought it was high time we brought linear tracking down to a more acceptable level.

Hence,our introduction of the SL-QL1 at just under £220.

Now don't run away with the idea we've cut any corners.The SL-QL1 is a direct-drive,quartz-locked turntable with speed



accuracy to within 0.002%.

It's also fully automatic and includes our EPC-P202C cartridge.

True, it's a little wider than its illustrious parent (though some might prefer its more conventional proportions).

But, at a mere 3½ inches high by 17 inches wide, our Sl-QL1 makes other linear tracking turntables look positively cumbersome.

Look at those who've followed in our tracks and you'll soon see what we mean.

Nothing even comes close to matching the low profile and price of our SL-QL1.

It's just the excuse you need to start going straight.

Technics

SL-QL1 linear tracking turntable

300/318 Bath Road, Slough, Berks SL1 6JB. Tel: Slough 34522

Price inclusive of VAT and correct at time of going to press.

party-type conditions, so if a system is used in the village hall disco one weekend, it will be no surprise to find burned out voice-coils and/or amps the next day.

In the reviews we recommend minimum and maximum amplifier power ratings, because despite the difficulties there is certainly a need for some sort of advice in this area. Further details are specified in the technical introduction, and the suggestions that we make should not be regarded as inflexible. The minimum power rating takes the speaker's sensitivity into account, and the recommendation assumes that a minimum loudness on 'typical' progam in a 'typical' room is required. The maximum power rating is rather more a guesstimate based on our experiences of the model in use; as mentioned earlier, maximum amp power has little to do with the ability to destroy one's loudspeaker, and type of program and listening habits are much stronger influences.

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.

In order to assess the accuracy of the speakers under stereo conditions we have deliberately included some 'coherent' recordings (from Enigma records predominately), but it could be argued that the ability to create accurate stereo is of limited importance. Certainly it is more useful under some conditions than others, and additionally the stereo illusion simply seems to work better for some people than others. But it is probably not far off the beam to suggest that very few listeners have any real idea of the capabilities of a good stereo signal and system, and the fact remains that accurate stereo is for many one of the most important stimuli available from a hi-fi system, so it remains an important, if frequently misunderstood, aspect of speaker performance.

CHOOSING AND USING A LOUDSPEAKER

If one is planning to spend one or even several hundred pounds on a pair of loudspeakers, it does make a certain sense to take a little care over the choice, so I am repeatedly surprised to find that people often spend less effort than they might when purchasing a pair of shoes. However presumably the reader of this is prepared to take a little more trouble, by virtue of the fact that he has reached this obscure page of a very specialist publication devoted to trying to make things a little easier! The trap for the unwary is to allow us to take over the decision-making entirely. For one thing we don't sell loudspeakers; moreover we do not live in your room playing your type of music at your desired levels with your ancillary equipment. The fundamental criteria for deciding whether to purchase a piece of hi-fi equipment must be whether or not it satisfies your requirements, and to this end one of the most important things to do first of all is to specify these requirements.

Some of the questions such as setting a budget will be fairly straightforward to ask and answer, though getting some idea of the loudness required when taking account of trade-offs between size, bass extension and sensitivity becomes a little more difficult. But many of these questions can be resolved using our data, and it should be possible to get some idea of which models are likely to prove suitable. It is at this point that the subleties of room matching and taste become worth pursuing; it is here that lack of experience

clearly makes itself felt, and the most important asset becomes a helpful and competent dealer. A good demonstrator should be able to help a customer get some idea of where his tastes in sound quality lie, in terms of the relative importance of levels and locations of colorations, precision of stereo imagery, transmission of dynamics etc. (one should be wary of the overzealous demonstrator who will merely succeed in transmitting and inculcating his own preconceived ideas and prejudices). The overall quality of demonstration remains the best guide to the standard of the retailer, so if one wishes to visit several shops, a couple of known records (one liked but one disliked) will be a useful means of assessing the dealer as well as the speakers (any demonstration that can make a known but disliked record more enjoyable than hitherto must have something going for it!)

The final and in many ways most important part of choosing a speaker is a home demonstration. This service is offered by far too few retailers in my opinion, though I can appreciate that it can be a costly and awkward facility to provide. The more common alternative, which is in many ways equally satisfying, is the 'period of grace' system, whereby the retailer undertakes to accept an unsuitable product back after say seven days if undamaged; providing the customer does not become too demanding, remembering that the retailer has to make some profit, and the retailer keeps his side of the bargain (it is safest to get some sort of written confirmation of such an arrangement), then the system can work to everyone's benefit and is certainly the most practical way of avoiding customer disappointmenent.

Having returned home with the new pride and joy, what steps are likely to help them achieve their best performance? Well it usually pays to read the manufacturers manual, as this often gives sound advice on placement. Although some designs are deliberately designed to be placed on the floor, a bookshelf, or against a back wall, the majority work best on open stands away from walls; allocating part of your speaker budget to a pair of stands is usually a wise move. Naturally the room shape, established seating arrangements and other domestic considerations will play a large part in determining sites for the speakers, but if possible one should try a variety of locations, because the chances are that one will work better than the others. The sort of things to bear in mind are to try and place the speakers so they are reasonably symmetrical with respect to the major room boundaries; to avoid placing them too close or behind (it does happen!) heavy furniture; on a hard floor a rug between listener and speaker can help; to place them so they are both approximately the same distance from the listening area in order to get anything resembling stereo.

I personally recently had the opportunity of having my loudspeakers checked using sophisticated spectrum analysis equipment. An imbalance was discovered and largely corrected merely by moving one speaker about 10 inches, giving a notable improvement in an admittedly somewhat esoteric system. This is perhaps a pointer to the level of service that could benefit the consumer, though I know of no dealer currently making this facility available.

using special speaker leads. Switching systems between the amplifier and the speakers are to be avoided as far as possible.

The speakers should be wired to the amp with reasonably heavy duty cable, such as 13amp mains wire. Heavier gauges for longish runs (7 metres +) are available at reasonable prices from specialist manufacturers (eg QED, Radiospares). A variety of exotic and expensive cables are also available; their effects would appear to be a little unpredictable, though some people claim a marked improvement when using special speaker leads. Switching inserted between the amp and the speakers is to be avoided as far as possible.

Presented here is not just one example of Mitsubishi's mastery of linear tracking, but two.

The futuristic appearance of Mitsubishi's LT5V vertical deck, on the right, commands the maximum of attention, whilst demanding the minimum of space. A narrow shelf is all that's required to accommodate this superb departure from convention.

And for those whose tastes are decidedly horizontal, Mitsubishi offer the LT20 Quartz Lock Linear Tracking Deck shown below.

Its features include feather touch controls, automatic lead-in, return, repeat play, disc size detection and speed selection, plus of course the technical superiority embodied in every machine that carries the Mitsubishi name.

Only Mitsubishi offer such high performance levels in both horizontal and vertical linear tracking modes.

And, when you hear what you see here, you will experience the definitive advertisement for Mitsubishi linear tracking.

It's a Mitsubishi

MITSUBISHI ELECTRIC (UK) LTD., OTTERSPOOL WAY, WATFORD, HERTS. WD2 8LD.

MITSUBISHI AUDIO

TECHNICAL INTRODUCTION

While some aspects of the review method have already been discussed in the *Consumer Introduction*, the *Technical Introduction* gives a complete description of the details relating to our latest series of subjective and objective evaluations. These comprise three main sections, one dealing with objective measurements, and the others with subjective evaluation, classified as 'Live *vs* Recorded Tests' (comparison with live sounds) and 'Domestic Stereo Listening Tests' (a reasonably balanced selection of commercial programme) respectively. Slight differences in test procedures have occurred between successive projects, so in order to avoid risk of confusion some references to earlier tests have been omitted.

LIVE *vs* RECORDED TESTS

Most loudspeaker designers, while attempting to produce a commercially competitive model, will readily concede that a prime objective is to make the most accurate and hence natural sounding loudspeaker for the price. Indeed all the other components in the hi-fi chain are similarly engineered to produce the least alteration in program, whether it be disc, radio or tape. It follows that a highly relevant test is to compare a live sound (voice or musical instrument) with an accurate recording made of the same sound replayed via the test loudspeaker.

Testing for Fundamental Accuracy

Any model with pretentions to accuracy and neutrality should make a reasonable attempt to mimic reality. This test is undeniably difficult to set up, and it involves 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 decided to use an anechoic chamber to make the recordings, in this case the large facility at the Building Research Centre, Watford. (Previous trials at smaller anechoic locations had revealed that noticeable colorations were added to male voice recordings).

There are also other quite obvious problems; for example, the testing chiefly evaluates the energy and coloration of the speaker in the forward radiating angle, and tests little of the radiation off-axis – a factor which may possibly affect the frequency balance of a speaker when used in a different listening room. In addition, the range of test sounds are, of necessity, restricted. Errors due to mike position, the differing radiating properties of the test speaker and live source, as well as the recording and amplifying processes are also present, but despite all this, the use of a live source has proved invaluable in the past in pinpointing coloration and frequency balance problems.

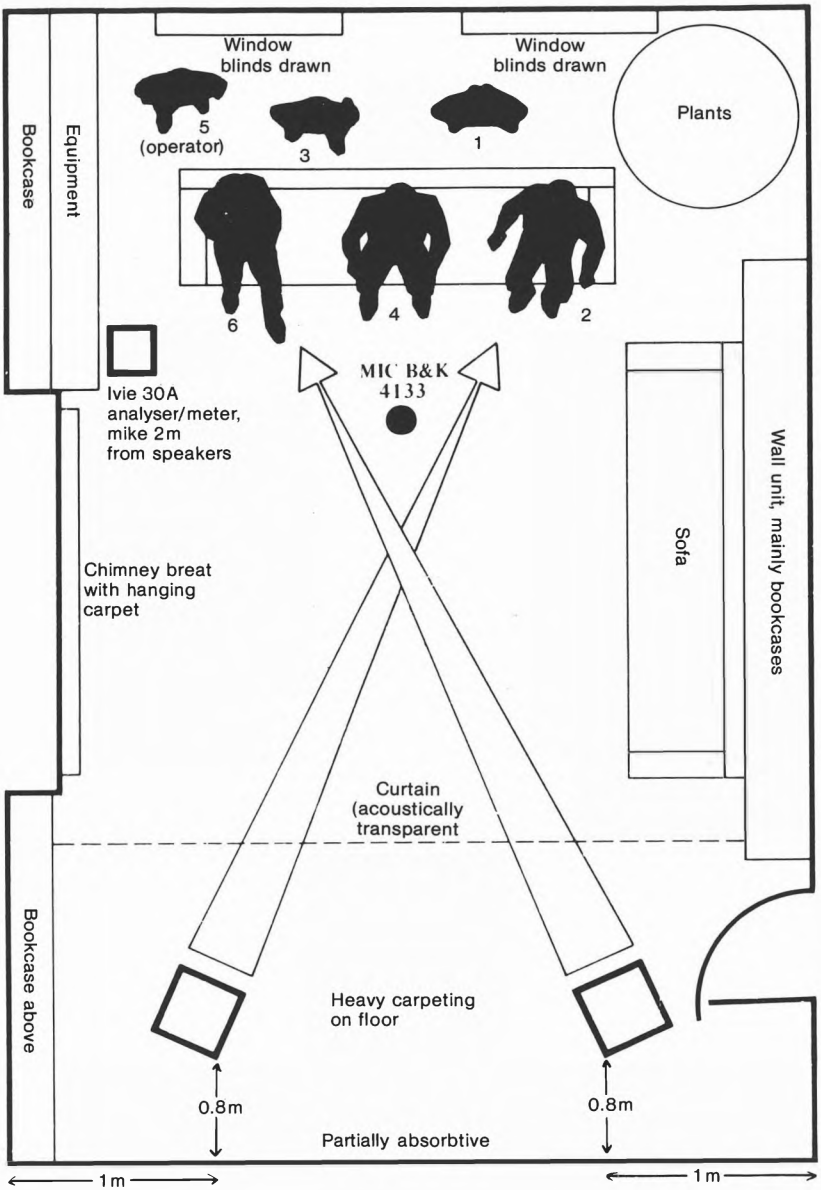
Replay environment

The recording was done in mono, for simplicity's sake as well as to improve localisation stability, and the replay environment was selected for a clean reverberation time, under which conditions the panel were able to judge quite accurately the characteristics of the test loudspeakers.

My personal listening room was analysed for reverb. character at the beginning of the project, and was found to be particularly favourable. Above 100Hz the Rt 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 Rt did not exceed 0.51 at 50Hz. Rt 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 a realistic distance between them and the test speaker (2.5–3m), it was decided to use the room for all our listening sessions.

The Test Procedure

This 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



Listening room data
Actual dimensions: 9′ 6″H x 13′ 9″W x 18′ 4″L.
(IEC mean recommended dimensions: 9′H x 13′ 9″W x 22′L).
Actual reverberation time: 0.3 seconds ±20%. 100Hz; less than 0.6 seconds at 50Hz.
(IEC recommended reverberation time: between 0.3 and 0.65 seconds, mean 0.45).

Substantial Victorian house; suspended floor and ceiling (the latter heavily loaded by speaker loan stock above); heavy carpeting (3 ply) on floor.
Over 50% of surface area of walls lined with book shelves; wall adjacent to loudspeakers reflecting, wall behind listening panel mainly absorbtive.
Dominant absorbtive furniture, two large Chesterfield sofas.

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. The obligatory curtain (acoustically transparent) separated the panel and sound source, thus concealing the identity of the loudspeaker under test, while the very nature of the musical sounds themselves forced us to take certain other problems into consideration. For example, in the case of a cymbal recording with a dominant frequency range from 2 kHz–15 kHz, the microphone position was adjusted to capture a balanced sample of the instrument's output, but by its very construction, a cymbal radiates as a dipole, and its sound in a listening room would thus be a combination of direct and reflected sounds. However, the reproducing speakers will predominantly radiate in the forward plane over this frequency range, and hence will not produce a significant output of wall-reflected energy. Accordingly when forward radiating speakers were auditioned, this discrepancy was dealt with by providing temporary absorption over most of the rear wall surface behind the instrument.

Choice of source material

The choice of exactly what sounds to use was a difficult one to make, as they all needed to be easily reproduced, but at the same time carry sufficient information to allow worthwhile judgements to be made. First on the list was male voice; hardly surprising, since our hearing systems are fundamentally designed to analyse speech. Acoustic guitar was also included, having proved useful on previous tests; both it and voice are sensitive indicators of midrange quality. Another revealing sound with great percussive transient quality was that of the side drum, both with and without snare. The treble range was allocated to an instrument which many speakers changed out of all recognition, namely the aforementioned cymbal, and a wooden xylophone was also used, producing a quickly damped percussive note with characteristic timbre. Our versatile musician was also capable of convincing short repeats of flute passages; this proved helpful in assessing both mid and treble range capabilities, deficiencies in the latter being revealed by the unique breath noises from this instrument. Finally, as an accurate recording of bass instruments is difficult to achieve, and in order to offer some basis for judgement in the low frequency range, an electric bass guitar was played 'live' through all the speakers in turn. Those readers familiar with a Fender Precision bass instrument will appreciate its characteristically even and predictable output, from bottom E (45.7 Hz) upwards, with a clean transient start to the plucked note and a characteristic tonal quality. Although admittedly a somewhat limited test, the bass quality of each speaker was assessed in terms of range, evenness, power distortion and finally, coloration. Bass judgements also appear in the stereo sessions.

Assessing Maximum Acoustic Level

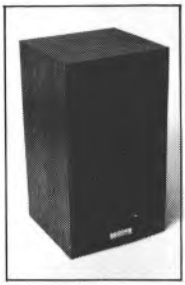
The live-vs-recorded session provided an arrangement whereby the 'maximum acceptable' sound level available from each speaker could be assessed. A well balanced tape section of rock program was played at increasing level, until either the loudspeaker began to sound distressed – rattled or distorted – or the amplifier clipped. A 500W amplifier was employed (per channel rating, 8 ohms), with simultaneous monitoring of peak program power, average program power and sound pressure level in dBA at 2m. The panel was also asked to judge the overall quality at high levels. For the record, the best examples were heading towards 110 dBA at the maximum amplifier headroom, and surprisingly, a large number of relatively small systems tolerated up to 500W peak without complaint. In fact, the least efficient systems in the survey actually needed the full 500W headroom in order to reproduce the drum, cymbal and xylophone at the correct level, even though the real instruments were played relatively softly. This was undoubtedly a result of the careful recording technique which retained much of the high transient peak nature of these instruments.

Control repeats

During the live-vs-recorded sessions, as with 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 afternoon, etc.

In the most recent sessions, models from the original tests were also inserted so that the correlation between the two sets of tests could be determined.

FROM THE BOTTOM TO THE TOP...
We demonstrate the lot!



MISSION 700

MISSION ELECTRONICS

This is our most popular loudspeaker in its price class and justifiably so. Now with increased power handling the 770 opens doors to the fourth dimension with a precision that will captivate you. On permanent dem of course! (amplifier rating 20-120 watts).

B+W DM12

B&W

For many years a leader in speaker technology this well-established company now have a range of products to keep them on top, from the amazing DM12 bookshelf monitor (illustrated) to the 801 studio monitors. Come along and listen to the DM12 along with the rest of the B+W range and we'll show you what we mean (amplifier rating, DM12, 25-60 watts)

FOR DEMONSTRATIONS AND PRICES * RING 01-318 5755

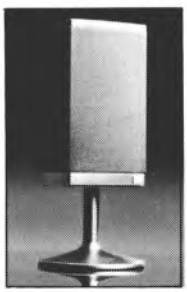
***Our prices are among the most competitive**

FOR MAIL ORDER AND EXPORT RING 01-852 1321

HEBYROOK HB2

HEYBROOK

This small speaker from Mecom Acoustics has established a fine reputation over the last year or so. A ported design constructed to unusually high standards, the HB2 has a definition and solidity that has to be heard to be believed. So why not come and hear? (amplifier rating 20-60 watts)



KEF CELESTE IV

KEF

The Celeste and Concord have gained an enviable reputation over the last couple of years for high quality sound at low cost. The Celeste IV carries on the same tradition of fine sound with a colourful approach. Both are now available in four colours. Drop in and have a listen, or just a look if you like (amplifier rating 15-50 watts)

BILLY VEE SOUND SYSTEMS

68 Lee High Road, London SE13

Ring 01-318 5755 or 01-852 1321

(Mon-Sat 10.00-7.00 pm. Thurs 10.00-2.00 pm)

World wide export service

Personal service

Mail Order

*Most recommended Combo's in stock

Part Exchange

Data analysis
The usual statistical analysis was applied to the numerical data, 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.

DOMESTIC STEREO LISTENING TESTS

These sessions proved more 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 5 factors: overall accuracy and/or realism; frequency balance or subjective response flatness; clarity and detail; coloration; precision and depth of stereo image.

Again concealed behind a 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.

Following several tests the Carver 'cube' power amplifier (*M400*) was judged suitable for the sessions, and peak levels were continuously monitored to ensure complete freedom from clipping.

A reasonable balance of taste was presented by the program excerpts, which included large pipe organ, piano, violin, choir, female spoken voice, full orchestral, female singing voice, two rock sections and a folk band. The sources were mainly original or copy master tapes, with three sections drawn from discs. The recording techniques that had been used were mainly crossed-pair, but multi-mike recordings were also included.

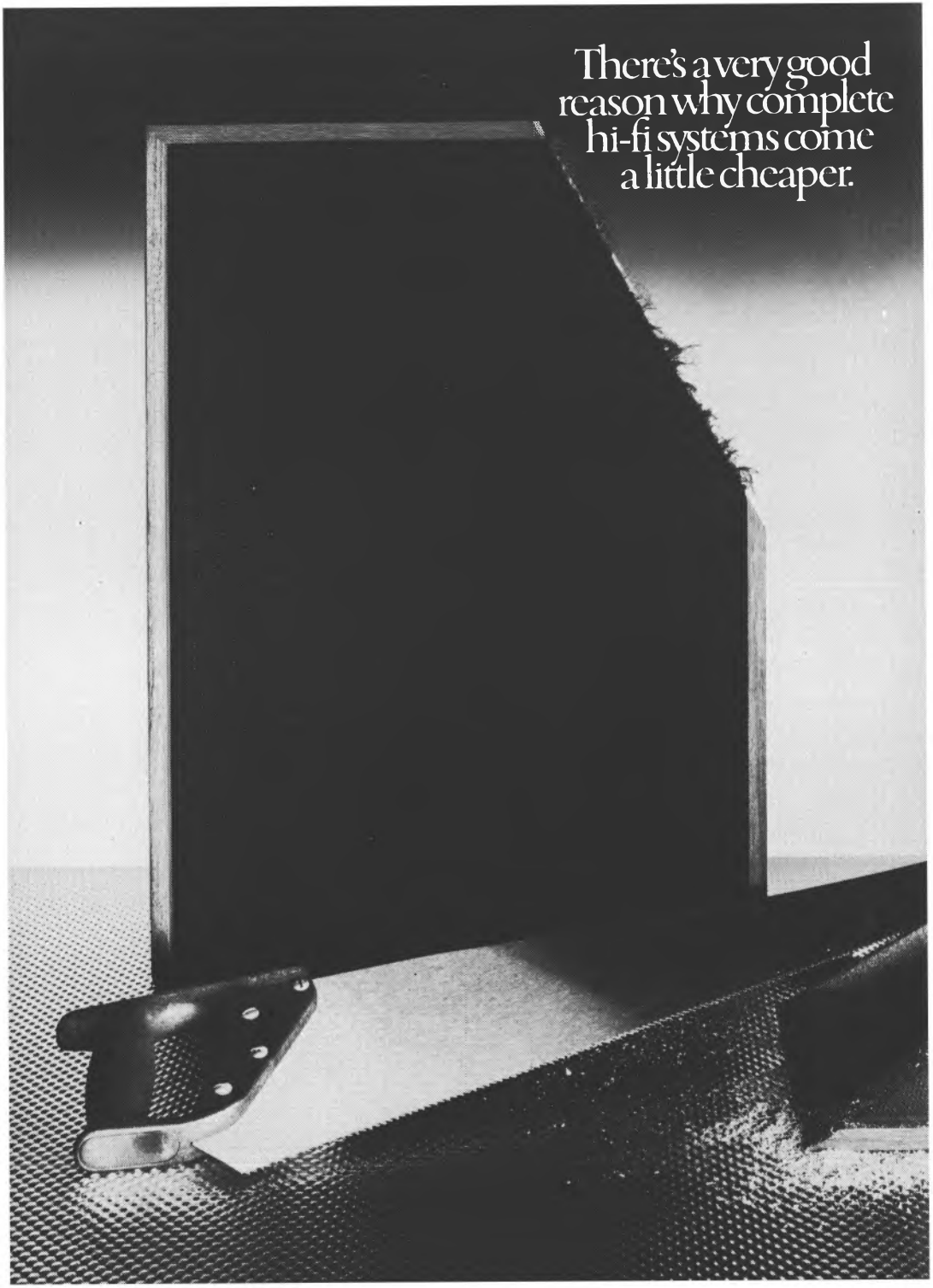
Data analysis
The test sheets were analysed in two ways, firstly for scoring on each programme excerpt, and secondly for each performance parameter, independant of program. Possible program/speaker interactions were also investigated and duly taken into consideration.

LAB TEST PROGRAMME

For this new edition we took advantage of the recently improved test facilities at the GEC Hirst Research Centre. The measurement procedures were carefully analysed prior to the testing to evaluate the necessary corrections. Hirst does not have a large chamber, and readings taken at low frequencies need to be backed up by a near-field frequency response, which gives a more accurate picture of the speaker's free field (4ohm) output below frequencies where cabinet diffraction becomes significant. This correction is valid up to 200Hz or so with most models. The main nearfield low frequency traces were superimposed on the 1 and 2 meter charts with the 100Hz frequency region taken as the point of coincidence, this known to be comparatively accurate on the 1 metre chart.

The speed with which the curves could be plotted at Hirst permitted a more thorough investigation of speaker performance than previously attempted, including both 2nd and 3rd harmonic distortion at 2 power levels. The lower level was set at 90dB spl (likely to be embodied in the forthcoming IEC standard), while the higher level chosen was the established 96dB/1 metre, which I feel is revealing at lower frequencies but which has been known to blow away a number of treble drivers as the sweep generator scans through the upper frequencies. Accordingly where 'suspect' speakers were involved, the 96dB distortion measurements were halted in the midrange, and appropriate marks on the curves indicate where this has been done. Virtually all speakers will perform satisfactorily on distortion at 90dB and the 96dB level proves useful in illustrating the limited power handling of the smaller and less sensitive models. The 100W peak power distortion measurements were again included, together with analysis of the effects of detachable grilles, of the usual listening and measurement axes, and of course an assessment of pair matching.

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


There's a very good
reason why complete
hi-fi systems come
a little cheaper.

Laser 120–The exciting new addition to the highly successful Wharfedale Laser range of seven different loudspeaker systems. 2-way Infinite Baffle system with 120 watts (programme) power handling. Matched veneer cabinets with detachable acoustically transparent grilles (as shown right).

Complete hi-fi systems tend to cut corners on the speakers to keep the price down. Why? Because it's impossible to tell what's inside a speaker by looking at the outside. And as complete systems are made by specialists in electronics–not in acoustics–they naturally make any savings on the speakers.

Which means that perfectly adequate electronic equipment often ends up being played through thoroughly inadequate loudspeakers. Fortunately it also means you can improve your system out of all proportion simply by substituting the speakers.

And the best speakers to replace them with are made by Wharfedale.

Because Wharfedale don't cut corners.

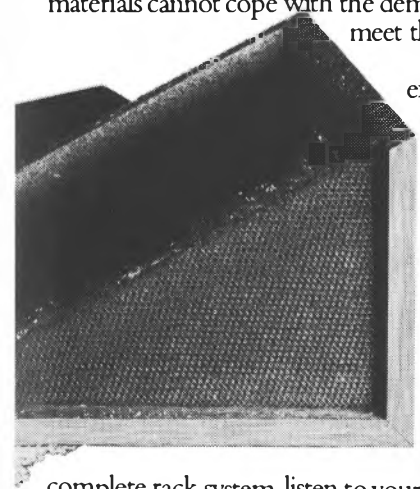
To make good speakers today is a difficult and expensive specialist business, depending as it does on the increasingly complex science of acoustic engineering.

The resources it needs are numerous. As well as money this involves time, a very specialist expertise and the accumulated knowledge of a team of experts dedicated to excellence. Wharfedale have just such a team of pioneering engineers who have constantly made major advances in acoustic techniques.

One instance is Laser Holography–a system which builds three dimensional pictures of a speaker's behaviour in action enabling imperfections to be exposed and corrected.

Even as others begin to learn the technique so Wharfedale have already developed further refinements and new uses.

Wharfedale's sophisticated use of computer optimization in speaker design produces loudspeaker systems which give the best possible performance for a given outlay. Where existing materials cannot cope with the demands of our advanced designs we develop entirely new ones to meet their exacting needs and performance specifications.



An example of this is the mineral-filled homopolymer–exclusive to Wharfedale and now used in many bass and mid-range drive units–infinitely superior to the paper cones still found in most speakers.

Our leadership in acoustic engineering and our constant striving for improvement gives us confidence that any Wharfedale speakers will outperform any other speakers in their price range–and often far above.

And that means any speaker in the entire Wharfedale collection–from the Laser 20 at around £50 per pair, through the powerful E Series, right up to the supreme TSR 112's at over ten times that price.

Let us share our confidence with you. Whether you are thinking of up-grading your existing system, building your first or going for a complete rack system, listen to your choice of electronics on a pair of Wharfedale speakers before you buy.

Then you'll be pleased to have us in your corner.

WHARFEDALE

Britain's most famous speakers

Rank Hi-Fi, Highfield Road, Idle, Bradford, Yorkshire. Tel: 0274 611131.

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 ⅓-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 1 m, frequencies above 200 Hz representing the ⅓-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 +/−3dB 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.

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 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

A new test has been introduced in this edition as part of our long term aim of improving the correlation between subjective and objective results. 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 ⅓-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 +/−30°, 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 meters 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 suggests 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 further investigation is 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 sound levels: 96dB was used for all the speakers excepting the very smallest bookshelf enclosures, where a reduction to 90dB was deemed appropriate. With an average sensitivity of 86dB/watt, typically just 10 watts 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 90dB 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 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 at 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. (Note that impedance graphs for reprinted reviews are referenced to a 3.3 ohm base line.)

Note that the new reviews in this issue employ 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' up 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,

The soft option for stereo nuts

Headphones are the only hi-fi unit in which comfort is a vital specification. So Bang & Olufsen considered the needs of the flesh as much as those of the soul in designing the U.70 headset.

Two-way adjustable earcups and silky-soft pads are the secrets of the U.70's extraordinary comfort, while the ortho-dynamic construction explains their superb reproduction quality – and their lightness. For although they can handle 2 watts RMS with all the accuracy and fidelity of a good loudspeaker, Bang & Olufsen headphones weigh only 300 grams – about 10½ oz. So now your private listening can be truly enjoyable instead of barely endurable.

Test the U.70's for quality and comfort at your nearest Bang & Olufsen dealer (he's listed in Yellow Pages) or send for further details to Bang & Olufsen UK Limited, Dept. HP, Eastbrook Road, Gloucester GL4 7DE.
Telephone (0452) 21591.

Bang & Olufsen

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

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

1. Slight but significant differences in microphone frequency response, particularly if 500Hz is chosen as a reference point with which to correlate subjective spectral balance judgements. This is unfortunately true of even the best 'lab reference' condensor microphones.

2. Proximity effects, whereby the range below 500Hz is elevated by 0.5dB or so at 1m relative to the speaker's previously calibrated response at 2m.

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 grille 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 +/–2.0dB 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.

At all of our branches we hold a superb display of top quality equipment at competitive prices. Demonstrations are available (bring your own record or tape if you like) and our helpful staff are always happy and able to offer knowledgeable, unbiased advice. We can also arrange home demonstrations and installations — just ask for details.

SEVENOAKS
HI-FI + VIDEO

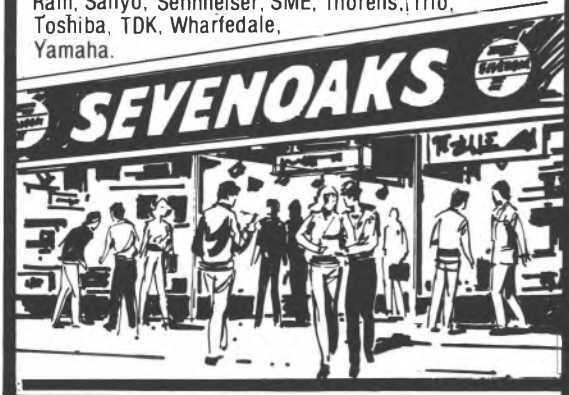
Most goods are available from stock, although it is best to phone to check prices and availability before setting out on your journey. Everything sold by Sevenoaks HiFi is fully guaranteed for parts and labour for a minimum of one year and maintained by our own service department. For added peace of mind ask about our service contracts and extended guarantees.

SUPER QUOTES

ARE ONLY A PHONE CALL AWAY!

A BIGGER BETTER SELECTION!
REALLY HELPFUL INTERESTED STAFF!
THE BEST AFTER SALES SERVICE!
WHAT MORE COULD YOU WANT!

Technics, Pioneer, Sony, JVC, Sansui, Panasonic, Mission, Akai, Ariston, Acoustic Research, Aiwa, Castle, Celestion, Celef, Dual, Fisher, Genesis, Grado, Hitachi, Kef, Krystal, Monitor Audio, Maxell, Marantz, Mordaunt Short, Mitsubishi, NAD, Nakamichi, Philips, QED, Quad, Revox, RCL, Reference Products, Ram, Sanyo, Sennheiser, SME, Thorens, Trio, Toshiba, TDK, Wharfedale, Yamaha.



SEVENOAKS (Sales/Mail Order)
118 London Road,
Sevenoaks, Kent.
Open Mon-Sat 9.30-1. 2-5.30
Closed all day Wednesday
(0732) 59555

LONDON SE18
162 Powis Street,
Woolwich, London, SE18
Open Mon-Sat 9.30-1. 2-5.30
Closed all day Wednesday
01-855 8016

TUNBRIDGE WELLS
34 Mount Ephraim,
Tunbridge Wells, Kent.
Open Mon-Sat 10-5
Closed all day Wednesday
(0892) 31543

CHATHAM
4 Railway Street,
Chatham, Kent
Open Mon-Sat 10-5
Closed all day Wednesday.
(0634) 46859

BRIGHTON
55 Preston Street,
Brighton, Sussex.
Open Mon-Sat 10-5
Closed all day Wednesday.
(0273) 733338

LATE NIGHT SHOPPING!
AT SEVENOAKS AND LONDON, SE18 THURSDAY UNTIL 7 p.m.

Acknowledgements (covering this and the last project)
John Atkinson (Hi Fi News), for panel service and loan of the Fender Precision Bass guitar. Mrs M. Barker. Roger Cawkwell, for his fine musicianship and great understanding as the 'live sound source'. Marianne Colloms, for typing and checking. Paul Crook, for invaluable assistance throughout the project. Tony Faulkner, Audio Engineer, for loan of program material and panel service. Rotel, for loan of *RB5000* amplifier. Sansui, for loan of *AU919II* amplifier. John Edwards, of GEC Hirst Research Centre, Wembley, for considerable assistance during the measurement phase.

Listening panel
John Atkinson, Caroline Atkinson, Trevor Attewell, Tony Bacon, Martin Colloms, Tony Faulkner, Alan Harris, Tony Lockwood, Alan McGechan, Evelyn McDermott, Peter Mapp, Adrian Orlowski, David Prakel, Damien Pullen. Additional data was provided by Paul Crook, who also acted as the independent sequence operator.

Location
Live recording at Building Research Establishment, Garston. Lab tests, open air, James Moir and Associates, Herts (earlier reviews), GEC Hirst Research Centre, Wembley (new reviews). Listening tests, author's calibrated and near IEC standard room. (This is an appreciably dry room of 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
1. Domestic stereo listening tests
Revox B77 high speed IEC tape deck.
Dolby A361 x 2 type 'A' noise reduction units.
TDK and BASF recording tape*.
Linn Sondek/Ittok turntable and tonearm.
Technics EPC205CIIIL: Linn Asak; Koetsu cartridges*.
Sansui AU919 II amplifier*.
Technics SH9020 power monitor.
Technics SU9070 pre-amplifier.
Lucas ILV speaker cable.
Ivie 30A sound level monitor/analyser.
Carver M400 'cube' power amplifier.
Quad 44 pre-amplifier.
B&K 2203 sound level meter.
2. Live-*vs*-recorded tests
Equipment noted above for domestic stereo tests (where relevant) plus:
B&K 4133 precision microphone.
Ivie 1P mike pre-amplifier and 30A sound level monitor.
Rotel RB5000 power amplifier (500W per channel–for precision peaks)*.

Instruments
(all loaned by R. Cawkwell)
Classical acoustic guitar, Paiste cymbal; Flute; Side drum; Wood block xylophone; Male voice (R. Cawkwell).

Lab testing
B&K 2010 tracking generator analyser*.
B&K 1614 filter set*.
H&H professional power amp*.
Nicolet 100kHz FFT analyser.
B&K 4133 precision 12.5mm microphone.
B&K 1623 auto tracking ⅓-octave filter*.
B&K 2305B high speed level recorder*.
B&K 1014 BF sweep oscillator*.
Ivie pink noise generator.
Farnell TM30 phase meter*.
Quad 405 power amplifier (lab-modified protection circuit).
Ivie 30A real time ⅓-octave spectrum analyser.
Telequipment D53 oscilloscope*.
Rion LR04 high speed level recorder.
Baxendall sweep oscillator.
Hewlett Packard HP3582A computing Fourier spectrum analyser.
Hewlett Packard HP85A desktop computer controller.
*denotes equipment loaned to *Choice*.

Programme used for stereo listening sessions
Live musician, instrument recordings (monaural technique, anechoic).
Arthur Wills, Ely Cathedral organ, crossed-pair mike technique, trial mastertape. (Pictures at an Exhibition Transcription.)
Rod Goodwin orchestra 'Big Band', multitrack technique, mastertape of film score.
Elton John '21 at 33', multitrack, pop from disc HISPD 126.
Esther Ofarim, 'Esther', female popular vocal from disc ATR 001.
Cantate Domino, cathedral choir from disc ATR 002.
Schumann, Piano Concerto, crossed-pair technique, mastertape.
Elgar, Sea Pictures (Janet Baker), female voice from disc, EMI ASD 655.
Opus 3, Opus 7900 Track 1, Tiden Bara Gar.
Little Feat, 'Dixie Chicken'.
The B52s.

A minor operation could bring major improvements to your hearing

When the symptoms are lifeless reproduction and tone deafness, it's all too easy to rush out and seek a cure in the form of a power oozing amplifier or sophisticated speakers. Which in many cases is quite the wrong medicine.

So often, it's the cartridge that's at the root of the problem.

Because unless this vital component is sensitive enough to faithfully follow the very complex contortions of your record groove, you can never hope to hear your favourite music the way it was recorded.

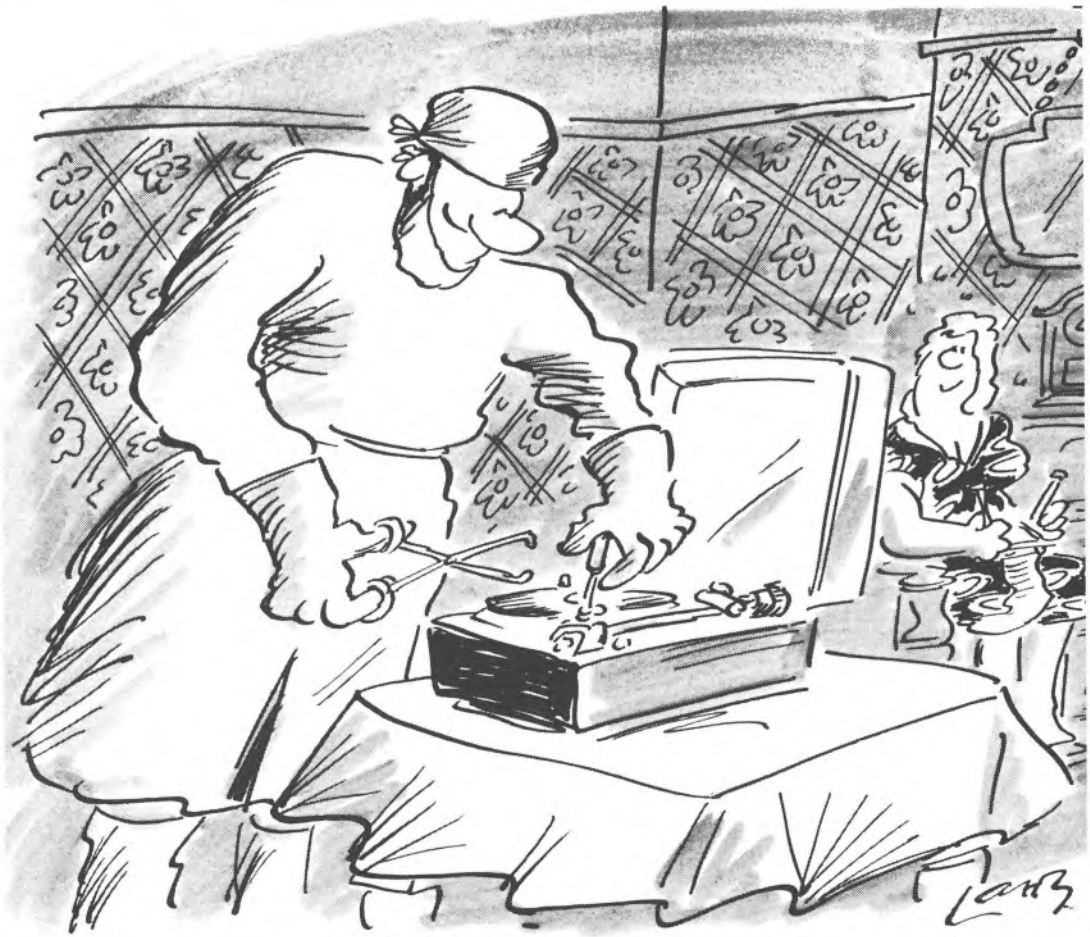
ADC cartridges, on the other hand, are built with absolute precision and incorporate some very advanced features to ensure highly accurate tracking ability, superb reproduction and yet minimal record wear.

And with a range of ten available, there's one to suit all listening tastes and equipment.

Changing your cartridge is easy. Your local ADC specialist dealer will be pleased to prescribe the right unit for your system and give all the help you may need to perform the operation.

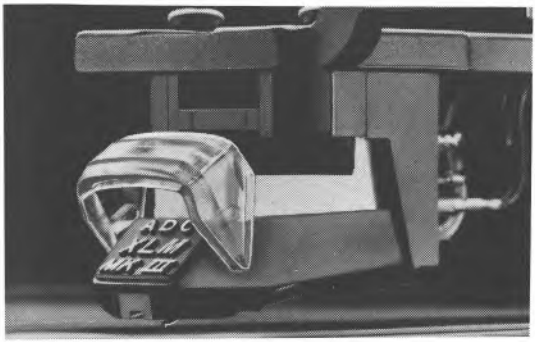
Call in and talk to him. His address is listed overleaf.

And should you feel in need of a second opinion about the quality of ADC cartridges, read on.



"For my taste and system I remain loyal to the ADC's, particularly in terms of value for money."
Paul Messenger in HI-FI NEWS & RECORD REVIEW.

"It is well detailed and very refined where appropriate, and its dynamics are good, but all in a very musical way."
Alvin Gold reviewing the ADC XLM MkIII Improved in WHAT HI-FI?



"This cartridge was universally liked for its clear natural rendition of voice which allowed each inflection to come over clearly."
Dave Berriman reviewing ADC QLM 36 MkIII Improved in PRACTICAL HI-FI.

"Very good sound quality for the price is coupled with a fine lab performance."
HI-FI CHOICE reviewing the VLM MkIII Improved.

ADC VLM MkIII Improved — HI-FI CHOICE BEST BUY
ADC QLM 34 — HI-FI CHOICE BEST BUY
ADC XLM MkIII Improved — HI-FI CHOICE BEST BUY
ADC ZLM MkIII Improved — HI-FI CHOICE RECOMMENDED

BEST BUY HI-FI CHOICE RECOMMENDED

Music to your ears.

ADC

Audio Dynamics Corporation, Powke Lane, Warley, West Midlands, B64 5QH. Tel: (0384) 65191

The ADC cartridge range

featuring ADC Induced Magnet System and revolutionary Omni Pivot System

ASTRION
The best cartridge ever made?
No compromise design with extended contact diamond stylus fused by laser onto a sapphire crystal cantilever and located on an Orbital Pivot Suspension block (a development of the Omni Pivot System) Ultra-low distortion over full frequency range and remarkable spacial sound characteristics.
Tracks at 1.2 grams ± 0.2 grams.

ZLM IMPROVED
State of the Art low mass cartridge with nude elliptic stylus on a tapered cantilever. Ruler flat frequency response and superb tracking ability at 1.0 grams ± 0.25 grams.

XLM MK III IMPROVED
Widely acclaimed low mass design with nude mounted elliptical stylus on a tapered cantilever.
Tracks at 1.2 grams ± 0.3 grams.

VLM MK III IMPROVED
As XLM but with straight cantilever for applications requiring a more robust stylus assembly without loss of performance. Tracks at 1.2 grams ± 0.3 grams.

QLM 36 MK III IMPROVED
Unique Diasa elliptical stylus nude mounted onto straight cantilever. Reduced tendency to resonance, lower mass and better tracking ability at 2 gram similarly priced conventional cartridge with bush mounted stylus. Tracks at 1.2 grams ± 0.3 grams.

QLM 34 MK III AND QLM 32 MK III
For medium to high mass arms.
Bushed elliptical stylus on straight cantilever.
QLM 34 tracks at 1.5 to 4 grams.
QLM 32 tracks at 2 to 4 grams.

INTEGRA RANGE
Low mass combined cartridge and headshell which plugs into International tonearm sockets. Carbon fibre construction and finely adjustable for overhang and vertical tracking to optimise tonearm geometry. Option of nude elliptical nude Diasa elliptical or bushed elliptical stylus.

ALT 1 TONEARM
One of a range of three easy to install low mass tonearms. Aluminium arm tube with interchangeable carbon fibre headshell. Effective arm mass 7 grams. Cartridge weight range 4 to 11 grams.

ADC

Audio Dynamics Corporation
Powke Lane, Warley, West Midlands, B64 5QH

YOUR ADC SPECIALIST. A good place to talk hi-fi.

ADC dealers are carefully selected for their helpful, knowledgeable approach to the business of choosing hi-fi. They won't attempt to blind you with science, they'll listen to your questions, and provide facilities for you to make a useful comparison between various manufacturer's products. Don't settle for anything less.

AVON
Bath: Paul Green Hi-Fi Tel 316197
Bristol: Radford Hi-Fi Tel 422709

BEDFORDSHIRE
Dunstable: Target Electrical Tel 67750
Kempston: Eedford Audio Tel 854133
Luton: B & B Hi-Fi Tel 27758
Luton: Technosound Tel 30919

BERKSHIRE
Maidenhead: D. Coles & Son Tel 26755
Newbury: B & B Hi-Fi Tel 32474
Reading: B & B Hi-Fi Tel 583730
Slough: Audiomart Tel 27021
Windsor: Radford Hi-Fi Tel 56931

BUCKINGHAMSHIRE
Aylesbury: Chiltern Hi-Fi Tel. 31020
High Wycombe: B & B Hi-Fi Tel 35910
High Wycombe: Hughes Hi-Fi Tel 30138
Milton Keynes: Technosound Tel 604949

CAMBRIDGESHIRE
Cambridge: Campkins Audio Tel 312240
Cambridge: Renbro Audio Tel 51234
Cambridge: Steve Botsball Audio Tel 68306
Chesterton: Spanchley & Co Tel 358611
Peterborough: Hi-Fi Consultants Tel 51007
Peterborough: Soundsense Hi-Fi Tel 41755
St Ives: St Ives TV Centre Tel 66380

CHESHIRE
Birkenhead: Studio Electrics Tel 051-6475382
Chester: Newdawn Hi-Fi Tel 24179
Northwich: Watts Tel 3691
Wallasey: Armstrong Smith Tel 051-639 9257
Warrington: Cobalt Hi-Fi Tel 36215
Wilmslow: Hi-Fi Centre Tel 24766
Wilmslow: Swifts Tel 26213

CLEVELAND
Billingham: Gilson Audio Tel 557420
Bishop Auckland: McKenna & Brown Tel 2266
Darlington: Gilson Audio Tel 61922
Darlington: McKenna & Brown Tel 65590
Middlesbrough: Gilson Audio Tel 248793
Middlesbrough: McKenna & Brown Tel 248345
Redcar: McKenna & Brown Tel 483829
Stockton: Bond & Mason Tel 67582
Stockton: McKenna & Brown Tel 69995

CUMBRIA
Barrow: Barrow Hi-Fi Tel 20473
Barrow: Searle Audio Tel 21233
Carlisle: G.D. & M. Dunglinson Tel 24918
Ulverston: Sound System Audio Tel 53596

DERBYSHIRE
Derby: Bucklands Tel 48425

DEVON
Exeter: Homesound Tel 72814
Exeter: K.J.B. Electronics Tel 37888
Newton Abbot: K.J.B. Electronics Tel 60188
Paignton: Upton Electronics Tel 551329
Plymouth: Peter Russell Hi-Fi Tel 669511

DORSET
Bournemouth: Bush & St. Clair Tel 34796
Bournemouth: Direct Vision Tel 877371
Christchurch: H.A.T.V. Tel 742706

ESSEX
Barking: Hyperfi Tel 01-591 6962
Barkingside: Audiotime Tel 01-550 2856
Chadwell Heath: Audiotime Tel 01-590 3286
Chelmsford: Rush Hi-Fi Tel 57593
Clacton: Cranham Hi-Fi Tel 29937
Epping: Chew & Osborne Tel 74242
Ilford: Prot Enterprises Tel 01-553 0144
Ilford: A.T. Labs Tel 01-518 0911
Leigh on Sea: Soundtrack Tel 79150
Romford: Rush Hi-Fi Tel 26840
Saffron Walden: Chew & Osborne Tel 23728
Waltham Abbey: Kendor Assoc Tel 715985

GLOUCESTERSHIRE
Cheltenham: Absolute Sound & Video Tel 583960
Cheltenham: Robbs Tel 513195
Cheltenham: Spa Vision Tel 23439
Cirencester TV & Hi-Fi Centre Tel 4756
Gloucester: Robbs Tel 419777
Stroud: Robbs Tel 2753

HAMPSHIRE
Denmead: Denmead Hi-Fi Centre Tel 50312
Fareham: Sounds of Fareham Tel 233544
Southampton: Parkers Audio Tel 45926
Stubbington: W.F. Waite Tel 4335

HEREFORD & WORCESTER
Bromsgrove: Downing & Downing Tel 72976

HERTFORDSHIRE
Barnet: Portogram Tel 01-449 4183
Hemel Hempstead: Hi-Fi Markets Tel 40999
Hitchin: Spectrum Tel 52248
Letchworth: Spectrum Tel 79548
Letchworth: Spectrum Tel 79571
Radlett: Radlett Audio Tel 3773
Watford: Herts Hi-Fi Tel 40633

HUMBERSIDE
Beverley: Simply Hi-Fi Tel 862696
Bridlington: Quay T.V. Tel 72870
Grimsby: Grimsby Hi-Fi Centre Tel 43539
Grimsby: G.E. Manders Tel 51391
Hull: Simply Hi-Fi Tel 29240
Scunthorpe: Les Wright Tel 67738

KENT
Beckenham: Hi-Fi Connections Tel 01-658 3450
Beckenham: S.M. Electronics Tel 01-650 4701
Bromley: Sound Systems Tel 01-460 4000
Bromley: Halcyon Electronics Tel 01-464 2260
Canterbury: Canterbury Hi-Fi Tel 65315
Erith: Hy-Tek Electronics Tel 39402
Margate: The Longplayer Tel 293477
Sevenoaks: Sevenoaks Hi-Fi Tel 59555
Tonbridge: Standens Tel 353540

LANCASHIRE
Blackpool: F. Bentell Tel 49625
Backpool: H. Wiseman Tel 28416
Chorley: Monitor Sound Tel 71935
Lytham: Badgertracks Tel 729247
Rochdale: Cleartone Hi-Fi Tel 524652
Southport: Audio Corner Tel 37332
Southport: Southport Hi-Fi Tel 36901

LEICESTERSHIRE
Hinckley: Hinckley Sound Centre Tel 611541
Leicester: Leicester Hi-Fi Tel 667801
Leicester: Mays Hi-Fi Tel 58662

LINCOLNSHIRE
Boston: Oldrids Tel 61251
Lincoln: Critics Choice Tel 38718
Lincoln: Lincoln Hi-Fi Centre Tel 20265
Stamford: Stamford Hi-Fi Centre Tel 2128

LONDON EAST
E. Barden: E8 Tel 01-2548811
Caversham Sales: E1 Tel 01-247 3453
D & J Electronics: E10 Tel 01-556 0017
Gem: E11 Tel 01-558 0223
Kimberleys Hi-Fi: E12 Tel 01-478 1175
Parkwest Electronics: E8 Tel 01-249 4814

LONDON NORTH
Amber Audio: N14 Tel: 01-886 3094
Analog Audio: N12 Tel 01-445 3267
Andys Electronics: N10 Tel 01 883 8969
Atlantic Electrics: N1 Tel: 01-607 6371
Barnetts Hi-Fi Centre: N7 Tel 01 607 2296
Cannonbury Radio: N1 Tel: 01-226 9392
Fotronics Int.: N15 Tel: 01-802 4131
Goodwin: N16 Tel: 01-888 0077
Grahams: N1 Tel: 01-837 4412
Martins Hi-Fi Centre: N16 Tel: 01-254 5053
Mason Radio: N4 Tel: 01-272 1231
W. Redfern: N19 Tel: 01-272 2183

LONDON NORTH WEST
Atlantic Electrics: NW10 Tel: 01 451 0302
Parkview Electronics: NW5 (2 stores)
Tel: 01 267 7223 and 01 485 8709
Signal Processing Systems: NW4
Tel: 01-202 5551
Studio 99: NW6 Tel: 01 328 6666
T.V. & Hi-Fi Studio: NW2 Tel: 01 450 3508

LONDON SOUTH EAST
Billy Vee: SE13 Tel: 01-318 5755
L.P. Stereo: SE9 Tel: 01 859 0115

LONDON SOUTH WEST
ACV: SW16 Tel: 01-769 3763
Chelsea Hi-Fi: SW3 Tel: 01 351 0200
Hi-Fi & Components: SW11 Tel: 01 223 1110
Jupiter Audio Centre: SW17 Tel: 01 767 2810
M. O'Brien: SW19 Tel: 01 946 1528
Sounds & Video Centre: SW12 Tel: 01 673 3398
South London Hi-Fi Centre: SW2 Tel: 01 674 2033
South London Hi-Fi Centre: SW9 Tel: 01-737 0192

LONDON WEST
Azat (London): W1 Tel: 01 580 4632
Ealing TV & Hi-Fi: W5 Tel: 01-579 3718
Hi-Fi Care: W1 (5 stores) Tel 01 580 3459/7383 and 01-637 0371/1908/8911
Lion House: W1 Tel: 01-580 7383
Mason Radio: W12 Tel: 01 743 3698
Musicraft: W2 Tel: 01 402 9729
Nandos: W2 Tel: 01-723 6809
REW: W1 Tel: 01 637 2624
Sona Electronics: W11 Tel: 01 229 6411
Sonic Sound Audio: W1 Tel: 01 637 1909
Telesonic: W1 Tel: 01 486 8177

GREATER MANCHESTER
Bolton: Cleartone Tel 22636
Hazelgrove: Chesterjate Studios
Tel 061-483 9823
Manchester: Central Radio Tel 061-834 6700
Stockport: Bespoke Audio Tel 061-456 8515
Stockport: Fairbothams Tel 061-480 4872
Urmston: Audio Counsel Tel 061 747 9722
Urmston: Shannon Radio Tel: 061-748 2339
Wigan: Wigan Hi-Fi Tel 37977

MERSEYSIDE
Crosby: PA Audio Tel: 051-924 7287
Liverpool: Beaver Radio Tel: 051-709 9898
Liverpool: W. Brady Tel: 051-773 6859
Liverpool: CBS Tel: 051-709 0388

MIDDLESEX
Eastcote: Eastcote Hi-Fi Tel: 01-868 2946
Edgware: Planet Hi-Fi Tel 01 952 3238
Enfield: A.T. Labs Tel: 01-363 7981
Greenford: Ivins Radio Tel: 01-578 9699
Ruislip Manor: T.A.S. Tel: 32217
Wembley: Wembley Hi-Fi Tel: 01-903 9506

NORFOLK
Gt. Yarmouth: Martins Electronic Centre Tel: 55044
Kings Lynn: Martins Electronic Centre Tel: 61683
Norwich: Martins Electronic Centre Tel: 27010
Norwich: Speechley & Co. Tel: 60801

NORTHAMPTONSHIRE
Kettering: Kettering Hi-Fi Centre Tel: 515266
Northampton: Listen Inn Tel: 37871
Northampton: Richard Reeves Hi-Fi Tel: 33578
Rushden: Rushden Hi-Fi Centre Tel: 2342

NOTTINGHAMSHIRE
Eastwood: Peter Ellis Audio Tel (07737) 2280
Mansfield: Baskills Tel: 641537
Mansfield: Forum Hi-Fi Centre Tel: 23716
Mansfield: Syd Booth Tel: 26315
Newark: Peter Ellis Audio Tel: 4571
Nottingham: Nick Dakin Hi-Fi Tel: 783862
Nottingham: Nottingham Hi-Fi Centre Tel: 784015
Nottingham: Superfi Tel: 412137
Sherwood: Forum Hi-Fi Tel: 622150

OXFORDSHIRE
Headington: Absolute Sound & Video Tel: 65961
Oxford: Westwood & Mason Tel: 47783
Summertown: Horns Tel: 511241
Summertown: Riocraft Tel: 53072
Wallingford: Astleys Tel: 39305
Witney: Witney Audio Tel: 2414

SOMERSET
Taunton: Homesound Tel: 73321
Yeovil: Yeovil Audio Tel: 25430

STAFFORDSHIRE
Hanley: Bowen Hi-Fi Centre Tel: 25194
Lichfield: RTTS Hi-Fi Tel: 22877
Newcastle: Clement Wain Tel: 613119

SUFFOLK
Bury St Edmunds: BG Audio & TV Tel: 5227
Hessett: Anglia Audio Tel: (0359) 70212
Ipswich: Eastern Audio Tel: 217217
Lowestoft: John Wells Photo & Audio Tel: 3742
Sudbury: System Sound Tel: 72348

SURREY
Croydon: Spalding Electrical Tel: 01-654 1231
Guildford: P.J. Equipment Tel: 504801
Guildford: Unilet Hi-Fi Tel: 71534
Weybridge: Cosmic Tel: 54522
Woking: Aerco Records Tel: 4926

SUSSEX
Bexhill on Sea: Radiovision Tel: 219443
Brighton: Jeffries Hi-Fi Tel: 609431
Eastbourne: Jeffries Hi-Fi Tel: 31336
Lewes: Lewes Hi-Fi Tel: 78133
St Leonards on Sea: B & K Hi-Fi Tel: 439150
Worthing: Phase 3 Hi-Fi Tel: 206820

TYNE & WEAR
Gateshead: Lintone Audio Tel: 774167
Newcastle: Hi-Fi Opportunities Tel: 27791
Newcastle: J.G. Windows Tel: 21356
Sunderland: Saxons Tel: 57578

WARWICKSHIRE
Leamington Spa: CTS Audio Tel: 29265
Nuneaton: BRG Hi-Fi Tel: 61825
Warwick: JCV Hi-Fi Tel: 43796

WEST MIDLANDS
Birmingham: N.N. Field Hi-Fi Tel: 021 622 2323
Birmingham: Five Ways Hi-Fi Tel: 021-455 0667
Birmingham: Forum Hi-Fi Tel: 021-707 3640
Birmingham: Griffin Radio Tel: 021-692 1359
Birmingham: Hopkinson Electronics Tel: 021-643 0097
Birmingham: Perfect Electronics Tel: 021-327 1497
Coventry: Forum Hi-Fi Centre Tel: 21218
Coventry: RSC Ltd Tel: 25983
Rowley Regis: Sam Riley Tel: 021-559 1043
Stourbridge: Downing & Downing Tel: 71747
Sutton Coldfield: Purlesound Tel: 021-355 1838
Walsall: Ray Charles Audio Tel: 612382
Wednesbury: Wilcox TV & Hi-Fi Tel: 021-556 0473
Wolverhampton: Midland Hi-Fi Studio Tel: 771774
Wolverhampton: Milwards Tel: 23982
Wolverhampton: Sounds Tel: 21126
Wolverhampton: Woods TV & Hi-Fi Tel: 772901

WILTSHIRE
Swindon: Absolute Sound & Video Tel: 38222
Swindon: TV & Hi-Fi Centre Tel: 28383

YORKSHIRE
Barnsley: Barnsley Hi-Fi Tel: 5549
Bradford: Errricks Tel: 31648
Bradford: RAM Computer Services Tel: 391166
Castleford: Eric Wiley Tel: 553066
Doncaster: Quadraphenia Tel: 21215
Halifax: Tape Recorder Centre Tel: 66832
Harrogate: Yorkshire Hi-Fi & Video
Huddersfield: Huddersfield Hi-Fi Tel: 44668
Leeds: Audio Projects Tel: 789115
Leeds: Leeds Jackson Tel: 781513
Leeds: Superfi Tel: 449075
Sheffield: Audio Centre Tel: 737893
Sheffield: Micron Audio Tel: 360295
Sheffield: Quadraphenia Tel: 77824
Sheffield: Sheffield Sound Centre Tel: 23365
Sheffield: Tele-Vision-Rentals Tel: 344468
York: Multisound Hi-Fi Tel: 51712
York: J. Saville Tel: 25755
York: Vickers Hi-Fi Tel: 29659

CHANNEL ISLANDS
Jersey: Sound Engineering Tel: 21735

NORTHERN IRELAND
Belfast: Audio Times Tel: 29907
Coleraine: Best Hi-Fi Tel: 52843

SCOTLAND
Aberdeen: Colburn Hi-Fi Tel: 25713
Aberdeen: Telemach Audio Visual Tel: 28817
Ayr: Vennel Audio Tel: 64124
Edinburgh: Audio Aids (2 stores)
Tel: 031-226 3979 and 031-667 2877
Edinburgh: Hi-Fi Corner Tel: 031-556 7901
Edinburgh: Russ Andrews Tel: 031-557 1672
Edinburgh: The Gramophone Shop
Tel: 031-2259535
Glasgow: James Kerr Tel: 041-332 0988
Glasgow: McCormacks Music Tel: 041-332 6644
Glasgow: The Music Room Tel: 041-221 2527
Glasgow: Victor Morris Tel: 041-221 8958
Kilmarnock: Vennal Audio Tel: 34826
Montrose: Robt. Ritchie Tel: 3765
Perth: K.K. Peddie Tel: 35611

WALES
Cardiff: Houlden Hi-Fi Tel: 44011
Colwyn Bay: Owens Hi-Fi Tel: 30982
Newport: Hi-Fi Western Tel: 62790
Port Talbot: Electronic Hi-Fi Tel: 882068
Swansea: F.W. Haines & Co. Tel: 54747

How would you like to play with Dire Straits?

Guitar. Keyboards. Drums. Vocals.

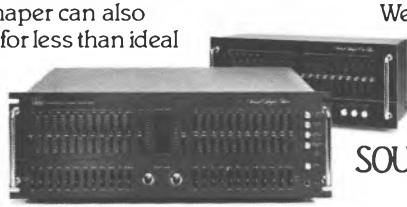
With an ADC Sound Shaper you can enjoy music the way you like to hear it.

Unlike the tone controls on your amplifier, which operate over a very broad frequency spectrum, a Sound Shaper enables you to pick out frequencies and apply boost and cut to suit your listening taste precisely.

A Sound Shaper can also help compensate for less than ideal room acoustics. It can reduce record surface noise, tape hiss and turntable rumble, help overcome speaker limitations, and adjust for a variety of other system weaknesses.

The end result: music that sounds better than you've ever heard it before.

There's a range of 5, 10 and 12 band Sound Shapers to choose from and your local ADC dealer will be pleased to demonstrate.



We guarantee you'll be impressed by what they can do for your system.

SOUND SHAPERS by ADC

Music to your ears.

SPECIAL OFFER
ANY 5 ISSUES JUST £10!
NO POSTAGE TO PAY

THE ONLY CORNERS WE CUT ARE ON OUR TAGS

You have probably seen them. In dealers windows, attached to display models at exhibitions or featured in advertisements in the hi-fi press. Manufacturers are inordinately proud of them. As well they might be. We dish them out pretty sparingly.

So just why does a *HI-FI CHOICE* recommendation carry so much weight?

Because we commit thousands of pounds and many hundreds of man hours testing equipment for every issue of *HI-FI CHOICE*. And when we say 'testing', we really mean it.

Each issue is authored by one of Britain's finest audio technicians. We pit machine against machine under controlled laboratory conditions comparing manufacturers claims against punishing reality.

We conduct 'blind' listening tests using a panel of listeners. We print the reviews, warts and all. These are preceded by a 'Consumer Introduction and a 'Technical Introduction', usually many pages in length. Each issue has a quick reference 'Overall Comparison Chart' and, of course, a 'Best Buys and Recommended Section'. Photographs of all models are included. Lastly, we award those little tags to a selection of the models tested.

We usually publish five *HI-FI CHOICE* editions a year. They cost £2.00 per copy. Each one dedicated to a particular theme. We laminate the covers to make them last for years and supply quality binders to keep them in for permanent reference. We also maintain stocks of back issues for people to buy through the mail (using the coupon below) or you can visit our new Back Issues Centre in the West End of London. This is located at 14 Rathbone Place, London W1P 1DE, five minutes walk from Tottenham Court Road tube station.

Any new issue of *HI-FI CHOICE* is usually to be found at W. H. Smith or other good newsagents. Some hi-fi dealers carry a stock of back issues, too, but in case of difficulty, contact us at the above address.

Ours is not a very economic way of producing a hi-fi publication. We could probably cut a few corners on obtaining the information we publish and make a lot more money. But our Series Editor, Paul Messenger, just wouldn't stand for it. And he stands for what is printed on the front cover of every *HI-FI CHOICE* — "The Most Comprehensive Guide to Buying Hi-Fi Ever Published."

BACK ISSUES CENTRE

We have a complete selection of all available *Hi-Fi Choice* back numbers in our flashy new Back Issues Centre in the West End of London, just half a minute's walk from Oxford Street (close to Tottenham Court Road tube station). Of course, you could order them from our excellent mail order service, using the coupon below, but by visiting in person you save on postage costs. The Back Issues Centre also often has back numbers of *Hi-Fi Choice* on sale which we cannot offer through the mail order service because of shortage of stock. And any new issue is usually on sale in the Back Issues Centre several days before it reaches your local newsagent. Our receptionists will also be happy to sell you a set of binders or take your subscription. Drop by next time you're in the West End. We're open Monday to Friday, 10am to 6pm, Saturday 11am to 6pm. The address is 14 Rathbone Place, London W1.

COME UP AND SEE US

These current issues of regular *Hi-Fi Choice* also available using the same coupon. Please tick the box under the issues you require. All issues (including the new *Best Buy Guide*) are £2.00 each. This includes all post and packing in the UK. Please add 60p for overseas orders.

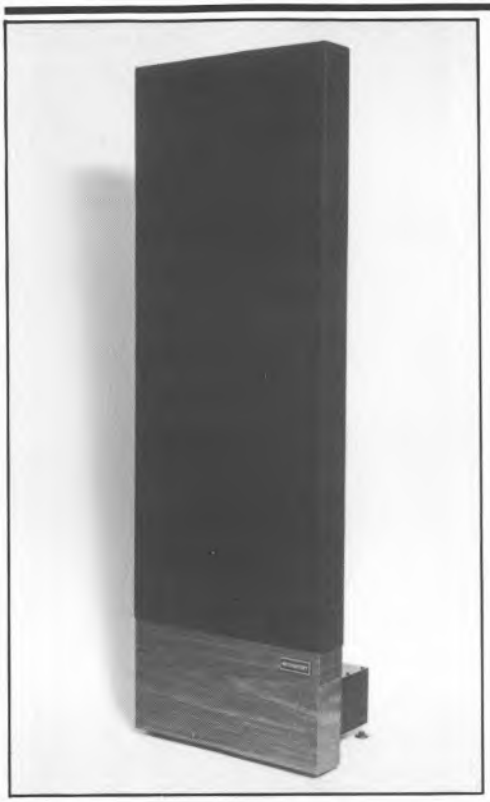
Name _____ Address _____

I enclose a cheque/PO for £ payable to Sportscene Publishers Ltd. Allow 3 weeks for delivery. Mail coupon to *Hi-Fic Choice* Offer, 14 Rathbone Place, London W1P 1DE. If you don't wish to clip this coupon please send your order, clearly printed, together with your remittance to the above address.

HFCL/81

Acoustat Model II

Transonic Imports, Brooks Court, Stamford, Lincs. Tel (0780) 55551



This US-designed electrostatic speaker is manufactured in Florida, and suffers the inevitable cost penalty imposed on an import, carrying a UK price well in excess of £1000.00. It is difficult to avoid comparisons with the other electrostatic model in this report, namely the new Quad *ESL-63*, and yet on the US market their roles are dramatically reversed, with the *Acoustat* costing about one third that of the Quad's Stateside price.

On arrival the *Model Two* required some assembly, namely attaching the power supply by four screws, plus some internal wiring connections and insertion of screw adjustable slide feet. Standing as it does some 5 feet high, the speaker cannot fail to dominate most room settings, and this is even more true with its optimum position clear of room walls. Mains supply is required for both left and right units; in contrast to their active thermionic versions, these Acoustats were passive designs, requiring normal external power amplifiers.

Technically the speaker is a full range transformer-coupled electrostatic, using a plastic film diaphragm charged to a high voltage and driven in push pull between perforated conductive electrodes. In an effort to improve efficiency and ameliorate the traditional low impedance of such designs, two transformers have been used in a kind of split frequency path mode, one for low and the other for high frequencies, with a broad central overlap. Strong claims are made for the benefits of this technique, but I was unable to fully verify these on test.

An unfortunate side effect of such large diaphragm speakers is their poor off-axis response, and this weakness inevitably dominated both the lab and listening tests. Its narrow beam angle particularly at the highest frequencies meant that at our standard 2.5 m panel listening distance the speaker could only properly serve two and at the most three of the listeners, so single listener trials were required to augment the main results.

Lab performance

Above 6 kHz the frequency response was critically dependant on measuring axis, so much so in fact that any one result is bound to be rather unrepresentative. On the reference sinewave the two poorer traces represented a well aligned result with the high frequency control set at the full and about the half way positions. Specific vertical alignment within 1 degree allowed the rather better reference response to be obtained. Analysis of these and the forward axis group of responses showed that in general terms the speaker was dominant in the 300 to 800 Hz range, and that the off-axis results would be poor. The behaviour was in fact so complex that the off-axis curves can only offer a glimpse of an overlapping array of wildly different responses, changing with small axis deviations.

The dotted 15° above response showed a 5dB or so loss above 600Hz but with a recovery at higher frequencies, while at 30° lateral the fall was severe and irregular (20dB down at 8kHz), the output continuing to fall at 45°. In consequence the room ambient or reverberant sound will be uneven, and the speaker's tonal balance will change rapidly with tiny changes in listener position.

Claimed to be of good sensitivity, the value of 82.5 dB/W measured was rather low, and was not helped by the impedance characteristic dipping to 2 ohms, 16kHz, with an average value of 5 ohms. The low frequency response was dependant on the nearest boundaries, but was certainly extended at a typical 32 Hz, −6dB.

At the admittedly high 96dB spl test level the

Model Two suffered from an appreciable amount of 3rd harmonic distortion below 200Hz; 30.0% was recorded at 150Hz, reducing to 3.0% at the more modest 90dB level. The distortion was much better at mid and high frequencies and 100W pulsed testing at 500Hz gave 0.8% 2nd and 0.3% 3rd; at 5kHz the results were even better at 0.12% and 0.07% respectively.

For a speaker of this price the maximum sound level of 97dBA in a room environment is rather restricted, and amplifiers of over 100W would result in overload. The integrated ⅓-octave room response was however remarkable in that the mathematical summation beautifully disguised the erratic directional behaviour, thereby resulting in a rather better response than was actually perceived. However the mid dominant region centring on 500Hz remained.

Sound quality

Reflecting its directivity problem, the speaker received a wide range of scores for both recorded and live programme. One problem was the obvious difference in presentation in terms of height and scale by comparison with conventional speakers. Off-axis listeners got a raw deal in terms of frequency balance and stereo imagery, but on-axis certain virtues were apparent, notably a near 'magic' midrange devoid of any enclosed or 'boxy' effects, with good transparency plus a fine rendition of detail. Conversely the lowest frequencies showed some 'lumpiness' and little real power, while the treble was notably ragged and uneven, with 'hissy' effects exaggerating surface noise.

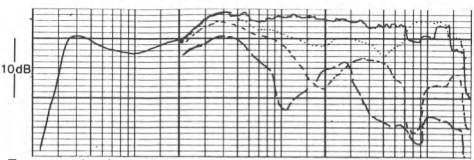
When precisely and accurately aligned for a single listener (which took much time and effort), it was possible to improve the effect of the treble range though it was never entirely convincing. Stereo imaging was better with increased distance, and 4–5 metres would appear to be the best listening distance in a very large room. As regards the frequency balance, the vocal rendition was 'small' in tonal balance, confirming the tendency to a forward midband as noted previously on test.

Summary

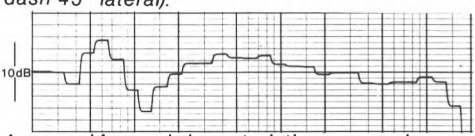
Handled very carefully the strong midband performance of the *Model Two* could be demonstrated to advantage, but was outweighed in my opinion by its other failings, notably low sensitivity and impedance, plus restricted power handling, critical stereo imaging, and extreme variability of subjective response with position. An interesting creation, the *Model Two* is at a distinct disadvantage in terms of its high UK price, and will undoubtedly suffer competition from both the Quad models.

GENERAL DATA

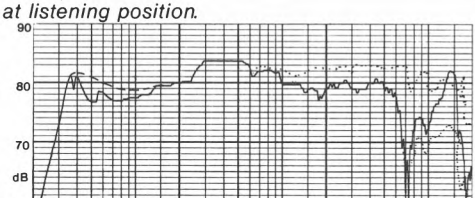
Size (h x w x d)	148 x 50 x 33cm
Weight	approx 25kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(80)–100W
Recommended placement	floor, away from rear wall
Frequency response within ± 3dB (2m)	150Hz to 14kHz
Low frequency rolloff (–6dB) at 1m	32Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	82.5dB/W
Approximate maximum sound level (pair at 2m)	97dBA
Impedance characteristic (ease of drive)	fairly difficult
Forward response uniformity	poor
Typical price per pair inc VAT	£1000



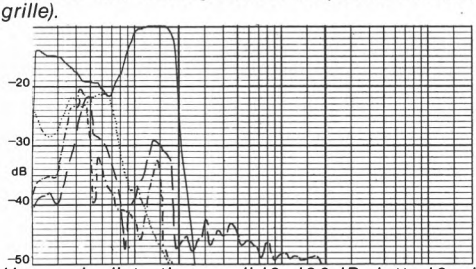
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



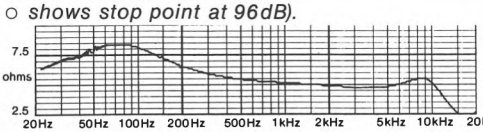
Averaged forward characteristic response in room at listening position.



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



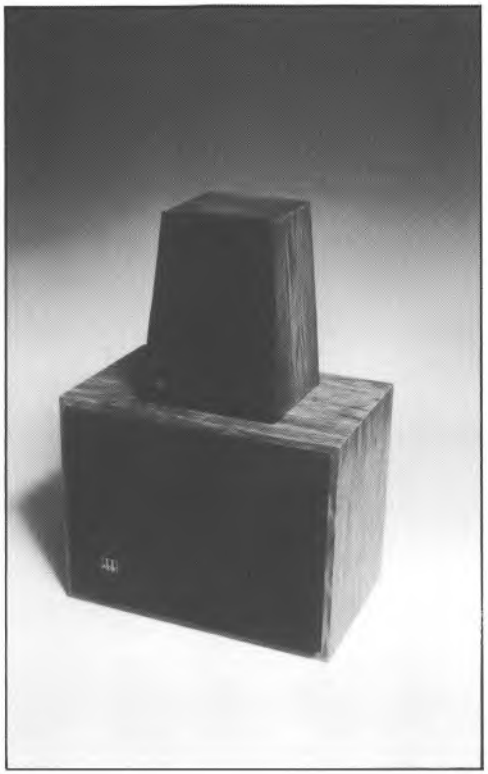
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod Z).

ADC MS650/MS10W

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



ADC have been in the speaker business in the USA for a number of years, but this is the first system to be properly distributed in the UK. Two models are in fact covered, comprising a complete system with a central floor standing mono bass cabinet plus two very compact satellite units making the stereo pair. The whole is priced at around £360.00, with the satellites alone costing some £199.00.

Passive central bass units present a problem due to the difficulties of summing the bass output from both amplifier channels at a low crossover frequency. ADC's ingenious solution involves complete electrical independence for the two channels, with the output summed at the bass driver motor by employing two over-lapped windings, one for each channel. ADC have proved this system can work, albeit at the expense of reduced magnetic flux utilisation as well as a loss in sensitivity, but the *MS10W* bass unit does exhibit a further and potentially serious problem. While most bass in programme is of a mono or near mono type and will sum at the woofer coil, in the case of rock programme with a bass line on one channel only difficulties may arise. While one channel drives, the other will be quiet, and load the coil winding with its output impedance. One amplifier channel will then try to drive the other *via* the motor transformer, which will attempt in its turn to null the bass output, and this could also affect the amplifiers. I have serious reservations concerning this system on technical grounds, despite ADC's optimism.

The bass cabinet is a sealed box of 29 litres internal volume, constructed of plain chipboard with a hickory effect synthetic veneer. A volume filling of synthetic wadding is used, and the steel frame 250 mm bass unit is fitted with an unusually thick and soft felted pulp cone capable of a large mechanical 'throw'. The crossover includes a rolloff for the bass unit only at 12 dB/octave, the satellites being left to their natural rolloff frequencies.

Built into a complete plastics moulding these small units have a fairly convincing 'grain' finish and come with foam grilles.

Their tapered construction should reduce coloration as well as improve the directivity performance. The enclosure is very compact (6 litres internal volume) and is equipped with a level control for the tweeter. A good quality 12 dB/octave crossover is fitted to this two-way system, which comprises a 170 mm pulp-cone bass/mid driver and a SEAS 25 mm plastic HF dome, both drivers being ferro fluid cooled.

Lab performance

At 1 metre the *MA650* measured +/−4 dB, 75 Hz–20 kHz when set to 'flat', but with the treble reduced this figure could be improved somewhat. The bass humped around 100 Hz and fell to −6 dB 65 Hz, so the subwoofer is certainly required. With it added, a −6 dB point of 41 Hz was achieved, but at 86.5 dB/W referred to 8 ohms the sensivity was 1.5 dB less than the ADC spec. of 88 dB/W ref 4 ohms.

Pair matching was good and the forward characteristic response showed very good integration on the off-axis curves. ADC's 'flat' control position gave a 3 dB shelf lift at in the treble however, and in general the curves and the sound were better at the −3 dB setting. A very smooth but low impedance was recorded, averaging 4.5 ohms (worse with the second amplifier channel connected) with the highly damped bass system resonance appearing at 50 Hz.

The system was clearly in trouble on 100W pulses at 500 Hz with 5.0% 2nd and 7.0% 3rd

harmonic distortion, but at 5kHz things improved to give 0.3dB of compression, plus 0.2% 2nd and 0.15% 3rd harmonic content. On steady state distortion at 90dB the results were good: typically around 0.6%, except for a rise in 2nd harmonic at 12kHz, but at 96dB the 2nd content reached 6.0%, 100Hz (1.0%, 3rd).

From the averaged room measurements, the low frequency response was reasonably balanced and extended, but a 600Hz prominance was exposed in the midrange, and the mid-treble (3–6kHz) was a little elevated.

Sound quality

On the live sound comparisons the system performed well. The bass was considered well-balanced, quite extended, and pretty clean, but at inputs above 75W a progressive increase in distortion could be heard. It could sound a trifle 'small' and 'boxy' on occasion, but the overall effect was lively, open and detailed, with good exposition of transient sound. Aside from the loss of low bass, removal of the woofer changed the reproduction of these live solo sounds very little.

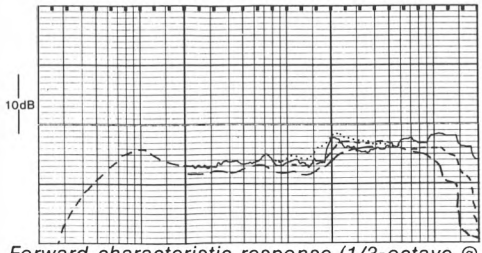
The system also fared quite well on the stereo sessions. The panel was frequently impressed by its open and lively chacracter, with its relatively dry and usefully extended bass. Stereo presentation was convincing, with good lateral and depth discrimination particularly for off-axis listeners, and it certainly sounded rather better than the measurements might otherwise have suggested. A few mild criticisms were made concerning a lack of bass definition, a touch of midhardness, and an excess of treble. And as expected, with the woofer off, the satellites sounded rather smaller, lacking sufficient 'weight' to do full justice to wide range programme, although the sound was fairly well-balanced and pleasant.

Summary

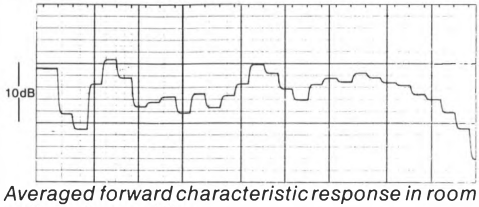
The strengths of this system are its lively and likeable character with fine stereo properties, its weaknesses concern restricted power handling and maximum level, plus some doubts about the parallel bass motor coupled with the lowish impedance.

GENERAL DATA

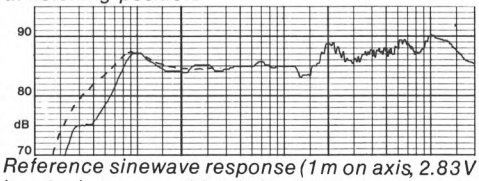
Size: Satellite (h x w x d)	29 x 22 x 21cm
Bass unit (h x w x d)	34 x 44.5 x 27.5cm
Weight Satellite	6.8kg
Bass unit	18kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(80)–100W
Recommended placement	satellites on stands or open shelf
Frequency response within ± 3dB (2m)	60Hz to 14kHz
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)	101dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	very good
Typical price per pair inc VAT	£360 (£199 satellites only)



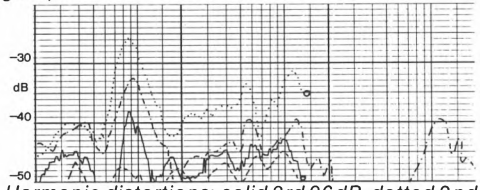
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



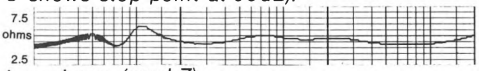
Averaged forward characteristic response in room at listening position.



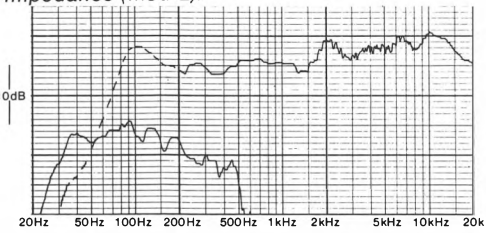
Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



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



Impedance (mod Z).



Frequency responses of satellites and subwoofer

Acoustic Research AR18S

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

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 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 *'18* 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 7 ohms, 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

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

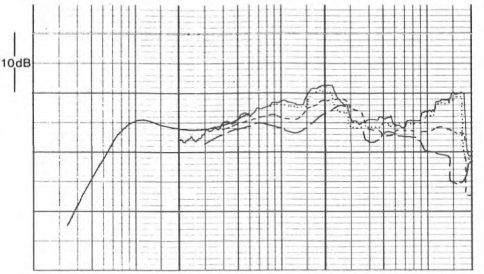
A 'peaky' 'forward' quality characterised the sound of this speaker, sufficiently so, in fact, to mask much of the expected improvement resulting from removing the grille. Wall mounting helped, but did not completely solve the frequency balance problem, namely the upper-mid prominence in the 'hard' region, 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

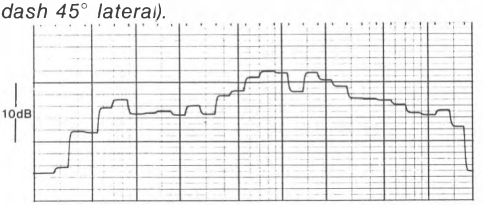
The *AR18* is not a particularly competitive speaker in the context of this issue, but it should not be dismissed out of hand. It presents a reasonable amplifier load, possessed a high sensitivity and good maximum sound level capability. As it is also reasonably compatible with wall mounting it could well appeal in some systems and situations.

GENERAL DATA

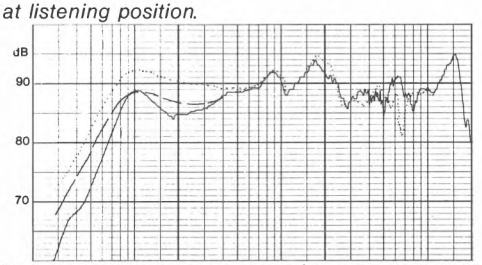
Size (h x w x d)	42 x 24.5 x 17cm
Weight	5.9kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–75W
Recommended placement	open shelf, near wall
Frequency response within ± 3dB (2m)	80Hz to 16kHz
Low frequency rolloff (–6dB) at 1m	60Hz
Voltage sensitivity (ref 2.83V, *ie*: 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	£90



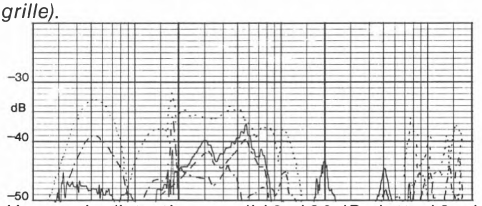
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



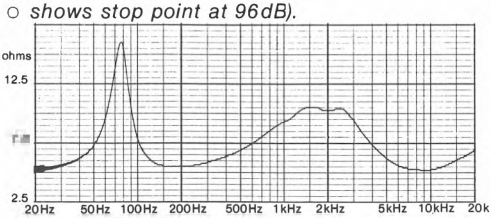
Averaged forward characteristic response in room at listening position.



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).

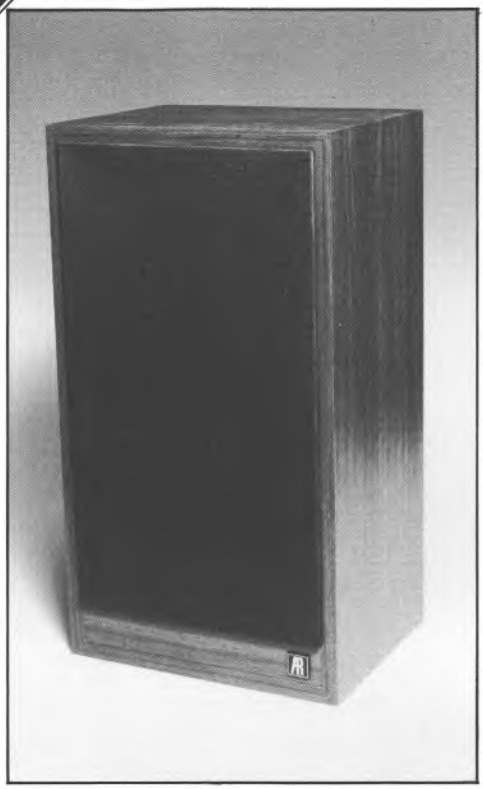


Impedance (mod Z).

BEST BUY

Acoustic Research AR48S

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 asymetrically 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 unrebated 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–3kHz 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 prominance 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.

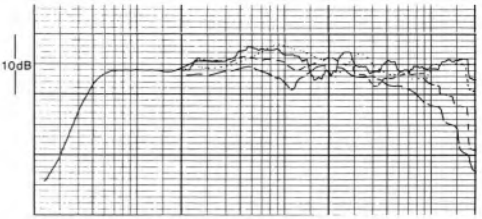
This picture was similar for the stereo sessions also, with the speaker sounding a trifle 'old fashioned' in terms of coloration levels, but at the same time considered easy on the ears. Lateral stereo presentation was to a good standard, although some loss of depth and 'see-through' ambience was experienced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

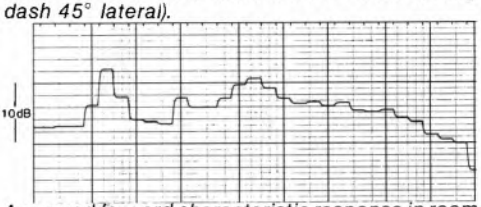
If the above does not sound too encouraging, in fact the numerical scores attained by the *'48* indicate Best Buy rating at the price. It provides a competitive package offering good power handling and sensitivity, plus a pleasantly relaxed sound while demonstrating a good standard of both stereo and bass reproduction. It is certainly one of the most civilised AR speakers at popular price levels that *Choice* has tested for some time now, and it therefore deserves recommendation with only minor reservations.

GENERAL DATA

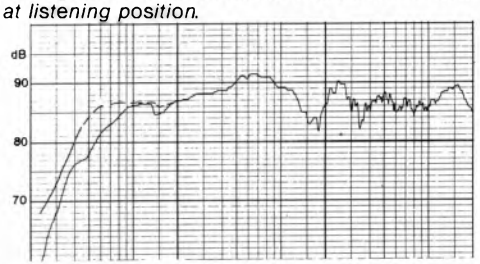
Size (h x w x d)	64 x 35.5 x 28cm
Weight	17.2kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–100W
Recommended placement	stand
Frequency response within ± 3dB (2m)	50Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	40Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt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



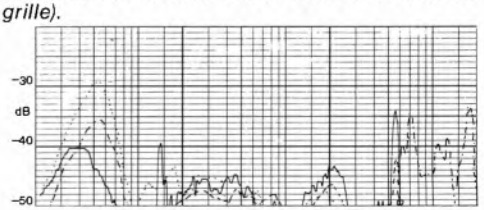
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



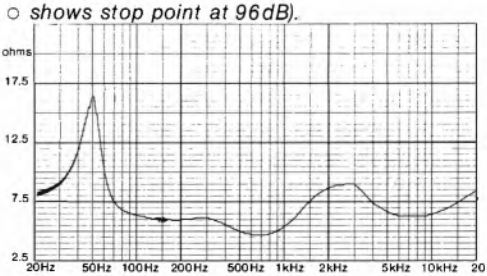
Averaged forward characteristic response in room at listening position.



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



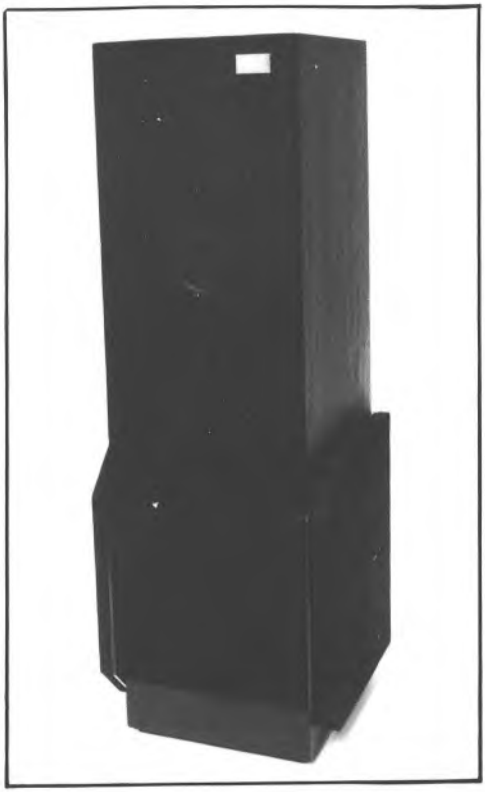
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod 2).

Acoustic Research AR90

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



Similar to the larger *AR9*, the 90 makes a small concession in ultimate power handling and bass extension by allowing the use of two 250mm low frequency drivers per enclosure instead of the 300mm units used for the *'9s*. The remaining drivers are the same, namely a 200m pulp cone midrange a 38mm soft dome lower treble, and a 19mm soft dome upper treble, arranged in a vertical-in-line format. An 'acoustic blanket' (a thick felt layer) surrounds the drivers.

The *'90* is a tall, slim floorstanding enclosure finished in walnut veneer. The two woofers are located near the ground on the cabinet sides, with the upper mid and treble units employing ferro-fluid filled coils for improved damping and heat dissipation. The bass loading is sealed box, with the drivers sharing a 90 litre internal volume. The massive high power crossover divides the input at 200Hz, 1.2kHz and 700Hz, the first low crossover point allowing control of the main frequency response dip caused by the floor reflection. Switches are provided for -3dB and -6dB attenuation of lower mid, upper mid, and high frequencies.

Lab results

The response curve was unusual, in that while an approximately uniform trend was present above 150Hz, a step down of 6dB occurred at frequencies below this level under anechoic conditions, and this is deliberately engineered to take account of the 6dB lift provided by the close floor mounting of the bass unit. A notch was also present in the axial response at 2kHz, and up to 8kHz the range was elevated by 2-3dB. However allowing for floor 'lift', the -6dB low frequency point was well extended at 30Hz referred to a fairly high sensitivity of 90dB per watt.

Pair matching was fairly good, with an imbalance of up to 2dB between 5 & 7 kHz, but matching typically within 1dB elsewhere. At 1m 96dB the third harmonic distortion registered a fine 1.5% at the 30Hz LF limit, improving to 0.3% at 100Hz, and being typically 0.015%

Predictably enough the power handling was excellent. High levels of bass guitar (80W) were tolerated, although at one point a minor rattle from behind the terminal panel was apparent. Up to 300W per channel may be used, but in view of the 'poor' rating on amplifier loading, the amplifier chosen should be capable of adequately driving low impedance values. The impedance curve in fact dropped to nearly 3ohms on no less than three occasions, namely 100Hz, 2kHz and 6kHz, and the *'90* is clearly a 4 ohm rating model (acknowledged by the manufacturers in their specification.) Thus the apparently high voltage sensitivity must be set against the low impedance, and the true sensitivity is actually nearer to an average 87dB/W.

Setting aside the response step below 150Hz, the main axial response at 2m is fairly uniform, meeting +/-2dB limits. A minor problem was evident at 1.5kHz, but the vertical and horizontal off-axis curves were well integrated through this region to 4kHz. At higher frequencies a strong dip occurred in the vertical plane 10° below the HF unit axis, a further dip appearing at 10kHz when 10° above. Hence the system is fairly critical of listener ear height which ideally should be on the HF unit axis.

Sound quality

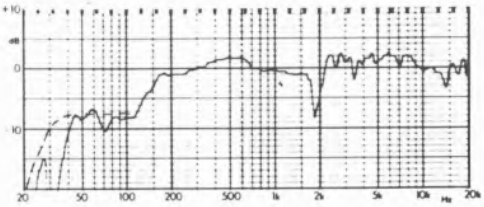
On the live sound comparisons the *'90* was rated as average — somewhat disappointing considering its price. While detail was quite good, the sound was judged mid-prominent with some boxiness and a mild dulling of transients. The bass register was powerful and deep but not very 'explicit', while the harmonic spectrum of the bass guitar sounded uneven.

Fortunately the above colorations were less noticeable on the stereo program, where the *'90s* achieved a well above average rating for general accuracy and sound quality. Stereo imaging was to a high standard with good space, fair depth and precise localisation. Listener position in the lateral plane proved uncritical, and the reproduction was well balanced and detailed, though some hardness was apparent at higher levels.

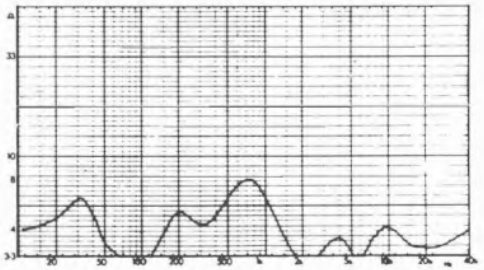
Summary

This substantially engineered loudspeaker might be difficult to drive and is relatively costly, but it offered a good stereo performance, a well extended bass response and a generally neutral, well balanced sound. High volume levels are possible, and the speaker may be conveniently located close to a back wall.

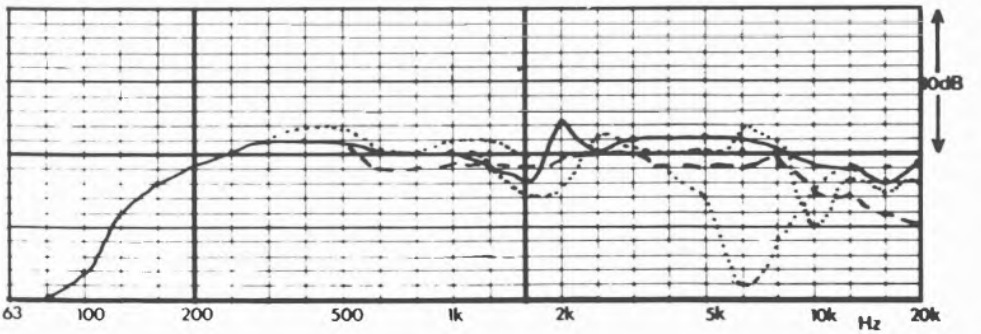
Size	108(42.5) H; 37(14.5) W; 38(15) D; cm(inches)
Weight	37(82) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15-300W
Recommended placement	on floor back to wall or greater than 6m from wall
Frequency response within ± 3dB (2m)	125*Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	30Hz*
Voltage sensitivity (ref 2.83V, ie. 1 watt in 8 ohms)	90dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	v. good
	30Hz 1.5%, 100Hz 3%, 400Hz-0.5%, 6kHz-1%, typically 0.2 to 0.1% over range
Impedance characteristic (ease of drive)	poor
Forward response uniformity	good
Typical price per pair inc. VAT	£690



Axial sine wave reference response. 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)



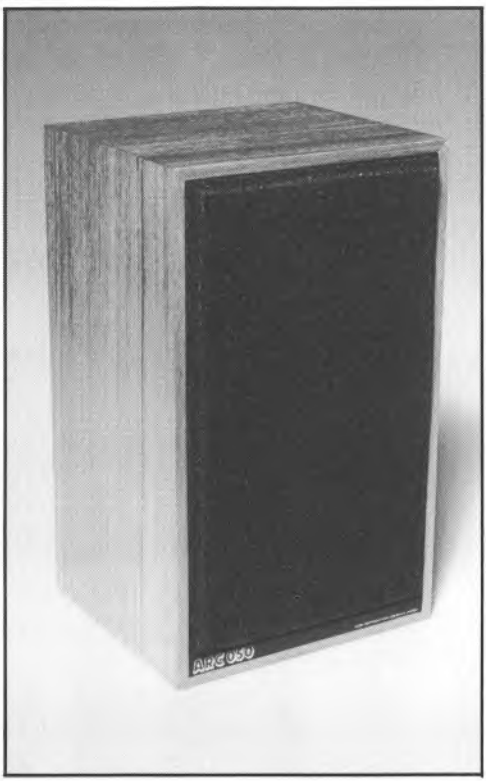
Impedance vs frequency (mod Z)



⅓-octave averaged frequency response. 2m solid axial; dotted 10° above and below; dashed 30° horizontal

ARC 050

ARC Ltd., Horton House, 2 Urmston Lane, Stretford, Manchester M32 9BP. Tel 061-865 6494



This new speaker's big brother the ARC *101* did well in the last issue, and we hoped for a similar result here. Unfortunately this was not the case, though we are not entirely sure why, and can only point to the changes in tweeter type, an updated crossover, and much smaller cabinet volume and frontal dimensions.

Intended for close-to-wall mounting on stands, the *050* is a compact 11 litre sealed enclosure of very rigid chipboard construction. A finely finished teak veneer is supplied with a contrasting black foam grille, and the panels are damped internally by a combination of bituminous cladding and soft fibreboard.

The crossover is housed in ARC's proprietory plug-in box at the rear of the enclosure, which is detachable and allows immediate access to the driver terminals for connection of power amplifiers driven from an active crossover network. Heavy gauge internal wiring is used, and the broad conductors on the crossover printed circuit are augmented by heavy wire soldered into position. Low loss electrolytic capacitors and medium power inductors are used, comprising 5 elements in all plus one resistor. I understand that ARC are pursuing a patent application for plug-in crossovers related to easy adaptation for active working, and it is interesting to recall that a number of years ago the KEF *Concerto* also had a plug-in crossover secured by a screw to the outside of the driver baffle just beneath the front grille; the interest in active speakers at that time was rather less than it is today.

The high frequency driver is a new ARC unit with a 25 mm diameter soft fabric dome diaphragm recessed by 1.7cm in the front plate. ARC's 200mm pulp cone covers the bass/mid, with the high rigidity cone reinforced by a hard centre plug; the attention to detail even extends to damping pads on the limbs of the pressed steel driver frame.

A system resonance at 68 Hz was noted, reflecting the small size of box, and contrasting with the *101*'s resonance of 50 Hz, working in 2.5 times the enclosure volume.

Lab performance

In assessing the printed responses some account should be taken of the potential increase of up to 3dB in low-mid and bass output, resulting from use as recommended near a rear wall. In fact the corrected axial reference response suggests that little allowance need be made, since the output was already comparatively uniform. Comfortably meeting +/−3.0dB limits, the pair matching was quite good except in the 2kHz to 7 kHz range, where one speaker was less smooth than the other with deviations of up to 2dB. Sensitivity was average at 86.5 dB/W (lower than the *101* sample) and the system rated as a good amplifier load, with the −6dB low frequency point at 55 Hz.

As with the *101*, very good power handling was demonstrated, allowing an unclipped rating of up to 150W per channel which generates a substantial maximum level of 105 dBA for a stereo pair in the listening room.

Examining the forward characteristic response, the +15° dotted curve showed some increased loss in the 5.0kHz region, suggesting that for the best results the speaker should be fairly high, bringing the bass unit near to listener ear level. The output was somewhat humped in the upper midrange, 600 Hz–3kHz, and less uniform off-axis than is usual for this band.

On 100W pulsed input, 0.3dB of compression

was measured at 500Hz with good distortion results, 2.8% 2nd and 0.6% 3rd order content. At 5kHz the pulse compression was negligible and both 2nd and 3rd harmonic remained at the 0.5% level, while at 96dB 3rd harmonic was respectably low (generally under 0.3%) and rising only a little below 100Hz. 2nd order harmonic was however higher, with peaks to 1.5% at 100Hz, 300Hz, 2kHz and 15kHz; these were not particularly affected by a level reduction to 90dB, but in any case were considered relatively unimportant.

Room average responses were taken for both wall mounted and open stand positions, and the resulting balance was acceptable for both locations though preferable in bass terms when wall mounted. This improved the low frequency range by some 3–4dB, though with some reduction in uniformity due to stronger coupling to the unavoidable room modes.

Sound quality

Matching the *101* in its high ranking on live sound comparisons, the *050* gave a good effect on transient and percussive sounds. The treble was crisp and airy, though with some extreme high frequency edge, and overall the balance tended to 'thinness', especially in the midband, which could be a little 'hard' with traces of 'boxiness' also audible beneath. The bass register coped well with massive inputs of electric bass guitar, and was both lively and quite even, if lacking weight on the lowest notes.

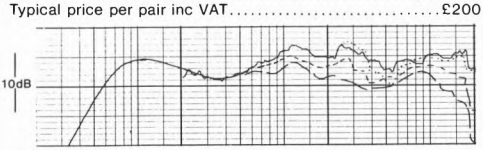
On the recorded sounds the results were however much less promising. The speaker possessed good 'attack' but lacked both transparency and depth, and several comments of 'sharp', 'flattened and hard midrange', 'nasal' and 'small box' were noted. Against the wall the stereo imaging lacked precision and was described by one panelist as spread over wide areas. Tried later on open stands with some bass lift the stereo imaging improved markedly, but while the larger and deeper *101* last time round could maintain satisfactory imaging at the recommended 0.3m spacing, the *050* was not as satisfactory in this respect.

Summary

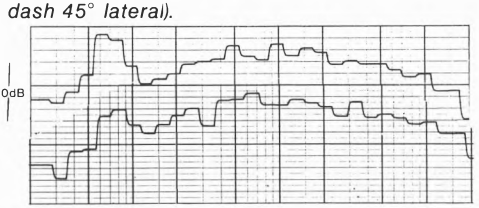
At £200.00 odd this miniature does not set any new standards of accuracy, and is rather expensive. On balance it is certainly not a bad speaker, but remains a less successful smaller companion to the *101*, assuming of course that the latter has not altered in the interim. Its qualities include a lively midband attack, better suited to disc than tape or broadcast material, plus a dry bass, low distortion levels and great power handling. But the recorded programme results and its attendant levels of coloration preclude recommendation at the price.

GENERAL DATA

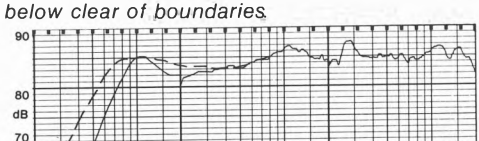
Size (h x w x d)	40 x 24 x 21.5cm
Weight	7kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–150W
Recommended placement	on stand near rear wall or on open shelf
Frequency response within ± 3dB (2m)	65Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	55Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	86.5dB/W
Approximate maximum sound level (pair at 2m)	105dBA
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc VAT	£200



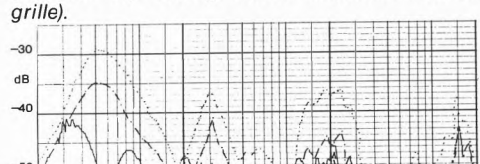
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



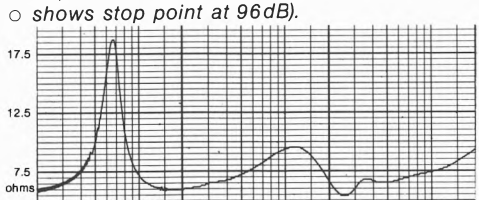
Averaged forward characteristic responses in room at listening position. Above against wall, below clear of boundaries.



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



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



Impedance (mod Z).

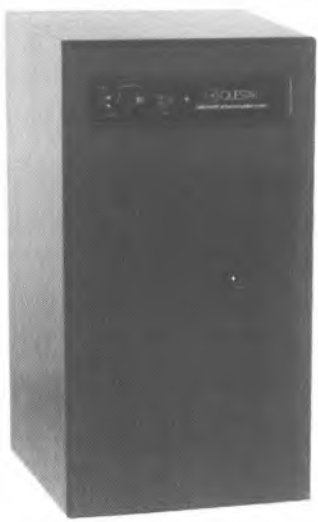
WESTWOOD & MASON

WE STOCK:

KEF CODA 2	MISSION 700	SPENDOR SA2
KEF CAPRICE 2	MISSION 727	SPENDOR BC1
KEF CELESTE 4	MISSION 770	BBC LS3/5A
AUDIOMASTER MLS4		

We also stock:
A&R, ARISTON, DUAL, HEYBROOK, KEF,
LINN, LOGIC, MONSTER CABLE,
MERIDIAN, MORDAUNT-SHORT, NAIM,
NYTECH, ORTOFON,
QED 79 STRAND CABLE,
QUAD, REGA, SENNHEISER, SONY,
SPENDOR, SUPEX, THORENS. TRIO.

WESTWOOD & MASON (OXFORD) LTD,
46 GEORGE ST,
OXFORD
TEL OXFORD (0865) 47783
DEMONSTRATIONS BY APPOINTMENT ONLY. CLOSED THURSDAY.

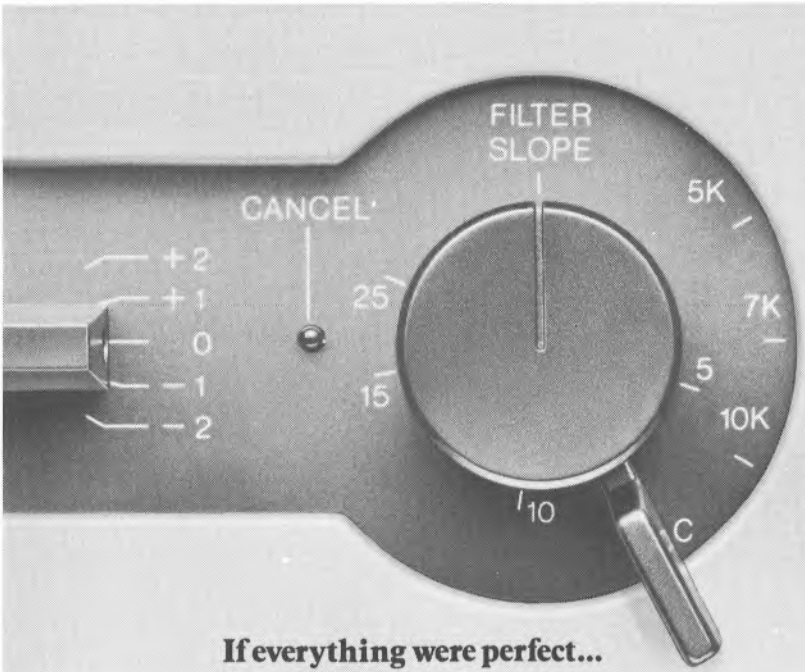


QUESTAR

ANNOUNCING OUR NEW QA-2 MOSFET ACTIVE LOUDSPEAKER

Our new QA-2 mosfet active loudspeaker system is a smaller, cheaper version of our QA-1 design. The small baffle area of the QA-2 gives it a remarkably open and spacious sound, while the four built-in 90W Mosfet amplifiers allow the full dynamics of a musical programme to be recreated. In fact, compared to conventional equipment, we think the sheer *realism* of our Mosfet active systems will astonish you. The QA-2 comes fully complete with all electronics built-in including over 350 watts of amplification. At just £500 excluding VAT, we strongly urge you to audition our remarkable QA-2 alongside *any* conventional remote amplifier-passive loudspeaker system.

for further details, contact:-
Questar Electronics, 6, The Pleasance,
Roehampton London SW15 5HF
Telephone: 01-876 5376



If everything were perfect...

. . . a control unit would consist of a volume control and a programme selector switch.

In practice, correctly designed tone controls can make a significant contribution.

For a constant sound level, replay from a gramophone record produces distortion which increases very rapidly at high frequencies — doubling in fact for every major third increase in pitch.

There comes a point when the contribution of this distortion is increasing at a greater rate than the musical content and this is what decides the optimum setting of the comprehensive Quad filter system, an essential and integral part of every Quad pre-amplifier.

The rate of attenuation can be set anywhere between 0 and 25dB per octave starting at one of three frequencies 5k, 7k, or 10kHz and an appropriate setting can be found for each record to provide more of the music and less of the distortion.

To learn all about the Quad 44 write or telephone for a leaflet.

The Acoustical Manufacturing Co. Ltd., Huntingdon PE18 7DB. Telephone: (0480) 52561.

QUAD

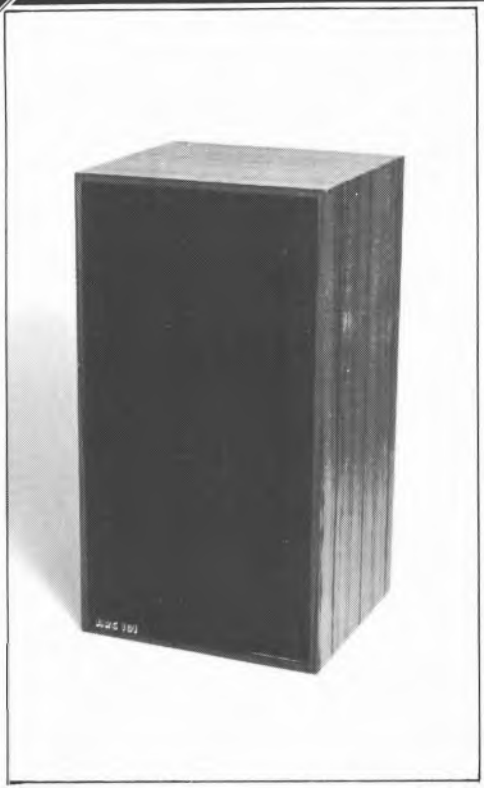
for the closest approach to the original sound

QUAD is a registered trade mark.

RECOMMENDED

ARC 101A/P

ARC Ltd., Horton House, 2 Urmston Lane, Stretford, Manchester M32 9BP
Tel 061-865 6494



British made and designed, the ARC models are newcomers and possess some interesting design and operating features. Subscribing to the philosophy of high cabinet rigidity, this sealed box enclosure of some 28 litres is reinforced by two massive circumferential internal braces with double layer bitumen and fibre-board damping. A low diffraction foam grille is fitted to conceal the two drive units; the bass/midrange is handled by a rigid pulp cone 200mm driver with special modifications including doping, while a 25mm MB soft fabric dome tweeter completes the vertical lineup. The two are integrated by a reasonable quality five element plug-in crossover which is located on the outside rear of the cabinet. This is done deliberately so the user has the option of 'active' operation, *via* separate power amplifiers and a special electronic active crossover. (The British electronics firm Nytech have worked closely with ARC in this respect.)

The design includes a tapered low frequency response to account for placement interactions, the recommended position being on stands backed against a wall. We found 0.2m to be the optimum gap between speaker and wall.

Initial tests on our first samples showed signs of an out-of-phase tweeter, and although we corrected this a second pair was requested for checking. These exhibited no such fault and were an improved version bearing a 'A/P' designation.

Lab results

These relate to the first sample, and the published curves should be viewed with caution as they are not very representative of current production. The phase cancellation was clearly apparent at the 3.5Hz crossover point before we reversed the tweeter leads, but this anomaly aside the characteristic response above 200Hz was quite even and well balanced, with indications of good dispersion. The low frequency rolloff will be augmented by its recommended location close to a wall, improving the −6dB at 60Hz point to a little below 50Hz.

Fine third harmonic distortion results were obtained at 96dB, though second harmonic reached 3.3% around 2kHz, possibly from a damped breakup mode in the midrange driver. Driven to 100W on tone pulses little additional distortion was recorded at 500Hz and 5kHz, though some dynamic compression was noted (respectively −0.3 and −0.5dB). Rated as 'good' on amplifier loading the *101* was a true 8 ohm design, with low reactive effects (30° max at 2kHz) and at the same time showed a reasonable 88dB/W terminal sensitivity at 1m. With a 150W power ceiling, respectably high 106dBA sound levels are available in a typical room, while the pair match was very close (even so far as the notch depth of the first incorrect samples was concerned!) The grille introduced negligible change.

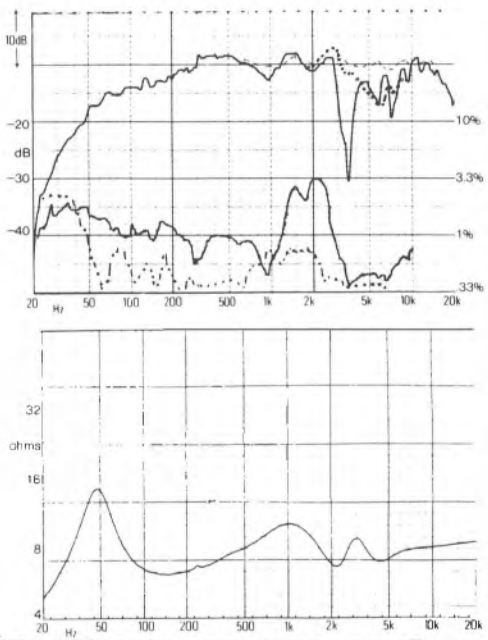
Sound quality

These results relate to the second and improved pair. Scoring 'average' on the live sound comparisons the *101* was a trifle coloured with a slightly middy and wooden effect. Detail was good however, giving a lively result without excessive brightness. Bass power handling was also fine with 60W average (200W peaks) accepted from electric bass guitar, producing an even and well differentiated output.

The results improved on stereo programme. The balance tended to be slightly thin and forward, but

with good smoothness and fine driver integration. Found to be a touch 'reedy' on organ, and also slightly aggressive, it was also agreeably transparent and direct; stereo imaging was to a good standard, with promising depth and ambience where appropriate. The bass was notably firm and even, though it was lacking in extreme bass energy; dynamics were well reproduced.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB. Sinewave dotting shows later samples.
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ½-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).

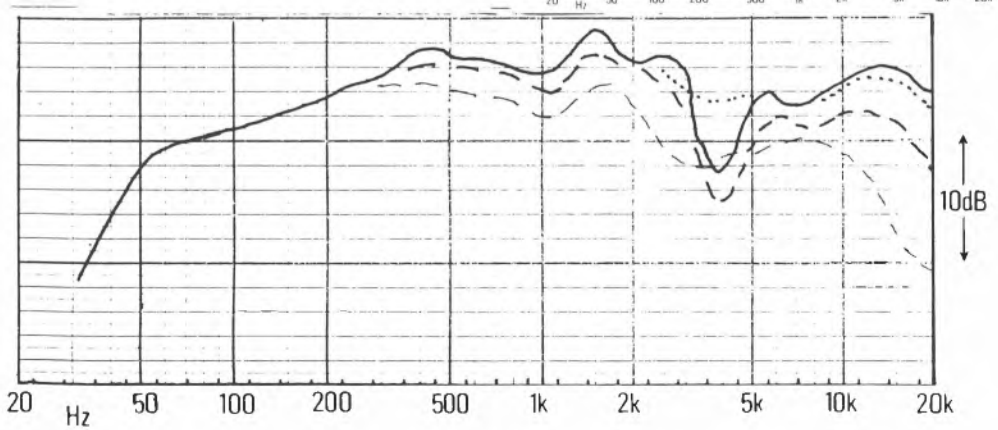


Summary

The *ARC101* shows that specialised pulp cone technology can result in a compact system of above average sensitivity, offering a transparent and relatively neutral sound coupled with good stereo imaging. However, when used as recommended near a rear wall, the stereo is inevitably degraded though the frequency balance is improved. This model continues to merit recommendation in this new edition despite increased competition in its price range, in view of its favourable sound and facility for simple active conversion, as well as an unusual ability to work well when positioned close to a wall.

Size (H, W, D)	56.5, 31, 28 (22, 12, 11) cm(inches)
Weight	12 (26) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15–150W
Recommended placement	0.3m from wall on shelf or stand
Frequency response within ±3dB(2m)	150Hz–20kHz* (2nd sample)
Low frequency rolloff (−6dB) at 1m	60*
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m	88dB
Approximate maximum sound level (pair at 2m)	106dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	good
Impedance characteristic (ease of drive)	good
Forward response uniformity	good (2nd sample
Typical price per pair inc VAT	£320

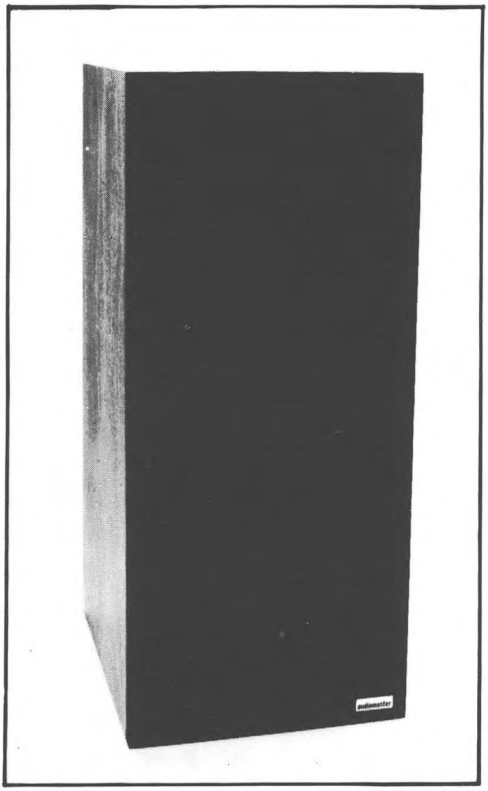
*see text



RECOMMENDED

Audiomaster MLS4

Audiomaster Ltd., 33 Bridle Path, Watford, Herts. WD2 4BZ. Watford 33010.



The MLS4 represents yet another UK designed two-way stand mounted enclosure, employing a lowish efficiency plastic cone bass/mid unit. While its price is modest, the designer does not appear to have compromised either performance, external finish, or constructional quality. Our samples were finely veneered in American walnut with matching square-edged brown grilles.

This 46 litre enclosure is reflex loaded by a 64mm tunnel port, and has bituminous panel damping and an acoustic foam lining. Bass/midrange is handled by a large magnet, bextrene-coned driver from Audax, who also provide the 25mm soft fabric dome tweeter. A good quality 12-element crossover is employed, the whole design exhibiting attention to detail.

Lab results

Pair matching was good with a maximum deviation of 1dB in the 300-500Hz range, although both speakers showed a dip at 2.3kHz. Sensitivity was faily low at 85dB/watt, which is in part due to the useful low frequency extension to 37Hz -6dB, and by the fact that the over most of the range the speaker proved pretty easy to drive. However the impedance graph does show a dip to just under 5 ohms at around 9kHz, and so only qualifies for an 'average' rating; from 20Hz-2kHz the mean value was around 10 ohms.

Third harmonic distortion was rated as very good, with a moderate 6% at the 96dB reference level, 46Hz, reducing to 0.8% 100Hz and holding at typically 0.3% over the remainder of the range, with the exception of a small region of 0.5% around 300Hz. Power handing was suprisingly good, and with care amplifiers of up to 150w per channel could be used. Up to 40W programme of bass guitar was tolerated with mild port chuffing, reproduction remaining clean up to 20W, while up to 101dBA was possible from a pair at 2m in the listening room.

At the measuring distance of 1m, the sine wave reference curve was generally well balanced and controlled, bar a 5dB trough centred on 2.6kHz. The treble response was smooth but slightly rising. At 2m the ⅓-octave averaged curves revealed that the trough was not a phase anomaly, while the uniformity of, and more particularly the consistency of the off-axis curves was exceptional. The latter illustrated skillful crossover design, and indicated that the minor trough noted above was in fact due to an inherent drive unit characteristic. Finally, the good curves in the vertical axis above and below further indicate that this model should be relatively uncritical of listener positioning.

Sound quality

When compared with simple live sounds the *MLS4* scored consistently high, showing a well balanced character with only slight criticisms made of a tendency to show up program hiss a little, coupled with some exaggeration of sibilants. The bass register was a trifle boomy but quite truthful and well extended.

This good rating was maintained on the stereo program sequences, thus confirming the results of a previous panel test using earlier samples and conducted for Hi Fi News (June '79 issue.) Stereo imaging was rated as good if not

Audiomaster MLS4

(revised and reprinted)

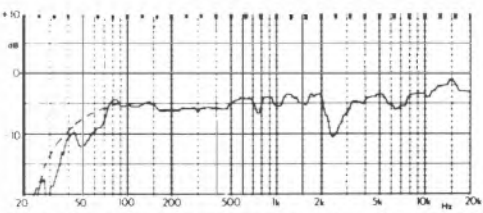
exceptional; lateral positioning was fine, but some depth loss was noted, giving a 'flattened' impression.

In general the sound was considered to be detailed and neutral but there was also an unmistakeable, albeit moderate, emphasis in the upper treble range, lending a 'breathy' effect on voices, and suggestive of 'fizziness' on violins and other similar sounds. This factor was considered to be the major coloration effect, and its seriousness may well depend on the qualities of the ancillary equipment employed.

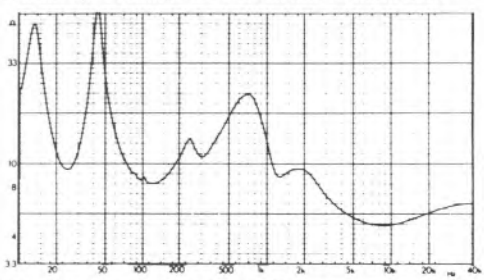
Summary

Overall the *MLS4* has clearly achieved a creditable standard. With a minor reservation concerning the treble range, the model has showed useful power handling, moderate coloration, good clarity and an neutral character. The bass register was extremely clean and well extended, while the engineering and finish were both very good, as was the dispersion and forward uniformity. The *MLS4* clearly deserves recommendation at its current price of *c.* £215 per pair inclusive.

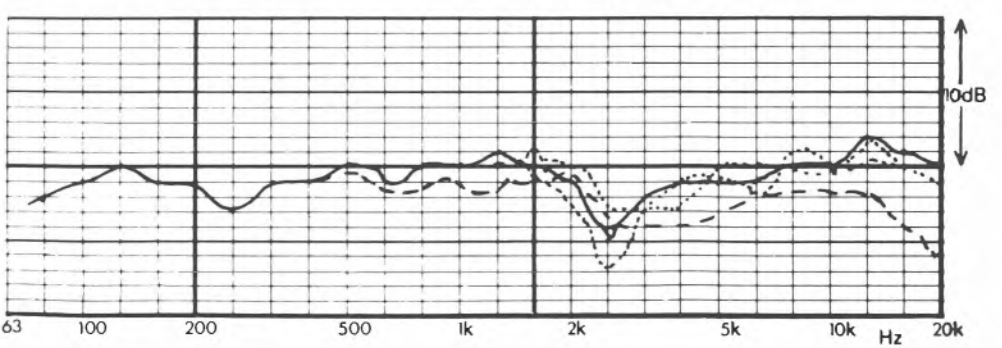
Size	62.5(24) H; 27.5(11) W; 31(12) D; cm(inches)
Weight	14(30) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15-150W
Recommended placement	25cm stand, clear of walls
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	37Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	85dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good 46Hz-6%, 100Hz-0.8%, 300Hz-0.5%, 0.3% typical
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£215



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)



Impedance vs frequency (mod Z)

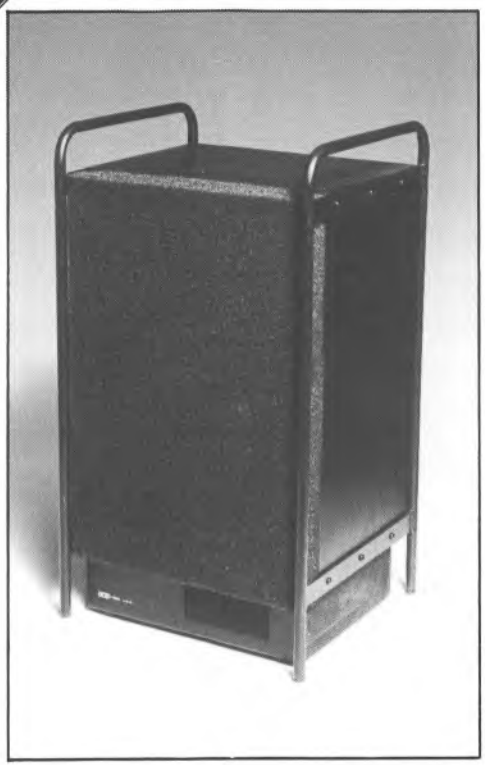


⅓-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

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 intersting 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 11cm pulp cone Philips midrange driver. The bass units comprise 12cm 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 *pi* (or acoustic space), these ranging from greater than 4*pi* (free field plus bass lift) to ½*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 4*pi* the axial response was very promising, meeting ±2.5dB limits from 36Hz to above 20kHz. The low frequencies were also dramatically extended for the box size, reaching down to 29Hz, –6dB, which is better than many purpose-built subwoofers.

Three of the *pi* settings are shown in the 2m characteristic response measured in ⅓-octave bands, with 'm' corresponding to maximum bass and *pi* 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 2dB deep from 4 to 8kHz, or conversely a mild mid prominence (depending on your point of view).

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

Capable of 108dB linear at 1m, a stereo pair could produce 109dBA, substantially loud in a listening room, and when set to '3 *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 4*pi* 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 2*pi*, 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.

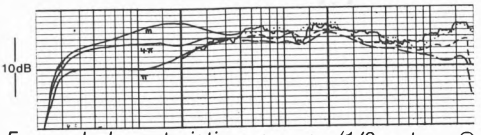
Summary

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.

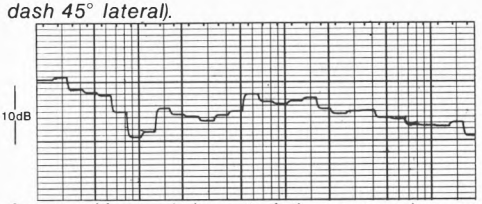
The performance belies its size, and while this system would be a prime choice for a bass enthusiast (organ, rock, etc.), it will also give high quality results on a wide range of other programmes. A warm recommendation is justified. *Note:* We have been informed that further development has taken place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

GENERAL DATA

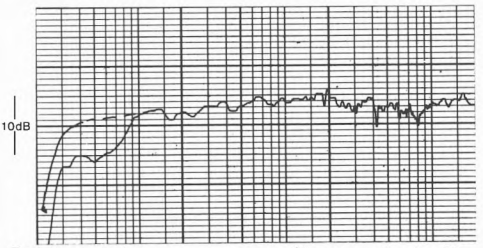
Size (h x w x d)	52 x 32 x 26cm
Weight	16kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	active
Recommended placement	versatile control adjustments
Frequency response within ± 3dB (2m)	35Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	29Hz
Voltage sensitivity (ref 2.83V, *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



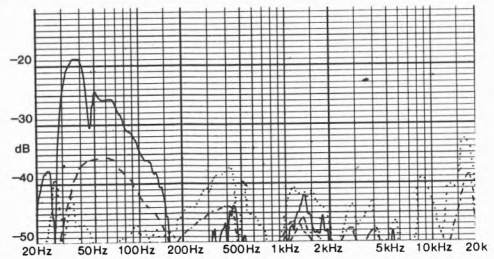
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



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

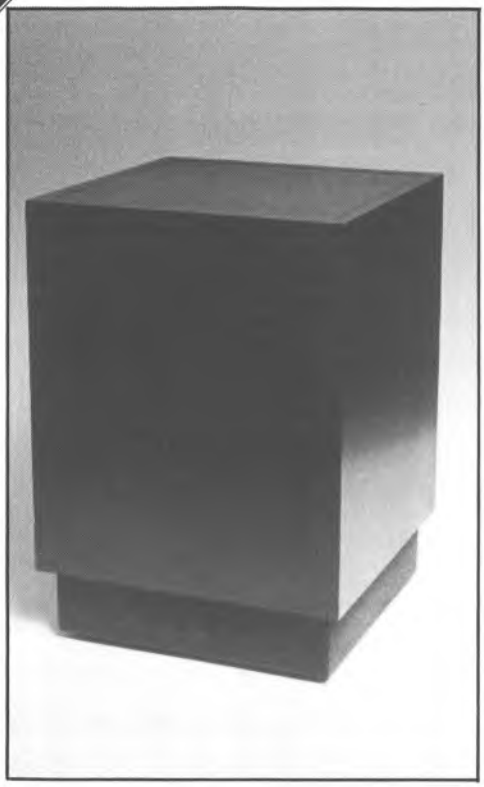


Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).

RECOMMENDED

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 unneccesarily 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 airflow 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

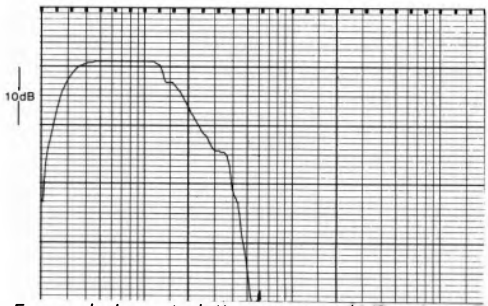
While the *B250* holds the honours for extremely wide low frequency performance, the *B240* nonetheless offers an octave more of extreme bass by comparison with most other highly ranked speakers in the £300–400 range. This is achieved at an effective price, with improved electronics, a

good standard of engineering, and a good acoustic performance.

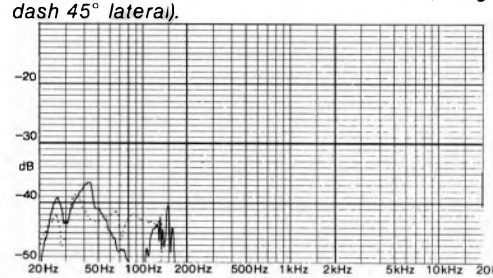
The final results will of course depend on the settings chosen by the purchaser, his room, choice of satellite system and its amplification. But in this specialist sector of the market the *B240* reigns supreme, and can be confidently recommended for those who can exploit its potential but for various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

GENERAL DATA

Recommended placement.... floor, behind and between satellites
Frequency response within ± 3dB (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)..... 107dBA*
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).

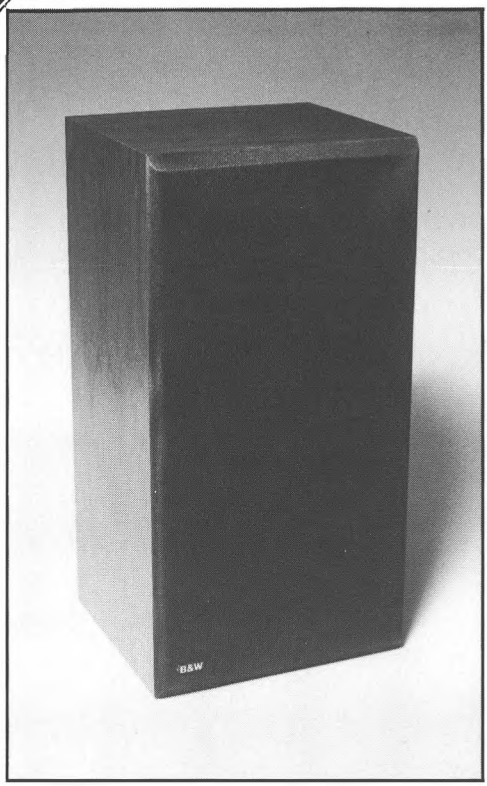


Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).

BEST BUY

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 toleranced 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 +/−3dB 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, −6dB).

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 embarass 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.

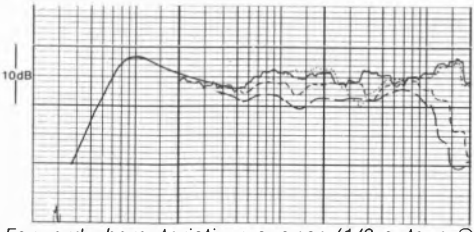
On the recorded sessions it was less well received, though the results were still creditable at the price. Coloration was again noticed, particularly of the 'wooden' and 'boxy' kind, while a clouding of detail linked with mild aggressive tendencies in the midrange gave an impression of reduced transparency 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

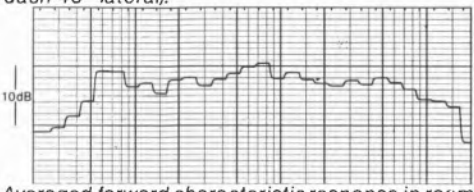
While not the best of the budget models in this issue, the *DM10* nonetheless sets a fine standard by offering a lively neutral frequency balance, a useful sensitivity, and good power handling, plus low distortion and fairly high maximum sound level at a competitive price. Such performance undoubtedly merits a Best Buy rating, but 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

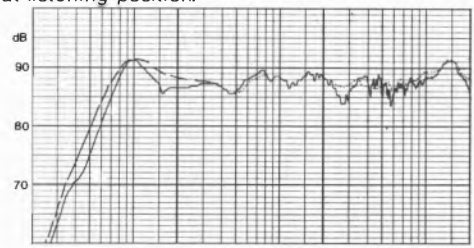
Size (h x w x d)	48.5 x 25 x 23.5cm
Weight	6.6kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–100W
Recommended placement	stand
Frequency response within ± 3dB (2m)	62Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	55Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt 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



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

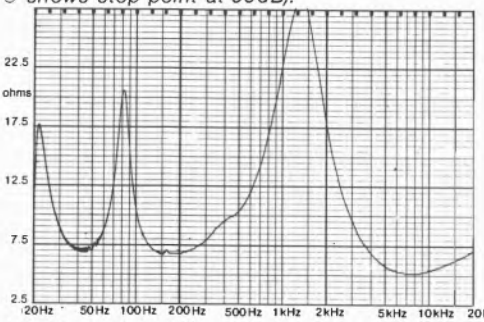


Averaged forward characteristic response in room at listening position.



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).

RECOMMENDED

B&W DM12

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

In terms of driver complement and physical size, the *DM12* could perhaps be regarded as a successor to the *DM5*, but in terms of sophistication and performance, it is closer to the long-lived *DM4*. A high power compact, it parallels the KEF *R101* in several respects, notably in its use of resilient driver decoupling to reduce cabinet resonance excitation, its electronic protection circuit which guards against abuse or amplifier faults, and also in the third order method for low frequency alignment, which is employed in both models, using a series capacitor element.

The bass/mid driver uses a massive ceramic magnet mounted on a die-cast 185mm frame and is fitted with a 150mm bextrene cone. The high quality 10-element crossover incorporates protection against thermal overload and DC amplifier faults. The high frequency band above 3kHz is covered by B&W's own *T26* fabric dome tweeter. It had a foam-lined grille offering good diffraction characteristics and the well finished 12 litre sealed box enclosure is constructed of 12mm chipboard with bituminous panel damping.

Lab results

As expected the composite grille did smooth the response, particularly in the 5kHz region; but it also attenuated it, for example, by 2dB at 17kHz. The pair match was excellent to 5kHz, above which the output differed by 1–2dB at several points; a worst case 4dB was recorded at 20kHz. Sensitivity was marginally higher than claimed at an average of 86dB.

An elevated midrange region around 1kHz was a feature of the response – a point not properly brought out by the low resolution factory curves which accompanied these samples. On a relative basis the presence band was mildly depressed before the treble energy output recovered to a mild prominence around 13kHz. On the lateral axis the dispersion was clearly good, and the 15° vertical response taken above axis showed that the speaker should in fact be at or slightly higher than ear level in order to produce the most uniform frequency response (shelf or high stands location is suggested).

As claimed, the impedance was that of a good 8 ohm design, and while phase angles of up to 45° existed, these were at harmless higher impedance points. Appropriate for the size and sensitivity, the −6dB point rolloff point was noted at 60Hz. Driven to 96dB (a high level for its size) good distortion results were obtained, although inevitably with rising third harmonic towards the low frequencies; however, a figure of 3%, 100Hz for the latter was still good. The 100W pulsed distortion test was passed with flying colours, exhibiting negligible extra compression or distortion (less than 0.1dB).

Sound quality

When mounted fairly high on a stand (0.4m) the *DM12* did not fare too well compared with live sounds. The reproduction was considered 'boxy' and 'thickened', while a treble band unevenness was also noted with odd sibilants on speech. Some nasality was also present, and the mid prominence was obvious to the panel. However for its size the bass power handling was very good, with the speaker tolerating an average of 40W of electric guitar. While the upper bass sounds were clearly

B&W DM12
(revised and reprinted)

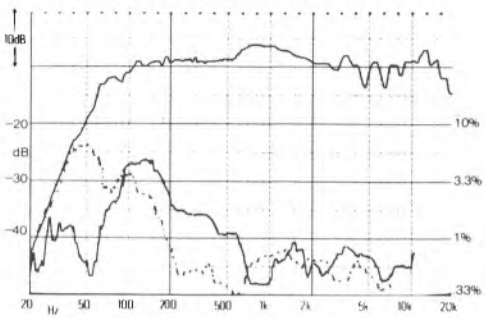
delineated, the low bass was deficient in power.

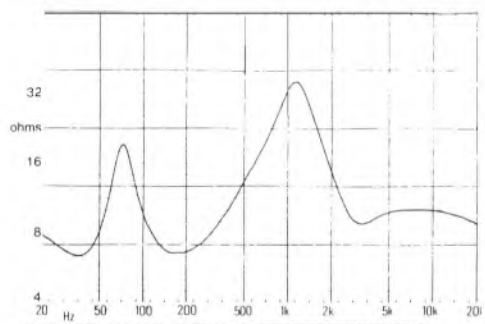
On the stereo sessions the speaker sounded 'large' for its size, though bass notes were still subdued. Coloration was moderate with some midrange bias and 'boxiness', plus a slightly 'dulled' treble, this countered by a degree of extra zip in the higher ranges, which tended to bring out surface noises and clicks a little. The image quality was in fact quite good, with respectable depth, and the general sound quality was certainly well above average.

Summary

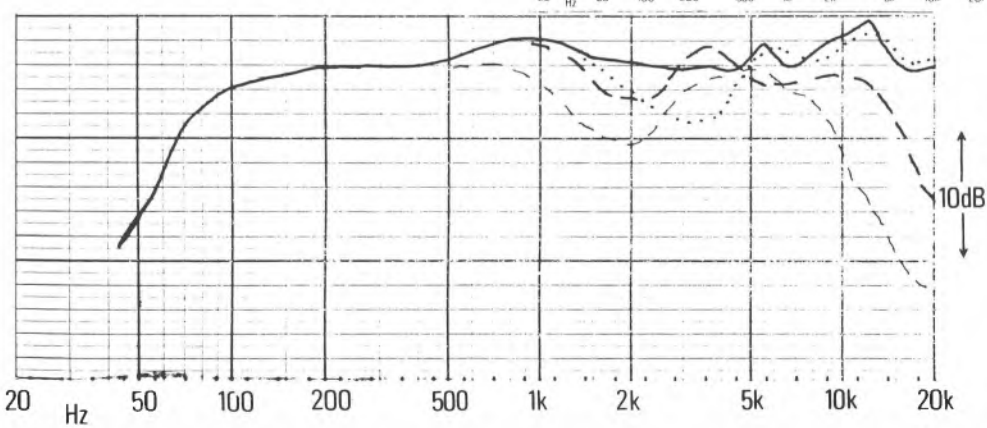
The subjective performance of this model was uneven, mainly due, we feel, to the charted response trends. However, the results were good for the size of enclosure and in relation to its price of around £200. Construction and appearance were both very good, and the protection provides a further plus point, so a recommendation is clearly indicated

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal: dotted, 15° vertical).





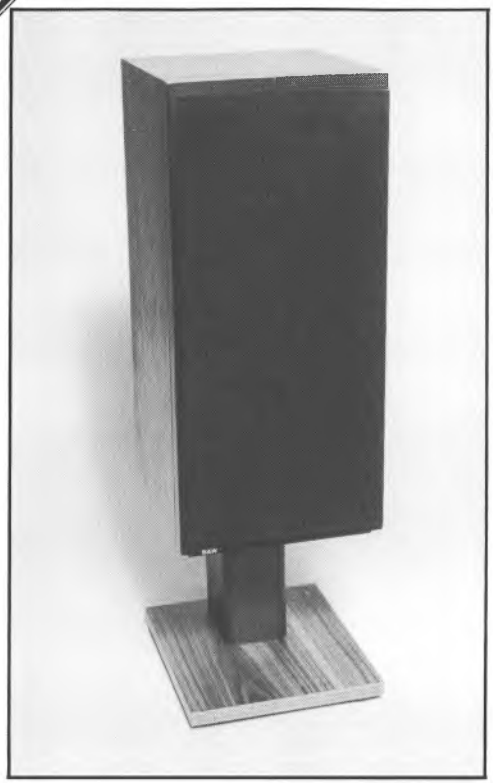
Size (H, W, D)	35.5, 22, 27 (14, 8.75, 10.5) cm(inches)
Weight	9.6 (21) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25–150W
Recommended placement	open shelf or stand
Frequency response within ±3dB (2m)	90Hz–20kHz
Low frequency rolloff (−6dB) at 1m	60Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms)	86dB
Approximate maximum sound level (pair at 2m)	102dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	very good
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc VAT	£200



RECOMMENDED

B&W DM14

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



The price of the *DM14* must be seen in the context of the complete system, which includes an elaborate integral steel and wood stand intended to be screwed securely to the base of the speaker. The *'14* is essentially a version of the previously reviewed *DM12*, stretched vertically to accommodate a second bass/mid unit, and with the sealed box internal volume increased from 12 to 25 litres. *In toto* three drivers are employed, namely two 18cm B&W bextrene cone bass/mid units, and the B&W 25mm soft dome tweeter. Both bass drivers have die-cast frames, and are slightly decoupled from the enclosure by fairly stiff grommets. This technique reduces the transmission of driver frame resonances into the enclosure where they might selectively resonate with panel modes to produce coloration.

As with the *DM12*, comprehensive electronic circuitry is inbuilt, with overload actuating a disconnection relay and illuminating a warning lamp on the front panel. The crossover board carries a complex array of high quality components, and reflects B&W's 'fully engineered' approach to speaker design. As with the *'12*, the *DM14* uses a third order technique for low frequency loading, which offers an improved bandwidth/sensitivity compromise at low frequencies, without adding the coloration which often occurs with ported systems. Furthermore, very good power handling may be obtained (as demonstrated effectively on test).

The substantial chipboard cabinet is reinforced by a massive circumferential brace located between the main drivers, with thick bituminous pads plus foam plastic lining and wool filling used to damp panel resonances as well as internal modes. The grille is fitted with a foam edge liner adjacent to the high frequency unit to reduce diffraction effects.

Lab performance

The axial sinewave response showed a generally good characteristic, with a slight downtilt from 100Hz to 2kHz followed by a somewhat 'lumpy' elevated treble. An average sensitivity of 86dB/W was indicated, with a satisfactory bass extension to 46Hz, −6dB, and pair matching was held to a good +/−1dB overall.

Assessed in third octave bands at 2m, the main anomaly concerned a mild 3dB high treble plateau from 9–15kHz. This improved greatly on the 30° off-axis lateral trace and in fact a 25° angle – overangled inwards to the listener – gave the smoothest subjective results as well as fine stereo. The 15° above response showed loss in the 2–4kHz presence range, and a listener position close to the mid/treble axis is to be preferred, which is possible with the supplied stands provided that the listener is not too tall. On the whole the forward characteristic responses were well integrated.

The power handling was excellent, 100W pulses defined with negligible compression or spurious distortion, while on steady state drive at 96dB the distortion was commendably low above 120kHz, and more than satisfactory below this. At 90dB, 1.0% 2nd harmonic was present from 6–12kHz, though this was considered to be of little significance, the design thus giving a fine overall distortion performance. Rated as a good amplifier load, it was easy to drive with a minimum value of 7 and a typical impedance of 10 ohms.

Assessed by room averaging, the output fell below 50Hz and showed a neutral overall balance up to 7kHz, but was then slightly let down by the lack of a continued rolloff in the treble, illustrated by the 'corner' at 12kHz.

The tests indicate a sensible maximum amplifier rating of 200W, though more still is possible, and substantial 104dBA sound levels were achieved with 200W per channel inputs in our listening environment.

Sound quality

The *DM14* proved to be a significant improvement over the *DM12*. Subjectively coloration was lower, the frequency range more extended and the balance better. On the live comparisons it fared much better than the *'12*, and was considered lively, open and dynamic, with only mild criticisms of a 'boxy' coloration as well as a tendency to treble 'scratchiness'. The upper registers were judged to be a trifle excessive, although two keen-eared listeners in fact correctly identified a lack of extreme treble energy. The bass was fairly deep, and showed fine power delivery plus an even character and essentially low levels of both coloration and distortion.

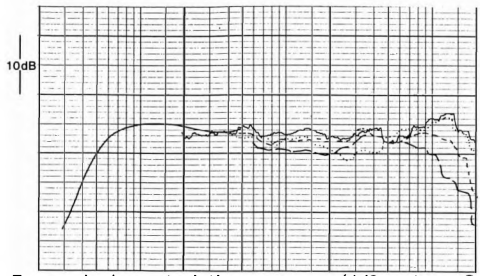
Good results were also obtained on the stereo sessions, where the coloration levels were considered to be relatively low though with some mid congestion and clouding of detail, as well as a degree of 'boxiness' and 'thickening'. The treble showed a touch of 'fizz' and 'abrasiveness', and could do with being a little smoother, while some loss of instrumental detail was also noted as well as a lack of excitement. The stereo presentation was however quite good, with satisfactory rendition of depth and ambience.

Summary

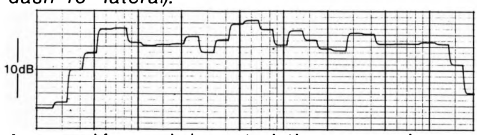
Allowing £40.00 or so for the price for the stands, the distinctively styled *DM14* has undoubtedly done well. While not the most neutral speaker in its class, it offers an essentially clean sonic balance with remarkable dynamic range and power capacity, sounding at its best when over-angled by some 25° to cross in front of the listener, as noted above. Distortion is low and with large amplifiers it can attain genuinely high sound levels. The system is well engineered and finished and comfortably offers sufficient value for a *Choice* recommendation.

GENERAL DATA

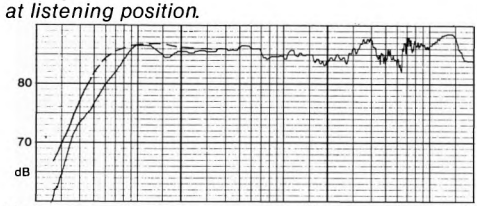
Size (h x w x d)	56.5 x 25.5 x 29.5cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–200W
Recommended placement	away from walls on supplied stands
Frequency response within ± 3dB (2m)	50Hz to 20kHz
Low frequency rolloff (−6dB) at 1m	46Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	86dB/W
Approximate maximum sound level (pair at 2m)	104dBA
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc VAT	£300 inc stands



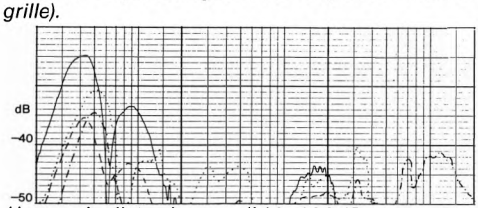
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



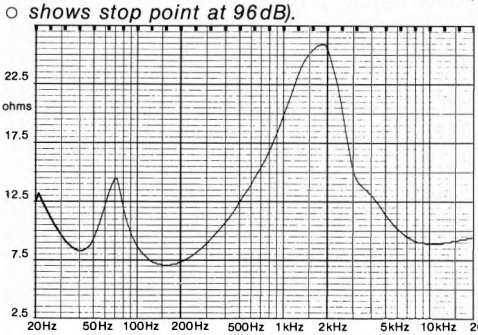
Averaged forward characteristic response in room at listening position.



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).

REAL HIFI IN IRELAND.

WHY BY APPOINTMENT?

Because we believe this is the only way to audition hi-fi equipment properly.

There is no charge for an appointment, you simply telephone us, arrange the time (bring a couple of records), sit down and listen. You can compare turntables, amplifiers, tuners, tape decks and loudspeakers – naturally we stock the "best buys".

There is no better more civilised way to the best sound around, and the prices are surprisingly reasonable too!
We are open Saturday without appointment so that you may browse around if you wish. However don't forget our funny lunch hour 2–3.30pm.

NOEL CLONEY AUDIO CONSULTANTS

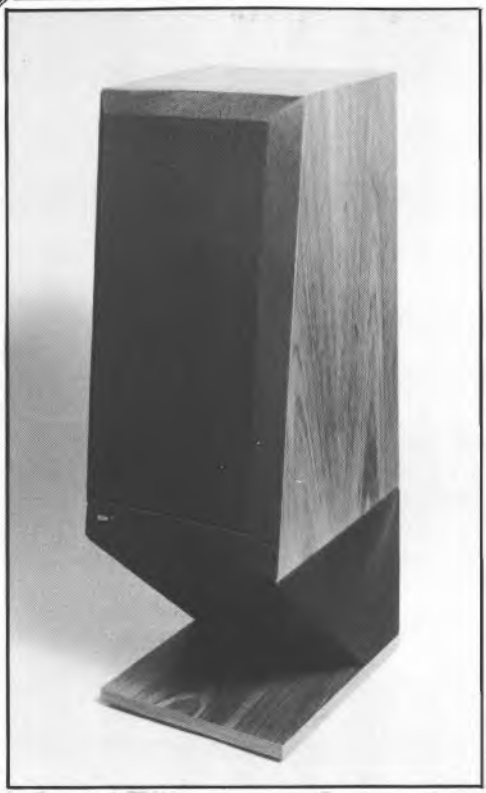
BARCLAYCARD VISA

AUDIO CONSULTANTS
LEINSTER MEWS
154 LEINSTER ROAD
RATHMINES
DUBLIN 6
TEL: 961316
TELEX: 25576 WARK-EI

RECOMMENDED

B&W DM16

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



In the past B&W have repeatedly shown themselves capable of producing a broad and diverse range of speakers. The *DM16* is a distinct departure from the ordinary, using a costly and superbly finished enclosure with strongly sloped front panel. Massive stands are supplied; a far cry from the usual steel framework, they have matching veneer and grille work and might perhaps be more correctly classified as 'bases'.

This speaker was one of the heaviest it has ever been my misfortune to have to carry about, and once established in a listening room it is not likely to be moved far! However, due to the front panel slope and the incorporation of a very generous (and hence low coloration) rear chamber for the midrange driver, the internal volume loading the bass unit is not particularly large at 45 litres.

The speaker comprises a three-way sealed box system, with slightly decoupled driver mountings for the bass and mid units. A vertical in-line driver array is adopted for optimum lateral stereo symmetry, and the low frequencies are handled by a 280mm bextrene-coned driver fitted with a massive magnet assembly and built on a die-cast frame. The mid unit is exclusive to B&W, using a woven polyamide cone doped with a damping/stabilising coating, and the HF is handled by B&W's own 25mm soft fabric dome tweeter. A sophisticated crossover is employed, consisting of third order bass-loading elements and full electronic protection. High density 20mm chipboard is used for the enclosure, which has a thick wool filling, bituminous cladding on the walls, and extensive bracing, and the deep contoured grille avoids diffraction problems by using a costly welded steel frame of negligible acoustic obstruction.

Lab performance

Producing a notably smooth axial characteristic, the reference response did however demonstrate some interesting features. The balance appeared to drift slowly downwards from a gently humped bass region at 100Hz, and within this trend the 1.5kHz to 3kHz region showed mild depression. The low frequency range possessed a moderate extension to 44Hz, −6dB, and the rolloff was slow – a plus point – although sensitivity at 85dB/W was below average.

At 2m the characteristic response showed very good integration and uniformity, and the system has clearly been aligned (as it should be) for the forward axis and not for 15° above; the latter, though closer to the physical baffle axis in fact demonstrates an inferior response. At 30° and 45° laterally, the traces were very flat, and this system could well be used without any need to swing the enclosure inwards to face the listeners as is often done.

In common with other B&W systems the *DM16* happily soaked up 100W pulsed inputs, demonstrating negligible compression and low distortion levels (typically 0.8% 2nd and 0.2% 3rd order at both 500Hz and 5kHz). This picture was reflected in both 90 and 96dB steady state levels, with 3rd harmonic at the low frequencies never exceeding 0.9%, and 2nd at a harmless 1–2% level below 250Hz.

Ultimate power handling fell below that of the *DM14*, and 150W seems a fair figure, providing a satisfactory peak sound level of 102dBA in a listening room. A minimum amplifier power of 20W per channel would also appear appropriate. The impedance rating was average, dipping to 5.3 ohms, 100Hz, but few amplifiers are likely to be bothered by this.

In overall shape the integrated room response

from 50Hz to 16kHz was commendable, corresponding closely to the required result, although a slight forwardness in the 5kHz range was apparent, together with a curtailed extreme bass.

Sound quality

The *DM16* performed consistently well on both live and recorded sessions. During the former the bass was felt to be a trifle 'rich' and upper range dominant, while when deep bass was present it was recessed a little. Certain colorations were noted: a trace of 'chestiness' or 'fullness' on speech was described with some 'hardness' or 'boxiness' in the midrange, and a comment of a slight 'off axis effect' in the treble was also made which is appropriate enough in view of the baffle slope. Spectrally the sound was felt to be well balanced with clear and clean transient definition.

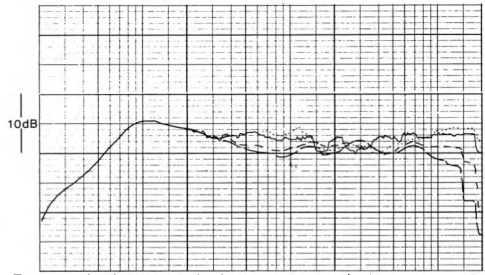
On the stereo programme the sound was promising with a good sense of space and ambience, and while some loss of transparency was apparent, frontal detail was fine. Occasionally some coloration was noted, but mild in degree. On piano some 'hardness' and 'ringing' was present in the midrange, and the lower mid/upper bass was also described as slightly 'hollow' by two panelists; in the fact the bass could have done with more 'tautness' and precision.

Summary

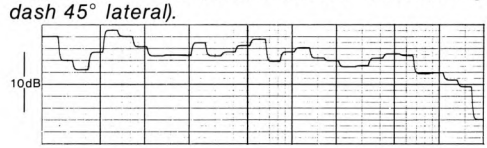
While this speaker is clearly not 'Best Buy' material, it is nonetheless recommended, setting a high standard in several respects. A consistent, reliable performer, distortion is very well controlled, the balance neutral, and coloration fairly low; the whole is superbly engineered and finished, and cannot be damaged by excessive inputs. It possesses a more 'furnished' appearance than most models, and the price is not excessive in view of the massive bases supplied as standard.

GENERAL DATA

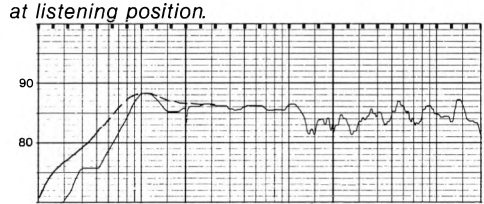
Size (h x w x d)	65 x 33.5 x 42cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–150W
Recommended placement	.... away from walls on supplied stands
Frequency response within ± 3dB (2m)	52Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	44Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	85dB/W
Approximate maximum sound level (pair at 2m)	102dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	very good
Typical price per pair inc VAT	£550 inc stands



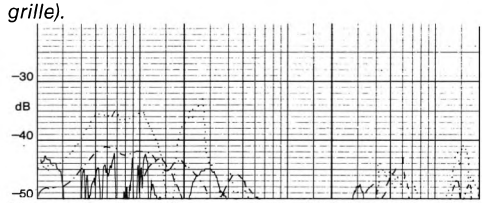
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



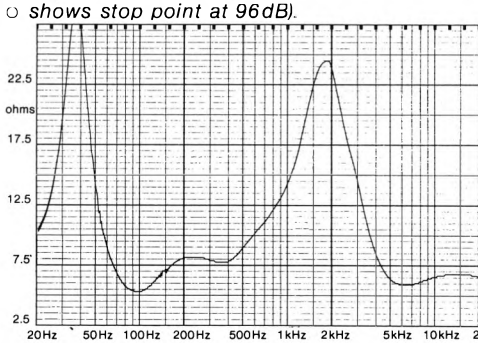
Averaged forward characteristic response in room at listening position.



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).

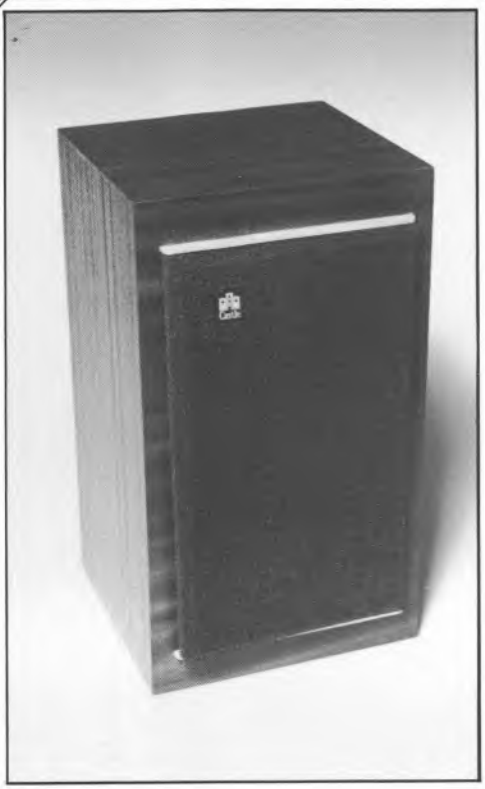


Impedance (mod Z).

BEST BUY

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 +/−1dB: 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 −6dB point at 64Hz, but the axial reference response was inspiring, meeting fine +/−2.5dB limits overall, and showing a promisingly even balance.

Under ⅓-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.

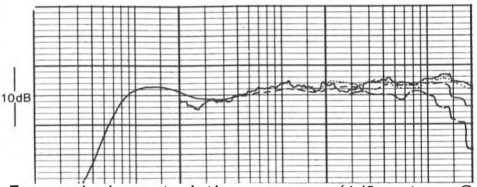
Promising scores were also obtained on the stereo tests, where the imaging was found to be clearly defined with some depth and good lateral precision over a wide listening angle. Low bass notes were lacking in power, but the balance was surprisingly good if tending to be slightly 'light' and 'middy' 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

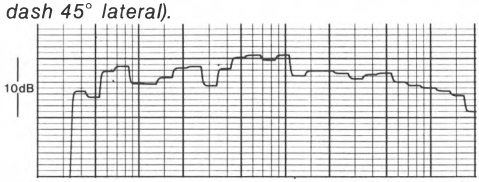
Once again we find a Castle speaker in the Best Buy category. This tidy little box packs a surprising 'punch' in terms of a clear even and lively sound, offering a high sensitivity, easy amplifier load, high dynamic range and moderate distortion, plus fine finish and engineering. At the price and size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

GENERAL DATA

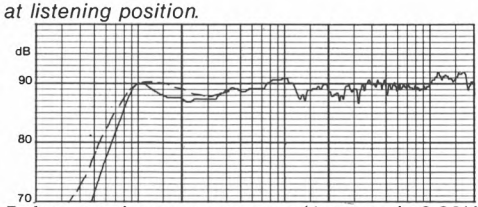
Size (h x w x d)	37 x 21.5 x 22cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–50W
Recommended placement	open stand
Frequency response within ± 3dB (2m)	75Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	64Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms)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



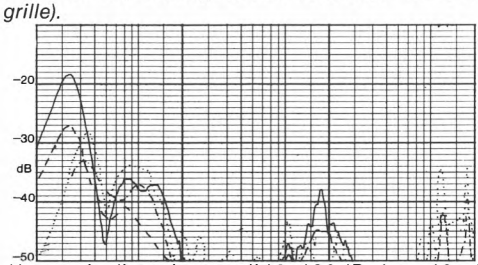
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



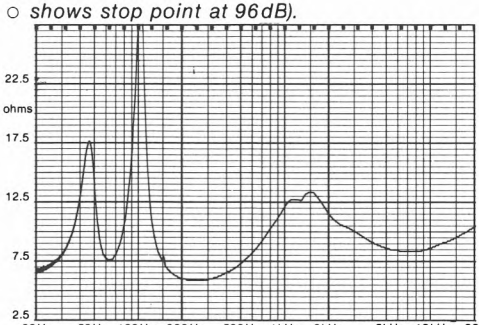
Averaged forward characteristic response in room at listening position.



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).

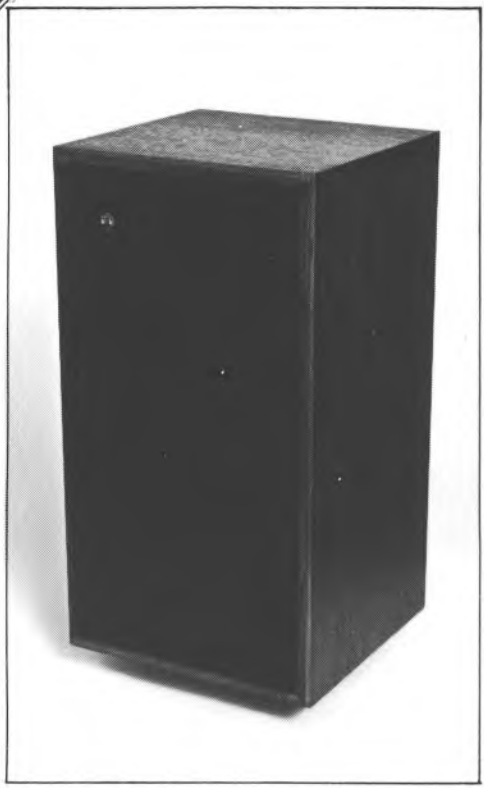


Impedance (mod Z).

BEST BUY

Castle Kendal II

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



The latest version of the *Kendal* incorporates a slightly improved high frequency unit, the original 30mm plastic cone with a small centre dome and a somewhat peaky upper range being replaced by a more sophisticated unit, which approximates to an annular radiator with a centre phase correcting plug; the modest fabric cover from earlier designs has however been retained. The remaining driver is a robust 200mm cast frame unit with a rigid flared pulp cone, coated with a damping agent.

Possessing a very good finish, this 30 litre enclosure is rather traditional in its appearance, and is constructed mainly of 15mm chipboard, with bracing and some rear damping. It is reflex loaded *via* a sensibly large 52mm diameter tunnel port, and a good quality, essentially four-element crossover at 3.5kHz is used (12dB/oct electrical), whose function is complemented by designed acoustic rolloff in the drivers. A detachable foam grille helps to minimise cabinet diffraction effects.

Lab results

Having tested a number of Castle models, I was disappointed to find poorer than usual pair matching for these samples. A 1–2dB imbalance was apparent from 600Hz to 4kHz, but I would suspect on past track record that this is not typical of production. The sensitivity was usefully high at 89dB, and is in no way compromised by the easy to drive impedance characteristic. The −6dB LF rolloff was appropriate at 52Hz, and is in fact quite extended in view of the sensitivity.

The axial frequency response met tight ±2.5dB limits between 65Hz and 20kHz, but contained a small elevated region at 600Hz, and a hint of restraint in the treble registers. The group of off-axis curves were very well integrated showing excellent crossover phase control; clearly this speaker should prove relatively uncritical of listener position.

Swept distortion analysis at a 96dB sound level (1m) showed good results especially at low frequencies, although third harmonic did exceed 1% in the 1–3kHz range. Peak power distortion was also good, though a significant 0.6dB compression was recorded at 500Hz, the −0.3dB result at 5kHz being rather better. Possessing a low maximum power rating, the sensitivity allowed a high 105dBA maximum sound level from a pair at 2m – very good at the price.

Sound quality

The *Kendal* scored 'very good' on the live sound comparisons, being aided by its good bass rendition, which was quite even with fairly good extension and surprising acoustic power. Coloration was quite low with a neutral frequency balance and surprisingly explicit transients; one panelist commented that although imperfect, the *Kendal* nonetheless gave a very plausible imitation.

A weaker performance was experienced on the stereo programme, with a noticeable loss of image focus which was probably due to the noted pair imbalance. (Previous *Kendals* gave good results on this test.) In addition, the depth impression was somewhat masked, which is attributed to residual coloration in the design, while the LF register did not sound quite as smooth as the responses suggested. These problems aside, however, the general sound quality was promising, being well above average for its price and class.

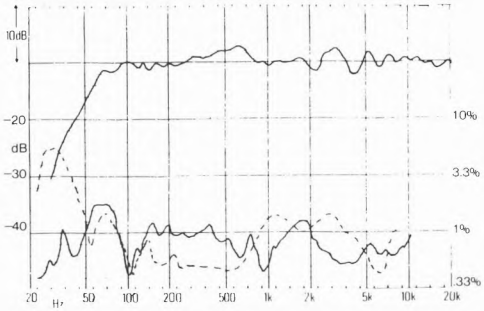
Summary

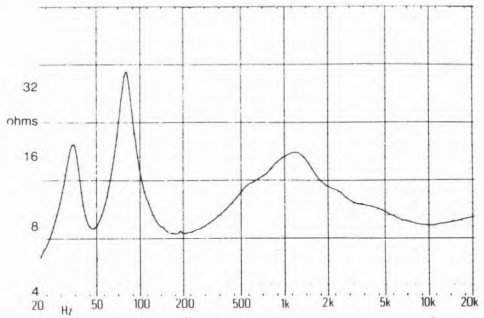
On track record we can expect *Kendals* to be

Castle Kendal II
(revised and reprinted)

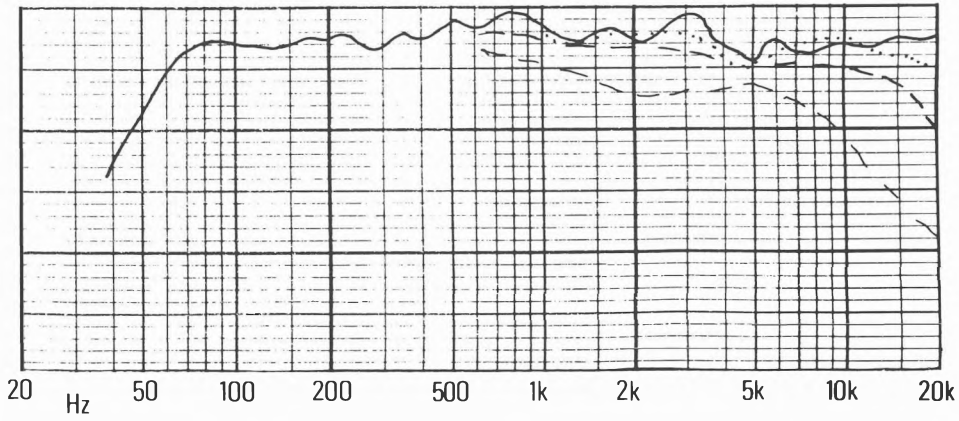
rather better balanced than our test samples, but even accepting the performance of the latter, a recommendation is still indicated. The combination of modest size and high constructional quality together with good efficiency and bass, plus generally good sound reproduction combine to merit best buy status at around £160. The high sound level capability may also be important to a purchaser.

Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).





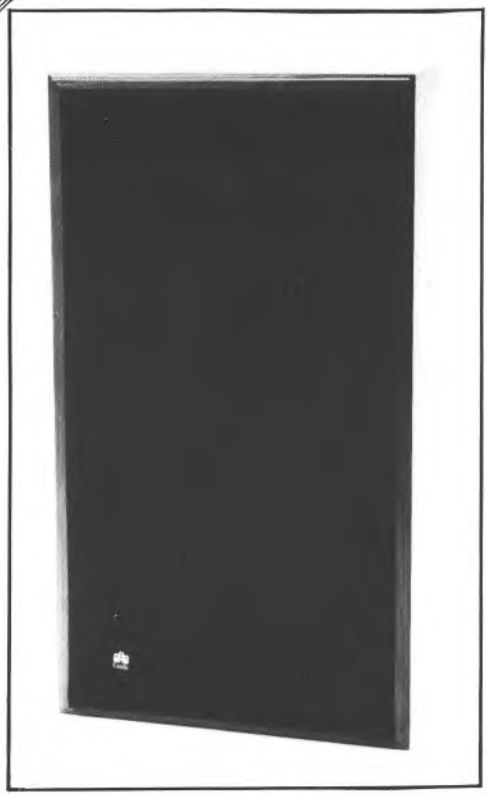
Size (H. W. D)	52.5, 29, 28 (20.5, 11.5, 11) cm(inches)
Weight	10 (22) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10–100W
Recommended placement	open shelf or stand
Frequency response within ±3dB (2m)	60Hz–20kHz
Low frequency rolloff (−6dB) at 1m	52Hz
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m	89dB
Approximate maximum sound level (pair at 2m)	105dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	acceptable
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good
Typical price per pair inc VAT	£165



BEST BUY

Castle Conway II

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



This rather bluff enclosure measuring some 63cm(H) by 35cm(W) and 37cm(D) conceals a larger than average internal volume of 52 litres, and this, taken together with Castle's good track record on low frequency design, promised a worthwhile bass performance. Our samples were teak veneered on all surfaces with a glossy lacquer finish, the grille being of black Declon foam with some ribbing to lighten the appearance.

A three-way system with crossover points at 750Hz and 4kHz, the dividing network is of good quality, comprising 13 elements. The three drive units are Castle's own, namely a 210mm doped pulp cone bass on a diecast frame, reflex loaded by a 53mm diameter tunnel port; a 80mm doped pulp paper-cone mid unit, also with a die cast frame, and finally, the Castle cone/dome mylar tweeter, nominally 30mm in diameter.

The cabinet is rigidly constructed in high density board with beam bracing and a foam lining. A universal connector provides DIN and 4mm socket connections. Curiously, the three protection fuses are located inside the enclosure on the crossover board beneath the bass driver; however, as the units were not damaged and the fuses remained unblown with up to 300W program per channel, this should not prove any sort of a problem.

Lab results

The match illustrated by the review pair was very good and generally to within 0.5dB throughout. The sensitivity was fairly low at 86.5dB/W, although the speaker was quite easy to drive, and is in fact marginally more efficient than the typical plastic-coned systems of the same dimensions. The -6dB LF point was well extended at 38Hz.

Rated as very good on third harmonic distortion, 3% was noted at 50Hz, reducing to 0.3% by 100Hz and holding typically to that level throughout, bar minor lapses to 1%, 1.5kHz and 0.5% in the treble. The *Conway* also demonstrated fine power handling, coping well with all program particularly live electric bass guitar. Slight port chuffing was noted at around 20W input, but the audible failure did not occur until beyond 60W, and on wide range program up to 250W per channel was gracefully accommodated. The impedance dipped to just under 6ohms between 100 and 150Hz implying an 'average' amplifier loading, although the Conway is elsewhere easy to drive with the values at nominally 9ohms.

At 1m the reference trace illustrated a fine +2, -3dB characteristic from 45Hz to 20kHz, being essentially even and well balanced. Minor dips were present at 1.6kHz and 2.4 kHz, plus a small irregularity above 15kHz.

The smooth frequency response was maintained at 2m, meeting fine +1, -2dB limits overall. The set of characteristic forward responses were excellent, showing fine uniformity and integration on all measured axes. Thus the *Conway* is relatively uncritical of listener position and does not 'beam' in the forward plane.

Sound quality

Living up to the promise indicated by its lab performance, the *Conway* acquitted itself well in

Castle Conway II

(revised and reprinted)

the live sound comparisons. While not entirely free of boxy effects — noted on male voice for example — the general quality was open and clear, with fine, well controlled and powerful bass.

With the more complex stereo programme the results were even better, the speaker gaining a top class rating for stereo imaging, with depth, precision and ambience all well conveyed.

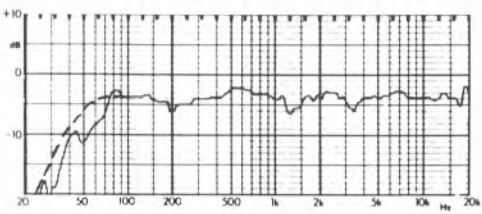
Driven to high levels it did not sound 'loud' in the fatiguing sense, and performed well on solo piano and heavy rock program alike. Mild criticisms centred around a slightly 'fizzy' HF register, plus a trace of mid 'wiriness' and hardness; overall the panelists were favourably impressed.

Summary

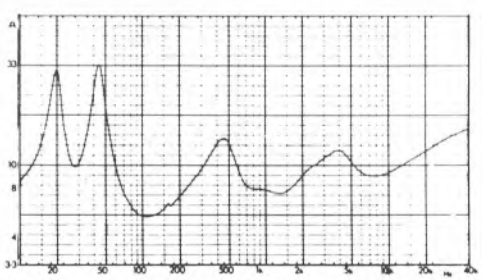
Once again Castle have come up with a very strong competitor, and like its smaller brother the *Richmond,* the *Conway* has done well in our exhaustive tests. Relatively easy to drive and of normal sensitivity, it proved quite uncoloured and showed good dynamic range and stereo, plus fine detail rendition, with a clean extended bass and low distortion. Dispersion was excellent, and at around £290 the *Conway II* can be strongly recommended as fine value.

A new version of the *Conway,* designated *IIA,* has recently been added to the range. Featuring an integral stand and styling changes, it is claimed to be acoustically identical and is a little more expensive. Both new and current models feature a revised and improved tweeter, and may be confidently recommended.

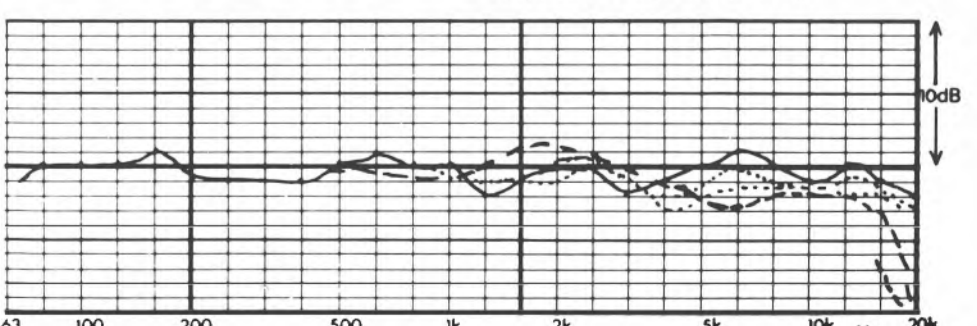
Size	63.4(25) H; 27.5(11) W; 31(12) D; cm(inches)
Weight	18.5(41) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–200W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	38Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86.5dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	v. good
	50Hz–3%, 100Hz–0.3%, 1.5kHz–1%, 6kHz–0.5%, typically 0.3%
Impedance characteristic (ease of drive)	average
Forward response uniformity	excellent
Typical price per pair inc. VAT	£290



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)



Impedance vs frequency (mod Z)



⅓-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

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 +/−2.5dB 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 ⅓-octave characteristic showed evidence of a loss in output around 6kHz, the overall curve having a 'humped' appearance with prominences located at 130Hz, 2kHz and 14kHz. (In practice however the response is a little better than this, since these measurements were taken with the grille on.) The off-axis curves suggest that the speaker output is well integrated and not over-critical of listener axis.

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

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

Assessed by ⅓-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.

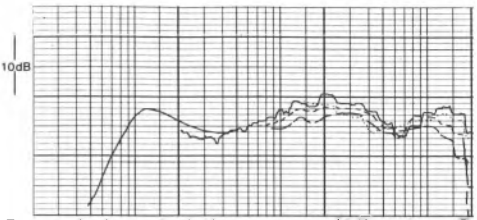
On the stereo sessions it was not so well regarded, although in view of its budget price the grading was reasonable. The upper treble was considered a trifle prominent, while the sound lacked 'weight'. Although it gave a reasonable impression of ambience, and the stereo presentation was quite good, it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

Summary

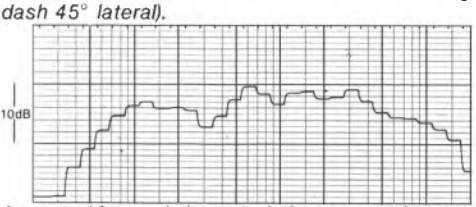
This small and inexpensive speaker is quite presentable, particularly when used without the grille. At £80.00 it justifies a recommendation on value grounds and is worth trying. On the debit side the frequency balance was none too even, distortion was poorer than average and the bass response was rather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

GENERAL DATA

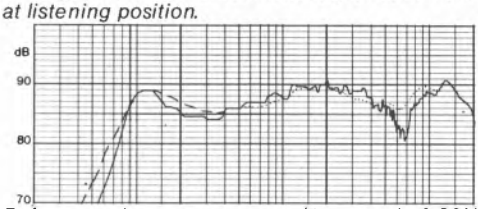
Size (h x w x d)	33 x 21 x 18.5cm
Weight	4.4 kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–50W
Recommended placement	open shelf
Frequency response within ± 3dB (2m)	85Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	76Hz
Voltage sensitivity (ref 2.83V, *ie*: 1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



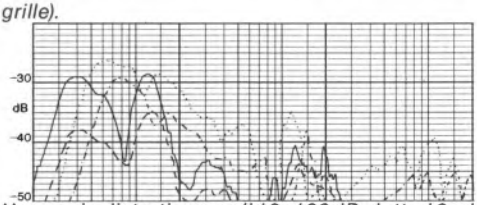
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



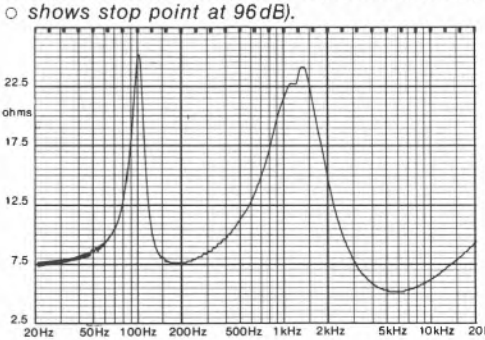
Averaged forward characteristic response in room at listening position.



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).

BEST BUY

Celestion 130

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

One of the brand new cost-conscious range of speakers from Celestion, the *130* is a two-way system using a 20 litre sealed box enclosure, a 200mm bass/midrange unit and a 25mm soft fabric dome tweeter. The latter is a new design made by Celestion themselves, and offers good sensitivity as well as an improvement in sound quality over earlier types. A doped pulp cone with a high loss pvc surround is used for the 200mm driver. The five-element high power crossover is electrically second order at low frequencies, and third order for the treble range filtering.

The dark walnut vinyl clad enclosure is made from chipboard with a polyester fibre volume filling. The grille baffle is not chamfered internally.

Lab results

The *130* exhibited very good pair matching with a lab sensitivity of 88dB/W – an above average figure which is not unduly compromised by the impedance minimum of 5.3 ohms at 6.5kHz. An 'average' amplifier loading was indicated by the results, and a fairly high 55° phase angle was measured at 2.2kHz, albeit at a safe 11 ohms. Removal of the grille was found to change the response significantly in the 2–6kHz range, entirely eradicating the dip at 5.5kHz, and some listeners could very well prefer to use this model with the grille discarded.

The axial frequency response was quite tidy for an inexpensive model, and except for the grille 'notch' it met ±3dB limits from 80Hz to 18kHz on critical sine wave excitation. ⅓-octave analysis smoothed things out somewhat and helped to clarify the major response trends – a slightly depressed treble plus an even more depressed presence range between 1.5 and 6.0kHz. The group of off-axis responses were however well controlled, denoting a good system design as well as good stereo potential.

A fine distortion performance was produced at 96dB 1m, which is a highish sound level for this size of box. Some third harmonic distortion was evident at 1kHz (about 1.5%), but the low frequency range was particularly good, indicating a well-optimised motor design. A 0.4dB compression was measured at 100W, 500Hz, but the 5kHz short toneburst was well handled, with less than 0.1dB loss. Classified as suitable for amplifiers of up to 75 watts per channel, the *130* was capable of quite decent sound levels, recording up to 102dBA for a pair under normal conditions.

Sound quality

The rather unexciting word 'average' described the *130* performance on all listening tests, but as price-*vs*-performance is an important consideration, this is in fact a very good result as the speaker costs around a third of the group average.

On live tests colorations were audible, with speech considered fairly 'boxy' and 'sibilant', the latter despite a general and slight dullness in the frequency balance. The midrange was thickened and prominent. Some audible bass distortion was apparent on the bass guitar input above an average of 4 watts, but the *130* went on to cope with 40W before gross overload occurred. Inevitably fundamental bass notes were weak.

On the stereo programme the speaker sounded a trifle 'loud', again demonstrating a mid domin-

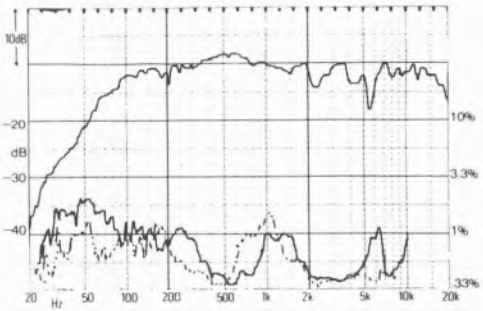
BEST BUY

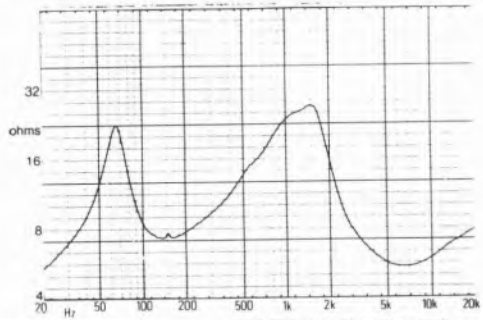
ance and a lack of openness and transparency, but still better than many other models in this report.

Summary

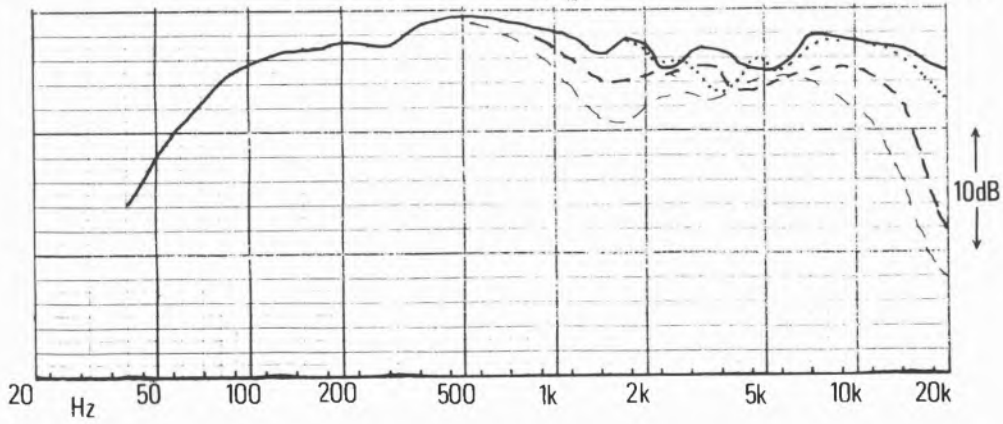
The performance and engineering represent good value for money, and the system was fairly easy to drive. It offered above average efficiency and sounded pleasant enough, so at a modest £115 a pair the *130* qualifies for inclusion in the 'best buy' category.

Top: Frequency response, 1 m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).





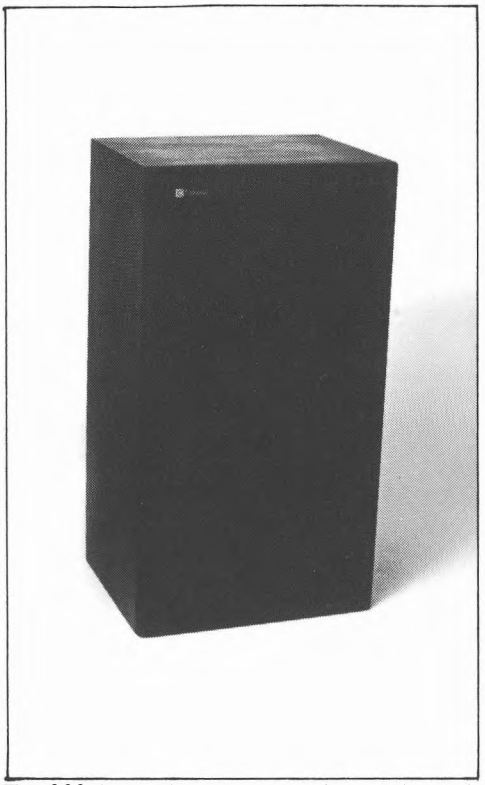
Size (H, W, D)	48.5, 25, 24 (19, 10, 9.5) cm(inches)
Weight	7.7 (17) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15-75W
Recommended placement	open shelf or stand
Frequency response within ±3dB (2m)	77Hz-20kHz
Low frequency rolloff (−6dB) at 1m	60Hz
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m.	88dB
Approximate maximum sound level (pair at 2m)	102dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	good
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair	£115



RECOMMENDED

Celestion 200

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



The *200* is another new Celestion model and appears to belong to that increasingly popular type whereby two 200mm units are used in tandem to provide good power handling, but where only the upper driver of the pair is allowed to continue into the midrange to meet the ubiquitous 25mm soft dome tweeter. Other examples of this *genre* are now available from KEF, AR and B&W, for example. However, the technical data for the *200* describes an interesting though puzzling variation on this theme, in that both 200mm drivers work in parallel through the midrange while one acts as an ABR at low frequencies. This is done in order to maintain an 8 ohm system impedance using two 8 ohm nominal drivers, and is achieved by a good quality six-element crossover.

The wood veneered chipboard cabinet has an internal sealed volume of 37 litres, and is undamped. A volume filling of polyester wadding is included and the plain grille baffle is not rebated (see response comments).

Lab results

The pair matching was fairly good, and generally to within ±1dB, but removal of the grille provided some improvement, notably in the depth of the notches at 2.5 and 5kHz. Lab sensitivity measured 88.5dB/W which is somewhat higher than specified; with our estimate of 150W peak programme power handling, this offers a generous sound level maximum of 104dBA in a typical environment. The low frequency cut off was 58Hz – very similar to the *130* – although the power handling capacity was higher. At an undisputed 8 ohms, the impedance characteristic confirmed that the *200* presents a good amplifier load.

The sine wave response at 1m was promisingly flat in the fundamental area of 70 to 500Hz, but deteriorated thereafter with an irregular upper mid and presence range, showing peak-to-trough differences of the magnitude of 8dB. Above 6kHz however the treble range was quite even. At 2m and using ⅓-octave averaging the anomalies were plain to see, persisting at 15° above axis and exhibiting good correlation with the axial responses. Laterally off-axis the loss in output at 30° was greater than usual in the midband but showed a more uniform trend, and this was confirmed by trial listening with the speakers deliberately over-angled inwards.

Swept distortion results at 96dBA were fine, and this standard was maintained with the 100W pulsed input, with a low 0.2dB compression at 500Hz and less than 0.1dB at 5kHz.

Sound quality

On live sound comparisons the speaker confused the panel, as its uneven character suited some sounds very well at the expense of others. Some 'hollowness' and 'box' type colorations were evident, while the presence range lacked integration and 'attack'. Nevertheless it gave a fair impression, and the overall scores were quite good. Bass reproduction was fairly clear with up to 50W average handled without great distress.

Further confusion was encountered on the stereo sessions, where this design pleased some panelists rather more than others. Despite its audible unevenness, the subjective clarity was good, with fair imaging, and a generally acceptable performance for the price.

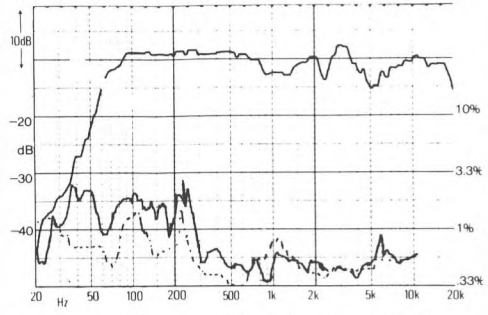
Celestion 200
(revised and reprinted)

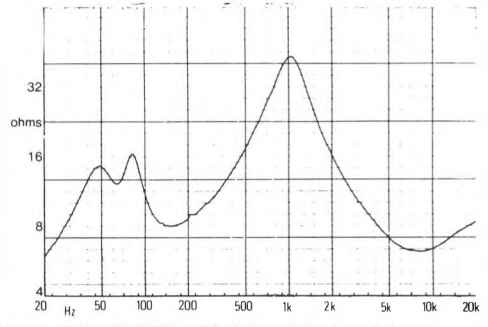
RECOMMENDED

Summary

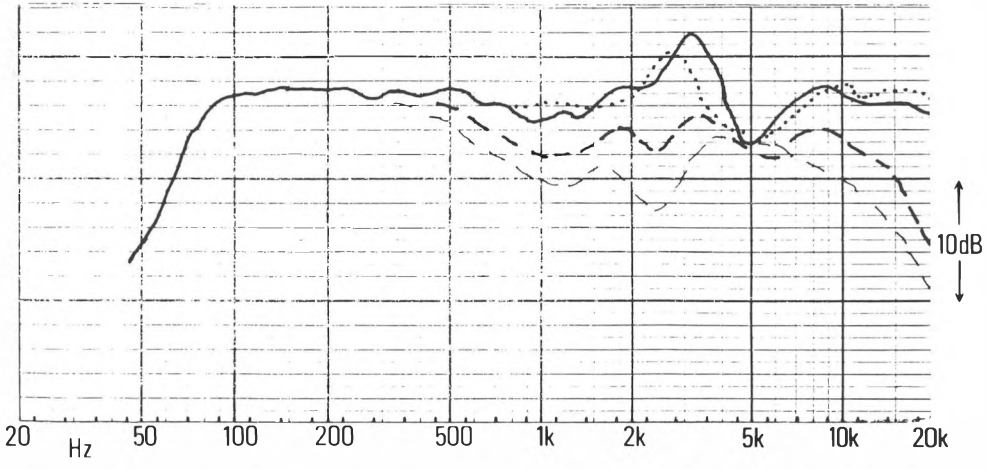
While clearly exhibiting some weaknesses, the *200* is a model worthy of audition. The sound is a little better than the arbitrary adjectives in the table might suggest, and technical quibbles apart, the line of rating it achieved justifies the price and merits a recommendation.

Top: Frequency response, 1 m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



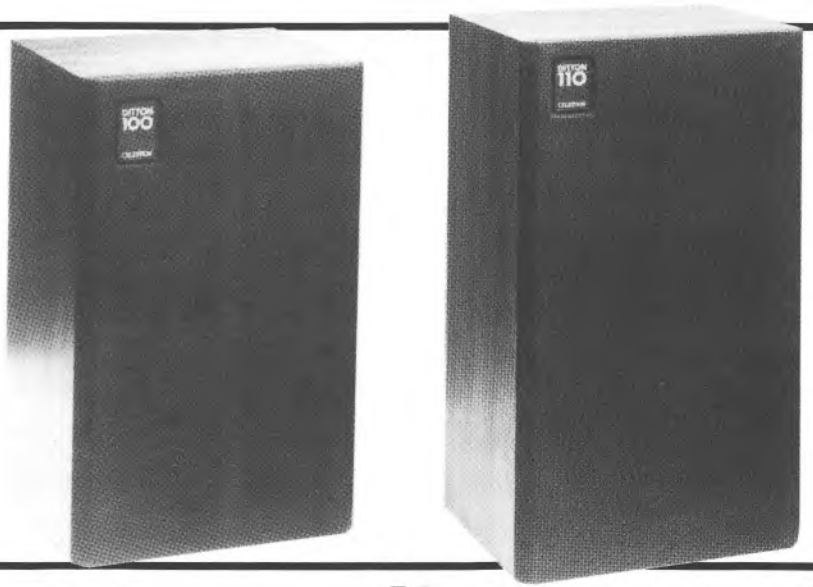


Size (H. W. D)	60, 33, 26.5 (23.5, 13, 10.5) cm (inches)
Weight	12.7 (28) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15–150W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz–20kHz
Low frequency rolloff (−6dB) at 1m	58Hz
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m	88.5dB
Approximate maximum sound level (pair at 2m)	104dBA
Distortion (96dB at 1m)	very good
Distortion (100W peak)	very good
Impedance characteristic (ease of drive)	good
Forward response uniformity	above average
Typical price per pair	£195



From CELESTION

TWO NEW DITTONS

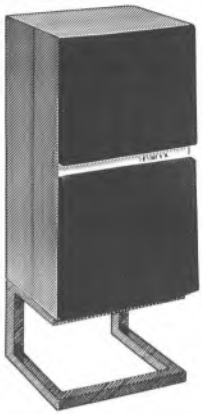


Two more 'best buys' both under £100 per pair ....at your dealer now!

Celestion speakers

Rola Celestion Ltd.,
Ditton Works,
Foxhall Road,
Ipswich, Suffolk. IP3 8JP
Telephone 0473 73131

HEYBROOK makes more music...



TT2 Turntable

This record deck incorporates in one elegantly-styled unit the best features of both the solid plinth and suspended chassis designs.

The massive plinth is 72mm thick and constructed from four laminated layers of high density material. It is extremely inert and resistant to all types of feedback.

Within this plinth a mild steel sub-chassis is suspended on a dynamically balanced, acoustically isolated three-point suspension which further eliminates feedback. The heavy platter assembly gives excellent speed constancy and is driven by a precision rubber belt. This finely machined platter rotates on a close tolerance hardened steel bearing. Thus all parts in the record playing assembly are closely coupled to effectively dissipate and control resonances. This process is further enhanced by firmly fixing the arm-board to the sub chassis. Speed change from 33 to 45 is effected manually.

The resulting sound is clean and lively, with satisfying solidity and weight. Detail resolution is very good and stereo imagery is precise and with good depth. The high quality of its performance makes the TT2 a first class match for the very best equipment, while the value-for-money price (£195 inc. VAT) means that at last the full potential of all good quality systems can be realised for a reasonable outlay.

HB2

The immediately striking thing about the HB2s is that they sound big . . . Bass is amazingly extended. . . . The other aspect is the coherent and natural imagery produced.
In fact the large and spacious sound stage the HB2s project remains satisfying after a period of listening.
Hi Fi Answers, July 1979

A firm, detailed perspective with good imagery indicated fine integration of the two units. Treble is lively and well controlled. Ambience is well preserved and gives a depth and coherence to the sound. . . should be heard by anybody in the market for a pair of speakers to see what can be accomplished for £185 per pair.
Popular Hi Fi, November, 1979

They possess that effortless sound quality which at first was almost impossible to believe.
Detail and subtlety of voice and instruments are also excellent and quite the best I've heard for a long time.
The design as a whole is a success because coloration is remarkably low. Just listen to them and you'll forget all about size and costs!
Practical Hi Fi, November, 1980

The Heybrook HB2 has little competition, there being few compact speakers capable of its detailed performance, mid definition and bass content.
What Hi Fi, August, 1981

HB3

. The HB3s produced an exceptionally detailed, dynamic and uncoloured sound. Imagery was sharp and positive with a clear, open sound-stage, showing good dispersion and integration of the drive units even when sitting off-axis.
Hi Fi for Pleasure, December, 1980

The bass is one of the smoothest and least coloured I have encountered. . . . stereo is very good. . . . information and detail equals or betters anything in its price class." One of the great strengths of the model is its ability to remain very convincing at very low levels, although the highish sensitivity permits generous sound levels to be achieved. . . . I am already convinced that this is an important model and it may well prove to be a classic.
Subjective Sounds (Hi Fi News) Feb. 1981
"£385 per pair.

The Heybrook is one of the few speakers to convey a feeling of power where appropriate to the music.
Its realism in setting up a performance in the living room is uncanny, not because it's so precise, but because it's so solid. Dynamics were notably well handled without any feeling of holding back or being unable to cope with the climaxes.
. The Heybrooks are in my opinion among the best few speakers in their class.
Hi Fi Answers, March, 1981

made for music by MECOM (ACOUSTICS) LTD.

Knighton Hill, Wembury, Plymouth, Devon. Phone (0752) 863188

HEYBROOK

Making music at specialist retailers throughout the UK and 12 other countries. For full details contact the manufacturers.

For further information and full review reprints please complete and return this coupon.

Name .....

Address .....

TT2 Turntable
HB2
HB3
Please tick

Chartwell/Rogers PM55

Swisstone Electronics Ltd., 4–14 Barmeston Road, London ASE6 3BN. Tel 01-697 8511

This small speaker is relatively inexpensive, yet it is built to the high standard usually encountered with more expensive models. A diminutive 6 litres estimated internal volume, the enclosure is reflex-loaded at the rear by an equally diminutive ducted port, just 3cm in diameter by 10cm in depth. The system resonance is placed at 85Hz, and the enclosure is tuned to 50Hz, by which point the acoustic output is well down. However, as with other miniatures, the tuning actually serves to increase the audioband power handling rather than to extend the frequency response.

Constructed of *Medite* with real veneer on all surfaces, the strong enclosure is lined with acoustic foam and is well finished, with electrical connection *via* 4mm sockets with screw terminals. The complex and good quality network comprises 9 elements crossing over at 4kHz, including three damping/attenuating resistors.

The two drivers comprise a steel-framed 13cm bass/mid unit with a generous magnet assembly and a polypropylene cone, plus a new 19mm plastic cone/dome tweeter from Audax. As with other polypropylene drivers, Chartwell make this unit themselves, and have fitted a high power coil; in fact their maximum limit to avoid damage is 150W programme average (at which level the bass region would be suffering from considerable distortion in our estimation).

Decoupling is used for the low frequency driver mounting; this is a technique pioneered by KEF which seems to be finding wide favour amongst other speaker designers.

Lab performance

The axial reference curve showed a promising characteristic up to 12kHz, above which a peaky region some 5dB high was plotted; some strange irregularities were also present from 1.5kHz to 5.0kHz, their origin unknown. The sensitivity was established at a low 83dB/W, which is 2dB less than specified. A restricted bass extension is also defined by the −6dB point at 65Hz.

Assessed in ⅓-octave bands, the prominent extreme treble was still present, although the 30° lateral off-axis curve looks as though it may subjectively smooth out this characteristic. The balance definitely tended to brightness above 3kHz, with a suspicion of bass warmth at 150Hz; overall the off-axis uniformity was very good, showing fine crossover control and integration.

However this system was not a good performer in terms of distortion, even at the lower 90dB power level. At 96dB 2nd harmonic reached 10.0% 150Hz, while the treble unit also produced quite high levels of 2nd harmonic from 15kHz to 18kHz, though the 1.5kHz to 14kHz range was well handled. 100W pulses stretched the system to the limit, with 10.0% or more distortion at 500Hz and compression approaching 1dB, while at 5kHz overload was again apparent, with 10% 2nd and 3.0% 3rd harmonics. A 50W rating suggests itself, and this was confirmed in the high level subjective tests.

While some mild uneveness was present, the ⅓-octave room characteristic averaged over the 3 mike positions showed a remarkably uniform trend, +/−3dB, 40Hz–16kHz. This was taken using a second pair supplied by Chartwell, which showed reduced peakiness in the upper treble. As all the samples we had were pre-production, it is hoped that these samples are more indicative of final production or of future improvement than the first model measured.

Sound quality

The low frequency range subjectively agreed

well with the lab result, being satisfactory at low volumes but noticeably 'fuzzy' and lacking definition at inputs above 50W/channel. The extreme treble was described as 'prickly' by one panellist with a 'wiry' tendency and a 'pinched' 'thin' midrange. Notwithstanding this, some 'chestiness' or excessive lower range 'warmth' was also apparent on speech, together with 'boxy' effects on the live sound sessions.

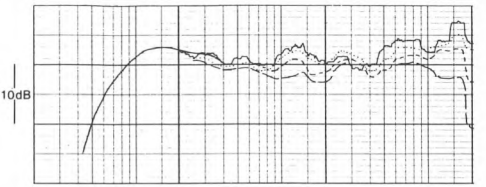
The stereo comparisons did not reveal any outstanding virtues, the overall effect described as 'lumpy' and 'wooden', with an unsatisfactory level of detail on complex sections, plus a 'small', 'shallow' character.

Summary

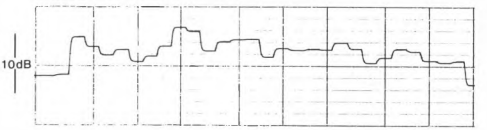
Despite undoubted care in the design and construction of this miniature, it is really not quite good enough for recommendation at the quoted typical price of £120.00 a pair. Let down by a lack of dynamic range and inadequate distortion when driven hard – an area where the broadly similar Castle *Clyde* excelled at £40.00 a pair less – the *PM55* cannot be rated as good value, and we also have our doubts about the treble quality. Having said all this, the numerical scores for the subjective tests were reasonable enough for an audition to be worthwhile.

GENERAL DATA

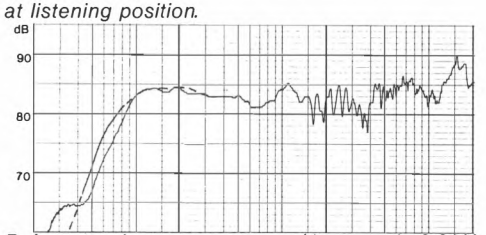
Size (h x w x d)	35.5 x 19 x 16.5cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(30)–40W
Recommended placement	open stands
Frequency response within ± 3dB (2m)	80Hz to 12kHz
Low frequency rolloff (–6dB) at 1m	65Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	83dB/W
Approximate maximum sound level (pair at 2m)	95dBA
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good
Typical price per pair inc VAT	£115



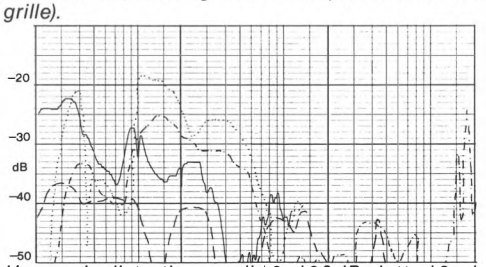
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



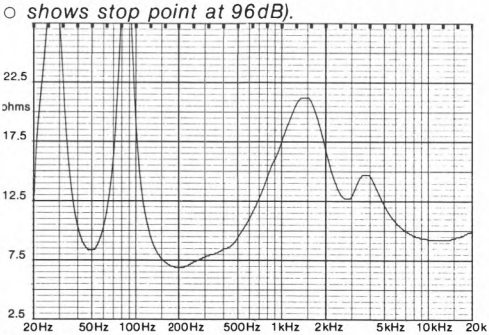
Averaged forward characteristic response in room at listening position.



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).

Chartwell Rogers PM110 II

Swisstone Electronics Ltd., 4–14 Barmeston Road, London SE6 3BN
Tel 01-697 8511

Physically similar to its predecessor the *PM100*, the *'110* is a compact, two-way reflex design of above average sensitivity for its size, the review samples being supplied in a dark rosewood veneer with a black Declon open cell foam grille. Standing some 46cm high, the use of a 25cm open stand is recommended. A 170mm unit with an exclusive polypropylene copolymer cone covers the bass/midrange at 2.5kHz, the 13 litre volume tuned by a modest 50mm diameter tunnel port. The ubiquitous Audax 25mm dome completes the vertical-in-line array.

The crossover was of excellent quality, comprising 15 elements, and the rigid enclosure was bitumen panel damped and lined with acoustic foam. The general standard of construction was very good, as was the finish, although the lacquer used did seem a trifle susceptible to marking.

Lab results

Excellent pair matching was illustrated – of the order of ±0.25dB over the whole range. The sensitivity was 86dB/W linear with a corresponding −6dB low frequency point at 63Hz, which is fine for this enclosure volume. Third harmonic distortion rated 'good' on the tests with typical values of 0.5%. The second harmonic distortion was on the high side at lower frequencies, reaching 10% at 100Hz, and I suspect that this would be audible on sustained notes such as organ. However it must be admitted that the test 96dB level is high for a smallish enclosure such as this.

The power handling was reasonably good, the system tolerating 15–20W of bass guitar and sustaining some 200W of more balanced wide-band program, and in so doing generating a high 102dBA maximum sound level. The impedance load rated average with the typical 10 ohms average slightly marred by a dip to 5 ohms at 13kHz.

On axis at 1m the response showed a uniform and well balanced characteristic though one which exhibited a rising trend with increasing frequency and thus a tendency to 'thinness' in the reproduction.

A well integrated group of off-axis responses was demonstrated, using ⅓-octave analysis at 2m. These proved superior to the results for the earlier *Mk I* model, and the result is a speaker uncritical of listener axis.

Sound quality

Achieving a 'good' rating on the live sound comparisons this speaker obviously could not compete with the larger models as regards bass reproduction, and it lacked both weight and power in this respect; however the bass quality was quite clean at moderate levels. Some 'boxiness' and 'nasality' were evident, and the frequency balance was slightly hard, although not unduly so for simple instrument comparisons.

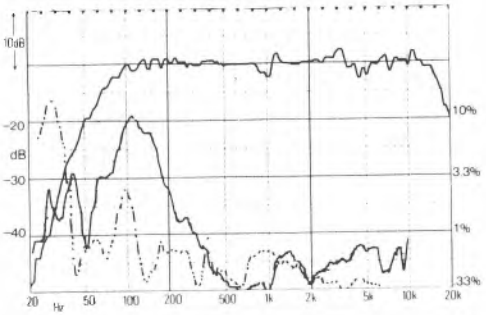
Results were poorer for the stereo sessions with an 'average' rating indicated overall; reasonable at the price but not as good as for the *Mk I*. Stereo imaging showed restricted depth and distortions of distance or ranging, while the subjective balance reflected a 'hard', almost 'metallic' quality in the presence range, which brought the sounds too close to permit the stereo depth impression to develop. Lateral source precision was quite good, while clarity was to a high order, but some bass loss was apparent on familiar programme.

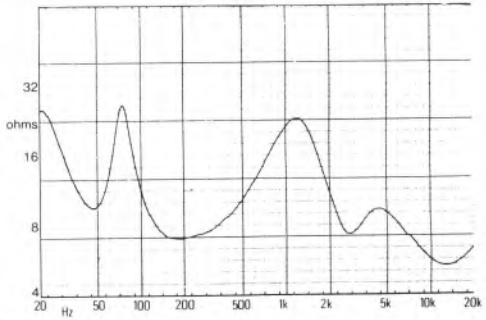
Summary
Chartwell have produced a relatively compact system of uniform frequency response, low apparent coloration and good clarity. The maximum sound level was very good for the box size while stereo imaging was reasonably good and distortion satisfactory, with the engineering and construction both excellent. It proved easy to drive, had reasonable sensitivity, and was not too critical of listening axis.

However the test results were distinctly poorer on sound quality than for its predecessor, which may have exhibited higher levels of coloration but also possessed a more natural frequency balance and perspective. The *110* is nonetheless reasonable value, and is worthy of consideration.

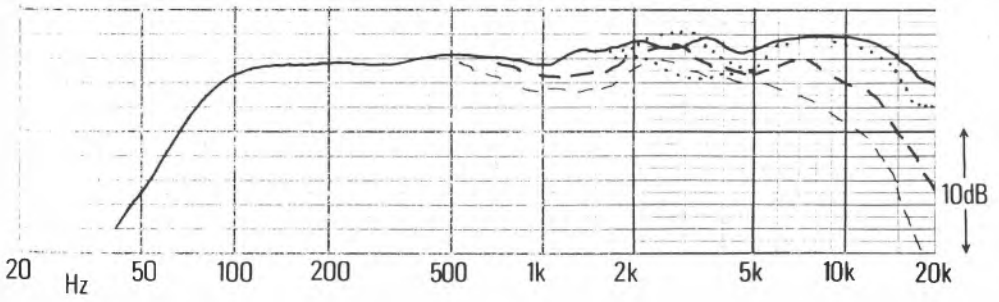
Update
We have been informed by Chartwell that since last year the *PM110 II* has been improved by the substitution of a better version of the tweeter and by a subtle profile change to the bass-mid driver cone, the latter resulting in a smoother presence range. Cabinet improvements have also been carried out, but we were not able to audition new samples.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).





Size	48(18) H; 29(9) W; 21(8) D: cm(inches)
Weight	7.5(16.5) kg(lbs)
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 ±3dB (2m)	80Hz to 16kHz
Low frequency rolloff (−6dB) at (1m)	63Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms)	86dB/W
Approximate maximum sound level (pair at 2 metres)	102dBA
Distortion (96dB at 1 metre)	good
Distortion (100W peak)	good
Impedance characteristic (ease of drive)	average
Forward response uniformity	very good
Typical price per pair inc VAT	£185



BEST BUY

Chartwell/Rogers PM310

Swisstone Electronics Ltd., 4–14 Barmeston Road, London ASE6 3BN. Tel 01-697 8511

Provisionally launched as the *PM210 II*, which in the light of earlier and similarly named models only served to confuse the public, this new speaker has been renamed the *PM310* and in fact replaces the *200/210* series. Despite interim inflation the price has been kept down, so in real terms the *310* might be considered some 30% cheaper than its predecessors.

Essentially a compact two-way reflexed design of conventional proportions, the internal volume is estimated at 32 litres, and is ported by a 14cm long duct with an exit diameter of 6.2cm. Constructed of the new *Medite* panel material, in this instance 12mm thick, the carcase walls are bitumen clad and lined with acoustic foam. The entire cabinet is finished in a quality teak veneer, and as with other Chartwell models, small rubber anti-slip feet are also fitted.

The main driver is a 200mm bass/mid unit made by Chartwell themselves; it is fitted with a sizeable magnet assembly built on a cast alloy frame. A polypropylene cone is used with a nitrile-based high termination surround. To take over above 3kHz is a 25mm soft-dome Audax tweeter. The complex and high quality crossover comprises a total of 12 elements including a few control resistors.

Chartwell rate the system at 300W peak programme, which I feel is too generous, since the low frequency performance was not at its best above 100–150W; 100W per channel is probably a sensible maximum, even though the system will survive more without damage.

Lab performance

This review was based on an early pair of *310*s which were subsequently supplanted by production models; the dotted line on the axial reference curve relates to the second pair.

A touch of 'BBC Monitor downtilt' is evident on the axial response, with a mildly depressed midband following the bass region (similar to the *Studio* and *BC1* balances). The first samples were further depressed from 2–6kHz, but this has been largely corrected with the second pair. The sensitivity was 86dB/W, an average figure marginally below spec., and the bass extension was also average at 47Hz, –6dB. We achieved +/3dB response amplitude limits from 58Hz to 16kHz, which is good, but the +/–2.5dB which Chartwell claim was clearly a trifle optimistic.

With ⅓-octave analysis at 2m, the response trends resolve into a mild bass hump at 110Hz, a couple of dB above the mean level. A prominence is also present in the upper treble at 14kHz (a frequently encountered defect with this tweeter), but the off-axis curves show promising integration.

The impedance dipped to just below 6 ohms, 200 Hz, but on average measured 10 ohms, so the speaker just attains a 'good' rating for amplifier load.

In contrast to the *PM155* distortion results were fine, falling off-scale above 500Hz at 90dB and with only a trace of 2nd harmonic at 13kHz. At 96dB the 2nd and 3rd order effects averaged 1–2% between 40Hz and 300Hz, and reduced in proportion with decreasing power level. At a 100W pulsed input both test frequencies were handled with negligible compression, distortion measuring 1.5% 2nd and 2.5% 3rd at 500Hz, and 0.7% 2nd and 1.3% 3rd at 5kHz. A 100W maximum input resulted in a satisfactory 101dBA maximum level, and 20W should be sufficient for good levels in smaller rooms.

Inspection of the room averaged response suggests a good balance above 200Hz, but with a degree of bass excess below this frequency,

rising to a 6dB maximum in the 60–80Hz range, and decaying rapidly below 50Hz.

Sound quality

Based on the second production pair, results were consistently good on both the live comparison and the stereo sessions. On the live tests, the bass was judged somewhat 'lumpy' with a reasonable extension, but with a 'softness' and lack of definition in the upper range. Overall there was evidence of some 'boxy' coloration and a touch of sibilance, together with an 'edginess' in the extreme treble.

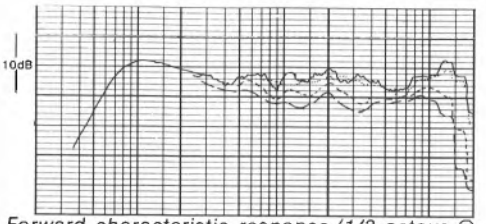
On the stereo prgramme the imaging was undoubtedly good, with superior depth, particularly when compared with this speaker's predecessor the *PM210*. The sound was notably detailed with good transparency, but it could have sounded 'smoother', and some coloration was still audible – a trace of 'plummy chestiness', a lack of bass clarity and some 'zing' and 'fizz' in the treble.

Summary

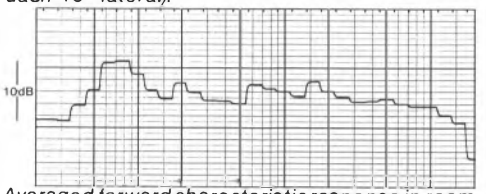
Criticisms apart, this speaker has performed well for its quoted price. Scoring was consistently high, the general quality of finish and engineering very good, and distortion levels were low. It has however some idiosyncracies and should be auditioned carefully before purchase. But the general standard set by this all-rounder nevertheless qualifies it for Best Buy rating.

GENERAL DATA

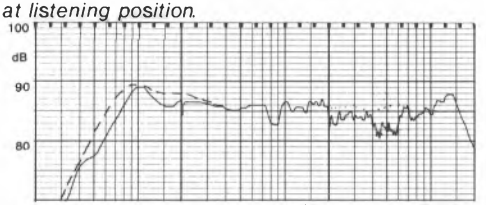
Size (h x w x d)	56.5 x 27.5 x 28cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–100W
Recommended placement	open stand
Frequency response within ± 3dB (2m)	58Hz to 16kHz
Low frequency rolloff (–6dB) at 1m	47Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	86dB/W
Approximate maximum sound level (pair at 2m)	101dBA
Impedance characteristic (ease of drive)	good
Forward response uniformity	very good
Typical price per pair inc VAT	£250



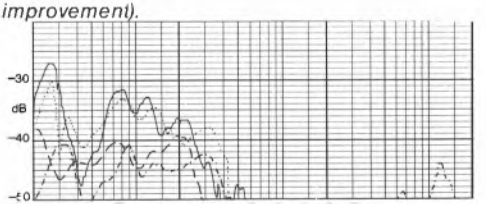
Forward characteristic response (1/3-octave @ 2m. dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



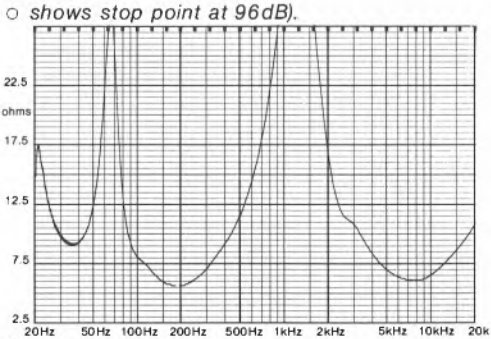
Averaged forward characteristic response in room at listening position.



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



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



Impedance (mod Z).

Dean Mini-Monitor

Dean, 40 The Maltings, Stansted Abbotts, nr. Ware, Herts. SG12 8HG. Tel (0920) 870881

This product comes from a young British company, and is one of a range of three. Not the least expensive, it is however the smallest, and its title suggests that it has some aspirations to a neutral balance and low coloration levels. The system is certainly very compact, with a 9 litre internal volume reflex-loaded by two small ducted ports, 3cm in diameter and 13.5cm in length. However these are plugged by BAF wadding at their inner extremity, so that the cabinet resonance failed to show at all on the impedance curve, and hence to all intents and purposes the model will behave as a sealed box system, with a main driver resonance at 64Hz.

Bass/mid range is handled by a heavy bextrene-coned 16cm driver built in a steel frame, and the treble by a 25mm soft-dome fabric tweeter, both units made by Audax. The electrical crossover comprises 8 elements including 3 resistors, with evidence of good component quality. The enclosure is built of thick chipboard panels, and is finely finished and veneered in American walnut. The many constructional details include the use of bituminous panel cladding to reduce panel resonance, plus a thick acoustic foam lining and fibre volume filling; the grille is well chamfered to reduce diffraction effects.

Dean specify the system as a low efficiency model, with a suggested amplifier power range of 30–70W per channel, which is close to our recommendation of 50–100W. They also suggest stand- or wall-mounting for the best results, but we would dispute the latter.

Lab performance

The axial sinewave response (dotted) showed a disturbing phase notch at the crossover point, which improved dramatically when the microphone was moved to or slightly above the tweeter position. The implication is that a fairly low stand should be used, with the listener's ear level at or a little above the top of the speaker. In the optimum position the response fell within +/−4dB limits, 54Hz–20kHz. Sensitivity was indeed low at 81dB/W (one of the least sensitive tested), while correspondingly the bass was fairly extended for the size at −6dB, 55Hz.

In ⅓-octave bands measured at 2m the 3.3kHz notch was consistent on all lateral axes in the 0° vertical plane, but would improve steadily as the optimum 10–15° above axis position is reached. While the losses off-axis were generally low, the lumpy characteristic held the value judgement to just 'good'.

The speaker presented a very good amplifier load, with an average impedance of 8–10 ohms (fortunate in view of the sensitivity). But it did not do as well on distortion, measuring a typical 1% throughout at 90dB and rather higher at 96dB, when one bass unit expired. (As these were ex-dem models it is possible that some prior damage may have contributed to the failure. On 100W pulses, 3.8% 2nd and 0.25% 3rd harmonic distortions were measured at 500Hz, with negligible compression; at 5kHz compression was rather higher at 1.3dB, with 2.7% 2nd and 0.6% 3rd harmonic.

Assessed by ⅓-octave averaging in the listening room, the 3kHz notch was still present to some extent, with the overall trend showing a gently falling characteristic from 60Hz to 10kHz, suggesting that the overall sound might be a little too 'rich'.

Sound quality

The scoring was reasonably good on the live sound comparisons, though some coloration

was noted including 'boxy', 'nasal', 'dulled', 'rich' and 'tubby' effects. The system lacked 'bite' and 'sparkle', with the bass too 'rich' and imprecise, though a reasonable peak power handling of up to 100W was demonstrated.

On the stereo sessions the results were disappointing. Some bass extension was evident, but the output sounded a little 'bumpy', and lacked detail. The overall balance tended to 'richness', with a loss of transparency and presence, but the upper treble showed some 'sizzle' and emphasis of hiss. The stereo presentation was unexceptional, the lack of natural attack lending a rather distant and 'unfocused' quality.

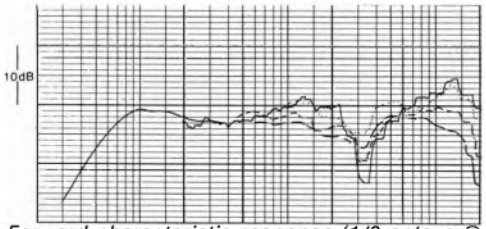
Summary

The *Mini Monitor* is an honest attempt at the quality miniature market, and has many of the right ingredients. Unfortunately the need for better crossover control and integration, improved sensitivity and distortion levels, and a higher than 96dBA maximum level all conspire to render it uncompetitive. Furthermore, the bass register lacks the power and authority expected in this price range.

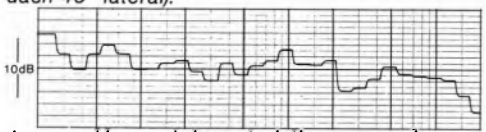
With better drivers, Dean may well be able to produce a good speaker. But given the strength of present competition, the *Mini Monitor* cannot be recommended.

GENERAL DATA

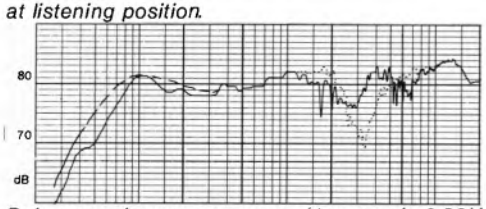
Size (h x w x d)	36.5 x 21.5 x 20.5cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(50)–100W
Recommended placement	open stand
Frequency response within ± 3dB (2m)	see text
Low frequency rolloff (–6dB) at 1m	55Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	81dB/W
Approximate maximum sound level (pair at 2m)	96dBA
Impedance characteristic (ease of drive)	very good
Forward response uniformity	good above axis
Typical price per pair inc VAT	£179



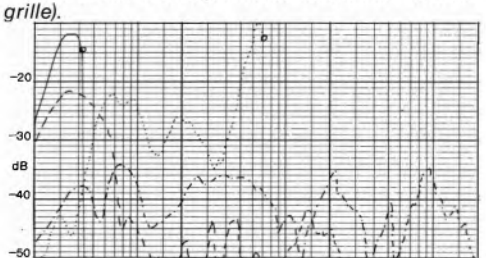
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



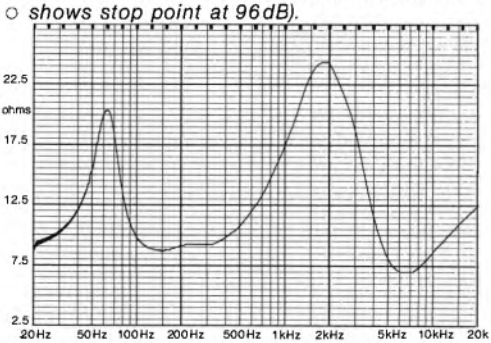
Averaged forward characteristic response in room at listening position.



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



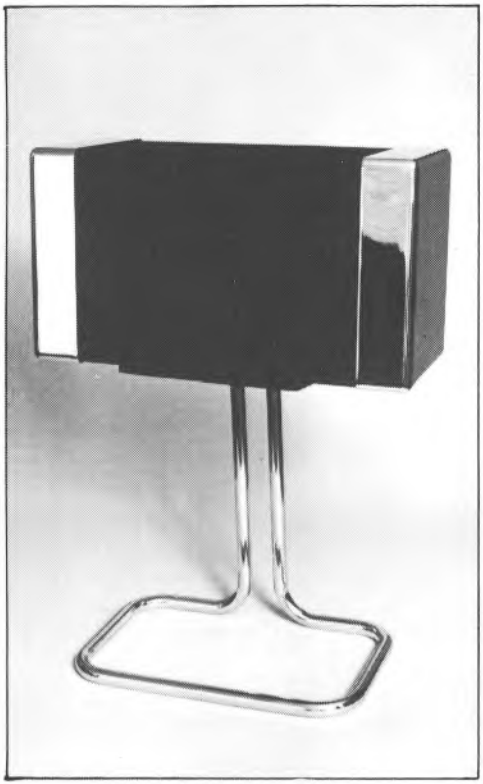
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod Z).

Gale GS401A

D.W. Labs Ltd., 88–90 Gray's Inn Road, London WC1X 8AA
Tel 01-404 5140



On sale for a number of years now, the Gale speaker is distinguished by its unusual horizontal format. The best-known version is finished in black with substantial rounded chrome end caps, but more recently a wood veneered alternative has been made available to suit conventional room interiors. The speaker still carries the name of the original founder of the Company, though this is now owned by D.W. Labs.

The driver array is a complex one. The mid and HF units are centrally placed above each other, while the bass units are mounted on the horizontal axis on each side of the centre, and comprise two 8 ohm 200mm pulp cone units connected in parallel. Fitted with its own cast rear chamber, the Peerless 100mm pulp cone unit is used for the midrange. nominally 475Hz to 5kHz, while the established Celestion *HF2000* tweeter covers the remaining high frequencies. The nine-element crossover (excluding resistors and fuses) possesses a 12dB/octave slope and carries a high power rating. The enclosure has an internal volume of 40 litres and is a sealed box design with undamped chipboard walls, but it does have some bracing as well as a dense fibreglass filling.

Lab results

The pair matching was reasonable with ±1dB imbalances to 6kHz, but up to a 2dB error thereafter. The lab sensitivity was above average at 88dB but this was compromised by the impedance which was rated as a 'poor' amplifier load. With the controls flat it dipped to 3.5 ohms 15kHz, 4.4 ohms 100Hz and typically measured 5 ohms. Phase shifts were however low and generally better than 25°. In power terms the sensitivity is some 3dB lower than our reading indicates, and the choice of amplifier must take account of the difficult load. The rolloff at low frequencies was quite gradual with a nominal −6dB cutoff at50Hz, but with useful output below this.

The on-axis sinewave response was not too promising considering the price, with ±5dB required to accommodate the peak-to-trough excursions. Distortion levels at 96dB were however low and the speaker rated as 'excellent' on the clean midband performance. Driven by 100W (8 ohm) pulse, it was fine at 500Hz but suffered a 0.4dB compression at 5kHz, with a 3% third harmonic content; in view of its impedance however, this input was actually nearer 200W so this result is perhaps not too important. The output was smoother in the ⅓-octave characteristic responses but still showed an elevated midrange, and not unexpectedly the great horizontal breadth gave weak lateral off-axis overall results; the dispersion was just about average and did not promise a good stereo performance.

Sound quality

In mono comparisons with live sounds the *401* scored well and was considered good on transients, possessing a 'lively', 'forward' effect, albeit with some unevenness in the midrange. The bass power handling was quite good (35W average 150W peak) with pleasing depth and evenness.

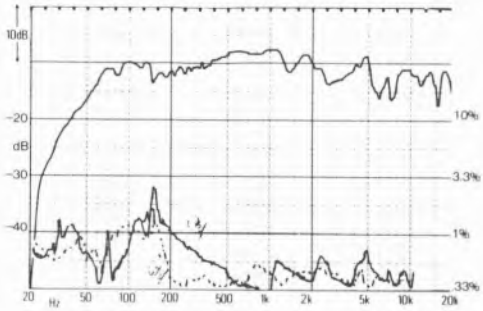
Conversely on the stereo tests the image quality was rated only 'average' with a lack of both depth and lateral precision. The performance was uneven, attracting widely divergent comments from the panelists, with some noting mild degrees of

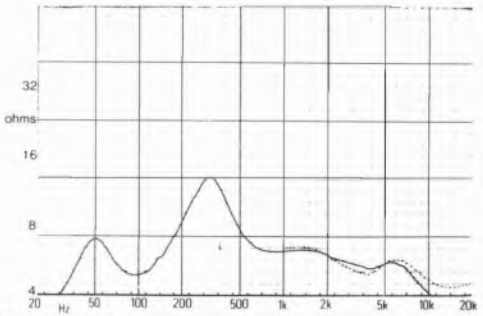
'fizz', 'hardness', 'nasality' and 'boxy' coloration. Despite the image problems, the overall sound quality was nonetheless 'good', and was approved by several listeners.

Summary

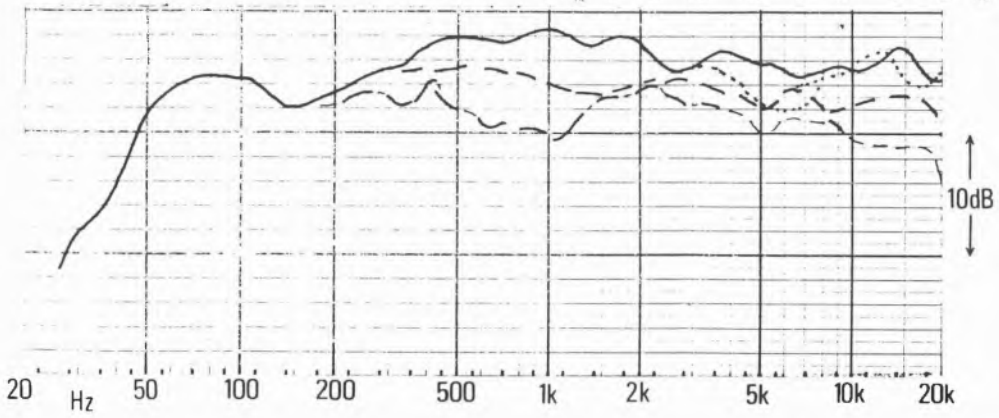
Rather expensive in terms of performance-*vs*-price, this speaker's inconsistent results indicate that some will love it and others reject it. I feel that the stereo weakness is a significant one, and it certainly affected its chances of a recommendation in this report, while the difficult amplifier loading is a further consideration. Nonetheless it is far from a write-off, and is worth considering, although a personal audition is imperative.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).





Size (H, W, D)	33, 60.5, 27 (13, 24, 10.6) cm(inches)
Weight	20 (44) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25–150W
Recommended placement	horizontal on open shelf or special stand
Frequency response within ±3dB (2m)	55Hz–20kHz
Low frequency rolloff (−6dB) at 1m	50Hz
Voltage sensitivity (ref 2.83V, *ie* 1 watt in 8 ohms) at 1m	88dB
Approximate maximum sound level (pair at 2m)	105dBA
Distortion (96dB at 1m)	excellent
Distortion (100W peak)	good
Impedance characteristic (ease of drive)	poor
Forward response uniformity	average
Typical price per pair inc VAT	£500 (chrome)



Grundig M1500

Grundig International Ltd., 40/42 Newlands Park, Sydenham, London SE26 5NQ
Tel 01-659 2468

Speakers made for the continental European market are not widely distributed in the UK, and in fact the *M1500* is the first Grundig model to be assessed in *Choice*. It turned out to be quite unconventional, particularly as regards the enclosure, which essentially comprises a sealed box of 26 litres volume made from two very rigid moulded plastic shells. Complex curved shapes are used, as well as a contoured low diffraction driver baffle which would be costly to realise in conventional wood panels. The mouldings are made of a dense structural foam with good acoustic properties.

The enclosure has a sprayed metallic-grey finish which complements the detachable grille. The three drivers used include a 205mm straight-side pulp bass cone, a 45mm soft dome upper mid and a 19mm soft dome tweeter. Unfortunately the mid and treble units are laterally disposed which can upset the dispersion symmetry in the lateral plane, and hence impair stereo image stability. The crossover is relatively simple, comprising just eight elements.

Lab results

The pair matching was quite good with the low profile grille producing few aberrations. Lab sensitivity measured an above average 89dB/W, but account must be taken of the poor amplifier load presented: typically 5 ohms, it dipped to less than 4 ohms at 100Hz, although the phase angle was kept to low levels of less than 25°. The system resonance was placed at 55Hz, resulting in a −6dB system rolloff of 50Hz.

The 1m on-axis sinewave response was encouragingly uniform and well balanced. The ⅓-octave characteristic at 2m confirmed the trend, but also revealed that the off-axis output was rather untidy, and worse still, asymmetric from left to right (both lateral axes are plotted on the graph).

Aside from a small peak of 3rd harmonic distortion at 600Hz, the results at a 96dB sound level were good, with effective control at low frequencies. Pulsed by 100W equivalent 8 ohms (but as far as the Grundig was concerned nearer 200W), a moderate compression was recorded but with little extra distortion, the results being −0.3dB, 500Hz and −0.2dB, 5kHz. Suited to amplifiers in the 15–100W range, a reasonable 103dBA maximum sound level was possible.

Sound quality

Scoring 'average' on the mono live sound comparisons, the coloration levels were reasonable with some 'chesty', 'hard' and 'sibilant' effects. The balance sounded rather 'light' and 'thin' while bass power handling was not very great, distortion becoming audible at above 10W of bass guitar, with gross overload at 35W.

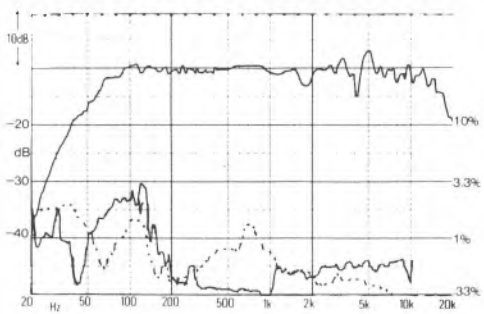
The stereo imaging definitely had problems, exhibiting a 'phasey' central focus and a perspective which varied strongly with listener position. I am sure that had the tweeter been mounted above the mid unit, better results would have been obtained; even so, the general sound quality on commercial programme was liked by the panel. Demonstrating a 'light' character, it sounded fairly smooth and 'open' with good rendition of detail.

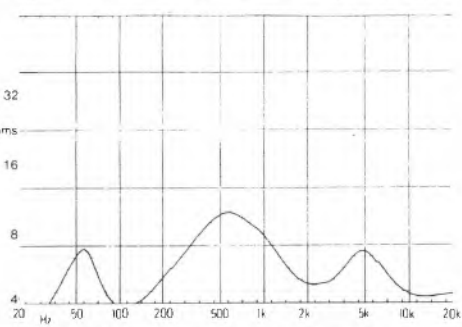
Summary

Despite the problems noted, this modern-looking

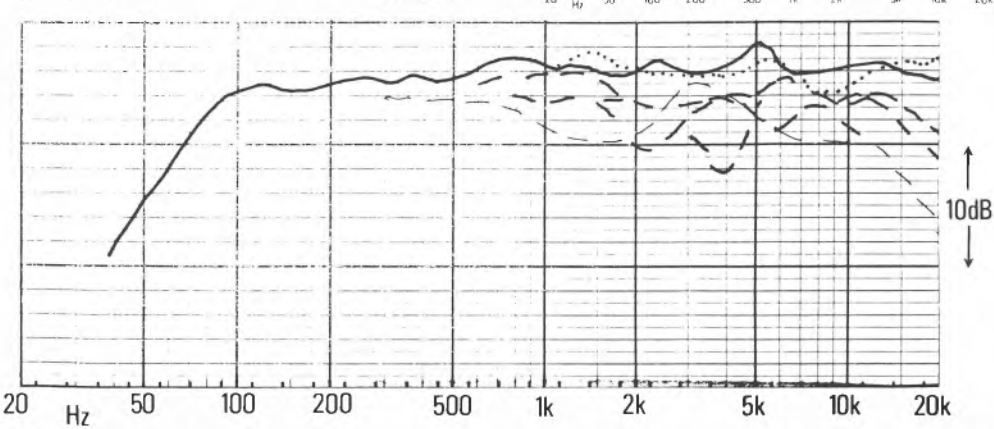
speaker was good enough to be worthy of consideration at its quoted price. Apparently a similar slightly larger model with the preferred vertical-in-line driver format is available, and perhaps this is also worth examining. If Grundig continue to build on the standard set by the *M1500* they could establish a significant foothold on the UK speaker market.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



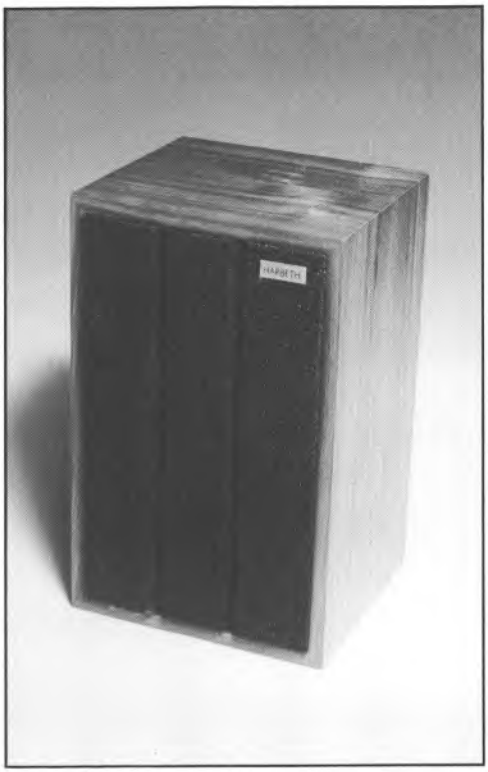


Size (H, W, D)	55, 29, 22 (22, 11.5, 8.7) cm(inches)
Weight	10 (22) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15–100W
Recommended placement	stand
Frequency response within ±3dB (2m)	75Hz-20kHz
Low frequency rolloff (−6dB) at 1m	50Hz
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m	89dB
Approximate maximum sound level (pair at 2m)	103dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	good
Impedance characteristic (ease of drive)	poor
Forward response uniformity	average
Typical price per pair inc VAT	£210



Harbeth ML

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



Harbeth's new model the *ML* is a miniature two-way sealed-box system of some 9 litres internal volume – a little larger than an *LS3/5A*. It has a tidy appearance and is finished in a fine quality real walnut veneer. The front panel is constructed from 12mm multi-ply, but the remainder of the carcase 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 700 Hz, while the range below this was stepped down by a further 4 dB from 500 Hz. In a slightly less extreme form such a characteristic might suggest a suitability for wall mounting. Furthermore the response above 4 kHz is rather uneven. Based on the upper range level, the sensitivity averaged 84 to 85 dB/W, which is below the mean for the group. The bass characteristic lacked extension, with the −6 dB point charted at 70 Hz, and though this would be augmented by a wall position, Harbeth suggest the use of open adjustable stands clear of walls.

The dip at 4 kHz 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 1.2 kHz to 4.5 kHz, plus another hump at 15 kHz, 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 2 kHz and reappearing above 6 kHz, although below 100 Hz the figures were better than average for such a small system. However on 100W peak input at 500 Hz it was not too happy, with 10% of 2nd harmonic and 1.5% of 3rd, though the compression at 0.2 dB was slight. At 5 kHz 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 96 dBA 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 highish 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 50Hz 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 goot detail. The bass register was both lacking in power and showed a restricted bandwidth.

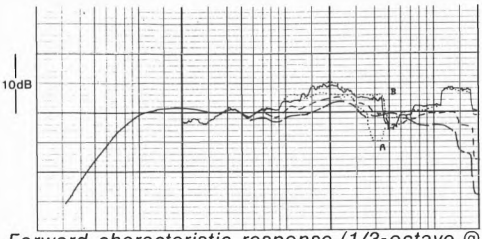
On the live comparisons the 'light' balance proved an advantage on the dominant percussive solo material, as is often the case. Nevertheless criticisms of a 'boxy' quality coupled with a 'zingy' treble were made, and the system often showed 'hardness' in the midrange.

Summary

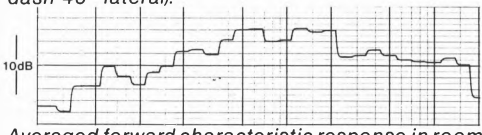
The performance of this new Harbeth does not justify recommendation. The system is comparatively expensive at £190.00 a pair, and does not compare favourably with the *3/5A*, which is more accurate, and broadly comparable in terms of size, price, power handling and bandwidth.

GENERAL DATA

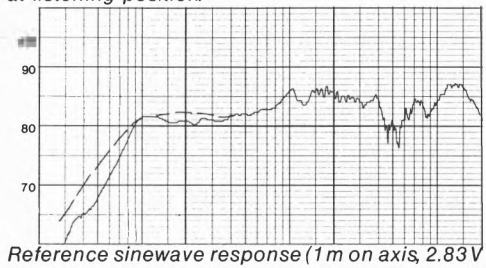
Size (h x w x d)	34.5 x 21.5 x 19.5cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–50W
Recommended placement	high stand or open shelf
Frequency response within ± 3dB (2m)	90Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	70Hz
Voltage sensitivity (ref 2.83V, *ie*: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



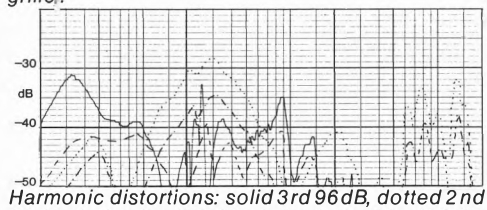
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



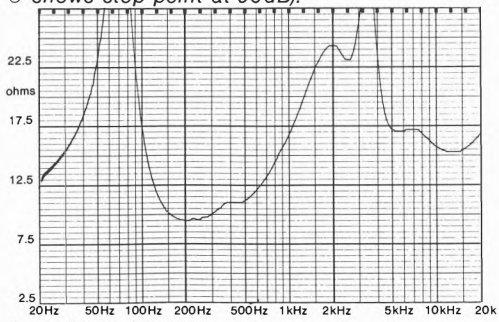
Averaged forward characteristic response in room at listening position.



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, ○ shows stop point at 96dB).



Impedance (mod Z).

"A revelation... dynamic, uncoloured and extremely coherent."

Popular Hi Fi

Reviewing the AR 38s, *Hi Fi for Pleasure* says, "For around £160, I consider the AR 38s to be well worthy of recommendation." Reviewing the AR 18s, the same magazine concludes "they are not just recommendable – they are deserving of an enthusiastic recommendation." And *Practical Hi Fi* says the AR 18s "will not find itself out of its depth whatever the system." Hear for yourself at your AR dealer. *Popular Hi Fi* on the AR 925, October, 1981. *Hi Fi for Pleasure*, July, 1981. *Practical Hi Fi*, June, 1981.

AR Hear what you've been missing.

TELEDYNE ACOUSTIC RESEARCH. Write for information and authorized dealer locations. High Street, Houghton Regis, Dunstable, Bedfordshire LU5 5QJ, England. 10 American Drive, Norwood, MA 02062, USA. A.C. Simmonds and Sons, Ltd., 975 Dillingham Road, Pickering, Ontario, Canada L1W-3B2. W.C. Wedderspoon Pty. Ltd., P.O. Box 3-5, Ford Street, Greenacre 2190, New South Wales, Australia.

AIWA - - ARISTON - - B & W - - CHARTWELL -

- CELESTION - - DIESIS - - KEF - - HITACHI - - SANSUI - - OPTONICA -

- DUAL - - SHURE - - GLANZ - - ORTOFON - - SENNHEISER - - ELITE -

(0689)
27944
119 HIGH ST
ORPINGTON
KENT

ORPINGTON HI-FI

A JOHN MARLEY HIFI CENTRE

JUST A FEW OF OUR BEST BUYS.....

FREE STANDS AVAILABLE ON COMPLETE SYSTEMS.

CAPRICE II
149-90

KEF 1054

CODA II
79-90

ALL OF WHICH ARE ON DEM.

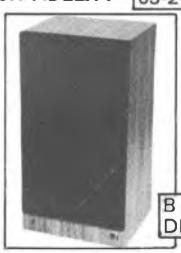
KEF THE SPEAKER ENGINEERS

STUDIO I
£325.00

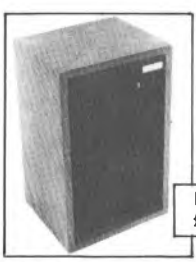
Rogers
BRITISH HIGH-FIDELITY

KEF
REFERENCE
03-2 £249.00

B & W
DM10



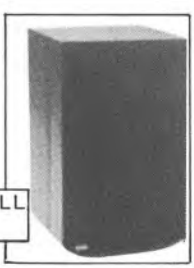
B & W
DM12



LS35A
£195.00

ON ALL OUR LOUDSPEAKERS WE GIVE 7 DAY EXCHANGE IN CASE THEY DON'T SUIT YOUR ROOM.

CHARTWELL
PM310



UP TO £1000 INSTANT CREDIT – 2 YEAR GUARANTEE PARTS & LABOUR

OTHER JOHN MARLEY HIFI CENTRES

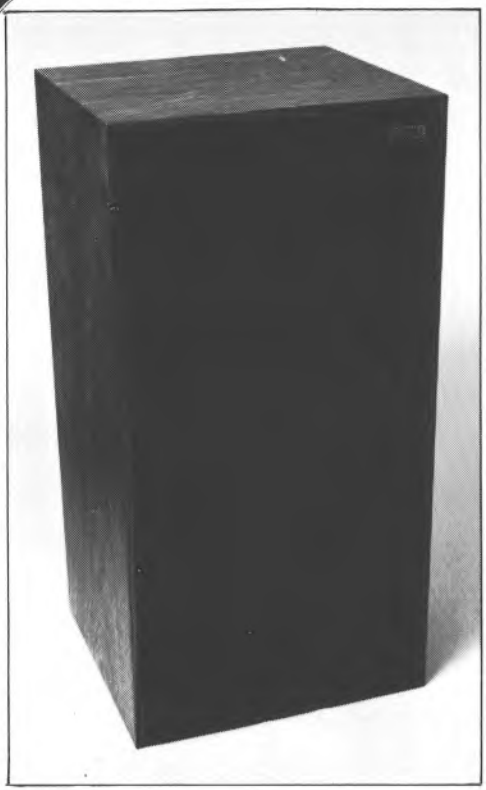
MAIDSTONE HIFI	DOVER HIFI	WESTGATE HIFI
77 KING ST	43 HIGH ST	2 STATION RD WEST
MAIDSTONE	DOVER	CANTERBURY
KENT	KENT	KENT
0622-61882	0304-207562	0226-69329

ROSERS - - AKG - - TECHNICS - - PIONEER -

RECOMMENDED

Harbeth HL1 III

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



Since its introduction the *HL1* has been subject to small detailed improvements culminating in the latest Mk III version reviewed here. We experienced some quality control and consistency problems with earlier models, but happily these now seem to be behind the company, with current review samples showing good matching and agreement with the designer's target specification. In particular, recent improvements have concerned the need for greater low frequency power handling.

A 50 litre enclosure reflex tuned by a large 62mm diameter tunnel port, the cabinet is of thin wall high quality veneered plywood, with bituminous panel damping and extensive seam 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 ±3dB limits, 55Hz–18kHz. Third harmonic distortion levels were also very well controlled at 96dB, typically measuring 0.5% or better above 150Hz. The less annoying second harmonic content peaked at 8% around 100Hz, and this might be audible on sustained bass notes. The system fared less well on a diet of 100W pulses despite the low 2Hz repetition rate. Although perfect at 500Hz, a +0.3dB expansion occurred at 5kHz generating 5% of second and 1.8% of third harmonic distortion. Crossover saturation is the probable cause at this equivalent 100W programme level.

Examining the forward ⅓-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

Harbeth HL1 III

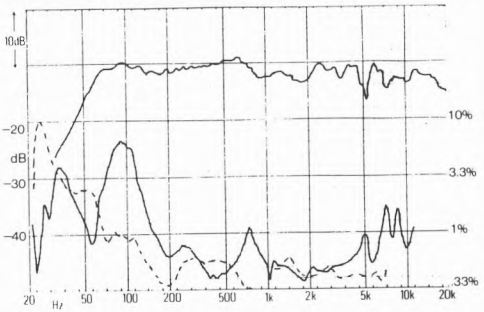
(revised and reprinted)

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 sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).

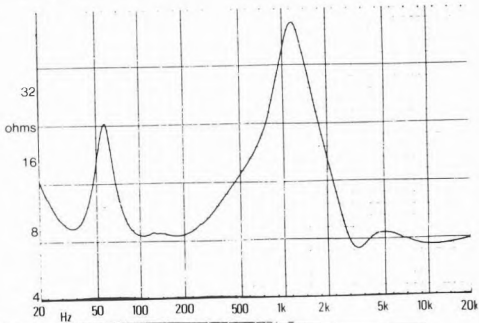
Summary

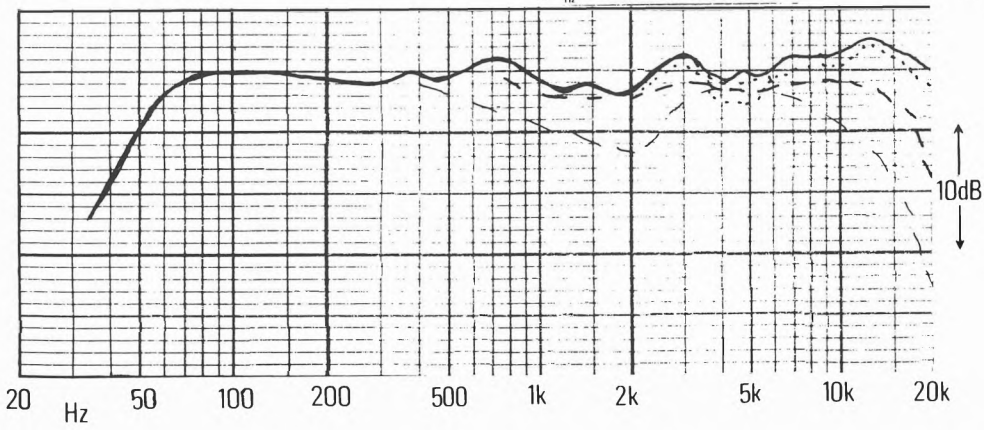
The standards of clarity and workmanship together with the low levels of coloration set this speaker apart from the common crowd, and it continues to maintain its position in the recommended listings. Possessing a fine overall sound quality, it offered an easy to drive impedance and above average sensitivity.



Size	63.5(25) H; 32.5(13) W; 30.5(12) d: cm(inches)
Weight	13.5(30) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15-100W
Recommended placement	on stands away from walls
Frequency response within ±3dB (2m)	63Hz to 18kHz
Low frequency rolloff (−6dB) at (1m)	46Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	87dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	102dBA
Third harmonic distortion (96dB at 1 metre)	v. good 65Hz–2%, 100Hz–1%, 200Hz–0.2%, 500Hz–0.35%, typically 0.3%
Impedance characteristic (ease of drive)	good
Forward response uniformity	v. good
Typical price per pair	£395

*Check text

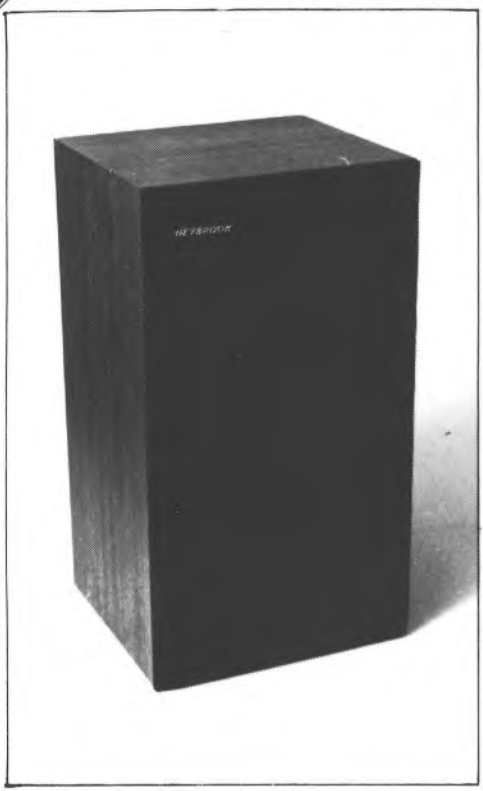




RECOMMENDED

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 0.5 m 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 ±4dB were required to contain the sinewave response which was otherwise reasonably uniform.

Subjected to ⅓-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

Heybrook HB2

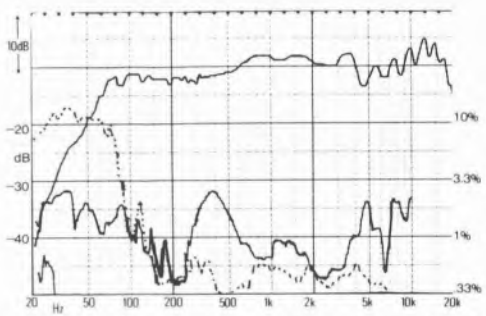
(revised and reprinted)

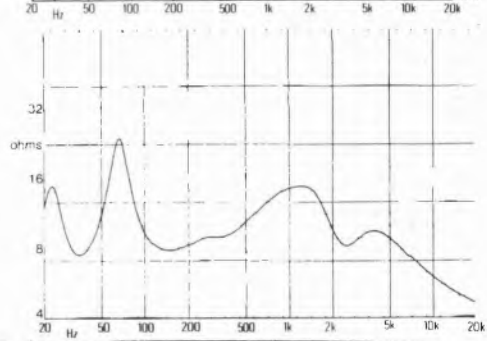
the speaker was not driven too hard, and the balance tended to openness with light sibilance, but in a smooth and acceptable manner.

Summary

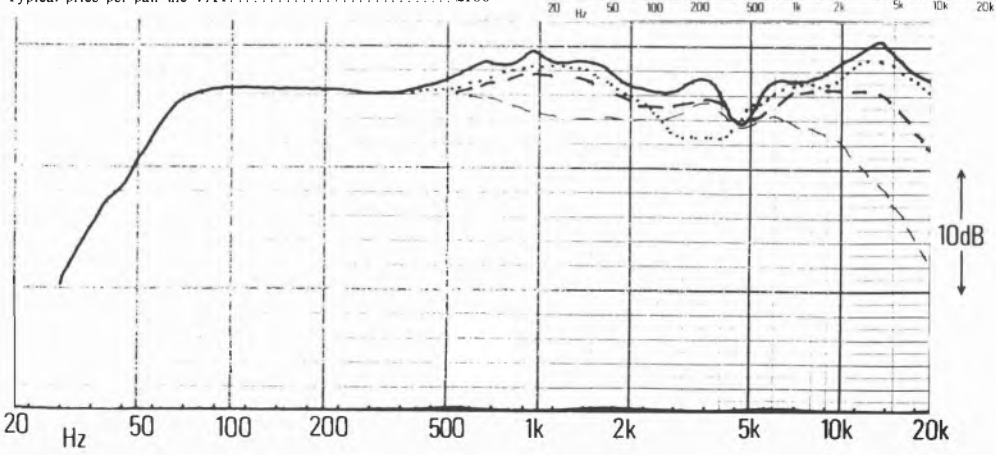
Although possessing a restricted maximum level and power handling, the *HB2* was a refined low coloration performer of compact dimensions. It gave a good overall sound quality as well as a consistent character throughout the frequency range, and is undoubtedly worthy of recommendation. This was Heybook's 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 (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-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 ±3dB (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	£180



RECOMMENDED

Heybrook HB3

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

The *HB3* has been available for some time now in different development stages, all showing good potential so far. Two pairs were in fact supplied for this review, and the first were fully measured before Heybrook contacted me explaining that, while these incorporated a late improvement to the subjective performance, in fact the lab results would be suspect, as indeed they were. With some burning of the midnight oil Heybrook re-submitted in time for the listening sessions a version hopefully satisfying both subjective and objective test standards; where possible the test results have been updated.

A sturdy three-way system of some 37 litres bass enclosure capacity, the *HB3* is built to a standard reflecting great attention to constructional detail and finish. A light oak veneer on the carcase contrasts with the two contoured foam grilles, which are separated by a horizontal alloy bar. The enclosure is rigidly constructed of 18mm chipboard, and is double-braced by a full circumferential section and a heavy duty pvc cylinder from front to back, the latter forming the midrange rear cavity. Substantial bitumen cladding is used for internal panel damping, and the interior is lined with absorptive foam; the mid cavity uses wool as well. Intended for mounting near to a rear wall, special floor stands are supplied complete with self adhesive fixings.

The three drivers are all SEAS units, comprising a shallow-flare 250mm bass and 100mm midrange, both with doped-pulp cones, and a 20mm plastic dome tweeter. A vertical-in-line driver array is used, with the 'line' offset on the baffle to generate a directivity pattern which should improve stereo when wall-mounted. The substantial and good quality crossover is rather inaccessibly located on the inside upper surface of the cabinet top, and heavy duty wiring is used throughout. Allen bolts secure the drivers, on whose tightness Heybrook lay great emphasis, but in fact on our samples the bass units had been secured so firmly that it was beginning to crack the front frame edge.

Lab performance

On the axial reference curve taken at 1 m we have a glimpse (dotted) of the output from the first pair; the solid line is that generated by the second samples. The step down below 500Hz is intentional, and relates to taking account of the energy transition/augmentation resulting from near to wall mounting. The upper band was well behaved, meeting +/−2.5dB limits 300Hz–16kHz, and the reference sensitivity was a little above average at 88.5dB/W. The system resonance lay at 50Hz, providing a −6dB rolloff at 49Hz, which is not very extended for the enclosure size, though it will be somewhat improved near a wall (shown as an estimated dashed line in the characteristic response at 2m). Whilst in the main the off-axis curves are pretty uniform, a phasing effect is seen on the 15° above (dotted) curve, suggesting that the driver integration was imperfect in this region and that the listener should not be above the axis of the treble unit.

Classed as a 'difficult' load requiring a tolerant power amp, a 3.5ohm dip was recorded at 1kHz, with an average impedance of 5 ohms; this will compromise the sensitivity somewhat.

Using 100W peak input at 500Hz, the *HB3* was close to overload with a noticeable 0.3dB expansion, plus 5.0% of 3rd and 1.2% of 2nd order distortions; 5kHz resulted in no problems however, with 1.2% of 2nd and 0.25% of 3rd; and the steady state distortion results were also satisfactory. (Although the graph looks unpromising,

in the main it is composed of relatively harmless 2nd harmonic.)

Two room responses were generated, wall mounted as directed, and one on slightly higher stands in free space. More bass is undoubtedly generated at 60 Hz on the wall, but I do not regard the overall result as superior, as the wall-generated irregularities are quite strong over several octaves from 80 Hz to 1 kHz. Positioned in open space, a mild loss of bass was present, but this proved to be less of a disadvantage in our location.

Sound quality

While not top-ranked, the *HB3* did consistently well on all the listening tests when open-stand sited. Low frequency reproduction was not its strongest point, and although it could sustain a massive peak input of close on 500 W, the bass seemed a trifle 'slow' but did possess some extension. On the live sessions the extreme treble appeared to lack 'sparkle', and the mid-range had a unique tonal character different to most other models, but plausible nonetheless. It also demonstrated a tendency to excessive 'openess' a well as a 'cold' slightly 'metallic' effect.

On the stereo sessions the image precision was fine, with good presentation in the lateral plane. Some depth loss was apparent partly because of the 'forward' presence range, but clarity was to a high standard, and despite the forwardness it reproduced a surprising amount of spatial ambience.

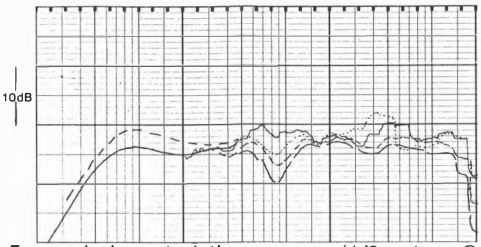
Located near to the wall, the sound was less coherent, the stereo lost some central focus and was spread over a wider area.

Summary

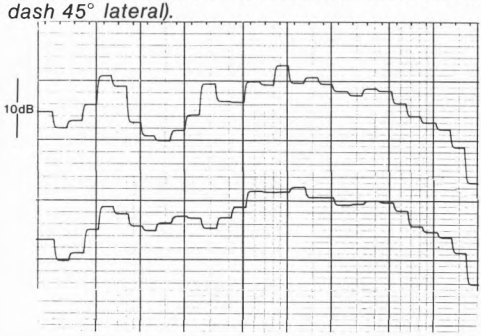
The *HB3* remains a promising loudspeaker which if fully refined could win many devotees. And despite the fairly high price and the problems encountered, the pair finally tested deserve a provisional recommendation on the basis of their performance. The matter of wall *versus* open-stand mounting still needs to be resolved, and an interested purchaser should keep an open mind about this, trying both and some intermediate compromises. He must also remember to match the *HB3* to a tolerant 4 ohm-capable amplifier.

GENERAL DATA

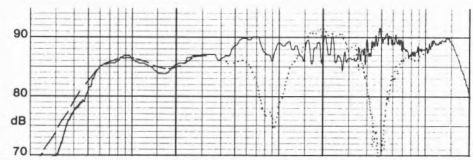
Size (h x w x d) ..... 62.5 x 33.5 x 31 cm
Recommended amplifier power per channel
(for 96 dBA per pair at 2 metres minimum) ..... (15)–200 W
Recommended placement ..... on supplied stand near rear wall
Frequency response within ± 3 dB (2 m) ..... 65 Hz to 16 kHz
Low frequency rolloff (–6 dB) at 1 m ..... 49 Hz
Voltage sensitivity
(ref 2.83 V, *ie*: 1 watt in 8 ohms) at 1 m ..... 88.5 dB/W
Approximate maximum sound level (pair at 2 m) ..... 106 dBA
Impedance characteristic (ease of drive) ..... difficult
Forward response uniformity ..... good
Typical price per pair inc VAT £380



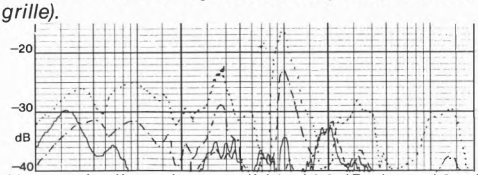
Forward characteristic response (1/3-octave @ 2 m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



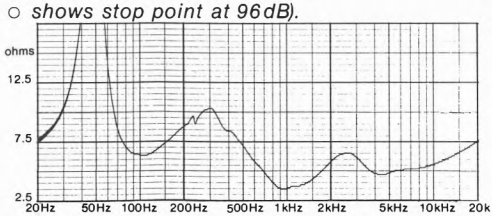
Averaged forward characteristic responses in room at listening position. Above against wall, below clear of boundaries.



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



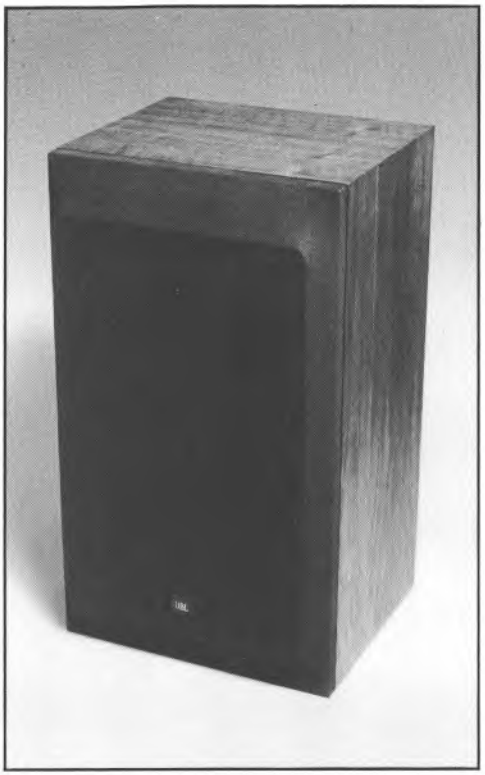
Harmonic distortions: solid 3rd 96 dB, dotted 2nd 96 dB, dashed 3rd 90 dB, chain-dashed 2nd 90 dB, ○ shows stop point at 96 dB).



Impedance (mod Z).

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 to 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.

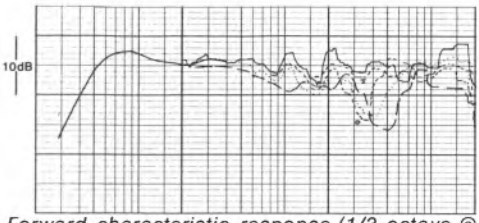
The panel was more impressed during the recorded sessions, awarding fairly good scores. The sound was liked for some measure of 'impact', clarity and overall balance, but was less well received than the *150*, particularly as regards stereo stability, precision and depth. The bass was also marginally 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

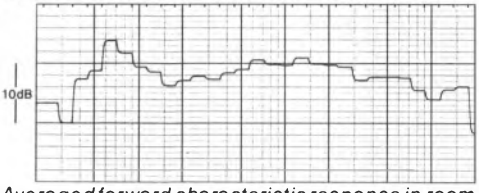
This is a finely made speaker offering a high dynamic range and above average bass, plus good sensitivity and fine sound on rock programme. However the overall quality suffers from directivity and moderate coloration problems, and cannot be recommended at the relatively high asking price. The *L112* 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

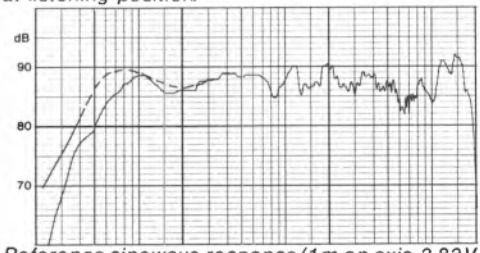
Size (h x w x d)	62 x 33 x 34cm
Weight	approx 22kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–400W
Recommended placement	open stand, clear of walls
Frequency response within ± 3dB (2m)	45Hz to 16kHz
Low frequency rolloff (−6dB) at 1m	43Hz
Voltage sensitivity (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



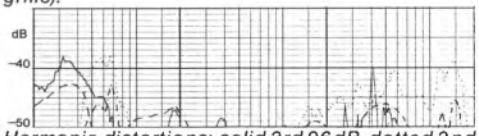
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



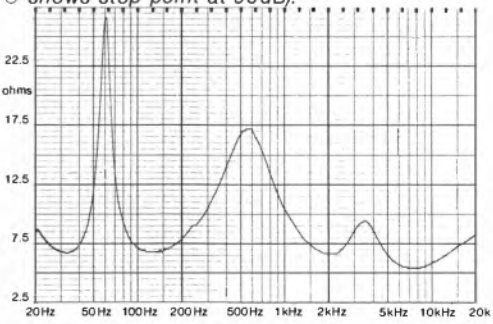
Averaged forward characteristic response in room at listening position.



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, ○ shows stop point at 96dB).

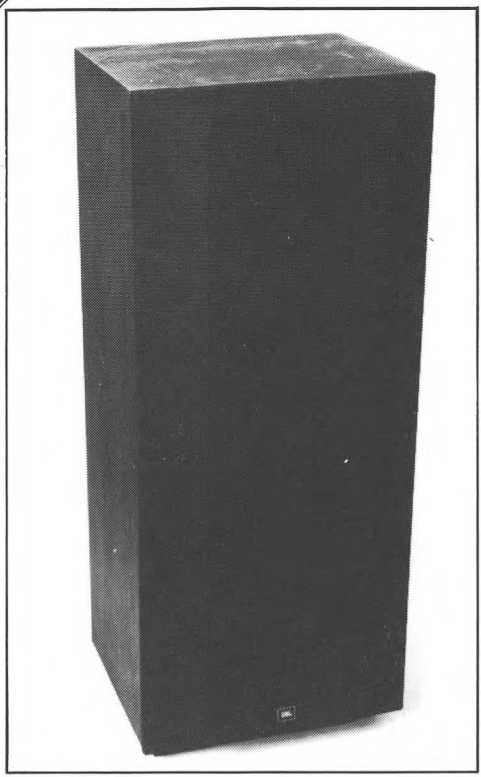


Impedance (mod 2).

RECOMMENDED

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.

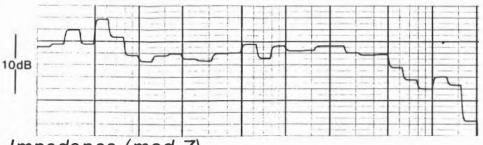
On stereo programme the speaker gave a 'big' sound, partly as a result of its physical height and its wide bandwidth. The bass was superbly clear and unusually extended, if slightly excessive, while 1000W of electric bass guitar was handled without knocking or distortion. Stereo imaging was to a good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

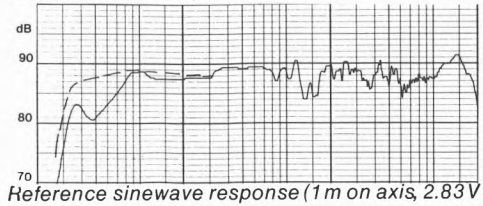
Continued refinements have helped to maintain the competitiveness of this model, and despite its high UK price it provides a sufficiently good standard of sound quality to deserve continued recommendation. Its particular merits include low distortion, a wide dynamic range and exceptional power handling,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

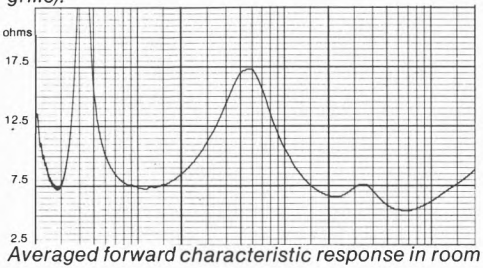
Size (h x w x d)	105.4 x 43 x 33cm
Weight	36kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–500W
Recommended placement	on floor clear of walls
Frequency response within ± 3dB (2m)	35Hz to 18kHz
Low frequency rolloff (–6dB) at 1m	32Hz
Voltage sensitivity (ref 2.83V,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



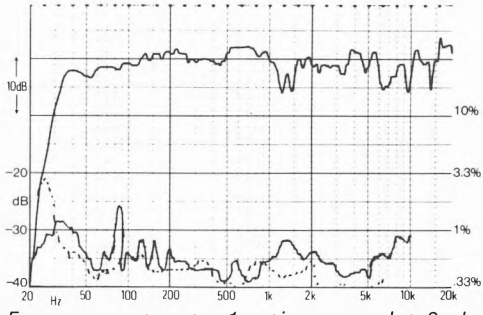
Impedance (mod Z).



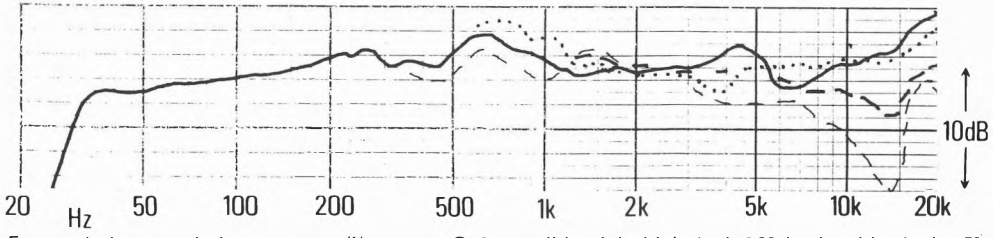
Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



Averaged forward characteristic response in room at listening position.



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



Forward characteristic response (⅓-octave @ 2m, solid axial, thick-dash 30° horiz., thin dash 45° horiz., dotted 15° vert.).

RECOMMENDED

JR 149 II

JR Loudspeakers Ltd., 114 Ashley Road, St. Albans, Herts. Tel (0727) 64337

Successfully established over a number of years now the *JR149* has now acquired a *Mk II* label brought about by a major redesign. Comprising a two-way sealed box design, the external appearance is virtually unchanged with the cylindrical rigid damped metal structure retained. A generous 5m of attached cable is also still provided, but the whole interior has been revised by its designer, Jim Rogers. The volume has been increased to 8 litres with better space utilisation, and the driver baffle is now a strengthened *Medite* panel with a more substantial internal tensioning bolt.

The original drivers were made by KEF, namely a 110mm Bextrene cone bass and 19mm plastic dome tweeter (the same lineup as for the *LS 3/5A*). These have been replaced by similarly dimensioned units from Focal and Scan, the former a bass driver fitted with a long throw Bextrene cone and massive magnet, and the latter a nominal 19mm doped fabric design (a version of the *D200* series similar to that used for the Linn *Kan* and *Isobarik* speakers).

The crossover is set nominally at 2.2kHz. The enclosure form guarantees minimal edge diffraction and in conjunction with the small driver sizes should result in excellent off-axis uniformity. The latest crossover in fact possesses a nominally improved power handling and uses fine quality components. The present resistor for adjusting the high frequency balance has been retained, the instructions allowing for user access to effect this.

Lab performance

Measured on sinewave at 1m, this speaker's output was remarkably uniform, recording +/−2dB from 68Hz to 15kHz and producing negligible bias or tilt. The sensitivity was low at 82–83dB/W for our pair, but with a −6dB point at 57Hz which is quite extended for the size of enclosure, and which derives from the system resonance at 63Hz.

As expected the characteristic response at 2m was quite remarkable, showing the most extraordinary uniformity and integration plus minimal off-axis loss or irregularity. On axis it met +/−1.3dB limits from 95Hz to 14kHz.

A mean impedance of 10 ohms was denoted, but because of a dip to 5.3ohms, 3kHz only an 'average' amplifier loading was indicated, though in fact this should pose no problems for the majority of amplifiers.

The speaker performed well on high level dynamics in the mid and treble, as shown by the results on the 100W pulsed input. At 500Hz 0.9dB of compression was measured but only 2.9% 2nd and 0.5% 3rd harmonic distortion. At 5kHz compression was negligible, with similar harmonic levels. Low in 3rd harmonic effects, the crossover was well clear of saturation.

On swept distortion 3rd harmonic was low even at 96dB (less than 1% above 150Hz), and most of the charted distortion was of the less important 2nd harmonic type, averaging 1% in the mid and treble and increasing proportionately at low frequencies. At 96dB 2nd order effects rose to 4.0% 200Hz and 11.0%, 100Hz which would be subjectively audible, and corresponded to a 25W continuous input.

The room response was of interest since it partly reflected the way in which such a small wide-dispersion speaker actually drives a room when stand mounted. It demonstrated an effect I have long suspected, namely that in acoustic terms a flat anechoic response is not necessarily correct for an acoustically small speaker. The balance was very good above 2kHz, but showed some excess mid energy due to the speaker's unusually wide dispersion in this range.

Sound quality

From a purely academic viewpoint I was eager to see whether the panel results would reflect the room or the test responses, particularly since the latter were so good; in the event the comments reflected a little bit of both.

The speaker was felt to be very smooth and well integrated with a 'sweet' and somewhat restrained treble, which correlates with both lab and room measurements. Despite its ability to take quite large power inputs without mechanical damage, the bass was a weak area, since the output lacked fundamentals and lost precision due to the highish harmonic distortion content at higher sound levels.

The speaker demonstrated a wide, stable and open stereo image with well developed bass depth for the price. But it could also sound a little 'boxy' and mid-biased on occasion, with a trace of 'dulling' and 'closed in' effects.

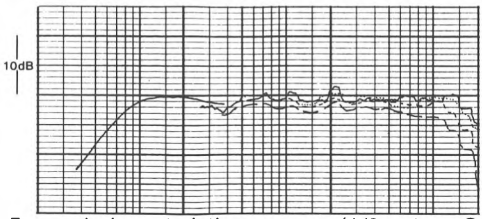
Summary

This speaker failed to excite the panel partly because of the restricted dynamics inevitably imposed by small drivers in small boxes. To its credit however it was appreciated for its general smoothness and neutrality, as well as exceptional stereo properties.

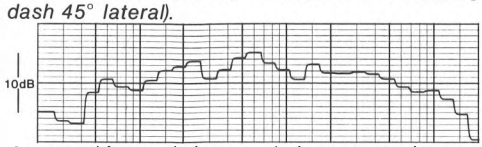
For the purchaser interested in an unusual looking model of generally good quality, suitable for moderate level reproduction (no more than reasonably loud symphonic levels), it is well worth trying, especially in view of the good construction and fine stereo. It presents an interesting alternative to the *LS3/5A*, and the performance certainly merits recommendation at a target price of £160.00 a pair.

GENERAL DATA

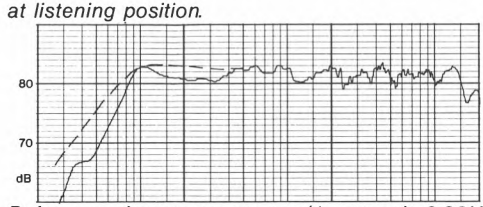
Size	38.5 x 23cm dia
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(30)–75W
Recommended placement	open stand
Frequency response within ± 3dB (2m)	73Hz to 16kHz
Low frequency rolloff (–6dB) at 1m	57Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	82dB/W
Approximate maximum sound level (pair at 2m)	94dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	excellent
Typical price per pair inc VAT	£165



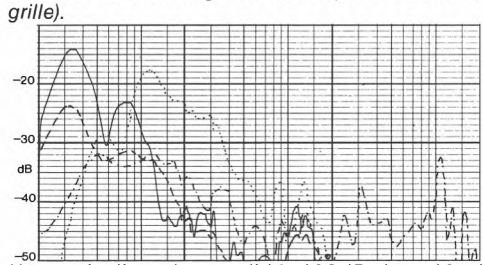
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



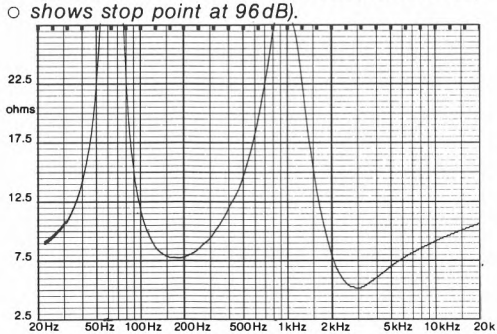
Averaged forward characteristic response in room at listening position.



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).

RECOMMENDED

JR Metro

JR Loudspeakers Ltd., 114 Ashley Road, St. Albans, Hertfordshire
Tel (0727) 64337

A true miniature speaker of just 5 litres internal volume, the new *Metro* designed by Jim Rogers is a stylish and beautifully presented example of its kind. Coming with a brown grille and matt *Nextel* cabinet finish in a matching colour, the inert sealed enclosure is made of a new resin fibre which possesses good resonance properties; bituminous damping and foam volume filling is also used. The internal construction is reminiscent of the *LS3/5a* in appearance. It uses a fine six-element crossover (including two resistors). The 100mm bass/mid unit has a rigid pulp cone with a foam roll surround and the 25mm soft dome tweeter is sufficiently recessed to afford some time delay compensation. Overall it is remarkably well made for the price.

Lab results

With a predictably low sensitivity of 83.5dB/W the −6dB low frequency point was placed at a high 85Hz, although in practice shelf mounting would improve this to around 60Hz. The 10 ohm nominal impedance classes it as a good amplifier load and it proved easy to drive; the phase angle of impedance averaged 35°, with a worst case recorded at 2kHz (fortunately at a harmless 12 ohms).

Pair matching was very good and generally to within ±0.5dB. With such a small speaker the swept sinewave distortion measurement was made at 90dB rather than the usual 96dB, and this should be borne in mind if comparing the good results for the *Metro* with those for other models. At this drive level third harmonic distortion was clearly well controlled and second was virtually inaudible throughout. The soundness of the crossover design is illustrated by the 100W peak distortion results, where just 0.2dB of compression was noted at 500Hz, and none at 5kHz. With a suggested ceiling of 75W per channel, a modest 97dBA maximum level for a pair should be available in most rooms. This would be slightly improved by shelf rather than open stand mounting and in fact represents two or three dB more than is available from the slightly larger *LS3/5A*.

On axis at 1m the response, while generally smooth and balanced, showed signs of slight lumpiness on occasion, while the low frequency 100–500Hz range was a little subdued – again more suited to shelf mounting. Averaged over ⅓-octave bands the picture changed little. Provided that the crossover has been well designed, such a small speaker should produce excellent dispersion; this was indeed the case with the *Metro,* whose output varied very little over the 60° x 30° forward solid angle.

Sound quality

Considering its size the *Metro* did well, attaining 'average' scores, which is creditable as it costs only about one-third of the group average price. Possessing a slightly 'light' and mid-biased balance, a little more presence range energy could have been advantageous, as the reproduction was slightly 'boxy' and 'tubby', albeit less coloured than most. The speaker could only sustain 5W of electric bass guitar before overload, though in practice it withstood acceptable levels of bass input where full range programme was concerned.

The stereo imaging was quite good with accurate positional focus and space. From the characteristic 'small' sound and noticeably restricted bass extension, it was clear to the panel that they were

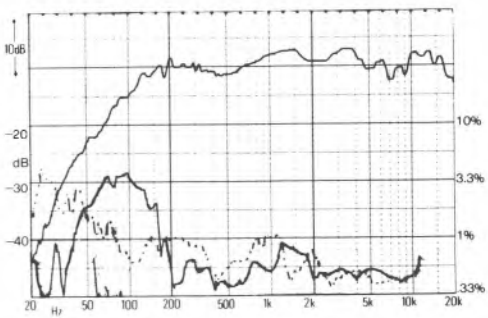
RECOMMENDED

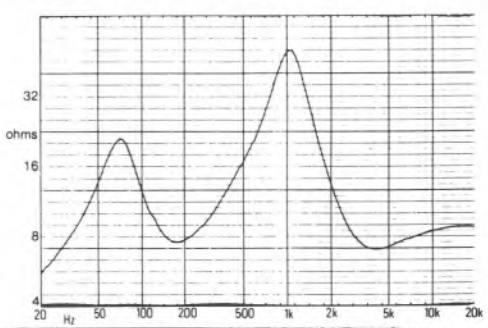
listening to a 'miniature', but it nonetheless did quite well overall.

Summary

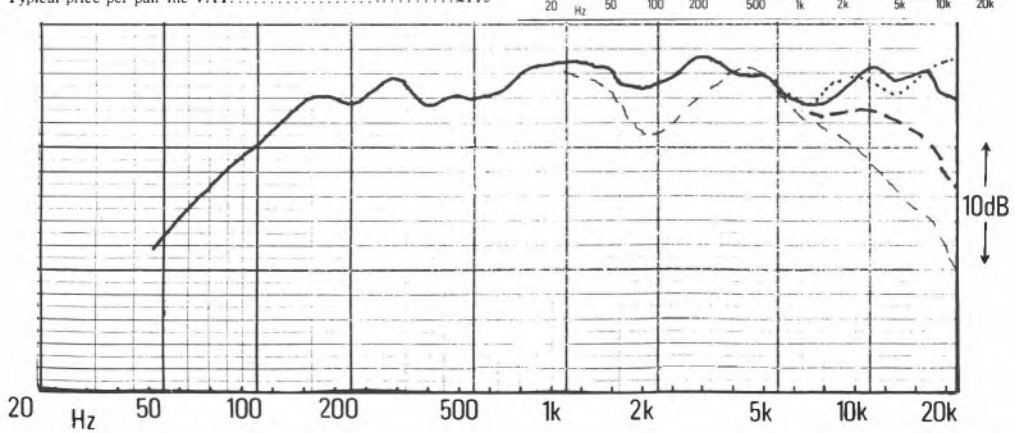
Irrespective of its size the *Metro* has done pretty well at the price, and is a well made and finely finished model, possessing moderate levels of coloration and a natural frequency balance. However its small dimensions do impose significant limitations in terms of sensitivity, power handling, bass response and maximum attainable level, and these preclude 'best buy' status. Conversely because of its size it represents a remarkable achievement, and can be warmly recommended.

Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 90dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).





Size (H, W, D)	28, 16, 19 (11, 6.3, 7.5) cm(inches)
Weight	4.5 (10) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30–75W
Recommended placement	open shelf or stand
Frequency response within ±3dB (2m)	120Hz–20kHz
Low frequency rolloff (−6dB) at 1m	85Hz
Voltage sensitivity (ref 2.83 V, *ie* 1 watt in 8 ohms) at 1m	83.5dB
Approximate maximum sound level (pair at 2m)	97.0dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	very good
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good
Typical price per pair inc VAT	£115



Kossfire and Dyna*Mite. The new sound explosion in loudspeakers.

Here's a dynamic duo that's created an explosion in sound innovation. The Kossfire/210 and Dyna*Mite M/80 loudspeakers from Koss. Sound for sound and value for value, no other imported or stateside speakers can match them.

The 4-driver Kossfire loudspeakers offer superb performance throughout the bass, midrange and treble frequencies. Kossfire's unique dual tweeter design doubles the power handling capability over the all-important treble range while virtually eliminating distortion. And Kossfire's 12-inch woofer, 5-inch midrange and perfect stereo imaging make it the first loudspeaker in its price range to live up to its promise. And that's a promise!

The Koss Dyna*Mite M/80 may be mini speakers but they're dynamite in sound. Unlike other mini speakers, the Koss Dyna*Mite M/80's feature a unique 3-driver system with perfect mirror-image performance whether they're standing up or lying down. Dual 4½-inch woofers and 1-inch dome tweeter deliver a bass, midrange and treble performance you've never heard before from a mini speaker. And the Dyna*Mite's natural, hand-rubbed walnut veneer cabinet, make them an attractive addition to any room, bookshelf or van.

Telephone or write for more information on the new Kossfire and Dyna*Mite loudspeakers. And visit your Audio Dealer for a live demonstration of all the Koss loudspeakers, stereophones, and the new Koss Music Box. Nobody makes music sound better than Koss. And that's a promise.

KOSS® Stereophones /Loudspeakers

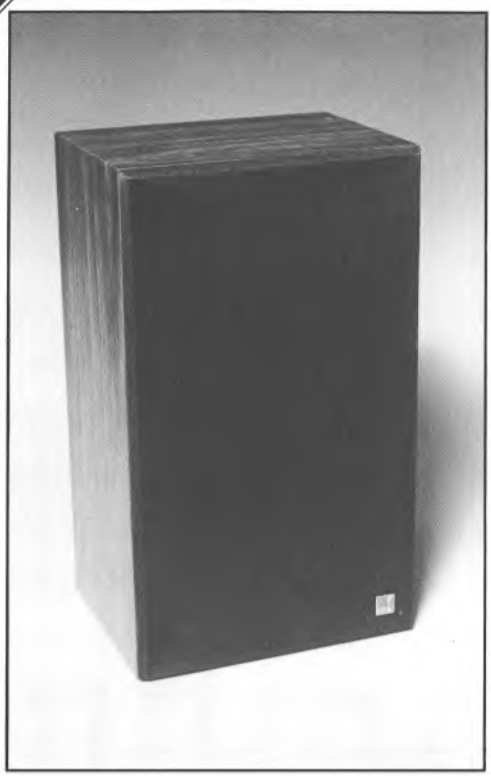
hearing is believing®

KOSS U.K. LTD., subsidiary of Koss Corporation 114 Ashley Road St Albans Herts AL1 5JT Tel St Albans 69763

BEST BUY

KEF Coda

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 to 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.

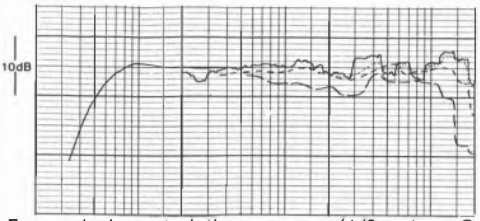
More coloration was noted on the live comparisons, but the system's detail and tonal accuracy won the day and high scores were recorded. Up to a 150W peak of bass guitar was happily tolerated, the system demonstrating a fair fundamental bass power, a neutral and even character, plus an ability to play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

Summary

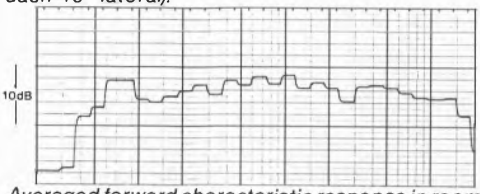
This compact speaker possessed a great many attributes, notably good sensitivity, wide dynamic range and power handling plus moderate distortion and an essentially neutral frequency balance with satisfactory bass extension. It also demonstrated fine stereo, good clarity and detail, so it deserves to 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 £300.00 a pair. As such, it provides embarrassing competition for some of KEF's own more expensive models.

GENERAL DATA

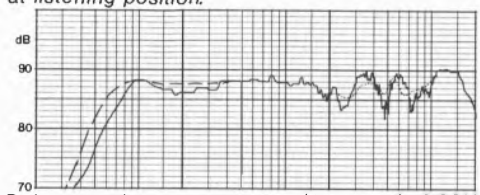
Size (h x w x d)	47 x 28 x 22cm
Weight	7kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–100W
Recommended placement	... open shelf or ideally on open stands
Frequency response within ± 3dB (2m)	62Hz to 18kHz
Low frequency rolloff (–6dB) at 1m	50Hz
Voltage sensitivity (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



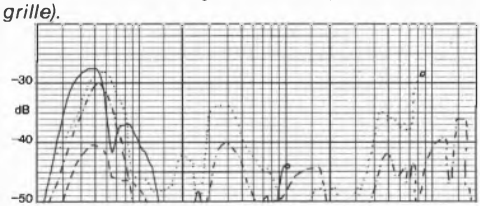
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



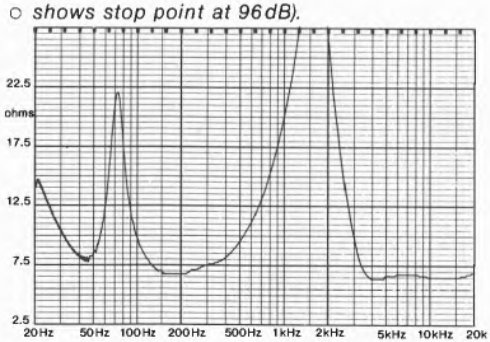
Averaged forward characteristic response in room at listening position.



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

KEF Caprice

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

KEF seem to be caught in the current marketing trap, whereby all small loudspeakers must be labelled 'bookshelf'. By restricting depth to 22cm, such a system may be located on even a shallow bookcase flush fitted to the wall, but in subjective terms such a location unfortunately sacrifices much of the stereo quality, freedom from coloration, and accuracy of tonal balance. In common with many other accurate speakers the *Caprice* in fact sounds best when properly located on open stands clear of the room walls.

While it is a *Coda* lookalike in general specification, size and lineup, there are several important variation, not the least of which is the 2 : 1 price difference! The *Caprice* uses a decoupled frame bextrene-cone 200mm bass/mid unit with a generous magnet assembly, which has higher cone mass and a lowered system resonance than the *Coda* (from 73 to 69Hz). A more complex 12-element crossover divides the frequency range, though this includes three resistors and two capacitors for 3rd order low frequency tuning. The 25mm soft dome tweeter is KEF's own refined driver, as also used in the *R105.4* and *R103.2*; in fact, if you change the box shape and add the electronic protection the *Caprice* could turn into a *R103.2* yet it costs £100.00 less.

The same prejudicial grille fitted to the *Coda* is also used for the *Caprice*, and similar criticisms are appropriate. Decent foam grilles would have done both these models a service, and probably would offer a further reduction in price, since they are now less expensive than cut chipboard with a paint finish plus hand-applied woven cloth.

Lab performance

Measured at 1m, the *Caprice* illustrated an extremely uniform response up to 6kHz, above which a very mild lift in the treble was present; in the lower range, +/−2dB limits sufficed for 55Hz to 6kHz, while the upper lift amounted to 1.5dB. With an average 87dB/W sensitivity the low frequency response was quite extended, showing a −6dB rolloff point of 45Hz. Close to the 8 ohm standard with a minimum impedance no lower than 5.6 ohms, the *Caprice* was rated a 'good' amplifier load.

At 2m with ⅓-octave averaging, the output proved to be very consistent particularly on axis. Note should however be taken of the small dip at 3kHz at 15° above, which suggests that the speaker should be at or slightly above ear level. As with the *Coda*, off-axis lateral plane listening is perfectly possible, with 20° almost perfect. The speaker met close overall limits under these conditions, in practice measuring +/−2dB.

The distortion results were favourable, with some 3rd harmonic reaching 0.8% midband, 96dB but not increasing beyond 1.0% until below 70Hz. Second harmonic was higher at around 1–2.0%. At 90dB, which is still a fairly high sound level, most distortion has vanished below the 0.3% baseline. At 100W, compression was negligible with 5th harmonic at 0.3%, 3rd at 1.0% and 2nd 5.0%, all more than satisfactory at both 500Hz and 5kHz.

In the listening room the response indicates a fine balance, showing a gentle rolloff at high frequencies and good power delivery down to 50Hz with little emphasis. Minor uneveness was also present throughout the upper midrange, 500Hz to 3kHz, and this speaker's output did not sound quite as well integrated or coherent as the *Coda*, for example.

Sound quality

As with the *Coda* the *Caprice* scored consistently high in all the listening sessions, and in some respects it was more subtle in its approach, with a smoother more restrained effect plus worthwhile extra bass. Conversely some of the excitement and 'alive' quality of the *Coda* was suppressed, harking back to the *103.2*. Interestingly, the *Caprice* was felt to be rather better balanced than the *103.2*, and has scored significantly higher in these tests.

Compared with live sounds this model was felt to be slightly 'rich' in the midband, with a trace of 'glassiness' in the treble and mildly sucked out in the middle. Slight 'Bextrene type' 'nasality' was present, although this was not serious, and while the bass showed fair extension, it only scored average, demonstrating some 'softness' and 'lumpiness'. Power handling was however good.

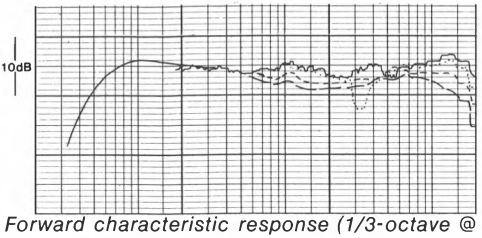
On the stereo sessions slight 'tubbiness' and a suspicion of 'edgy' treble was reported, but the tonal character was liked, showing an airy, transparent and detailed picture. Good enough stereo was demonstrated with grilles on, but the focus significantly improved and the speaker scored over the *Coda* in this area and in its ability to produce a convincing degree of detail after they had been removed.

Summary

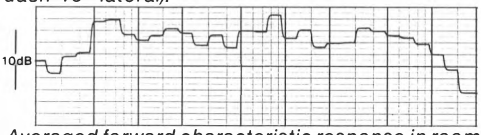
A year ago the *103.2* just merited a Best Buy rating. The *Caprice* is in fact a *103.2* without the protection circuitry and genuine veneer finish, but with a more lively tonal balance which in our opinion makes it rather better. This is a clean, neutral and compact speaker of good dynamic range, sensibly wide response, high quality construction, and cost effective engineering, so it obviously qualifies for Best Buy rating.

GENERAL DATA

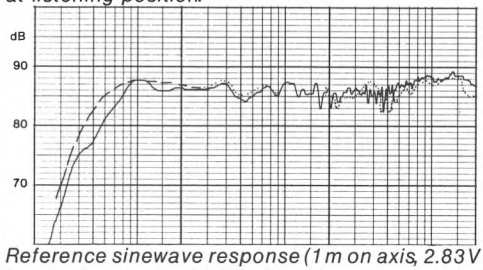
Size (h x w x d)	47 x 28 x 22cm
Weight	8.3kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–100W
Recommended placement	open stand
Frequency response within ± 3dB (2m)	54Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	45Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	87dB/W
Approximate maximum sound level (pair at 2m)	102dBA
Impedance characteristic (ease of drive)	very good
Forward response uniformity	excellent (grille off)
Typical price per pair inc VAT	£150



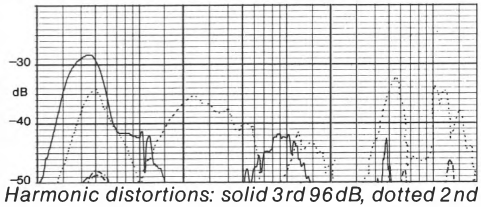
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



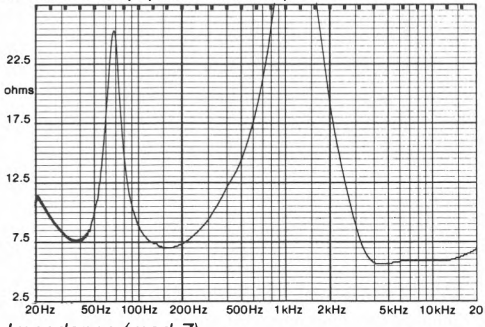
Averaged forward characteristic response in room at listening position.



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).

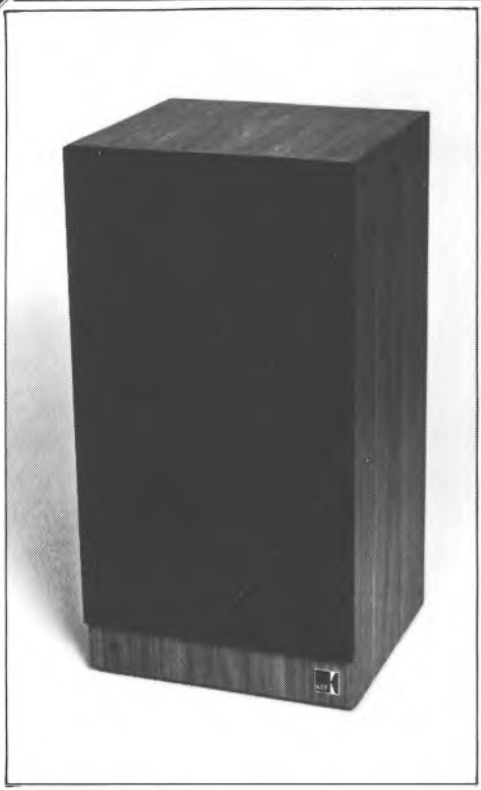


Impedance (mod Z).

RECOMMENDED

KEF R103.2

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



The original *R103* was one of the most technically advanced speakers of its time, and still stands comparison with current references. However it was costly and difficult to manufacture, and a new version is now available which is also a two-way compact sealed box system (19 litres). This uses an entirely new high power 200mm bextrene driver for bass/midrange, which possesses a revised profile and trochoidal steel frame designed for balanced anti-vibration mounting to reduce cabinet panel resonance. The tweeter is also a new design from KEF, comprising a 25mm fabric dome unit.

As with the *101* and *105* a third-order alignment is used at low frequencies, this providing both bass improvement over simple sealed box loading, as well as subsonic overload protection (a series capacitor element). KEF's full electronic overload protection unit (S.Stop) is also incorporated in the complex 14-element crossover, and in common with all the *Reference* series speakers, the *103.2* is subject to extensive computer aided tolerancing and matching.

Lab results

Pair matching was indeed very good, and generally within ±0.6dB up to 18kHz. An average sensitivity of 86.5dB was recorded, which is some 4dB greater than for the original *103*. In terms of the size and sensitivity the 48Hz −6dB low frequency point was quite low, and the sensitivity is in any case assisted by the good amplifier loading offered by the 8 ohms nominal impedance. Fairly high phase angles were recorded – typically 40° with up to 60° at about 2.8kHz (12 ohms modulus) and 40° at 3.5kHz (7 ohms modulus).

At 1m with sinewave excitation the response was unusually smooth and well balanced, meeting ±2dB limits from 58Hz to 18kHz. At a fairly high 96dB sound level, distortion was quite low, with third harmonic well controlled except at 1kHz where a mild rise to 1% was recorded; second harmonic was higher than average at low frequencies, measuring 2%, at 100Hz, though this is pretty innocuous subjectively. Fed 100W tone burst pulses just 0.3dB of compression was noted at 500Hz, with no appreciable increase in distortion apparent, and at 5kHz the results were perfect. This, together with the high bass power handling capacity, means that the *R103.2* is judged capable of accepting up to 200W of programme, generating substantial 103dBA sound levels in a typical room.

The very uniform trend exhibited by the *103.2* was confirmed at a 2m measuring distance using ⅓-octave analysis. The dispersion characteristics were very good and a general trend to moderate 'richness' or downtilt in the frequency balance was apparent, more so in fact than for the *105.2*, and the grille was found to be partially responsible.

Sound quality

Scoring average on the live sound comparisons, the system was judged to have a mildly 'thickened' character, exhibiting some 'boxiness', and alternatively described as insufficient openness in the presence range. The bass was however fine with surprising depth and evenness, and it withstood 80W average (200W peak) of electric bass guitar.

On the stereo sessions the panel found the speaker easier to accept and awarded considerably higher marks. It was judged a little 'bland' yet very smooth, with aggressive colorations at a minimum.

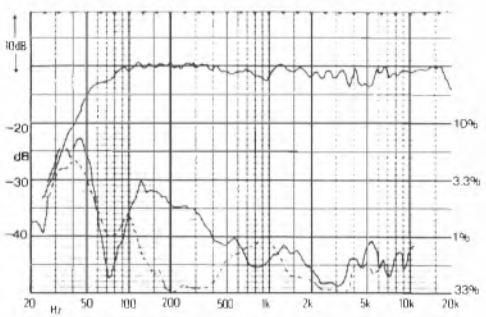
KEF R103.2
(revised and reprinted)

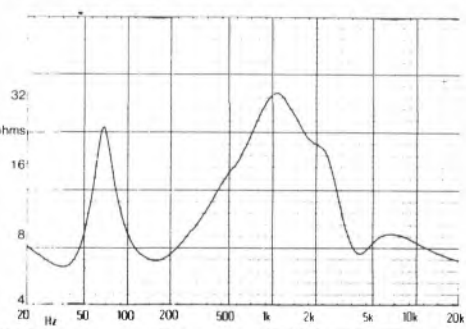
Piano and full orchestra were very well reproduced, and stereo imaging was to a good standard; the speaker tended to 'grow on' the panel slightly during the proceedings, which is an encouraging sign.

Summary

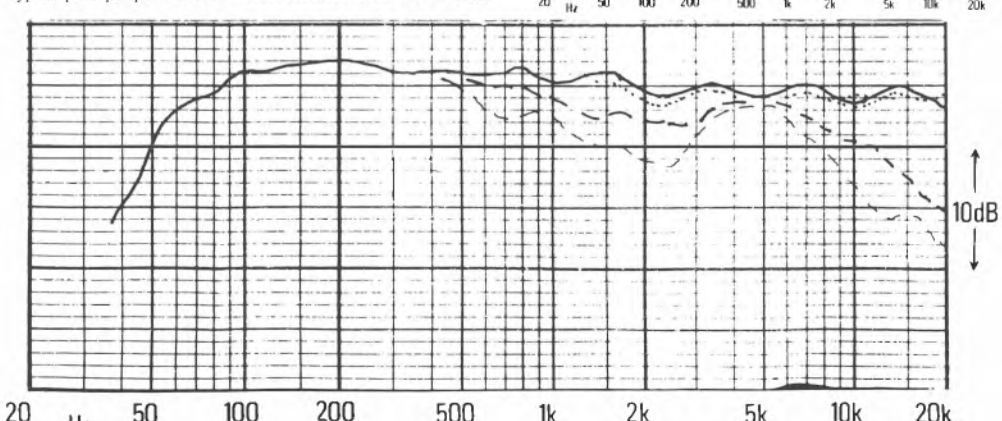
The *R103.2* was a strong performer, taking into account its above average sound quality and good stereo, plus its smooth slightly rich perspective and reasonable sensitivity. It also offered excellent power handling, moderate distortion, and surprising bass for its size. If the very good finish and engineering are taken into consideration as well as the comprehensive electronic protection, this is clearly the recipe for firm recommendation at a typical £260 a pair.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).





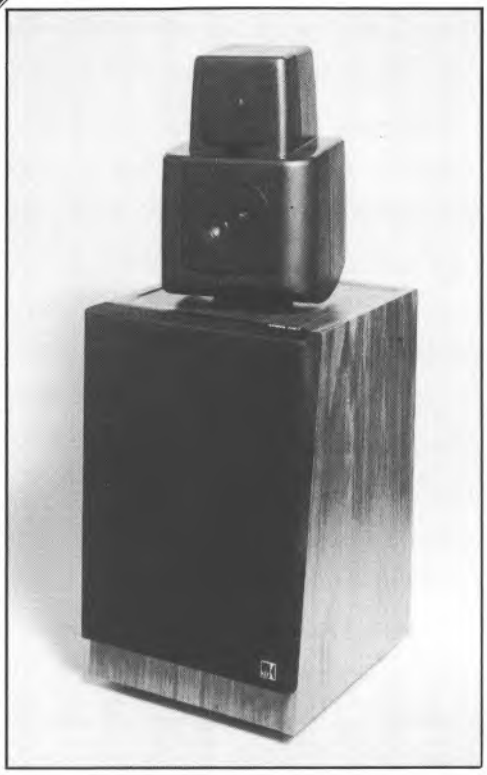
Size (H, W, D)	50.6, 26.5, 25 (20, 10.4, 10) cm (inches)
Weight	8.6 (19) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25–200W
Recommended placement	open shelf or special stand
Frequency response within ±3dB (2m)	50Hz–20kHz
Low frequency rolloff (−6dB) at 1m	48Hz
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m	86.5dB
Approximate maximum sound level (pair at 2m)	103dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	very good
Impedance characteristic (ease of drive)	good
Forward response uniformity	very good
Typical price per pair inc VAT	£260



RECOMMENDED

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 1 dB 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 1 kHz 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, +/−1.5dB from 150Hz to beyond 20kHz, which is better than a number of precision microphones! The bass slope has already been noted, while the −6dB point was moderately extended to 46 Hz and with a slow decay thereafter to 35Hz, −10dB.

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. The 100W pulsed inputs were accepted without protest, showing negligible compression and similar harmonic levels at both test frequencies, with 5.0% 2nd and 1.0% 3rd harmonic, both of which are satisfactory figures.

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 bass register of the *'4* was powerful and well extended, but undeniably slightly rich, even 'lumpy' in the upper regions. But in contrast to many other systems it could 'play tunes' well in the bass, and thus scored high in this area.

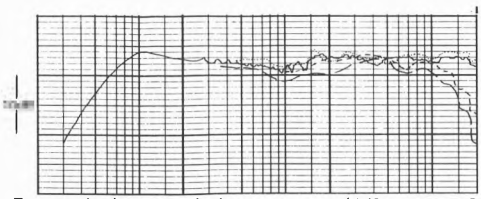
The comparisons with live sounds were in the *'4*s favour, though a trace of 'boxiness' and 'nasality' remained, with a mildly 'plummy' and 'chesty' quality in the upper bass. Stereo imaging was exceptionally good, with a seemingly effortless recreation of space, ambience, and depth (when present in 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

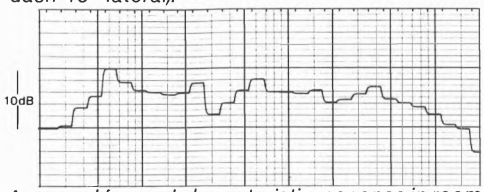
The *105* concept clearly has much mileage in it yet, and I suspect that given a choice, most listeners would prefer the *105.4* to the *105.2*. The latter has a slightly smoother and more extended bass plus a sweeter treble, but the former possessed a quality of 'liveliness' which sets it apart from the ordinary. It also offers one of the largest power handling capacities for this size of enclosure, and with a welcome cost saving over the *'2* the *105.4* is enthusiastically recommended.

GENERAL DATA

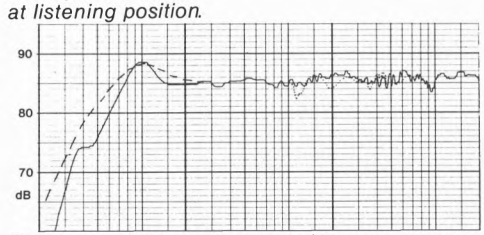
Size (h x w x d)	93.6 x 35 x 38cm
Weight	22kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	500W
Recommended placement	on floor, clear of walls
Frequency response within ± 3dB (2m)	55Hz to > 20kHz
Low frequency rolloff (−6dB) at 1m	50Hz
Voltage sensitivity (ref 2.83V, *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



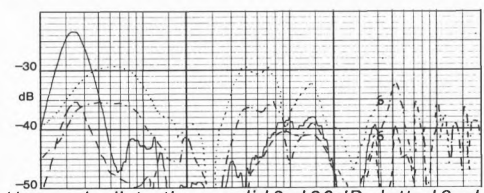
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



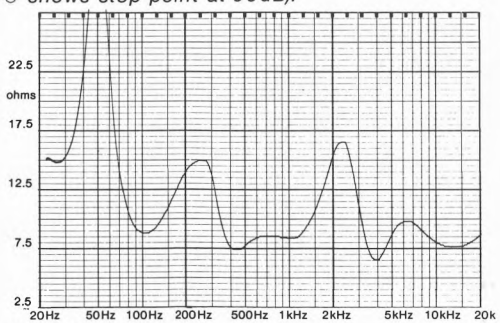
Averaged forward characteristic response in room at listening position.



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).

RECOMMENDED

KEF R105.2

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

Tested for the last issue in pre-production form, the Mark *2 R105* has been completely reassessed this time round, complete with its full grille assembly. This substantial floor-standing three-way system has a bass enclosure which alone measures 70 litres and uses a separate low diffraction moulded 'head' assembly to contain the mid and high frequency drivers; this is adjustable for tilt and lateral angle to aim the optimum axis at the listener without re-orienting the entire speaker. The overall configuration reduces phase and time delay distortion, and accurate driver integration is provided by a complex 24dB/octave crossover (acoustic). All vital components are computer matched to achieve a very close correspondence between the two 'halves' of a numbered stereo pair.

The 305mm trochoidal cast chassis bextrene coned bass unit is aligned to a third order response at low frequencies, and is located on anti-vibration mounts to reduce cabinet coloration. The 400Hz to 3kHz range is handled by a special 100mm bextrene coned unit, and the treble by a 38mm polyester dome tweeter. Instead of the fuses used in the original *105,* comprehensive electronic protection is now incorporated to cover bass excursion, absolute voltage, and dynamic thermal tracking for each driver. Peak power indicators and test facilities are also provided.

Lab results

As claimed, the pair matching was extremely good, and the terminal sensitivity was a little below average at 85dB/W. However, the low frequency range was well extended, with a −6dB point at 33Hz (without taking into account the floor-standing position that would normally be encountered).

The swept distortion results at 96dB were good, particularly at low frequencies, but there was a rise to 1% third and 1.5% second harmonic around 1kHz, which was somewhat worse than average. Fed 100W toneburst pulses, a 0.4dB compression was noted at 500Hz though with a negligible increase in distortion, while at 5kHz no compression or distortion was detected.

The sinewave response at 1m on axis was charted with and without the grille in position, and suggests that in the former case a detectable absorption of upper mid and treble energy occurs, placing a slightly rich balance on the otherwise remarkably uniform and extended response (±2dB limits suffice from 50Hz to 20kHz). At 2m with ⅓-octave averaging (grille on), the marginally attenuated presence and treble range was still apparent, but a notably even and well ordered array of off-axis responses was achieved, confirming the very good driver output integration. By normal standards the speaker is undoubtedly unusually flat in response. The high impedance characteristic presents an easy amplifier load, which helps to offset the low sensitivity; phase angles were held to 40° up to 15kHz, and typically measured 20°.

Analysed in the listening room using our new averaging test working in ⅓-octave bands, the *105.2* showed a fairly smooth and well-extended low frequency range, +/−3dB 40Hz to 500Hz, but also gave a hint of 'forwardness' in the 600Hz to 1.2kHz octave. The 2kHz presence region was marginally depressed by comparison, and on the whole the treble range rolled off too early despite a smooth extension to the highest frequencies.

KEF R105.2

(fully re-assessed)

RECOMMENDED

Sound quality

The *105 2* did well on live sound comparisons, with the bass range very even and deep, sustaining 150W average or 350W peak of electric bass guitar. Coloration was low, with a trace of 'nasal', 'hollow' and 'boxy' effects, and overall the panel felt that the speaker was somewhat 'duller' than life.

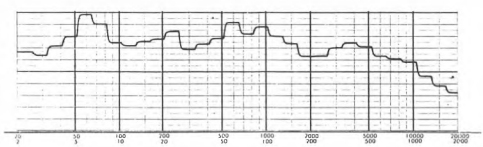
On the stereo tests the imaging was probably the best auditioned, exhibiting exceptional lateral stability and precision, and with a remarkable realisation of depth and ambience. Overall the sound quality on commercial programme was considered very good, with criticisms confined to a moderate tendency to a 'warm' and 'rich' character, and with a bass that could have benefited from sounding 'drier', in our room at least.

Summary

Aside from minor quibbles concerning frequency balance, the *R105.2* was an exceptionally well engineered design. It offered an easy load, a wide bandwidth, low levels of coloration, moderate distortion, as well as good power handling. Stereo reproduction was remarkable and full electronic protection was provided. While it may not satisfy those seeking a lively (and possibly exaggerated) sound more suited to loud rock programme, as it stands the *105* is surely one of the most consistently accurate speakers in current production. It should however be noted that the sound is more sensitive to room acoustics than many due to its wide midband dispersion, so where possible a home audition is recommended.

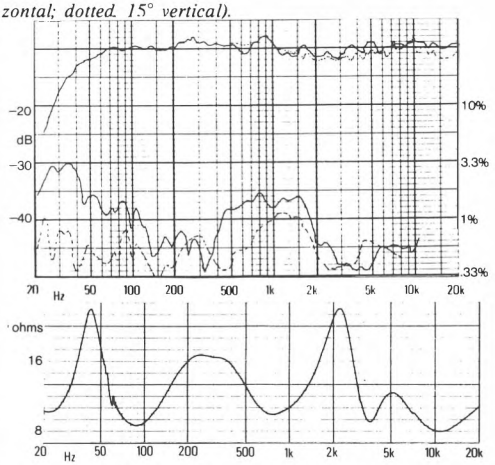
Completely reauditioned for this issue, the *'2* retained its very high ranking and thus continues to merit recommendation, although on balance we prefer the cheaper *105.4*.

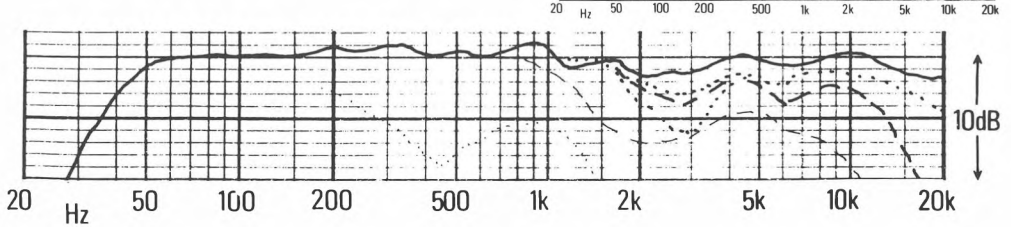
Size (H, W, D)	96.5, 41.5, 45.5 (38, 16.3, 18) cm(inches)
Weight	36 (80) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25–300W
Recommended placement	floor
Frequency response within ±3dB (2m)	37Hz–20kHz
Low frequency rolloff (−6dB) at 1m	33Hz
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m	85dB
Approximate maximum sound level (pair at 2m)	103dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	good
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good
Typical price per pair inc VAT	£860



Averaged forward characteristic response in room at listening position.

Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).

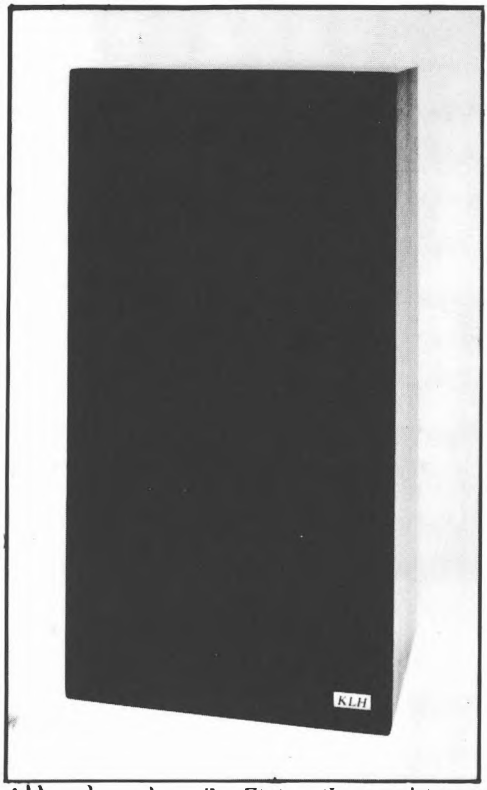




BEST BUY

KLH 317

Webland International Ltd., 4 Cromwell Place, London SW7 2JJ
Tel 01-385 9478



Although made in the States, the usual trans-atlantic price penalty does not seem to apply to this two-way sealed box design of approximately 20 litres internal volume. It employs a 250mm pulp cone driver plus a 25mm soft dome Peerless tweeter concealed behind a grille (the latter company is now in fact part of KLH.) While the external finish comprised an attractive vinyl wrap in the form of a hickory print with convincing 'knots' unfortunately the standard of internal construction gave rise to some misgivings. For example, the woodscrews used to secure the drivers had fragmented the inside surface of the baffle, leaving loose woodchips near the bass driver, while the thick grille panel was not chamfered and no panel damping was present, simply a loose Dacron fibre fill. No soldering was employed in the 3-element cross-over, this virtually floating inside the cabinet, the wires joined by twisting and clamping, using screw-on couplers. However at least it was more complex in terms of its operation than it first appeared, forming a third order high frequency arm and a second order low frequency arm.

Lab results

Generally good, only a small matching anomaly of 2dB was present at 800Hz, while the sensitivity was high at 89dB/W, with a typical –6dB low frequency point at 55Hz. Rated as very good on distortion, even at the low frequency extreme a 1% figure was recorded, with 0.25% at 100Hz and typical values of 0.4-0.5% over the remaining range. Power handling proved to be considerable, certainly in terms of the high 104dBA maximum sound level, the *317* also coping well with 150W of bass guitar, surviving 250W of full program power. Rated as very good on amplifier loading, the impedance did not fall below 7.5 ohms with a mean value of 10 — clearly the high sensitivity is real enough.

On axis at 1m the *317* met +5, –4dB limits, and although this is not in the 'superfi' class, the curve was still reasonably tidy. At 2m on axis, with $^1/_3$-octave band averaging, the system showed an upper mid plateau from 500Hz to 3kHz, although this was somewhat broken up when measured off-axis. The (dotted) 1.6kHz dip refers to the 10° below vertical axis and the 4kHz dip to the 10° above response, some energy loss being apparent from 3-6kHz, with the treble output a trifle prominent around 12kHz. Overall, however, the characteristic responses were pretty good.

Sound quality

When compared with live sounds, the *317* did remarkably well, its bright clear balance, fine bass guitar performance and high power handling all proving definite assets here, and comments of coloration were relatively few, relating to some hardness and boxiness.

The *317* did not fare quite so well on the stereo tests, with the wider band and more complex program sequences, and yet a 'good' ranking was still indicated, which is fine at the price. All the panelists were impressed by its clarity, and this helped to reinforce the stereo imaging which was ranked above average. Criticisms included a touch of fizz, brittleness, hardness and boxiness,

BEST BUY

but these comments still did not deter listeners from marking it favourably.

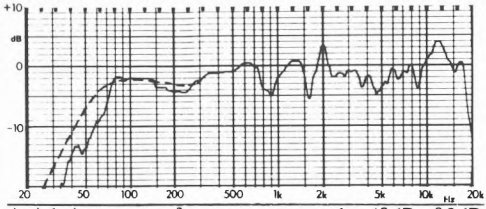
Summary

This is one of those fascinating systems which according to precedent, ingredients and 'rules' of design, might not have been expected to have performed as well as it did. However the lab results are in the main very praiseworthy, and the listening test results exceptional for the price.

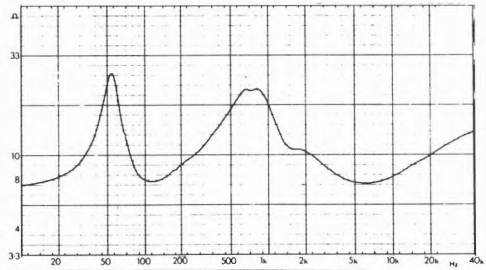
Essentially the *317* offered trim dimensions, a good appearance and high maximum levels, as well as usefully high sensitivity and a very good amplifier loading. The sound was generally neutral and relatively free of coloration, with clean, powerful bass and low distortion — all at attractive price. The 89dB/W sensitivity means that money can be saved on the matching amplifier as 30W per channel will bring over 100dB from each speaker!

A strongly recommended model. If prospective buyers can believe their ears and if a good consistency is maintained, then the KLH should sell in large numbers — however, the manufacturers should tighten up the internal construction quality.

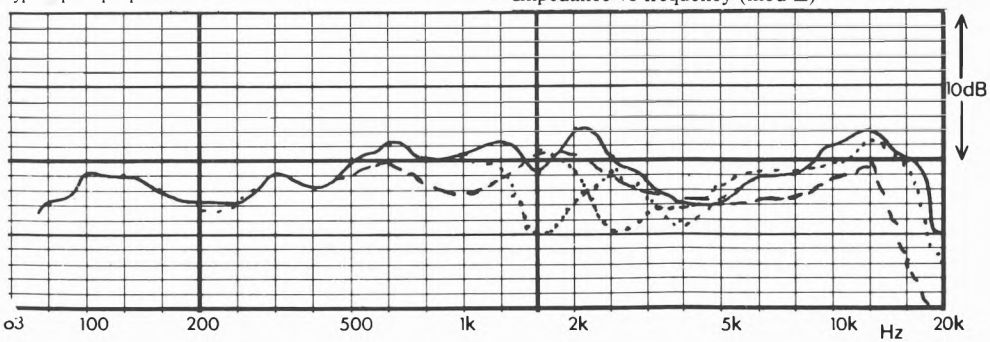
Size	58.5(23) H; 30.5(12) W; 25(10) D; cm(inches)
Weight	13.2(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10-100W
Recommended placement	stand or open shelf
Frequency response within ±3dB (2m)	80Hz-18kHz
Low frequency rolloff (—6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	v. good 66Hz–1%, 100Hz–0.25%, typically 0.5%
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	good
Typical price per pair inc. VAT	£125



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)



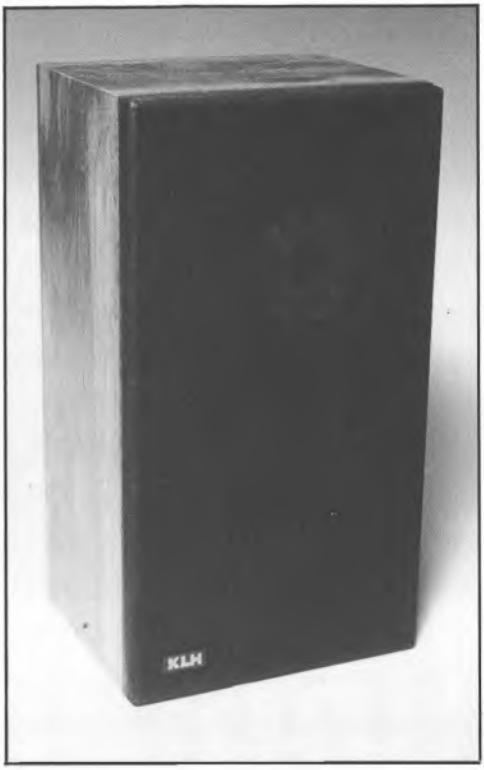
Impedance vs frequency (mod Z)



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

KLH 160

Webland International Ltd., 4 Cromwell Place, London SW7 2JJ. Tel 01-385 9478



After their foray into 'analogue computer' equalised and compressed miniature systems, KLH have used their polypropylene cone technology to produce a number of more conventional models. The *160* is a small sealed-box two-way design of 19 litres internal capacity, for which a high efficiency is claimed, quoted as 90dB/W. However the results for both pairs we tested suggested that 85dB is nearer the truth – around 4 times less in power terms. As the treble range was pretty well balanced (see room response), the systems must be assumed to have been in correct working order.

The two drivers comprise a 200mm bass/mid unit built on a light steel frame with a surprisingly small magnet, plus the KLH/Peerless 25mm soft dome tweeter. The seven-element crossover used good power capacity components, the total including three resistors.

A vertical-in-line system, the drivers have been slightly displaced laterally to smooth the diffraction effects, and the speakers are supplied in mirror pairs. While KLH explain that the best results will be obtained with vertical orientation, they go on to break faith by suggesting that it is OK to use them horizontally in bookcases. As is our custom, we auditioned them vertically, mounted on stands.

The undamped chipboard enclosures sounded rather 'live' when tapped, and the internal damping is left to some polyester fibre. There is a pleasing American birch vinyl exterior, but the grille is the usual cloth stretched over an unrebated chipboard frame.

Lab performance

Measured at 1 m, the sinewave reference response indicated a below average 85dB/W sensitivity. Several factors are worth commenting upon: the prominent bass hump at 80Hz; the crossover suckout of 6dB at 2kHz; and the peak in output at 14kHz, some 3dB high. At low frequencies a −6dB point of 48Hz was recorded, which is average for the size and sensitivity. Adding the grille resulted in a further 4dB dip at 6.5kHz (not shown).

At 2m the ⅓-octave analysis provided some smoothing of the output, and the 2kHz dip was clearly phase delay related, since it quickly cleared up with a change of axis. Our preference was for 5–10° above axis, with a simultaneous 10–15° lateral angle. The 2m characteristic was promising meeting a +/−3dB envelope, with a 'triple humped' trend emphasised at 80Hz, 1kHz and 14kHz.

In accordance with the specification on impedance the *160* was found to be an 8 ohms model and easy to drive, with the impedance momentarily dipping to just below 6 ohms, 3kHz, which will not worry any amplifiers. The graph also shows the system resonance at 65Hz, whose shape illustrates a low flux, low damping alignment.

On the whole distortion was very good except in the 500 Hz region, where significant quantities of 2nd harmonic were charted. Coincidentally the 100W pulsed power test was taken at 500Hz and showed significant distortion: 25.0% 2nd and 2.8% 3rd; conversely the 5kHz result was excellent, with negligible compression and 0.9% 2nd plus 0.25% 3rd.

The averaged room response was quite revealing of the 160's true character. The lumpy bass centred on 60Hz was exaggerated by the room mode at that frequency as well as by the roll off below 50Hz. The mid was dominant from 300Hz to 1.6kHz, and the sharp corner in the treble

rolloff was centred on the 12–14kHz band, while the extreme treble above 15kHz was notable by its absence.

Sound quality

In agreement with the distortion curves, the bass power handling was very good allowing a peak programme rating for the system of 200W, so despite the lowish sensitivity a decent 104dBA sound level can therefore be achieved; 20W is a sensible minimum amplifier rating.

When compared with simple live sounds the *160* showed promisingly good results. It was certainly coloured, but not severely so, with 'hollow', 'boxy', 'chesty', 'nasal', 'sibilant' and 'harsh' effects all apparent. On the plus side, it sounded fairly 'lively' and 'open', avoiding that all too frequently encountered 'deadening' of percussive transients.

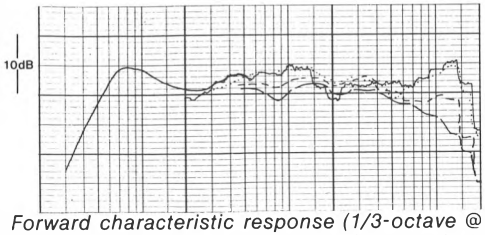
However on the more extended stereo sessions this model did not do particularly well. The mid balance sounded 'small' and 'thin' with a 'peaky' effect, while the treble proved to be rather 'fierce' and 'wispy', and the bass 'boomy' and tending to a 'one note' effect. Stereo imaging was just average, with some 'phasiness' or 'disembodiment' in the presence band (surely associated with the axial notch at 2kHz). Stereo showed a lack of real depth and only satisfactory lateral precision. In this instance the subjective comments reflected the room averaged response quite well.

Summary

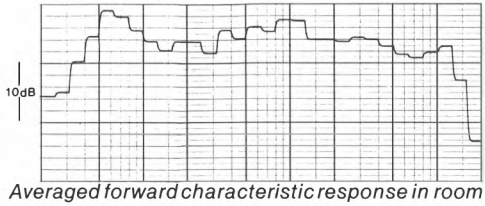
This speaker claimed a high sensitivity, but in fact was below average in this respect, and it did not offer an exceptional performance on any other grounds. Polypropylene is no wonder material: it needs careful handling to give a good result, and cannot be thrown into an economy box with an inadequate crossover, a weak magnet, plus 'edgy' tweeter and be expected to perform to a high standard. After the success of the paper-coned *317* in *Choice* two years ago, the *160* is a disappointment and does not merit recommendation.

GENERAL DATA

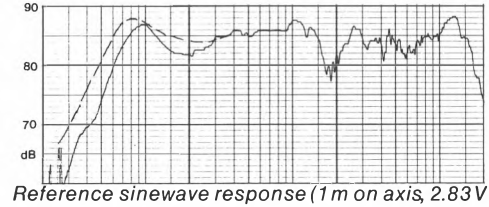
Size (h x w x d)	49 x 26.5 x 22.5cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–200W
Recommended placement	on open stand
Frequency response within ± 3dB (2m)	55Hz to 16kHz
Low frequency rolloff (−6dB) at 1m	49Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	85dB/W
Approximate maximum sound level (pair at 2m)	104dBA
Impedance characteristic (ease of drive)	very good
Forward response uniformity	good
Typical price per pair inc VAT	£160



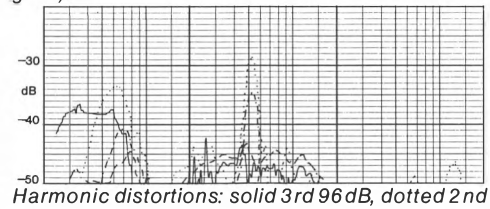
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



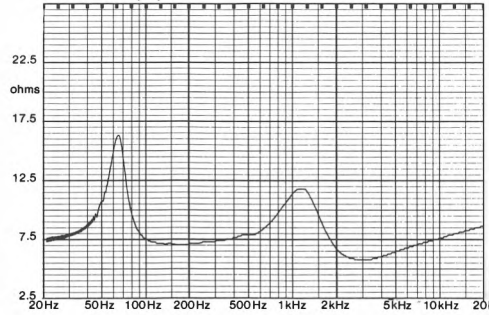
Averaged forward characteristic response in room at listening position.



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).

Bring your music into focus...

at your local B&W Loudspeaker Centre...

AVON
Paul Green Bath 316197
Audio Bristol Bristol 291931
Radford HI FI Bristol 422709

BEDFORDSHIRE
H & H Domestic Biggleswade 312960
Bedford Audio Kempston 854133
Technosound Luton 30919

BERKSHIRE
B & B HI FI Newbury 32474
B & B HI FI Reading 583730
Radford HI FI Windsor 56931

BUCKINGHAMSHIRE
Chiltern HI FI Aylesbury 31020
B & B HI FI High Wycombe 35910
Hughes HI FI High Wycombe 30138
Technosound Milton Keynes 604949

CAMBRIDGESHIRE
University Audio Cambridge 54237
Cottons Audio Peterborough 67682
HI FI Consultants Peterborough 51007/41755

CHESHIRE
Sound Centre Altrincham 83195
Newdawn HI FI Chester 24179
Sound on Sound Congleton 5649
Cobalt HI FI Warrington 36215
Swift of Wilmslow Wilmslow 526213

CLEVELAND
Gilson Audio Middlesbrough 248793
McKenna & Brown Middlesbrough 246644
McKenna & Brown Redcar 483829
McKenna & Brown Stockton on Tees 69995

CORNWALL
Camborne Audio Camborne 714286

CUMBRIA
Searle Audio Barrow in Furness 21233
G. Dungtinson Carlisle 20230
H. L. Elliott Whitehaven 3671

DERBYSHIRE
Micron Audio Chesterfield 34923
R. F. Potts Derby 043469

DEVON
Exon Audio Exeter 75048
Peter Scott Exeter 73309
Peter Russell Plymouth 669511
Richlow Electr. Torquay 65028
D. O. H. Coles Newton Abbot 3155
Homesound Exeter 72814
Homesound Taunton 73321

DORSET
Direct Vision Bournemouth 877371
H.A.T.V. Christchurch 473901

DURHAM
McKenna & Brown Darlington 65990
Musicore Durham 63347

DYFED
Milford Audio Milford Haven 4078

ESSEX
Centelec HI FI Chelmsford 84444
K. A. Cheeseman Colchester 73792
Chew & Osborne Epping 74242
Essex HI FI Hadleigh 558339
Craig HI FI Romford 28902
Chew & Osborne Saffron Walden 23728

GLOUCESTERSHIRE
Absolute Sound Cheltenham 583960

GREATER MANCHESTER
J. Koczur Rochdale 42107
Bespoke Audio Stockport 568515
Fairbotham & Co Stockport 4872
Lloyd Paton Urmston 9722

HAMPSHIRE
Tru-FI Sounds Vision Aldershot 26390
Hampshire Audio Chandlers Ford 65232
Hamminge HI FI Farnborough 47095
Russells TV Newport Isle of Wight 523864
Hopkins HI FI Portsmouth 22155
Whitwams Winchester 65253

HERTFORDSHIRE
Pontagram Barnet 4183
The Record Shop Hitchin 4537
Spectrum Letchworth 79548
David Payne St. Albans 64231
Telstape St. Albans 64337
Anglia Sound & Vision Stevenage 55336

HUMBERSIDE
G. E. Manders Grimsby 51391
A-Z Radio Hull 508021

KENT
Ashford Audio Ashford 29119
Whomes HI FI Bexleyheath 01-303 2339
Ricamens Canterbury 66866
Westgate HI FI Canterbury 69329
HI FI Shop Dover 207562
Maidstone HI FI Maidstone 61882
Orpington HI FI Orpington 27944
Standens Tonbridge 353540
Goulden & Curry Tunbridge Wells 30151
H. C. Coppins Welling 01-303 5341

LANCASHIRE
F. Benfell Blackpool 49625
Monitor Sound Chorley 71935

LEICESTERSHIRE
Maya HI FI Leicester 58662
Stuart Westmoreland Loughborough 30465

LINCOLNSHIRE
Addy's Boston 60106
Grantham Elec. Grantham 66301
Critics Choice Lincoln 38718

LONDON
D. J. Electronics E10 01-556 0017
Myers Audio E17 01-520 7277
Canonbury Radio N1 01-226 9392
Bartletts TV N7 01-607 2296
Andy's Electronics N10 01-883 8969
Analog Audio N12 01-445 1443
Martins HI FI N16 01-254 5053
Goodwins HI FI N22 01-888 0077
Sound Distinctive NW7 01-959 1020
Billy Vee Sound SE13 01-318 5755
Ellis Marketing SE25 01-653 4224
Piercy's SW1 01-821 0333
S. F. Board SW11 01-223 5532
M. O'Brien SW19 01-946 1528
Vision Sound SW19 01-874 2496
R. E. W. Audio W1 01-580 1785
Sonic Sound Audio W1 01-637 1908
Nusound W2 01-724 0454
H. L. Smith W2 01-723 5891
Telstape W2 01-723 1942
Ealing TV W5 01-579 3718

MERSEYSIDE
W. Brady Liverpool 733 8859
C. B. S. Audio Liverpool 708 0750

NORFOLK
Martins Great Yarmouth 55044
Martins King's Lynn 81883
Martins Norwich 27010

NORTHAMPTONSHIRE
Sound Quality Kettering 83833
H. G. Rapkin Northampton 37515
Richard Reeves Northampton 33578

NOTTINGHAMSHIRE
John Kirk HI FI Attenborough 252988
Peter Ellis Audio Eastwood 2280
Syd Booth Mansfield 26315
Peter Ellis Audio Newark 704571
Nick Dakin Nottingham 783862
Peter Anson Nottingham 783312

OXFORDSHIRE
H. J. Wadley Bicester 2117
Horne of Oxford Oxford 511241

SALOP (SHROPSHIRE)
Avon HI FI Shrewsbury 55166

SOMERSET
Watts Radio Somerton 72440
Yeovil Audio Yeovil 25430

STAFFORDSHIRE
W. T. Parker Burton on Trent 42661
Clement Wain Newcastle 613119
HI FI Studio Newcastle 613902
Tom Reekie Stafford 51234
HI FI Studio Stoke on Trent 47125

SUFFOLK
Anglia Audio Bury St. Edmunds 70212
John Wells Lowestoft 3742

SURREY
Cosmic Radio Addlestone (Weybridge) 47356
Spalding Electr. Croydon 01-654 1231
Dorking Audio Dorking 882897
Lloyd & Keyworth Farnham 715534
Surbiton Park Radio Kingston on Thames01-546 5549
Tru-FI Sounds Vision Redhill 66128

SUSSEX (EAST)
Robert Harding Brighton 608444
Robert Harding Burgess Hill 5090
Complete Audio Eastbourne 27382
Lewes HI FI Lewes 78133

SUSSEX (WEST)
Jaysound Audio Bognor Regis 826355
Sports & Radio Bognor Regis 865331
Bowers & Wilkins Worthing 64141

TYNE & WEAR
Lintone Audio Gateshead 774167
J. G. Windows Newcastle 21356
Saxons Photomarket Sunderland 57578

WARWICKSHIRE
C. T. S Leamington Spa 29285

WEST MIDLANDS
Five Ways HI FI Birmingham 455 0667
Norman Field Birmingham 622 2323
Downing & Downing Stourbridge 71747
Millwards Wolverhampton 23980

WILTSHIRE
J. D. Equipment Chippenham 4357
P. R. Sound Melksham 708045
Absolute Sound Swindon 38222

WORCESTERSHIRE
Johnsons Sound Service Worcester 25740

YORKSHIRE
Erricks HI FI Bradford 22972
Tom Jaques Doncaster 65565
Tape Recorder Centre Halifax 66832
Huddersfield HI FI Huddersfield 44668
Audio Projects Leeds 789115
Micron Audio Sheffield 380295
Multisound York 51712

SCOTLAND
Holburn HI FI Aberdeen 25713
Telemech Audio Aberdeen 28817
Vennal Audio Vis. Ayr 84124
T. N. McKay Dumfries 4117
Andrew Thompson Dunfermline 24541
Audio Aids Edinburgh 228 3979/687 2877
HI FI Corner Edinburgh 556 7901
HI FI Corner Falkirk 29011
James Kerr Glasgow 332 0988
Nairn HI FI Inverness 220440
John McLachlan Paisley 041 889 0101
Robert Richie Montrose 3765

B&W Loudspeakers Ltd.
Meadow Road Worthing West Sussex BN11 2RX England

Printed in England

Lentek S4

Lentek Audio Ltd., Edison Road Industrial Estate, St. Ives, Huntingdon, Cambridgeshire PE17 4LE. Tel (0480) 62225

On first appearance this small UK built loudspeaker may seem rather expensive, but a closer look indicates that more than usual care is taken in its manufacture, and this is naturally reflected in the price. Specialist stands are available to position the speakers at the optimum height, and a useful instruction book is also provided. The superb finish is in American walnut, and the Company offers a 3 year guarantee.

Technical details

The *S4* is a two-way sealed box, again using drive units from Son Audax. A 200mm bextrene cone bass-mid range unit (specially modified) operates up to 2.5kHz, with a selected 25mm fabric-dome tweeter continuing the range to 20kHz. A complex 10-element close-tolerance crossover divides the signal spectrum with 18dB/octave slopes. The enclosure is rigidly constructed and carries damping panels.

Lab results

An excellent pair match was demonstrated, within 0.5dB throughout. Sensitivity was comparatively low at 84.5dB, with a −6dB, 47Hz LF cut off, the latter corresponding with the fairly high 65Hz system resonance. Driven to the full 96dB test level, and despite the high power input this required, the third harmonic distortion remained at the 'excellent' level over the whole range above 80Hz. More usual figures were recorded at lower frequencies; for example, 3% at 50Hz.

With an impedance value of typically 9 ohms, which never fell below 7, the *S4* is classified as easy to drive. At 1 metre, under sine wave drive, it demonstrated a very even response, which met +1, −3dB limits, 50Hz-20kHz.

At 2 metres a small hump at 700-800Hz was evident, but apart from this, the forward dispersion characteristic was commendably uniform, with excellent integration demonstrated over the 30° lateral and 10° vertical off-axis curves. The output rolled off a little above 13kHz; for example, at 30° off-axis the 20kHz point was 8dB down. The LF characteristic was very even and reasonably extended for this size of enclosure.

Sound quality

This model's basic neutrality and lack of distinctive character (in the most positive sense), made it a logical choice for one of the control checks used for frequent repetition in the test sequence. Throughout, it consistently ranked 'above average' overall.

Its stongest performance was during the stereo tests where imaging was highly rated both for its depth and for its precision. Its mild failings were classed as 'sibilance', a degree of 'hardness', 'wiry' and 'reedy' effects, plus a mild mid-prominence and a lightish balance.

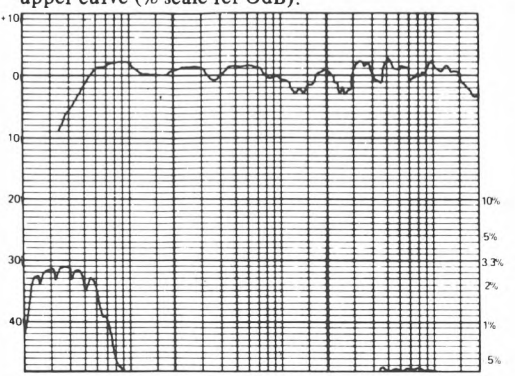
On live comparisons the colorations seemed to be slightly accentuated, and some mild buzzes could be heard on moderate levels of electric bass guitar. However, the S4 withstood the full peak output of the 500 watt stereo amplifier without breakup, reaching a fair 99dBA, although the mid frequency

sounds were rather hard at this volume. Generally speaking, in comparison with live sound, it was a trifle bright.

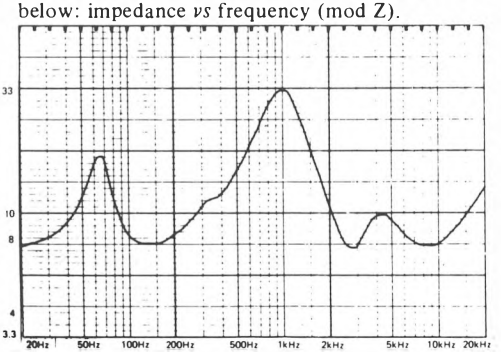
Summary

Times are catching up with this model and despite a recent revision the *S4* can no longer be recommended, though it remains a good loudspeaker, which is worth considering. More recent models have overtaken it including Lentek's own *S5*, by offering higher sensitivity, wider dynamic range, 'tighter' bass response, and a more 'lively' presentation without hardness or additional mid coloration. The *S4* remains a well made and finished example of its type, with an essentially neutral sound and good stereo image quality.

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

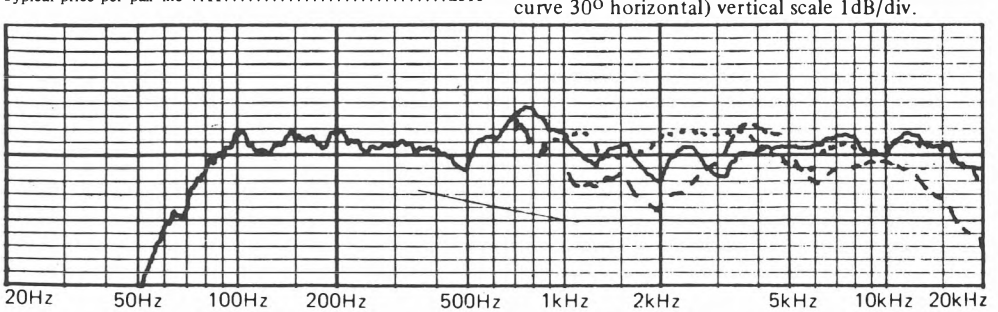


below: impedance *vs* frequency (mod Z).



Size	49.5(19.5) H; 25(9.75) W; 25.5(10) D; cm(inches)
Weight	11.7(25.7) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	47Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	84.5dB at 1m
Approximate maximum sound level (pair at 2 metres)	99dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	good
Forward response uniformity	v. good
Typical price per pair inc VAT	£310

below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

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

The sensitivity was above average at 88dB/W, with a useful bass extension to 44Hz, −6dB, rolling off slowly to −10dB at 34Hz. With ⅓-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 narrowwidth 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.

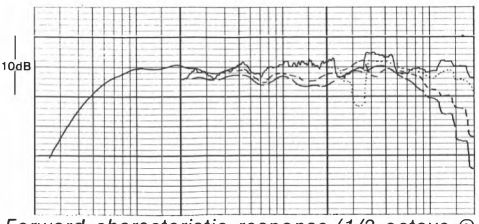
On the stereo sessions the speaker was found to image well with good depth reproduction and a high level of lateral precision. String tone was a trifle 'wiry', and voice slightly 'thin' tonally, with some hardness on piano. Extreme treble was deficient, although this was not judged too serious. Most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

Summary

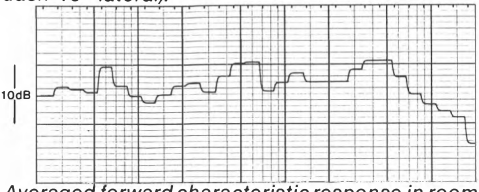
This fairly expensive, substantial and well-finished speaker has a performance commensurate with its price, and meets *Choice*'s required standards for recommendation. It offers moderate distortion, good sensitivity, an extended low frequency response, and fine stereo imaging. The choice of amplifier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

GENERAL DATA

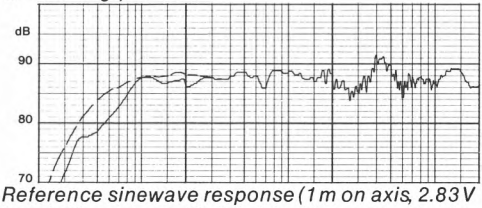
Size (h x w x d)	66 x 26.5 x 41cm
Weight	21.5kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–250W
Recommended placement	open stand
Frequency response within ± 3dB (2m)	64Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	44Hz
Voltage sensitivity (ref 2.83V, *ie*: 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



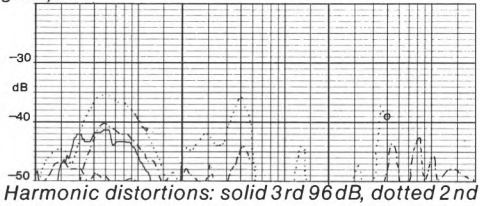
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



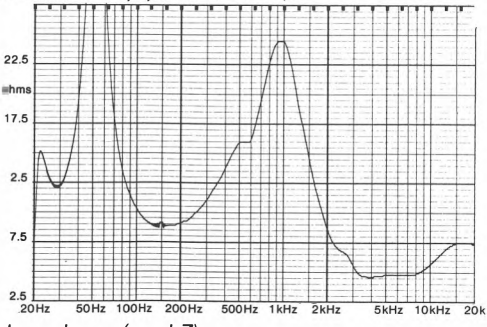
Averaged forward characteristic response in room at listening position.



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



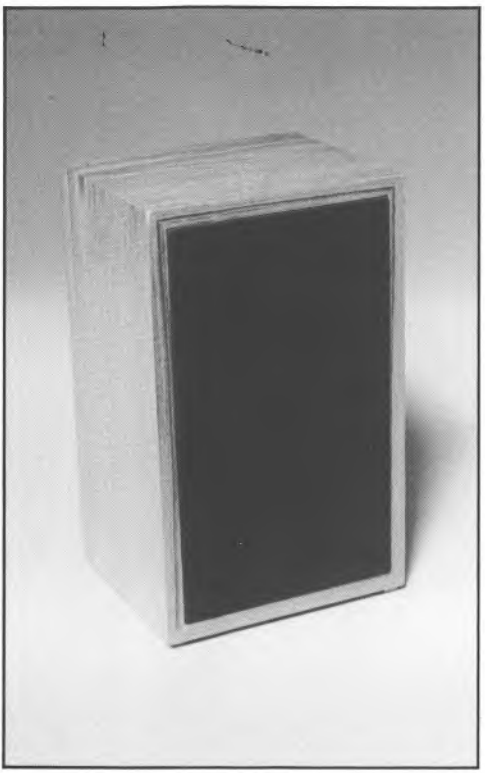
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod Z).

Linn Kan

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



Originally designed using *LS3/5A* enclosure dimensions, the *Kan* looks superficially similar to this model, and in fact uses a Linn-modified version of the same long established *B110* bass/mid driver, together with Linn's choice of tweeter, in this case a version of the Scan 19mm fabric dome unit.

Once inside the enclosure, the differences between this and the *LS3/5A* become more apparent. The *Kan* cabinet is made of high density chipboard containing about 5 litres of air, tuning the system to a low frequency resonance at 74Hz (rather high for a full-range system). The *B110* has small damping pads on its frame, and the enclosure is also clad in bituminous panels as well as fibreboard. Extensive sealing on frames and panels ensures an airtight fit, and to avoid interference by owners (or indeed reviewers) even the front grilles are tightly glued into position. A high power six-element crossover completes the system.

With product as musical and as contentious as Linn's, it is necessary to try to come to terms with the system's philosophy, as well as the individual product. Their disc-centred approach excludes tape, broadcast or digital replay, but they justifiably argue that the analogue LP disc will remain the prime source of programme for the domestic market for some time to come, and that its reproduction should be optimised before all else. Accordingly, as the *Kan* has in the main been designed to complement the Linn record playing system, so its priorities may be expected to conflict somewhat with our objectives of natural stereo and a highly neutral tonal balance. This review therefore follows two paths: first the *Kan* was fully tested and auditioned just like any other model, including blind trials in both stand and wall mounted locations; secondly, its ability to reproduce records was subjectively assessed using some of the key elements of a Linn system (*Ittok/Asak/LP12/*mat).

Lab performance

Nominally designed for wall location like the *Sara* and the *Isobarik*, the reference curve at 1m showed this clearly, with a step of some 5dB between the bass and the upper range, which is somewhat in excess of what is theoretically required. It was difficult to pin down the sensitivity but the curve shape suggested that a surprisingly high 87dB/W corresponded to the aural effect; this is 6dB greater than for the LS3/5A, which is equalised to flatness from 100Hz. The response was smooth but not uniform, the mid being elevated by 2–3dB from 600Hz–2.5kHz, whereas the –6dB rolloff between 70 and 90Hz (depending on location) means that low bass was entirely absent.

With an approximate wall correction shaded in (the greatest lift occurring with positioning near the side walls) the characteristic response looked very uniform, although the mid was still prominent. The 15° above response was superior to the axial curve, so the system should be mounted a little below ear level. As the off-axis curves were free field generated, they will not fully represent the equivalent response against a wall. The room averaged response brought us closer to the truth, and was plotted for both wall and stand mounting. Fine above 1.5kHz, the curves showed a potentially serious prominence 400Hz–1kHz, plus a deficient low-mid to bass region, which was unacceptably poor in the stand position. Even on the wall the 100Hz region was 8dB below the midrange, and it will be very difficult for any perceptive listener to fail to

notice such a serious balance problem. Rated as an 'average' load, the impedance dipped to 4.5 ohms, 3.6kHz, and may need some care in amplifier choice.

On distortion the *Kan* proved outstanding for its size. Just showing overload at 500Hz, 100W, the compression was satisfactory at 0.4dB, with 10.0% 2nd, 1.0% 3rd and 0.3% 5th. At 5kHz it was fine, giving 0.2dB loss with 2.6% 2nd and 0.3% 3rd. Steady state distortion was low even at 96dB, where it was mainly second harmonic. The genuine 100W power capacity meant that high sound levels of 103dBA can be achieved from a pair, and the dynamic range was certainly very good on technical grounds.

Sound quality

Discussing the standard tests first, the system was unacceptable when stand-mounted, as the lab tests indicated. Wall-mounted (no bookcase) it showed more promise, but was still strongly criticised for its unusual balance, the midrange prominence dominating the reproduction of nearly all material. On the live comparisons it was described as 'cuppy', 'thin', 'hard', with a 'ringing' midrange and a slight lack of treble. On the plus side, it sounded 'sharp' and 'lively' on mid transients, which was not unexpected.

Results were also disappointing on the stereo sessions. Grand piano took on a 'tinkly' 'bar room' character, bass was sadly deficient, and the stereo image lacked depth, being spread wide with much less focus than usual on programmes we knew well. It did however withstand surprising amounts of power without distortion, and gave a high level of musical detail, as well as sounding very 'transparent'.

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

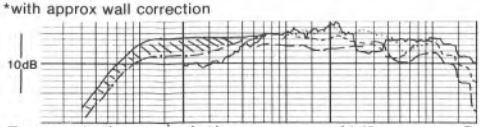
Summary

By *Choice* standards, the mid dominant balance and lack of real bass excludes the *Kans* from recommendation, but Linn have shown that by (or despite? *Ed*) altering the rules of frequency balance, it is possible to achieve an impressive level of clarity, loudness, dynamic range and excitement from a tiny box, and in these areas alone the Kan outstrips many larger systems. If this sort of package appeals, my advice is to try them.

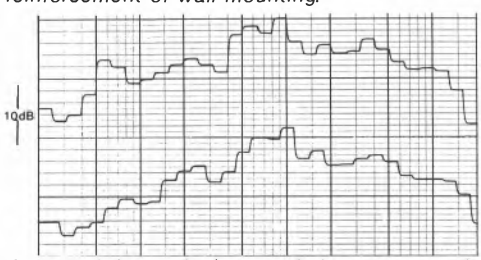
GENERAL DATA

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 ± 3dB (2m)	130Hz to 16kHz*
Low frequency rolloff (−6dB) at 1m	approx 70Hz*
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	88dB/W
Approximate maximum sound level (pair at 2m)	103dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	very good
Typical price per pair inc VAT	£190

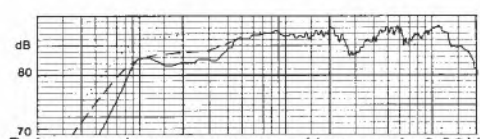
*with approx wall correction



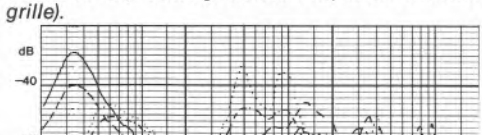
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral). Shading shows possible LF reinforcement of wall mounting.



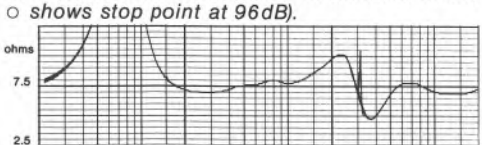
Averaged forward characteristic responses in room at listening position. Above against wall, below clear of boundaries.



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



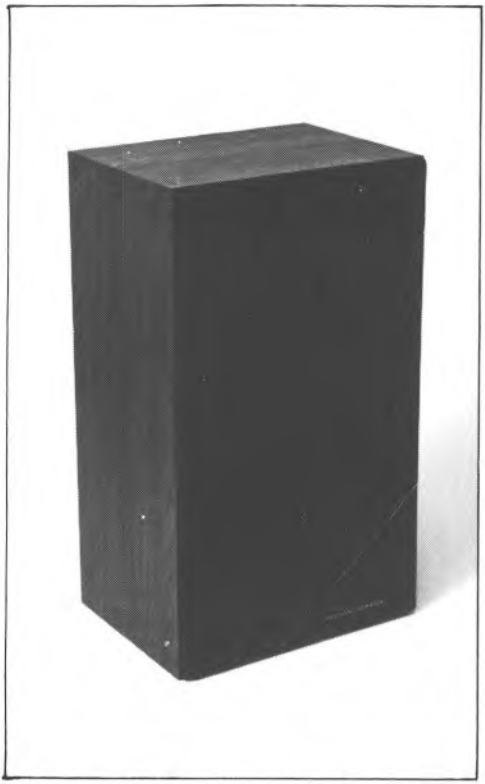
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod 2).

Marantz 445

Marantz Audio (UK) Ltd., 15/16 Saxon Way Industrial Estate, Moor Lane, Harmondsworth, Middlesex UB7 0LW
Tel 01-897 6633



Marantz have in the past shown a talent for producing good value products from what appear to be superficially unpromising constituents, the *HD445* proving just such a case in point. A European model, it is designed and manufactured in Belgium, and comprises a sealed box design of some 20 litres volume. Essentially intended for shelf mounting, if positioned on stands a little below ear level it also gave good results.

Three drivers are used, namely a 200mm pulp cone bass/midrange, a 100mm pulp cone upper-mid, and a Peerless soft dome tweeter, all light enough to be secured in position by woodscrews rather than bolts. Exhibiting quite good component quality, the simple crossover possesses six elements and the light vinyl covered cabinet contains some fibre absorption, but (not unexpectedly) no bracing or damping.

Lab results

Pair matching was pretty good up to 4kHz where a small 1dB imbalance in the treble range was noted. The grille was found to dramatically affect the response, attenuating the 4–8kHz range by 2–4dB, while the upper treble was also depressed. The grille-off results were preferable, and something should be done about this. Sensitivity was high at 90dB/W, and this is assisted by the good 8 ohm nominal impedance, which presents a decent amplifier load with low phase angles throughout. Generous sound levels could thus be attained – 105dBA in a typical room, comparable with much larger systems. The system resonance was rated at 65Hz with an accompanying −6dB response rolloff at a fairly high 72Hz; in practice shelf-mounting would augment this by some 10–15Hz.

The second and third harmonic distortion at 96dB was very good – a not uncommon result for a high sensitivity speaker – but this result was somewhat marred by a rise in third to just over 1% at 700Hz. The 100W pulsed input was a tougher test and perhaps unfair since it produced a whopping 110dB s.p.l. at 1m. Crossover saturation occurred at 500Hz with 2–3% distortion and 0.3dB of compression, but at 5kHz the correspondence was near perfect.

On axis the 1m response using the critical sinewave input was clearly mid-biased but relatively uniform; this was confirmed at 2m with ⅓-octave analysis. However this uniformity quickly disintegrated laterally off-axis, while the 15° vertical response was none too even either. By implication the drive units were not very well integrated, and serious phase and diffraction anomalies made the off-axis sound quality unpredictable.

Sound quality

This speaker scored a rather consistent 'average' throughout, which was most promising in view of its low price. Compared with live sounds some coloration was observed including 'nasal', 'boxy', 'hard' and 'hollow' effects, plus a dulling of the upper treble, and the design did not appear to be particularly subtle. It could however be driven quite hard in the bass, to produce well controlled results with levels of up to 100W peak input on electric bass guitar.

On the stereo sessions the imaging was found better than anticipated and proved good for the price. Sounding fairly lively on most commercial programme, it exhibited a slight 'loud' and

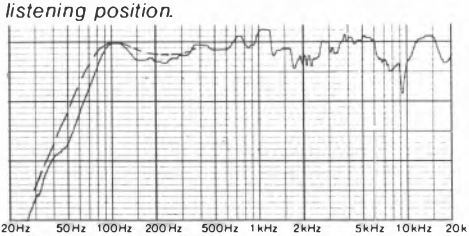
'forward' tendency, but most panelists found it surprisingly plausible.

Summary/Update

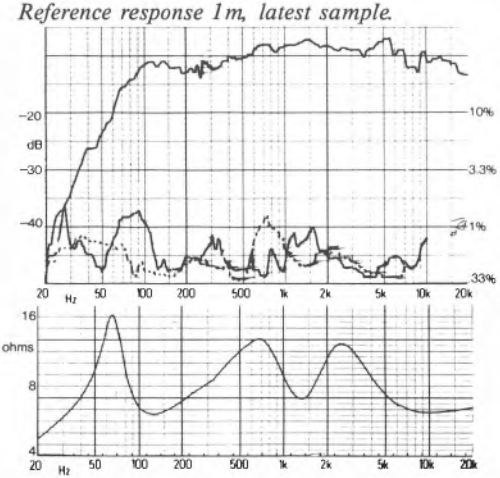
Since last year this speaker has been revised, so we have had another look at it. The new 1m axial curve showed a reduction in mid prominence and a slight reduction in sensitivity to 88dB/W, but was otherwise fairly similar. A room averaged response was taken, which showed a promising trend though still mid dominant, with a rolloff below 50Hz and above 6kHz, and a 'corner' at 12kHz. By this year's standards it was felt that the *445* was no longer as competitive as it had been, particularly with regard to coloration levels, and on balance can no longer merit full recommendation, though it is still worth considering particularly for the rock fan.

Size (H, W, D)	49, 29, 22 (19.3, 11.4, 8.7) cm(inches)
Weight	8.8 (18) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10–100W
Recommended placement	stand near wall or open shelf
Frequency response within ±3dB (2m)	90Hz–20kHz
Low frequency rolloff (−6dB) at 1m	72Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	90dB
Approximate maximum sound level (pair at 2m)	105dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	acceptable
Impedance characteristic (ease of drive)	good
Forward response uniformity	acceptable
Typical price per pair inc VAT	£105

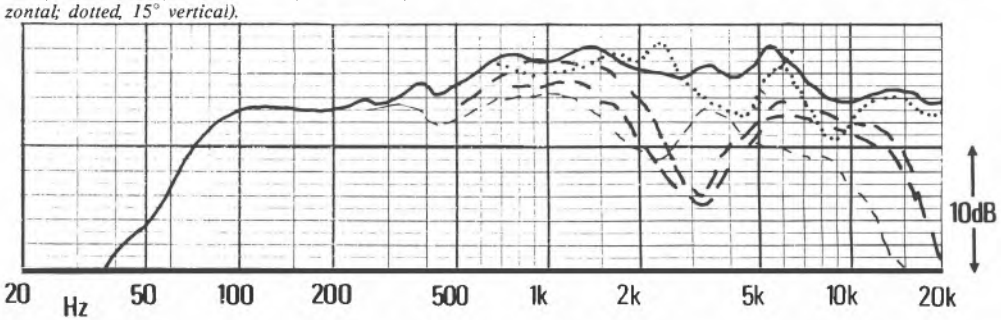
Averaged forward characteristic response in room at listening position.



Reference response 1m, latest sample.



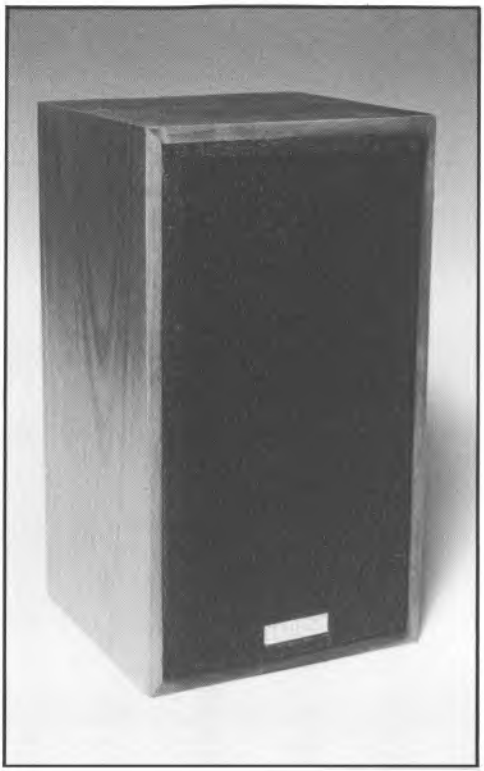
Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



BEST BUY

Mission 700

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



Mission has been active in the speaker market for several years now, but this is the first review in *Choice* of one of their less expensive models, the new *700* model costing around £110 a pair.

A two-way reflexed system of 22 litres internal volume, the attractively finished driver panel is unusual in that the high frequency unit is located beneath the bass/mid driver. This means that the latter will be at ear level if the speaker is positioned on an open stand or low shelf, and the acoustic centres of the two drivers will be the same distance from the listener to compensate for the usual time delay difference when mounted on a plane baffle. A simple three-element plus one resistor crossover divides the input at about 3.5kHz, the bass driver being a special 200mm plastic doped pulp cone, and the treble a 19mm soft plastic dome from SEAS. A simple foam grille minimises diffraction problems, and while the well finished veneered chipboard enclosure is acoustic foam lined, it is nonetheless quite 'live' as it contains no damping.

Lab results

For a budget speaker the pair matching was fairly good, typically to within ±1dB, while the sensitivity was usefully high at 88.5dB/W. Considered a good amplifier load, the *700* generally possessed a 10 ohm impedance with a low point of just under 6.4 at 3kHz, and its sensitivity can thus be fully exploited. The −6dB low frequency cutoff was at a fairly high 66Hz, but this is typical of the box size and sensitivity.

The speaker withstood the full 96dB sound level for the swept distortion test. Third harmonic levels were comparatively low at 1% down to 60Hz, but second harmonic was higher, although still satisfactory at 3% 100Hz, for example. The 100W peak input produced little additional 3rd harmonic content, although some 0.3dB of compression was noted at both 500Hz and 5kHz.

At 1m on axis the critical sinewave analysis showed a well balanced and controlled characteristic, though with some phase cancellation anomalies around the 3kHz crossover region. The response fell off sharply below 70Hz and above 15kHz. At 2m with ⅓-octave averaging the axial irregularity at 3kHz was resolved into a trough 3–4dB deep and about an octave wide, while good vertical integration was demonstrated by the 15° vertical response (taken 'below', and hence nearer the tweeter axis). Interestingly the 30° lateral off-axis curve showed the 3kHz problem as almost resolved, so our recommendation is for an 'over-angled inwards' presentation to give the best all-round results, particularly in regard to stereo imaging. Overall the responses do show a tendency to mid-forwardness from 750Hz to 1.5kHz.

A recent pair checked for this issue was inferior to the original review models, producing a slight bass hump, a lower sensitivity, and a 3kHz notch which was 8dB deep on the median axis. A further pair were requested, and these were found similar to the originals tested a year ago.

Assessed by room averaging, the latest *700* demonstrated a generally good standard of balance from 600Hz, with a mild mid prominence as well as a loss of energy in the presence range. The treble rolloff was smooth and well proportioned.

Sound quality

Scoring 'average' on live sound comparisons, the *700* was judged as offering a pleasant treble

BEST BUY

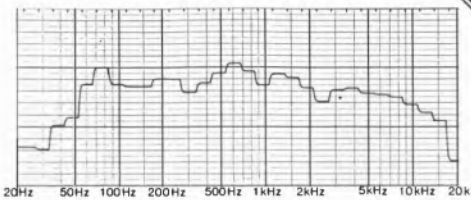
balance but with a loss of presence as well as a degree of 'boxiness' and midrange coloration on voice. The bass was reasonably good, and although 50W average on electric bass guitar was sustained before serious overload, some port 'chuffing' was apparent at 12W average, and fundamental bass notes were inevitably attenuated.

On the stereo tests the first of the '81 pairs was disappointing, with significantly poorer results than for last year. Imaging was less well defined and the system sounded more colored and less open with a tendency to bass boom. Reauditioned using the replacement pair the performance was much better, and we can report good stereo imaging as well as many of the qualities previously noted, namely detail, clarity, smooth treble and a pretty natural balance despite some coloration.

Summary

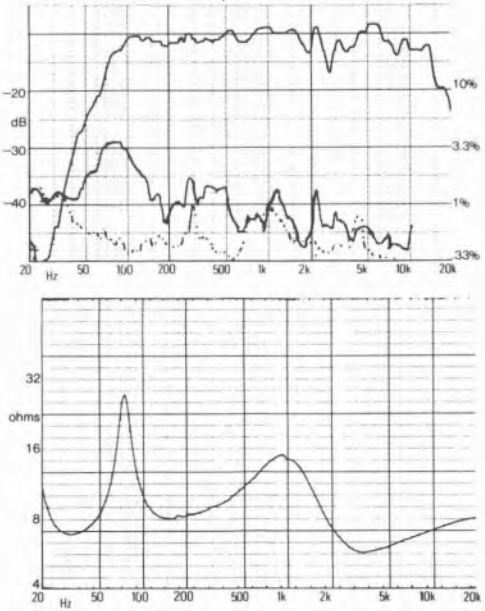
In the intervening year since first reviewed, the *700* has seen some changes, such as the introduction of the ferrofluid-damped tweeter plus certain cabinet improvements. The market as a whole has become more competitive, but we still rate the *700* highly, and at a typical price of £120 a pair it is undoubtedly in the recommended class. Among its virtues are moderate distortion levels, good dynamic range and power handling, plus good sensitivity and favourable amplifier loading. Both the finish and engineering are good for the price.

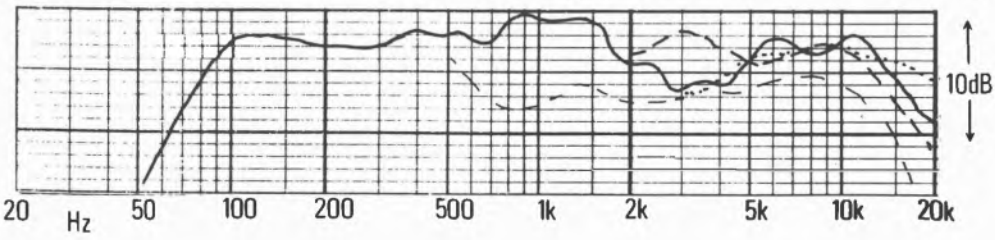
Size (H, W, D)	46, 26, 25 (18, 10.2, 9.8) cm(inches)
Weight	6.5 (14) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15–100W
Recommended placement	open shelf or stand
Frequency response within ±3dB (2m)	80Hz–18kHz
Low frequency rolloff (−6dB) at 1m	66Hz
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms)	88.5dB
Approximate maximum sound level (pair at 2m)	103dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	good
Impedance characteristic (ease of drive)	good
Forward response uniformity	above average
Typical price per pair	£115



Averaged forward characteristic response in room at listening position.

Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).

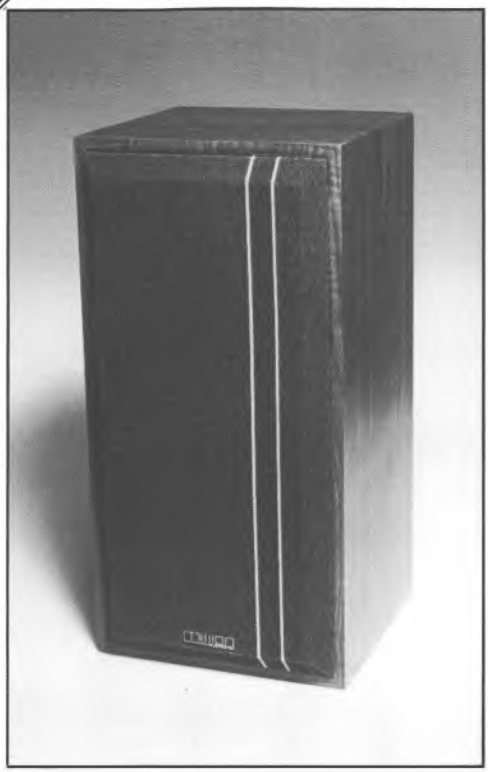




BEST BUY

Mission 727

Mission Electronics Ltd., Unit 9A, George Street, Huntingdon, Cambs. Tel (0480) 57151



This is Mission's latest model, and while it resembles a *700* in terms of its driver arrangement, as regards size and technology it is closer to the prestige *770*. A key design achievement has been cost-saving, the *727* retailing for around £120.00 less than the *770*. And according to our tests at least, this involves very little sacrifice in terms of the end performance.

A two-way reflexed design of some 27 litres internal volume, the enclosure is tuned to 38Hz by a fairly large 64mm diameter port, backed by a short 100mm duct. A new Mission 220mm bass/midrange driver is used, made in France and equipped with a large magnet, a die-cast frame, and a wide flare exclusive polypropylene diaphragm. The treble driver is the same as for the *770*, namely the ferrofluid-damped 25mm plastic dome from SEAS.

The 3-element plus resistor crossover is also similar to the *770*, and relies on carefully tailored driver responses to complete the overall integration of the system. The chipboard cabinet is internally damped by bituminous cladding and a high quality acoustic foam lining. Double lamination reinforces the front baffle, to which the bass driver is rigidly fixed. As with the *700*, the tweeter is mounted below the bass unit to achieve some phase delay compensation on the listening axis (a feature first seen and executed in the KEF *Calinda* a few years back).

In accordance with Mission's current policy, a high acoustic quality foam grille was fitted with two colour-contrasting fine vertical stripes. The cabinet was well constructed and excellently finished, and employed some of the heaviest internal wiring I have ever seen in a loudspeaker; personally, however, I do not feel that savings of tiny fractions of an ohm are particularly important.

Lab performance

One sample of our first pair showed loss in the 2–3kHz range, but this was quickly remedied by Mission, and the solid axial reference curve gives an idea of the correct response measured using the other half of the pair. Meeting +/−2.5dB limits from 60Hz to 17kHz, it nonetheless showed a somewhat lumpy tendency. Sensitivity was however slightly above average at a useful 88dB/W, and the low frequency range was extended at 50Hz, −6dB (Mission claim 'flat' to 50Hz!).

The 2m characteristic responses were somewhat confusing in the vertical plane. Curve A was near perfect (dotted) applied to a microphone axis 15° below the median, while the 15° above response (B), which is supposed to be nearer the true listening axis, shows a severe suckout of −10dB at crossover. More mysterious still is the correction which occurred in the lateral plane, as these traces were very good. Note that Mission advise the speaker should be over-angled towards the listener so that he is 10° or more off-axis, which would agree with our data.

Excellent dynamic range was shown by the *727*, which is deemed capable of accepting 200W per channel and yet operates satisfactorily on as little as 10W, and has the ability to produce up to 106dBA for a pair. 100W pulses were superbly handled with little compression, and typically 1% of 2nd and 0.3% of 3rd harmonic at both 500Hz and 5kHz. Steady state distortion measurements confirmed the story, the curves dominated by harmless 2nd harmonic with only a minor distortion region around 300Hz worthy of comment.

Some of the response 'lumpiness' mentioned earlier did show itself in the averaged room

analysis. Energy prominence was present at 60Hz and 600Hz, while in relative terms the presence band was slightly depressed; I am sure a little more attention to the crossover could improve matters here. Despite these criticisms, the room response nonetheless met +/−4dB limits from 40Hz to 12kHz which is a presentable result.

Sound quality

Achieving consistently good scores throughout the listening tests, it is fair to say that while the *727* was not free of idiosyncracies or faults, it was generally liked. When compared with live sounds, some 'boxy' mid emphasis was noticed, together with a slightly exposed and almost 'ringing' treble, while the mid balance was a trifle 'thick', but not enough to spoil the marking. The bass showed some loss of power in the lowest register, but it was above average in evenness and clarity, accepting high inputs of beyond 300W without serious overload.

On recorded programme the sound was smooth in character and a little recessed, with some chestiness and nasality. The presence band was noted for its slightly 'distant' quality, allowing the treble to stand out in mild relief. Despite this, clarity and detail were good, and the overall effect was pleasant, with the stereo image quality and depth presentation very promising.

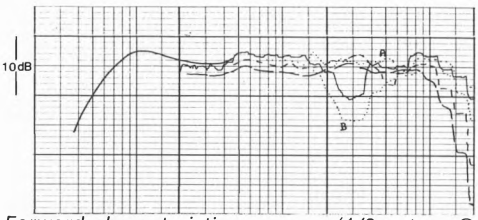
Summary

Though a little 'characterful', with minor quirks in off-axis response, the *727* achieved ratings worthy of much more expensive models. To this success must be added an easy to drive impedance of true 8 ohm rating, an above average sensitivity, and a wide dynamic range, plus fine power handling, low distortion, small dimensions and fine finish. At £250.00 a pair, it obviously deserves Best Buy rating.

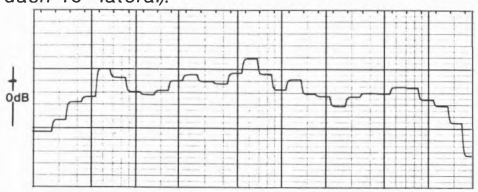
GENERAL DATA

Size (h x w x d)	57 x 29 x 28cm
Weight	10.5kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–200W
Recommended placement	open stand
Frequency response within ± 3dB (2m)	65Hz to 18kHz*
Low frequency rolloff (−6dB) at 1m	50Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	88dB/W
Approximate maximum sound level (pair at 2m)	106dBA
Impedance characteristic (ease of drive)	very good
Forward response uniformity	fairly good
Typical price per pair inc VAT	£245

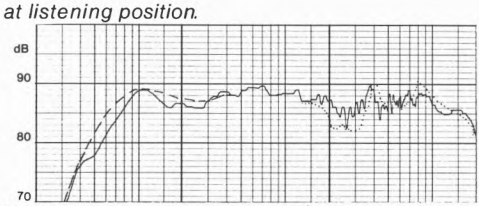
*second sample



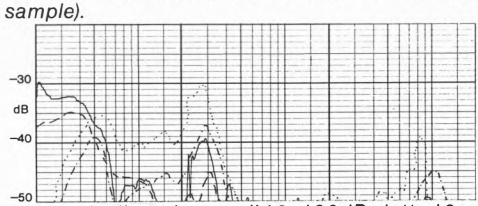
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



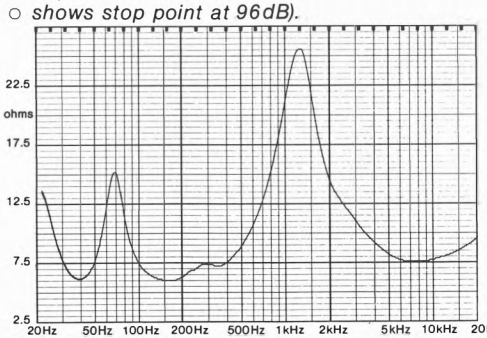
Averaged forward characteristic response in room at listening position.



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



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

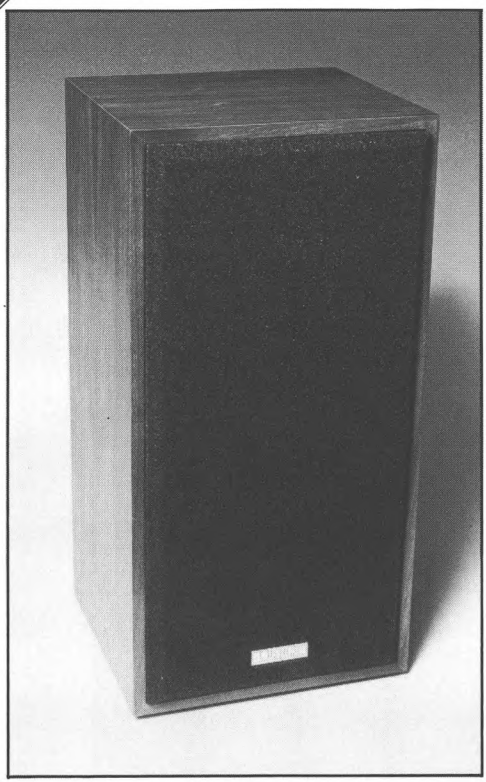


Impedance (mod 2).

RECOMMENDED

Mission 770 III

Mission Electronics Ltd., Unit 9A, George Street, Huntingdon, Cambs. Tel (0480) 57151



Following my criticism of the constant updating of this well established loudspeaker in an earlier issue, I have been given official permission to call this Autumn '81 series the *Mark III*. Throughout the changes the essential character of the speaker has been retained as well as the underlying design philosophy. Despite its size (just 35 litres internal volume), the *770* is intended as the no-compromise flagship of the Mission range. It aims to provide a high standard of dynamic range, distortion, clarity, neutrality and stereo imagery.

All versions have used a two-way vertical-in-line configuration, reflex-loaded by a small ducted port. The 210mm die-cast magnesium frame bass unit is a Mission design using their own polypropylene diaphragm and a high power high-linearity motor; the latest version also uses polypropylene for the rigid central reinforcing dustcap/dome. Rated up to 200W, the bass unit motor has a magnetic flux damping system. This helps to reduce distortion under conditions close to mechanical overload, as well as control the overall excursion when beyond the designed working limits. Ferrofluid damping is used in the SEAS 25mm plastic dome tweeter, and careful control of the driver characteristics has allowed a relatively simple 3-element plus resistor cross-over which can handle high powers. Superbly finished in an improved grade of American walnut, the enclosure is fitted with bituminous panel damping, an absorptive foam lining, and an acoustically good foam grille. Heavy duty screw terminals are fitted and the system is normally fused at 2.5 amps; for the arduous *Choice* test programme it was suggested that the rating be upgraded to 5.0 amps. (It is known that small fuses can have a minor effect on sound quality, but it was suspected that this departure from the specification would have little effect upon the end result.)

Lab performance

The distortion data has been brought forward from the previous issue, while new measurements include the 1 m reference curve. This reveals that the sensitivity has been slightly reduced to an average 86dB/W, and that the frequency response is now rather flatter than before, while the earlier tendency to a slight mid prominence is now better controlled. At 1 m on axis the *770 III* met +/−2.5dB limits, 50Hz–16kHz, which is a fine result. The bass is more extended to 45Hz, −6dB, again a good result for the size.

The new impedance curve shows a dip to 4.6 ohms at 5kHz, denoting an average amplifier rating, although few high quality models will be upset by this. It also revealed that both the driver resonance and the enclosure resonance have been reduced in frequency compared with those last year, changes associated with the improved bass extension previously noted.

Checks revealed the distortion was much the same as before with fine values throughout, plus very competent handling of the 100W pulses at 500Hz and 5kHz. Over most of the range the distortion was under 1.0% at 90dB and below.

The forward characteristic response showed a very good result with fine balance and off-axis consistency, particularly in the lateral plane. This improved balance was confirmed by the room averaged analysis which illustrated a worthy result (+/−3.5dB 50Hz to 5kHz), with a general consistency that was difficult to fault. The slight loss at 15° above axis suggests that the speaker should be stand mounted with the treble units approximately at ear level.

Sound quality

Showing improvements in terms of the consistency of tonal character over a wider variety of programme than before, good results were obtained on both live and stereo session. The *770* was felt to be 'richer' than before, and although the slightly 'hard', 'cold' quality previously apparent had helped to mask residual box colorations, the new balance was tonally more accurate and made for more relaxed listening.

Well above average on the live comparisons, some 'chestiness' and 'boxiness' was present, but the effect was lively and clear, with good transient definition. The bass proved reasonably deep with an even character, and although a progressive increase in port chuffing and distortion was evident to a mild degree, the speaker took 500W of electric bass guitar without distress or subjective overload. Rated at 200W it clearly offers a good dynamic range capable of up to 104dBA for a pair in an average listening room; 20W is a sensible minimum power for more modest levels.

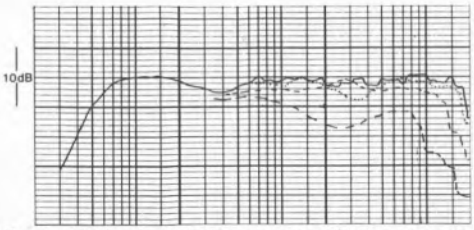
On the stereo session the speaker appeared better integrated than before, and gave a good performance in all regions of the spectrum. Image quality was to a high standard with above average depth presentation.

Summary

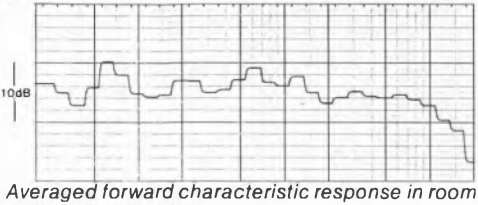
Despite a price somewhat higher than its immediate competition, the *Mk III* is clearly the most refined *770* yet and merits recommendation. A compact system, it offers an extended frequency range, plus an even, neutral, 'tuneful' character with low distortion and excellent finish. It is worth noting that the price includes stands.

GENERAL DATA

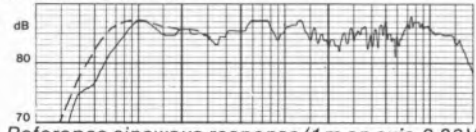
Size (h x w x d)	59 x 30 x 28.5cm
Weight	12.8kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–200W
Recommended placement	stand, clear of walls
Frequency response within ± 3dB (2m)	54Hz to 18kHz
Low frequency rolloff (–6dB) at 1m	45Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	86dB/W
Approximate maximum sound level (pair at 2m)	104dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	very good
Typical price per pair inc VAT	£385



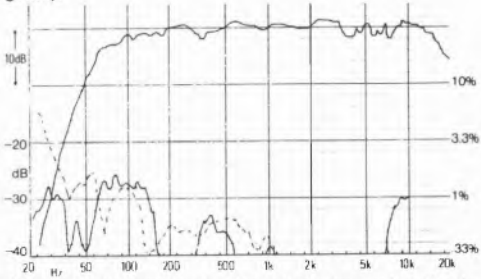
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



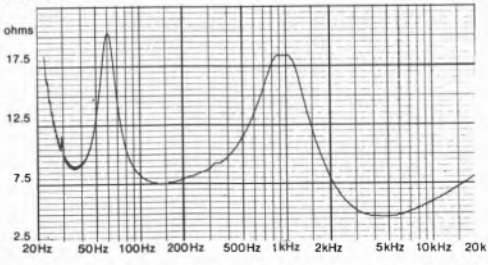
Averaged forward characteristic response in room at listening position.



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



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



Impedance (mod Z).

HYPER FI
Discount & Service

FREE DELIVERY HYPER FI TWO YEAR GUARANTEE

WE WILL MATCH ANY ADVERTISED PRICE AND STILL OFFER OUR UNIQUE 2 YEAR GUARANTEE. PLEASE RING FOR DETAILS

HYPER-FI HOTLINES: 01-591 6961/6962

OUR SPECIAL BARGAINS

We will match any Advertised price (on all Brand New current merchandise in stock and still offer our unique 2 year guarantee, and friendly service.

WHY BUY FROM HYPER FI ?

With our enourmous purchasing power we specialise in offering the best value in Hi—Fi available today.

We offer fast and friendly service that's second to none:—

1. 2 year guarantee (Parts & Labour) with our own engineers at hand on the premises (Hi-fi equipment only).
2. Free Securicor delivery (fully insured) on any equipment.
3. 14 Days Home Trial. If the Hi-Fi you buy from Hyper-Fi does not suit, return within 14 days in its original condition and we will happily exchange it for alternative goods. STOCKISTS OF:- Aiwa, Akai, ADC, A.R. Aurex, Celestion, Hitachi, J.V.C. Optonica, Marantz, Pioneer, Rotel, Sansui, Sony, Panasonic, Technics, Wharfdale — in fact all leading Hi-Fi brands available in this country.

PHONE THE HOTLINES:
Barking 591-6961/ 594 9901
Mail Order (Barking) 591-6962
Brighton 683335
B/Green 980 1936
H/church 74556
S/London 674 2033
W/stow 520 3989

HYPER FI EXCLUSIVE S

AKAI ATS08
AM-FM Digital Tuner
Auto Scanning, 20 presets. 0.9 Mv sensitivity. What Hi-Fi Guide Price (Jan.81) £360.
HALF PRICE EXCLUSIVE
Hyper Fi Price **£169.95**

PIONEER
SX 1980 Quartz Lock AM/FM Receiver D.C. Power amp. Independent Power Supplies. 270 watts RMS/Both\n 20-20Hz. 0.03% T.H.D. 3 Speaker Outputs, 2 Phono Inputs. 2 Tape Inputs. Twin Tone Controls. What Hi-Fi Guide Price (April 80) £820.
HALF PRICE EXCLUSIVE
Hyper Fi Price **£349.95**

TOSHIBA PC445
FRONT LOAD DOLBY CASSETTE DECK
Metal compatible sendust rec/playback head. 3 position bias/eq. switches. L.E.D. bar/peak meters. Auto repeat and output level control. What Hi-Fi Guide Price (March 81 £153.00
HYPER FI EXCLUSIVE
Hyper Fi Price **£89.95**

Technics SA202L
30 Watt RMS RECEIVER
3 Waveband T.A.D. 0.045
Twin Speaker Outputs
What Hi-Fi Guide Price May 1981 £149.95
Hyper Fi Price **£99.95**

DITTON 121 CELESTION
2-Way Infinite Baffle. 5-40 Watts Teak effect with black fronts
Hyper Fi Price **£69.95**

AKAI GXM50
GXM50 3-Head Cassette Deck. Super GX heads. Metal tape. Program search. W & F 0.14% frequency 25.–21KHz. What Hi-Fi Guide Price (Jan.81) £230.
Hyper Fi Price **£149.95**

PIONEER SA708
Stereo Integrated Amplifier. 65 watts per channel R.M.S. 20Hz–20KHz 0.02% T.H.D. D.C. Magic-eye design. Frequency response 10-50,000Hz. Two way dubbing. FLT meters. Four way speakers.
What Hi-Fi Guide Price Jan.'81 £192.
SAVE OVER £80 HYPER FI EXCLUSIVE
Hyper Fi Price **£99.95**

Technics SA-101L
FM/MW/LW STEREO RECEIVER
18 w. per channel R.M.S. at 8ohms from 40Hz–20KHz. THD only 0.04%. Two-stage Darlington connection IC output stage. Phono S/N ratio 70dB. Dual-gate MOS FET FM front end. Two flat-group-delay ceramic filters on IF stage. High linearity quadrature detector. PLL IC in FM MPX. Five-LED signal strength indicator. FM muting/mode selector. Main and remote speaker switches. Tape monitor switch.
HYPER-FI EXCLUSIVE
HYPER FI PRICE £79.95

ROTEL RP1000
Direct drive turntable. D.C.Motor. Auto Stobe with speed control. 4% glass fibre head shell. W+F 0.03% WHAT HI-FI GUIDE PRICE APRIL '81 £110
HYPER-FI PRICE **£59.95**
Also supplied with ROTEL RMc7 moving coil cartridge £69.95 (worth £35)

ROTEL RMC 7
Moving coil cartridge. (Same as AT 30E) Frequ. response 15–25,000Hz. Channel separation. 25 D.B. tracking force. 1.4-2 grams. Nude elliptical diamond.
What Hi-Fi Guide Pr. 30-4-81 £35. HYPER-FI PRICE **£14.95**

AKAI GXF80BL
GXF808L. 3 head 2 motor cassette deck. Super GX head. solenoid logic controls. W&F 0.09% frequency 25–21Khz. S/N ratio 62D.B. Prof. black finish. What Hi-Fi Guide Price (Jan.81) £300.
Hyper-Fi Price **£179.95**

PIONEER SX980
DC Power Amplifier power output 80 watts R.M.S. at 8 Ohms. 20Hz–20Khz. 0.05% THD and IMD.
Hyper Fi Price **£199.95**

Grado
Grado FCE + 1 Complete with ADC LMG1 Magnesium Headshell.
Hyper Fi Price **£13.50** POST FREE

ortofon ABC HALF PRICE
Ortofon VMS 20E Mk.2 Makers C.T.N.
Fitted in A.D.C. L.M.G.I. Magnesium Headshell.
Hyper Fi Price **£21.95** POST FREE

AKAI GXC4000D. 3 Head Stereo Deck. GX Heads. 4 Track 2 Channel Stereo System. S.O.S. Mic Line mixing. 2 Speed. In black professional finish. In Stock NOW.
Exclusive Hyper Fi Price **£199.95**

TOSHIBA SA520. 50 watts
HYPER FI EXCLUSIVE
R.M.S. Receiver. T.H.D. 0.05%. Twin Speaker outputs. Twin tape inputs. High-low filter. Beautiful walnut finish cabinet. What Hi-Fi Guide Price £215.
Hyper Fi Price **£99.95**

MARANTZ SD1015
Front load Dolby Cassette. Metal tape facility. Frequency 35Hz-17KHz. Wow & Flutter 0.08%.
Hyper-Fi Price **£59.95**

MARANTZ CD 320
Prof. port. Stereo cassette Dolby mains/batt. Permalloy head. Servo con. Dual flywheel.
HYPER-FI PRICE **£79.95**

TOSHIBA RT 8630S
Superb Stereo Radio Cassette M.Q.S.S. (Music Quick Selector System) AC/DC. 4-way speakers, 6w. output. 4 waveband. Our previous price £89.95
Special Offer Price **£69.95**

AKAI
38 watts RMS. Bohms both chans. driven 20-20KHz. 2 speaker outputs. L.E.D. Power Indicators. Twin tape input F.M. muting.
HYPER-FI EXCLUSIVE **£99.95**

CELESTION DITTON CS7
Export version of Ditton 44. 100 watts handling 12" base unit 5" mid-range. 1" mid-range. Walnut Finish.
What Hi-Fi Guide Price Aug. 80 Ditton 44 £285.
Ditton CS7
HYPER FI EXCLUSIVE
£169.95

Technics
Z11 System
25 Watt Output
3 Band Tuner
Free Delivery
Metal tape solenoid control, complete with belt drive turntable, magnetic cartridge 3 way speakers, deluxe rack, full length glass door.
Hyper Fi Price **£389.95**

CELESTION CS 5
Exp.version of Ditton 332 80 watts handling 10" base unit 5" mid-range,1" dome. Walnut or Black finish
HYPER-FI SCOOP
What Hi-Fi Guide Price March 81 £269.95. **£139.95**

MITSUBISHI BB1207
12" Monochrome T.V. AC/DC operation. Brilliant quality, two year guarantee.
Hyper-Fi Price **£59.95**

Technics SU-Z11 STEREO INTEGRATED AMPLIFIER
25 watts RMS 0.08% T.H.D
L.E.D. Peak power indicator. Thin tape input, twin speaker output. Attractive slimline design. 430mm width.
HYPER-FI EXCLUSIVE **£79.95**
Matching slimline Tuner ST-Z11L. **£59.95**

HYPER FI TWO YEAR GUARANTEE FREE DELIVERY HYPER FI TWO YEAR GUARANTEE FREE DELIVERY HYPER FI TWO YE

TWO YEAR GUARANTEE FREE DELIVERY HYPER FI TWO YEAR GUARANTEE FREE DELIVERY

AMPLIFIERS

AKAI

AMU11(20)	£59.95
AMU22(28)	£79.95
AMU33(43)	£109.95
AMU55(55)	£139.95
AMU06(72)	£149.95

AUREX

ST T50	£109.95
ST 10L	£114.95
ST 55	£169.95

HITACHI

FT 4400	£109.95
FT 3400	£69.95

J.V.C.

TX 1L	£79.95
TX 2L	£133.95
TX 3	£98.95
TX 3L	£159.95
TX 10L	£67.95

MARANTZ

ST 310	£64.95
ST 510	£149.95
ST 450	£99.95

OPTONICA

ST 3636	£79.95
ST 5100	£99.95
ST 7100	£179.95
ST 9100	£379.95
ST 5200	£129.95
ST 1616	£49.95

PIONEER

TX 608L	£69.95
F7	£189.95
F9	£239.95
TX-9	£69.95
TX-9	£139.95

ROTEL

RT 300	£54.95
RT 1000	£87.95

SANSUI

T5	£74.95
T7	£99.95
T9	£119.95
TUS 5	£119.95
TUS 7	£149.95

TOSHIBA

ST225	£79.95
ST230	

SONY

STJX2L	£72.95
STJX4L	£119.95
STJX5L	£139.95
STJ60	£109.95

TECHNICS

ST-Z1L	£49.95
ST S1L	£74.95
ST S7/7K	£179.95
ST 8044	£98.95
ST S2L	£89.95
ST S4L	£129.95
ST S4T/	
ST S4TK	£149.95
ST S6K	£179.95

TRIO

KT 4001	£49.95
KT 601	£87.95
KT 413	£129.95

CASSETTE DECKS

AKAI

CSM3	£69.95
CSM5	£89.95
CSM02	£89.95
GXM10	£119.95
GXM30	£129.95
GXM60	£149.95
CSF11	£109.95
GXF 80	£179.95
GXF 35	£159.95
GXF 33 (Auto R)	£169.95

AUREX

PCX6AD	£149.95
PCX25AD	£109.95
PCX45AD/ 44AD	£139.95
PCX88AD	£199.95

AIWA

ADM2000	£89.95
ADM800	£229.95
AD3100	£99.95
AD3200	£129.95
AD3500	£169.95
AD3600	£189.95
ADR500	£189.95

HITACHI

D22SII	£69.95
DE25	£79.95
D35S	£84.95
DE55	£109.95
DE95	£179.95

J.V.C.

KDA 11	£79.95
KDA 33	£119.95
KDA 7	£229.95
KDA 66	£219.95
KDD 35	£124.95
KDO 4	£149.95
DE 5	£154.95
DO5	£164.95
DD7	£289.95
DD9	£394.95

OPTONICA

RT 5100	£109.95
RT 5200	£139.95
RT 7000	£169.95
RT 7100	£249.95
RT7070	£239.95

MARANTZ

SD 1010/1015	£64.95
SD 5010	£189.95
SD 1030	£249.95
SD 2030	£119.95

PIONEER

CT 320	£89.95
CT 520	£114.95
CT 720	£169.95
CT 4	£129.95
CT 5	£159.95
CT6R	£189.95
CT 7R	£249.95
CT 8R	£329.95
CT 9R	£369.95

ROTEL

RD 18F	£79.95
RD 1000	£166.95
RD 300	£79.95

TUNERS

AKAI

ATK11L	£59.95
ATK33L	£109.95
ATS66L	£159.95
ATS08	£169.95

AUREX

ST T50	£109.95
ST 10L	£114.95
ST 55	£169.95

HITACHI

FT 4400	£109.95
FT 3400	£69.95

J.V.C.

TX 1L	£79.95
TX 2L	£133.95
TX 3	£98.95
TX 3L	£159.95
TX 10L	£67.95

MARANTZ

ST 310	£64.95
ST 510	£149.95
ST 450	£99.95

OPTONICA

ST 3636	£79.95
ST 5100	£99.95
ST 7100	£179.95
ST 9100	£379.95
ST 5200	£129.95
ST 1616	£49.95

PIONEER

TX 608L	£69.95
F7	£189.95
F9	£239.95
TX-9	£69.95
TX-9	£139.95

ROTEL

RT 300	£54.95
RT 1000	£87.95

SANSUI

T5	£74.95
T7	£99.95
T9	£119.95
TUS 5	£119.95
TUS 7	£149.95

TOSHIBA

ST225	£79.95
ST230	

SONY

STJX2L	£72.95
STJX4L	£119.95
STJX5L	£139.95
STJ60	£109.95

TECHNICS

ST-Z1L	£49.95
ST S1L	£74.95
ST S7/7K	£179.95
ST 8044	£98.95
ST S2L	£89.95
ST S4L	£129.95
ST S4T/	
ST S4TK	£149.95
ST S6K	£179.95

TRIO

KT 4001	£49.95
KT 601	£87.95
KT 413	£129.95

CASSETTE DECKS

HST 600	£198.95

PIONEER

RX10L	£149.95
RX20L	£299.95
RX70	£299.95

RECEIVERS

AKAI

AAR30(40)	£99.95
AAR21L(26)	£119.95
AAR31(38)	£139.95

J.V.C.

RS 55L(40)	£174.95
RS 7760 SE(A)	£239.95
RS11(25)	£99.95
RS33L(40SE/A)	£149.95
R1XL	£109.95

PIONEER

SX400L(20)	£89.95
SX 600(20)	£99.95
SX 700(40)	£129.95
SX D500(80)	£299.95
SX 890(60)	£189.95
SX 980(80)	£199.95
SX 1080(120)	£249.95
SX 1980(270)	£349.95

ROTEL

RX 100(40)	£134.95

SANSUI

R5L(26)	£99.95
R7(46)	£129.95
R88Z(30)	£139.95
3800Z(40)	£189.95
4900Z(65)	£229.95
5800Z(75)	£259.95

TECHNICS

SA400(52)	£139.95
SA500(70)	£169.95
SA 101L(20)	£79.95
SA 202L(30)	£109.95
SA 303L(40)	£129.95
SA 313L	£139.95
SA 515L	£279.95

SONY

STR VX2L	£119.95
STR VX3L	£149.95
STR VX4L	£229.95
STR S5L	£259.95

TOSHIBA

SA 750 (50)	£119.95

TRIO

KR710L	£109.95
KR720	£169.95
KR80	£194.95

CASSETTE DECKS

AKAI

CSM3	£69.95
CSM5	£89.95
CSM02	£89.95
GXM10	£119.95
GXM30	£129.95
GXM60	£149.95
CSF11	£109.95
GXF 80	£179.95
GXF 35	£159.95
GXF 33 (Auto R)	£169.95

AUREX

PCX6AD	£149.95
PCX25AD	£109.95
PCX45AD/ 44AD	£139.95
PCX88AD	£199.95

AIWA

ADM2000	£89.95
ADM800	£229.95
AD3100	£99.95
AD3200	£129.95
AD3500	£169.95
AD3600	£189.95
ADR500	£189.95

HITACHI

D22SII	£69.95
DE25	£79.95
D35S	£84.95
DE55	£109.95
DE95	£179.95

J.V.C.

KDA 11	£79.95
KDA 33	£119.95
KDA 7	£229.95
KDA 66	£219.95
KDD 35	£124.95
KDO 4	£149.95
DE 5	£154.95
DO5	£164.95
DD7	£289.95
DD9	£394.95

OPTONICA

RT 5100	£109.95
RT 5200	£139.95
RT 7000	£169.95
RT 7100	£248.95
RT7070	£229.95

MARANTZ

SD 1010/1015	£64.95
SD 5010	£189.95
SD 1030	£249.95
SD 2030	£119.95

PIONEER

CT 320	£89.95
CT 520	£114.95
CT 720	£169.95
CT 4	£129.95
CT 5	£159.95
CT6R	£189.95
CT 7R	£249.95
CT 8R	£329.95
CT 9R	£369.95

ROTEL

RD 18F	£79.95
RD 1000	£166.95
RD 300	£79.95

SANSUI

D85M	£84.95
D350M	£179.86
D550M	£214.95
D100M	£99.95

SHARP

RT 10F	£59.95
RT 11SII	£99.95

SONY

TCFX2	£78.85
TCFX3	£99.96
TCFX5C	£159.95
TCFX6C	£184.95
TCFX7	£249.95

TEAC

CX 310	£79.95
CX 410	£149.95
A 108 SYNC	£129.95
CX 350	£99.95

TECHNICS

RSM 51	£159.95
RSM 215	£89.95
RSM 206	£74.95
RSM 225	£109.95
RSM 230	£139.95
RSM 260/ RSM 260X	£159.95
RSM 260	£179.95
RSM 65	£149.95
RSM 270X	£219.95
RSM 280X	£239.95

TOSHIBA

PC 230	£59.95
PCX 10	£89.95
PCX 12	£69.95

TRIO

KX 400	£79.95
KX 500	£109.95
KX 600	£139.95
KX 800	£194.95

TURNTABLES

A.D.C.

BSR Quanta 600	£39.95

AKAI

APD 33C	£74.95
APB 21C	£49.95
AP 207	£119.95
APD55C	£94.95

AUREX

SRO 550	£99.95
SRO 770	£99.95

HITACHI

HT 324 II	£49.95
HT 40 S	£69.95
HT 41 S	£79.95
HT 660	£174.95

J.V.C.

LF 66	£89.95
QLA5R	£93.95
QLF1	£119.95
QLF6/X1	£224.95
QLF73F	£163.95
QLFY5F	£199.95
LA 21	£59.95
LA 31	£70.95
LA 41	£94.95
QLA 51	£104.95
LA 71	£144.95
LE 5	£139.95

MARANTZ

6025	£49.95
TT 2200	£69.95
TT2200	£68.95
TT4200	£79.95

OPTONICA

RP 5100	£109.95
RP 7100	£159.95

PIONEER

PL100	£54.95
PL2/PL120	£59.95
PL4/PL320	£84.95
PL6/PL120	£109.95
PL7/PL720	£139.95
PLB	£174.95

ROTEL

RP 310	£48.95

SANSUI

FR03	£69.95
FRD 255/Cart	£64.95
FRD 35/Cart	£84.95
FRD 45/Cart	£128.95

SONY

PSX 75	£168.95
PSLX 2	£239.95
PSLX 4	£94.95
PSLX 5	£109.95

TRIO

KD 1500	£54.95
KD2070	£79.95
KD3100	£92.95

TECHNICS

SLB2/SLB202	£68.95
SL B3	£84.95
SLD2/SLD202	£84.95
SLD3/SLD303	£99.95
SLD2/SLD202	£119.95
SLQ303	£134.95
SL 1800	£174.95
SL 1300	£199.95
SL 10	£299.95
SL 7	£179.95
SLDL 1	£159.95
SLQL 1	£198.95
SL 1200	£179.95
SL 1201	£149.95

SPEAKERS

ACOUSTIC RESEARCH

AR1BS	£89.95
AR2BS	£129.95
AR3BS	£169.95
AR 8S	£69.95
AR4BS	£229.95
AR9ZS	£289.95

AKAI

SWT 30	£99.95
SWT 50	£159.95
SWT 70	£189.95

CASTLE

Clyde	£89.95
Richmond II	£124.95
Kendal II	£174.95

CELESTION

Ditton 120	£57.95
Ditton 121	£69.95
Ditton 130	£109.95
Ditton 150	£139.95
Ditton 200	£184.95
Ditton 300	£224.95
Ditton 44	£284.95
Ditton 551	£249.95
Ditton 332	£269.95
Ditton 100	£69.95
Ditton 110	£89.95

IMF

T.D.L. 852	£69.95
Super Compact II	
	£169.95
ALS 30	£199.95

J.B.L.

55 Radiance	£129.95
77 Radiance	£179.95
99 Radiance	£219.95

J.V.C.

SK 600 II	£109.95

K.L.H.

331	£79.95
312	£134.95

MORDANT SHORT

Carnival	£149.95
Festival	£117.95
Pagent	£174.95

PIONEER

CS353(30)	£69.95
CS454(40)	£89.95
CS656(60)	£99.95
HPM-70(80)	£149.95
HPM300(60)	£129.95
HPM500(80)	£178.95
HPM50(80)	£164.95

RAM

Compact	£84.95
CD 10	£104.95
CD 20	£134.95
60	£194.95
70	£244.95
80	£289.95
P.M.S. 400	£649.95
LS 35/A	£149.95

ROGERS

LS 35/A	£178.95

SANSUI

ES 207	£147.95
ES 209	£169.95
J11	£79.95

TECHNICS

SB 3030	£99.95
SBA3	£148.95
SBA4	£186.95
SB 3050	£119.95

TENSAI

TS 9040	£99.95
TS 1000	£199.95
TS 9035	£79.95

TANNOY

T115 Cambridge	£119.95
T125 Oxford	£139.95
T145 Ascot	£199.95
T165 Chester	£199.95
T185 Dorset	£249.95
T225 Mayfair	£249.95
Chevriot II	£399.95
Berkeley II	£499.95
Arden II	£579.95
Windsor	£1299.95
Buckingham	£1999.95

TANGENT

Excelsior	£89.95
SPL1	£79.95
TM3	£129.95
XL-R2	£174.95

WHARFDALE

Laser 40	£64.95
Laser 60	£79.95
Laser 80	£99.95
Laser 100	£129.95
Laser 200	£149.95
Laser 400	£169.95
E20	£139.95
E30	£174.95
E50	£269.95
E70	£314.95
E90	£449.95

REEL REEL

AKAI

GX 625	£359.95
GX 4000 DBL	£199.95
GX 4000 DB	£219.95

PIONEER

RT 707	£399.95

SONY

TC 399	£219.95

TEAC

X7	£339.95
X3	£289.95
3440	£699.95

EQUALIZERS

AKAI

EA G40	£99.95
EA G80	£199.95

A.D.C.

SS1	£49.95
SS10	£79.95
SS2II	£119.95
SS3	£169.95

J.V.C.

SEA 20GL	£89.95
SEA 50	£144.95
SEA 70	£164.95

MARANTZ

IQ10	£87.95

PIONEER

SG 9800	£249.95

ROTEL

RE 700	£67.95
RE 500	£67.95
RE 1010	£87.95

SANSUI

SE 70	£129.95
SE 5	£89.95

TECHNICS

SH 8010	£99.95
SH8015/8015K	£99.96
SH8030	£189.95

TRIO

GE 80	£79.95

RACK SYSTEM

AKAI

PRO 1011W	£359.95
PRO 1032W	£429.95
PRO 1033W	£539.95
PRO 1065W	£639.95
PRO 3033	£999.95
PRO 911LW	£299.95
PRO 931LW	£359.95

AUREX

50 System	£514.95
66 System	£699.95

HITACHI

FULL RANGE	P.O.A.

J.V.C.

G10	£299.95
GR100	£289.95
GR303	£344.95
GX5	£529.95
GX200	£509.95
GX400	£699.95

MARANTZ

Module 250	£439.95
Module 250	£439.95

OPTONICA

5100 System	£449.95
7100 System	£849.95
9100 System	£1799.95
4100 System	£449.95

PANASONIC

SG 40	£329.95
SG 166	£398.95
2800	£359.95

PIONEER

X 330(No L/S)	£318.95
X 650(No L/S)	£399.95
X 770(No L/S)	£518.95
X 990(No L/S)	£609.95
XR110 " "	£279.95
XR210 " "	£329.95
XR310 " "	£379.95

ROTEL

A1000	£388.95

SANSUI

4000(No L/S)	£324.95
5000(No L/S)	£349.95
6000(No L/S)	£414.95
7000A(No L/S)	£469.95
8000(No L/S)	£519.95
9000A(No L/S)	£739.95

SANYO

V25	£299.95
H20	£349.95
V30	£449.95
V35	£769.95
V55	£949.95

SHARP

SG1E/SY1HX	£209.95
SY9HH	

SONY

FULL RANGE	P.O.A.
ZR1SSE34	£389.95
Z1/SSE34	£429.95
Z2/SSE44	£519.95
S80/SSE50II	£629.95

TECHNICS

Z22 System	£499.95
80's System	£799.95
Z11 System	£389.95

TOSHIBA

335 III	£499.95

TRIO

V300	£249.95
V400	£364.95
V400XE	£369.95
V405	£494.95
V80	£519.95
V1000 R	£934.95

MUSIC CENTRES

HITACHI

FULL RANGE	P.O.A.

J.V.C.

MF 33L	£209.95
MF 55LS	£349.95

PANASONIC

SG 2200	£184.95
SG 3200	£249.95
SG 2110	£154.95
SG 2220	£
SG 3220	£

SANYO

FULL RANGE	P.O.A.

SHARP

SG170/CP160	£129.95
SG270/CP270	£189.95

SONY

HMK 7000	£429.95
HMK 9000	£639.95
HMK 3000	£199.95
HMK 5000/E5520	

TOSHIBA

SM2770/L/S	£149.95
SM2950/L/S	£174.95
SM3180/L/S	£224.95
SM3350/L/S	£239.95
SM3650/L/S	£269.95
SMD30/L/S	£299.95
SM4750	£369.95

MICRO SYSTEMS

AUREX

System 10	£299.95
System 12	£449.95
System 15	£899.95

AKAI

UC5	£699.95
UC3	£279.95

AIWA

M101	£239.95
M302 (3pc+L/S)	
20w	£239.95
M301 (4pc No L/S	
35w	£314.95
606S	£329.95
M606F	£349.95
M605	£279.95
M502(60R)	£299.95
M501(4 pc No L/S	
50w)	£449.95

HITACHI

ACT 02	£289.95

J.V.C.

PC5L	£279.95
E5	£529.95

ROTEL

FULL RANGE	P.O.A.

TECHNICS

Mini System (3pc)	
SUC04/STC04L/	
RSM07	£399.95

SANYO

Micro	£249.95

CARTRIDGES

A.D.C.

QLM 32	£9.95
QLM 34	£10.45
QLM 36	£16.95
VLM	£24.45
XLM	£22.95
ZLM	£55.95

AUDIO TECHNICA

AT 10	£8.95
AT 12 XE	£17.95
AT 130 XE	£27.95
AT 30 E M/C	£34.95
AT 32 M/C	£84.95

AUREX

C400/2100D	£189.95

GOLDRING

G800 IGC/ADC	
H/SHELL	£48.95

GRADO

FTE-1/ADC	£10.95
FGE-1/ADC	£13.60
F3E/ADC	£16.95
F2/ADC	£27.95
F1/ADC	£39.95

ORTOFON

FF15ED	£11.95
F15E	£16.95
SMS201I	£24.95
M.C.A. 76	£49.95
VMS 101II/ADC	
H/S	£18.95
VMS5II/H/Shell	£19.95

SHURE

M75 ED	£12.45
M95 ED	£18.95
M44C	£7.95
M91 GD	£7.95
M91E	£14.95
M93E	£9.95
M97 HE	£32.95
M97 HE4M	£34.95

VIDEO RECORDERS

AKAI

VS 5EK	£639.95
VS 5EG	£639.95
VS 10EK/EG	£719.95

PANASONIC

NV3000B/ NVV300B	£699.95
WV 3200E	£549.95
WV 3000E	£429.95
WV 2600E	£369.95

JVC

HR7700VHS	£729.95
HR2200/TU22	£719.95
GX33	£349.95
GX88	£499.95
HR7200EK	£524.95

SANYO

9300 BETA	£399.95

SONY

SLC5	£449.95
SLC7	£629.95
C7E	P.O.A.
SL3000UB/ TT3000UB	£749.95
H.V.C.2000P	£614.95

TOSHIBA

V8600B	£599.95

ACCESSORIES

A.D.C.

A.L.T.I	£34.95
LMF1	£63.95
LMF2	£69.95
SLM3	£38.95
LMG1	£4.95
SLM2	£21.95

AKAI

D.T. 100 Timer	£54.95
MM 62 6 Line Mixer	£139.95

AUREX

ADJ1(Arden)	£134.95
ADS1(Arden)	£264.95
ADI15 (Arden)	£144.95

PIONEER

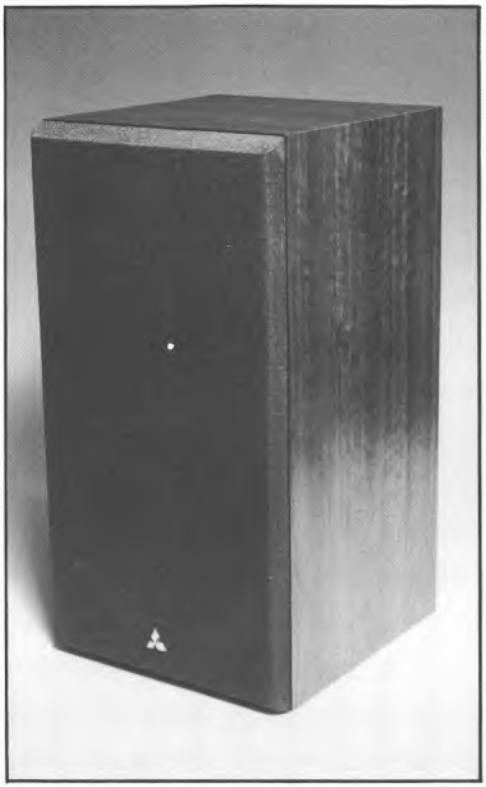
DT 510 Timer	£44.95

TECHNICS

SHF101 FM Wing Antenna	£39.95
SH4030 Slimline Digital Timer	£59.95

Mitsubishi DS 32B

Mitsubishi Electric UK Ltd., Otterspool Way, Watford WD2 8LD. Tel (0923) 40566



The *DS32B* is an unusually well made and finished system considering its price, with a driver and engineering content that would be difficult to replicate in the UK for the same price, let alone export to Japan and sell there. Unfortunately the quality of a given speaker system is not directly proportional to the engineering content alone. The skill with which the engineering is applied counts for far more, and this is an area where UK designers still excel.

Comprising a three-way system, a vertical-in-line driver configuration is used, and the sizeable 45 litre enclosure is reflex tuned by a long ducted (25cm) rectangular port fitted with a moulded and flared exit. The bass unit comes with a large magnet assembly and a long-throw motor coil. It is built on a nominal 250mm die-cast chassis and has a rigid pulp composition cone. Possessing its own rear chamber, the mid driver is a 110mm unit also using a pulp cone, with a damped centre region. The 31mm tweeter has a combination of cone and metal centre dome; it is built on a die-cast chassis and is beautifully finished. The crossover employs high quality components, and has front panel user controls for mid and treble output; these are sensibly calibrated over a small range, from +1, to −2.0dB.

The strong enclosure is built from 20mm chipboard stock, is heavily braced internally, and is finished in a pleasant 'wood grain vinyl'. However the grille was rather thick and is acoustically poor with no rebating. If true to form, we can expect a high sensitivity, a wide dynamic range and low distortion among its characteristics.

Lab performance

As anticipated the grille did not enhance the performance, and the 1m reference response shows numerous mild aberrations (dotted) with the grille on. When removed however the speaker attained a remarkable +/−2.5dB from 77Hz to 15kHz, immediately showing that this is no ordinary design. Sensitivity was high at 90dB/W, with the bass extended to 45Hz, −6dB – surprisingly low in view of the high sensitivity.

The published curve at 2m shows an error, as the low frequency correction has been inserted about 1.5dB too high. Allowing for this, the overall balance is promising and the forward characteristic pretty good. The severest effect was shown 15° above axis, where an energy loss of 6dB occurred between 4 and 5kHz; by implication this speaker should be stand-mounted to a height sufficient to bring the treble axis close to ear level.

As expected the distortion results were very good, with 3rd harmonic occasionally at the 0.4 to 0.8% level 96dB, and negligible at the 90dB sound level. 2nd harmonic (dotted) was a little higher, but still averaged less than 1.0% until below 150Hz, and then did not exceed 3.0% even at low frequencies. Distortion declined with reducing level. The system happily endured the 100W pulse signals, which generated very high 110dB sound levels at 1m; 2nd harmonic averaged 1.5%, and 3rd 0.8% at both frequencies, both harmless values. Nearer 4 than 8 ohms, the average impedance compromised the sensitivity a little, with a dip to 4 ohms, 140Hz, and 5.4 ohms, 3kHz.

Aspects of the room averaged response were encouraging. From 60Hz to 3kHz the output was remarkably uniform, holding to +/−2dB, and the small 'corner' on the treble rolloff at around 8kHz appears to be the only point of criticism.

Sound quality

Despite promising elements of lab measurement, steady state measurements cannot show whether a system possesses serious resonances or not, and there is still no test technique to qualify coloration properly other than auditioning.

On live sounds, the voice showed some 'boom' and 'chestiness', while the mid and 'forward' and 'boxy', and the material of the cone diaphragms seemed to be related to the sound – a sort of card/papery cone effect. Some bass overhang was also noted, and the mid-treble range could sound harsh. Low frequencies were found to give subtle pitch changes with different levels – a strange dynamic effect noted on bass guitar.

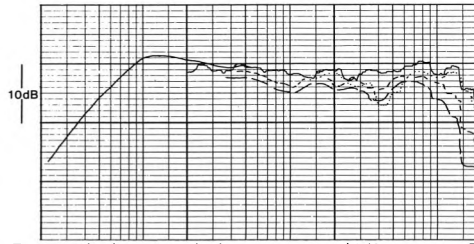
On the stereo programmes the imaging was tolerably good with the grilles removed, and also showed moderate depth. Detail and musical clarity were both promising, and conflicting views were expressed, with some panelists liking the sound, while others did not. Generally well balanced with a little bass 'richness', the upper ranges could also sound 'grainy', 'sibilant' and 'harsh'.

Summary

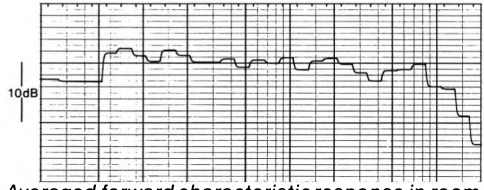
While capable of very high sound levels and quite well suited to less subtle rock programme, the *DS32* did not sound clean or smooth enough on most programme to warrant recommendation. It was lively and transparent, low in distortion, and beautifully made and finished; on these grounds it is worth considering, for it may sound better to your ears than it did to ours. If Mitsubishi keep up this standard of engineering, it may not be long before one of their designs is accorded our recommendation.

GENERAL DATA

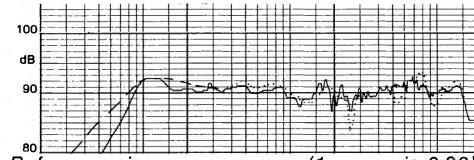
Size (h x w x d)	61 x 32 x 35.5cm
Weight	19kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–250W
Recommended placement	on stand
Frequency response within ± 3dB (2m)	60Hz to 15kHz
Low frequency rolloff (–6dB) at 1m	45Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	90dB/W
Approximate maximum sound level (pair at 2m)	109dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc VAT	£230



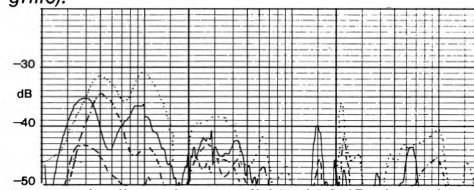
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



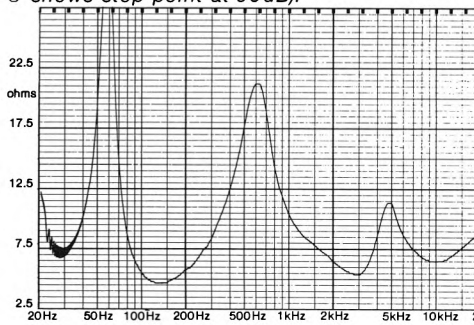
Averaged forward characteristic response in room at listening position.



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).

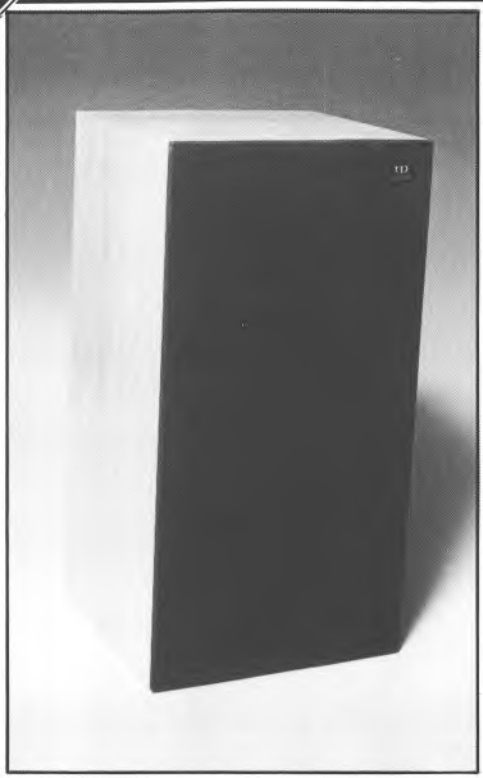


Impedance (mod Z).

BEST BUY

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 superceded 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 ⅓-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 unmistakeable, 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.

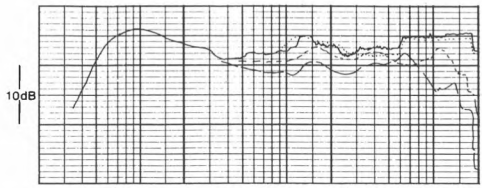
On the recorded programme the *66* still did very well, and the midrange was particularly liked. A mild uneveness in balance was recognised, together with a touch of excess bass, but the overall effect was well above average. Some loss of clarity and stereo depth were apparent, and with a 'tighter' bass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

Summary

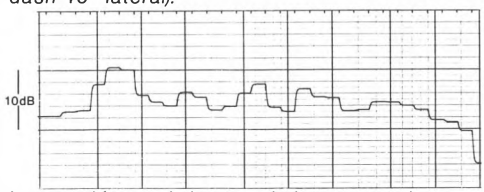
Though mild criticisms are in order, so that the intending purchaser must take the final decision whether to buy or not, the sonic performance *versus* price equation comfortably qualifies the *MA66* for Best Buy status. At the price the quality of external finish is exceptional, and the speaker is quite substantial in physical size and acoustic bandwidth, demonstrating low levels of coloration and proving easy to drive. As with other speakers of this bandwidth and sensitivity, stand mounting well clear of the rear and side walls is essential to obtain the best and most natural balance, as well as the best stereo effect.

GENERAL DATA

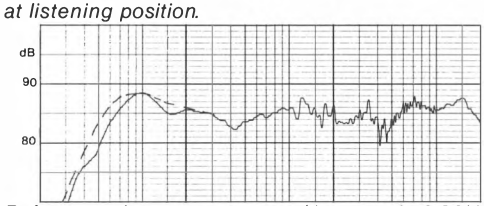
Size (h x w x d)	58 x 30 x 29cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–100W
Recommended placement	stand, clear of walls
Frequency response within ± 3dB (2m)	50Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	42Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt 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 inc VAT	£180 (est)



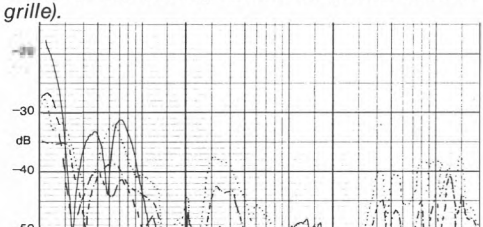
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



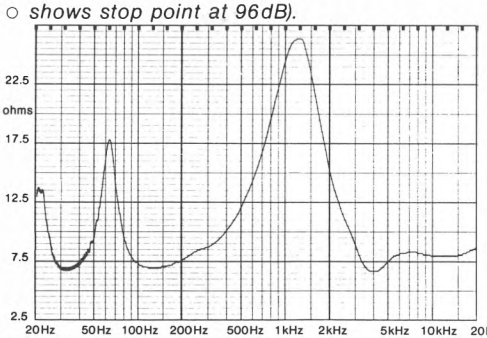
Averaged forward characteristic response in room at listening position.



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).

RECOMMENDED

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 reinforce 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 +/−2.5dB 48Hz–20kHz. The rated sensitivity was about average at 86dB/W, and bass extension was good for the size at 41Hz, −6dB.

The forward characteristic response showed excellent consistency and integration, plus a promisingly uniform frequency balance under ⅓-octave averaging, namely +/−2.0dB, 55Hz–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.

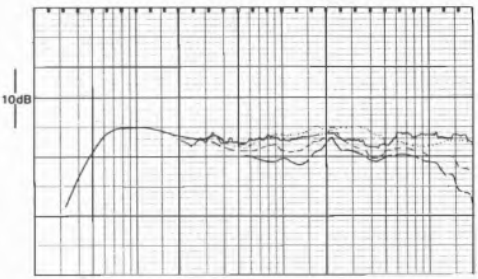
The marks improved significantly on the stereo sessions, sufficient to bring the *III* into the recommended class. Stereo presentation was well liked, with fine lateral stability and precision plus promising depth, while clarity was good in the midrange, though not quite as good as we would have liked 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

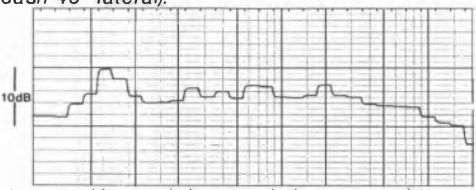
A highly competant three way design, the *Pageant III* shows improved bass extension, reduced coloration, a smooth lab and room integrated response, good quality construction, and an interesting furnished appearance. Conversely the treble was not favoured by some panelists, while in general distortion levels were higher than average. On balance the good ratings for the stereo sessions plus the overall promising performance justifies inclusion in the recommend category.

GENERAL DATA

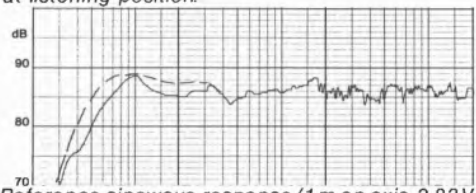
Size (h x w x d)	62 x 26.5 x 30cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)-200W
Recommended placement	clear of walls on stand
Frequency response within ± 3dB (2m)	52Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	41Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 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



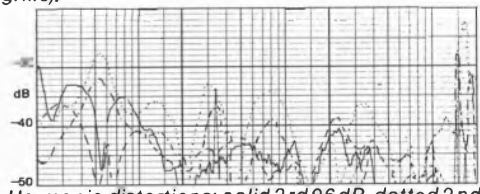
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



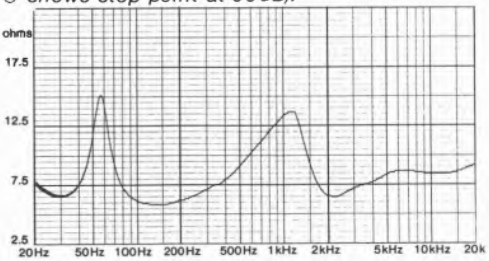
Averaged forward characteristic response in room at listening position.



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, ○ shows stop point at 96dB).

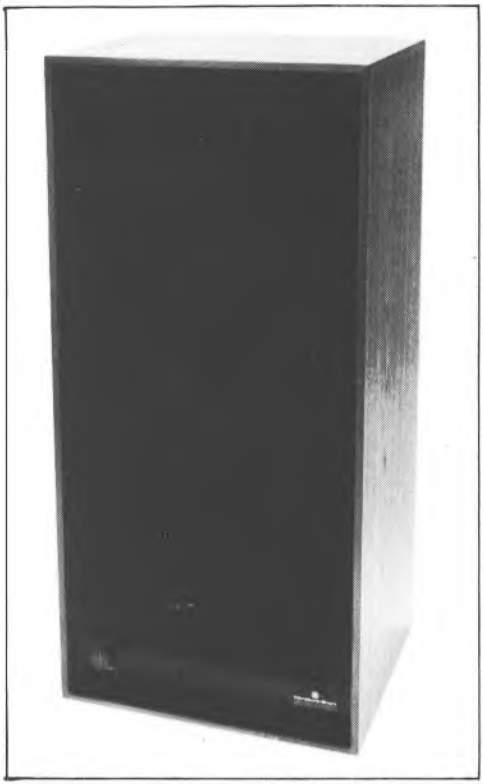


Impedance (mod Z).

RECOMMENDED

Mordaunt-Short Signifer

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



This recent introduction from Mordaunt-Short represents one of the heaviest models we had to contend with. The *Signifer* — somewhat reminiscent of the Spendor *BC3* in so far as its general size and appearance are concerned — is a stand mounted three-way system employing a new 25mm Isophon soft dome tweeter working above 4kHz. A 135mm diameter treated pulp cone unit handles the midrange; developed and manufactured by Mordaunt-Short themselves, it possesses a special surround termination. They also make the 300mm pulp cone bass unit which completes the vertical-in-line array of drivers.

This 70 litre enclosure is reflex loaded by a 62mm diameter tunnel port, the rear tightly packed against a polyester fibre pad which offers some degree of damping. Of rigid, braced but undamped construction, the cabinet is recessed at the front to accommodate the high power plug-in crossover, which is equipped with a single five-position control to adjust mid and treble balances in 1dB steps.

Lab results

An excellent pair match to within ±0.5dB was demonstrated up to 5kHz, holding to a good ±0.7dB at frequencies above this level. Of average sensitivity at 86dB/W, the bass register was well extended with a −6dB point at 33Hz. Generally very good on distortion, for example, 0.15% was recorded at 500Hz with typical values around 0.3%; although a good 2% at 35Hz was measured, the distortion rose surprisingly to 4%, 93Hz

The *Signifer* was not the easiest loudspeaker to drive, the typical impedance value being 6 ohms with dips to around 5 at important sections of the spectrum, namely 90Hz and 1.5kHz. In fact with the midrange boosted (dotted curve) the 1.5kHz minimum was closer to 4 ohms, and if the model is to be driven hard, a fairly load-tolerant amplifier should be used. Exhibiting excellent power handling, a 105dBA maximum was within the Signifer's compass, and it reproduced electric bass guitar very well up to a staggering 250W input level, a similar peak on wideband program causing no problems.

On axis at 1m the response held to within tight +/–2.5dB limits from 43Hz-10kHz, although above 2kHz some mild irregularities were present, with a notable peak at 11kHz coupled with a premature HF rolloff thereafter. Out at a more realistic 2m distance, using ⅓-octave averaging, the characteristic response was better integrated and looked good overall, with the exception of a slight prominence in the 12kHz region. The mild dip (dotted) relates to the '10° above' response, which is in any case representative of an unlikely listening axis for such a tall stand mounted model, while at 10° below and 30° laterally off-axis, the responses were excellent to 10kHz — remarkably so, in fact, for such a large, flat baffle design.

Sound quality

Placed in the top category on the live sound comparisons, the *Signifer* performed well on all sounds, but proved exceptional on bass guitar. Colorations were very slight, including mild 'edgy', 'boxy' and 'fizzy' effects.

The *Signifer* repeated this fine performance on the more complex stereo tests, with stable,

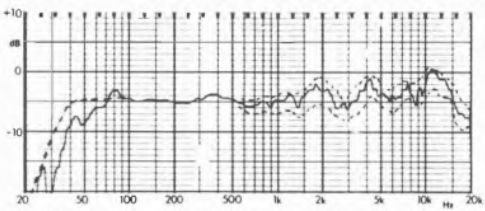
Mordaunt-Short Signifer

(revised and reprinted)

above average imaging and a good depth presentation. Musical clarity was also to a high standard, and the bass, if slightly boomy, was satisfactorily deep and powerful. Colorations were also well controlled, and mainly confined to a trace of treble peakiness.

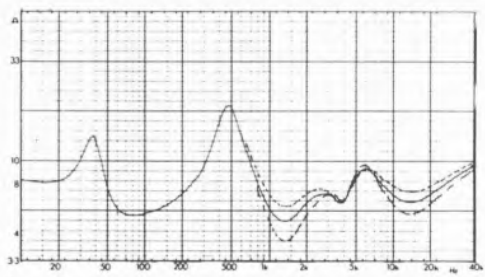
Summary

With one or two minor criticisms — notably amplifier loading and upper treble balance — this speaker offered a fine performance particularly on bass, power handling, loudness, coloration, distortion and maximum sound levels. Well constructed, with an attractive appearance and producing satisfying stereo, the *Signifer* justified its high price, and thus merits recommendation.

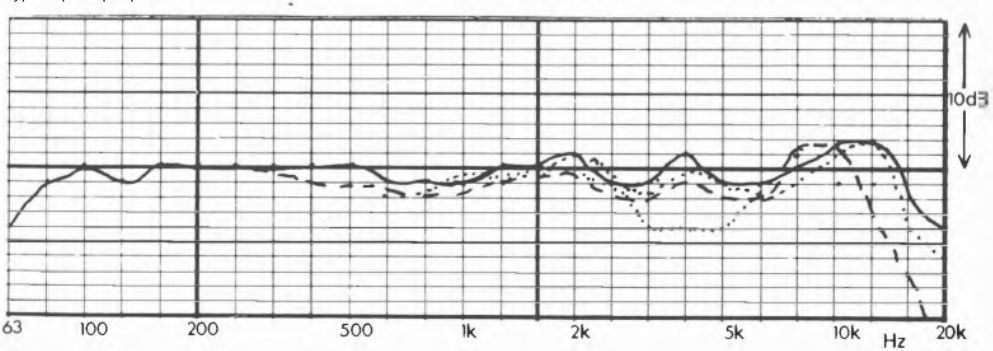


Axial sine wave reference response, 1 m (0dB=90dB sensitivity: dashing corrects chamber anomalies.)

Size	81(38) H: 38.5(15) W: 33(13) D: cm(inches)
Recommended amplifier power per channel (for 96dB A per pair at 2 metres minimum)	20–250W
Recommended placement	on M/S stand well clear of walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	33Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	v. good
	35Hz–2%, 83Hz–4%, typically 0.3% or less
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair	£630



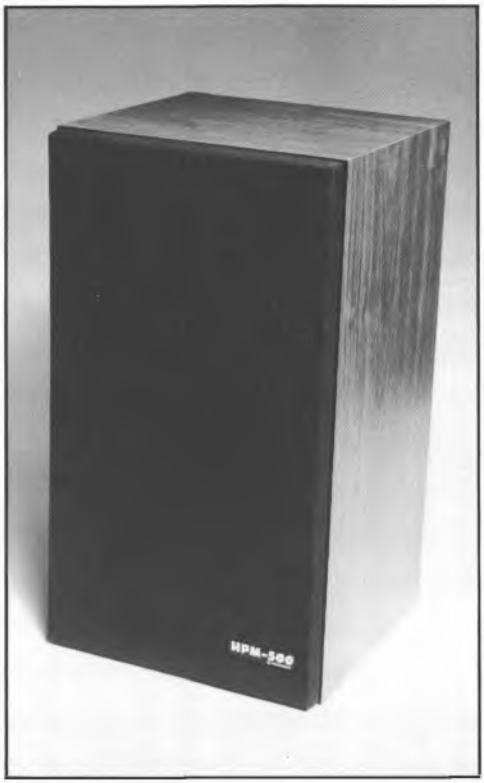
Impedance vs frequency (mod Z)



⅓-octave averaged frequency response. 2m solid axial; dotted 10° above and below; dashed 30° horizontal

Pioneer HPM 500

Pioneer UK Ltd., Pioneer House, The Ridgeway, Iver, Bucks. SL10 9JL. Tel (0753) 652222/7



Pioneer have made some mention of the cone material used for the main driver in this system. Called 'polymer graphite' (PG) it consists of graphite particles bonded by a tough polymer. Its physical properties, notably stiffness and hardness, are comparable with such metals as titanium and aluminium, and yet Pioneer claim a self-damping or a loss factor some 25 times better, and comparable with the paper/pulp often used for speaker cones. In consequence a cone made from PG is both light and rigid, and should have a wider and more uniform response before breakup and resonances. However when these do occur, they are generally more severe than with ordinary cones.

The *HP500* is essentially a two-way system, as in my view the third driver, a proprietory high polymer unit, only serves to extend the very highest frequencies. The two main units comprise a 250mm bass/mid working to 2.5kHz, and a 45mm cone type PG unit operating up to 8kHz, while the supertweeter augments the output beyond this.

The 38 litres enclosure is reflex-tuned to 34Hz by a port some 62mm in diameter by 11 cm long, while the main bass resonance is placed at 68Hz. The chipboard enclosure is undamped and covered in a walnut veneer type plastic vinyl. The drivers are fitted by woodscrews, but no sealing gaskets are used. The grille has no chamfer or rebate, and this does not bode well in acoustic terms, while the 4-element crossover seems sparse for a three-way system.

Lab performance

Set to 'flat', the treble output was clearly excessive, and the control was accordingly turned back to an '8 o'clock' position. Sensitivity was high at 89dB, and in conjunction with an extraordinary 400W peak power handling allows a remarkably loud 111dBA to be produced by a stereo pair. Notwithstanding this, the bass was reasonably extended to 45Hz, −6dB, but at the expense of a 'boomy' lift in output centred on 75Hz. A dip at 1.5kHz was also apparent on the curve.

At a 2m measuring distance and assessed by the more forgiving ⅓-octave analysis, the speaker illustrated the consequences of poor crossover design by a woeful lack of integration off-axis. (I recall similar results from a costly Pioneer system six years ago.) Such erratic off-axis behaviour destroys stereo coherence and contributes to coloration, as well as producing a different sound balance on every axis.

Comparing this result with the room averaged response, the irregularities were glossed over from 500Hz upwards, but below this point the energy was depressed with the excessive prominence in the bass clearly revealed. It is unusual for a speaker of such good sensitivity to show such weak bass control and damping.

However the distortion results were undoubtedly very fine, with 3rd harmonic averaging 0.5%, 96dB except above 5kHz. 100W pulses gave few problems, but at 500Hz the compression did reach a significant 0.6dB, with 2.0% 2nd and 0.3% 3rd harmonic products. At 5kHz the compression was negligible, with 0.5% 2nd and 2.0% 3rd harmonic. Rating an average amplifier load, the impedance dipped to a satisfactory 5.7 ohms, 140Hz.

Sound quality

The main feature of the listening panel data was the high level of disagreement amongst the panelists regarding this speaker's faults and merits. The results were partly dependent on

individual preferences concerning sound quality attributes, but also related to the panelists seating position.

With a 'forward' and 'brightish' character (8 o'clock setting), the *500* survived the live single sound tests fairly well. Colorations noted included 'coarse', 'wooden', 'metallic', 'boxy', 'shallow' and 'boomy' effects, plus variants thereon. The bass register, somewhat excessive and boomy as described, was however quite extended, and showed great power and clarity.

On the commercially recorded stereo programme the results were not to the required standard. Piano sounded 'thin' and 'hard' with a superimposed false echo, while stereo depth was poor, and the panelists commented on the presence of cabinet resonances as well as coloration. The stereo image was 'defocused' and only showed lateral precision in the lower mid registers. But despite all this, some degree of excitement and presence was identified, with a feeling that the elements of a good speaker could be lurking inside.

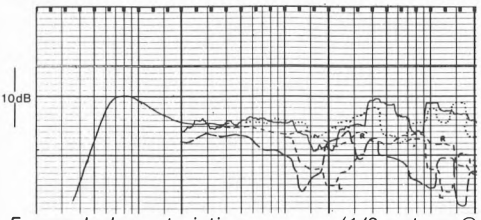
Summary

With an astonishing ability to play very loud considering the price and size, this speaker might appeal to a rock enthusiast, and it would be fine for parties or discos. On broader programme however it was too 'rough around the edges', needing considerable refinement, and cannot be recommended.

GENERAL DATA

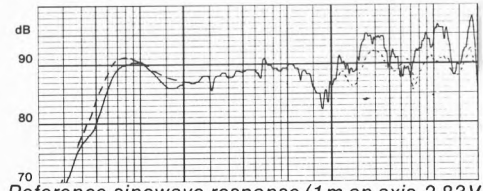
Size (h x w x d)	57 x 32 x 33cm
Weight	12.2kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–400W
Frequency response within ± 3dB (2m)	*
Low frequency rolloff (–6dB) at 1m	45Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	89dB/W
Approximate maximum sound level (pair at 2m)	111dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	poor
Typical price per pair inc VAT	£170

*with treble control adjusted below 'flat', see text

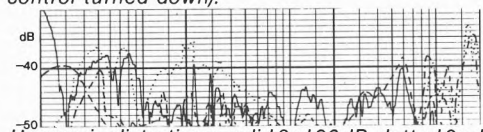


Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).

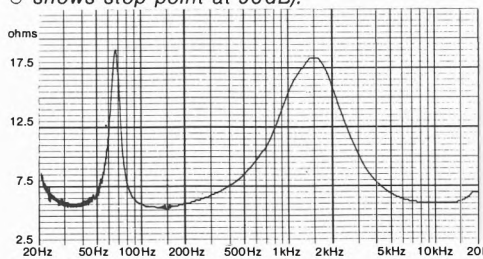
Averaged forward characteristic response in room at listening position.



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



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



Impedance (mod Z).

RECOMMENDED

ProAc Studio 3

ProAc, 30 Lodge Avenue, Elstree, Middlesex
Tel 01-207 1150

Paul Tyler, the founder of Celef Audio, also designs and manufactures speakers for the up-market Proac company. The *Studio 3* is their most expensive model to date, and costs around £1,200 a pair.

Externally the speaker does not seem particularly elaborate, vertically aligned 250mm bass unit, 75mm midrange and 19mm tweeter making up the driver complement. The thinwall chipboard carcase has bituminous panel damping and a fairly modest 51 litre internal volume, reflex loaded by a large 75mm diameter 50mm deep tunnel port. However, details are important here, and hold the key to the engineering quality of the *'3*. Front and back panels are in costly 19mm multiply, while the high quality 11-element crossover uses close tolerance components of high power handling capacity. All three drive units are unusual. The 19mm soft fabric dome tweeter is a ferro-fluid cooled version of the Scan *D2008*. The remaining two units are British and are virtually hand-made by ATC. The midrange unit is a large soft dome with a massive magnet and great power handling, and the bass unit has a 75mm coil and an equally large magnet on a die-cast frame, the diaphragm in this case being a highly rigid shallow pulp cone with heavy damping. These very costly units account for much of the system price.

Lab results

Pair matching was good and the sensitivity was just average at 86dB/W, though the very good power handling capability enables high sound levels of up to 109dBA for a pair, using amplifiers delivering up to 500W per channel. For the overall size the low frequencies were quite extended, with the −6dB point at 42Hz. As with the Celef *'HE* the grille was found to exert a significant influence, and the responses through the presence band were marginally smoother with it removed. The axial response was nonetheless well balanced with the grille in position, particularly above 200Hz, although some LF unevenness was also present below 200Hz (±2dB peak to trough). The excellent and balanced behaviour of the drivers and crossover was confirmed by the fine set of off-axis responses. With such good integration the potential for a fine stereo performance is self-evident.

At 96dB distortions were low, particularly the critical third harmonic which averaged 0.5%. At 100W peak (some 106dB at 1m) these low levels were maintained at 500Hz, although at 5kHz an 0.5dB compression was noted together with a mild 2% second harmonic content. Possessing a 6.4 ohm minimum impedance, the amplifier loading was an easy 8 ohms nominal, with the phase angles held to less than 20° above 100Hz.

Sound quality

Scoring highly on the live sound comparisons, the Proac showed a light, airy character sympathetic to the test sounds. The usual 'boxy' 'woodeness' of most conventional designs was absent, and percussion sounds were notably clean but without excessive treble emphasis. The electric bass guitar was also well handled, providing good evenness, depth and great power. The full 500W was tolerated on peaks with an extraordinary 140W average power input.

This model did equally well on the stereo programme sessions. The bass was judged slightly

RECOMMENDED

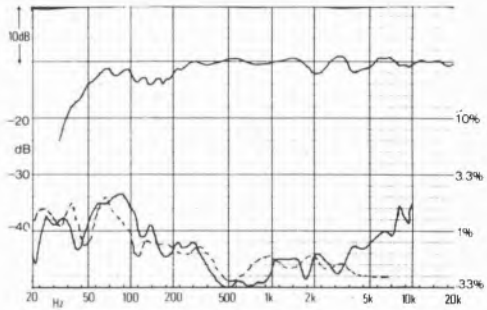
lumpy but was nonetheless favoured for its power and depth. Imaging was very good, and proved stable with a pleasing perspective and well developed depth, while the whole sound was 'atmospheric' and not concentrated on the enclosures. An 'airy' if slightly 'thin' effect was produced but without any hardness and with very little 'fizz', while coloration was very low by conventional standards. Clarity and detail rendition were also both very good.

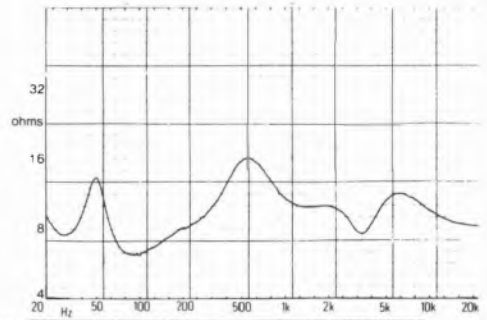
Summary
A compact, high quality speaker with extended bass and exceptional power handling, the Proac *3* offers a smooth and wide frequency response together with low levels of coloration and very good sound quality. The price is undoubtedly very high, but the performance is exceptional, and justifies recommendation.

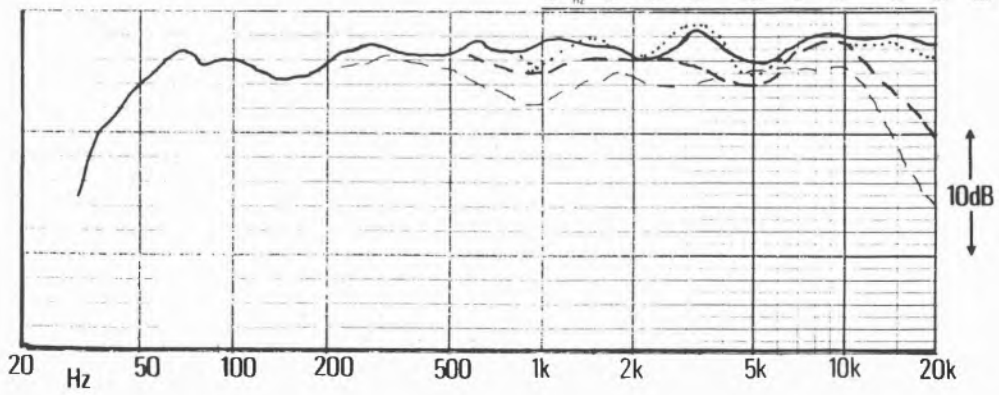
Update
There are now two versions of the *Studio 3* differing only in the magnetic materials used in the mid and bass drivers. The *AlNiCo* magnet version cost £1265; ceramic £977.

Size (H, W, D)	68.5, 30.5, 33 (27, 12, 13) cm(inches)
Weight	30 (66) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25–500W
Recommended placement	stands
Frequency response within ±3dB (2m)	47Hz–20kHz
Low frequency rolloff (−6dB) at 1m	42Hz
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m	86dB
Approximate maximum sound level (pair at 2m)	109dBA
Distortion (96dB at 1m)	excellent
Distortion (100W peak)	good
Impedance characteristic (ease of drive)	good
Forward response uniformity	very good
Typical price per pair inc VAT	see Update

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).







RECOMMENDED

Quad ESL-63

The Acoustical Manufacturing Co. Ltd., Huntingdon PE18 7DB. Tel (0480) 52561

This new design has been long awaited, and we even hoped it might be ready 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 clamped boundary of the diaphragm, and also equalisation for the axial frequency response. The size and apportionment of frequency range and delay to the elements allows control of directivity, which is adjusted to give a smooth and uniform decay at increasing off-axis angles. But it should still be borne in mind that the directivity of the *63* is poor by comparison with the best moving-coil designs, and that the speaker remains rather critical of listening angle.

The latter characteristic presented a problem on tests, since in the modest confines of my listening room only two of the six Quad panelists could be in the optimum zone, and when used as suggested on the floor at our typical 3–3.5m listening distance, the main axial treble response was directed nearer to their chests than their ears. Accordingly, the speakers were elevated by about 20cm on open stands and marginally tilted backwards. As with the Acoustat, further auditioning was also conducted with solo listeners to augment the panel subjective data.

The Quad *63* is a bipolar design which generates regions of acoustic power fore and aft, but is suppressed in the sideways directions. In consequence a rather different drive of room reverberation results compared with small box speakers which are considerably more omnidirectional. Thus even if the Quad did provide an identical axial frequency response to a low coloration moving-coil model, it would not sound the same due to the significantly different room reverberation tonal balance.

Lab performance

The sensitivity reading was not comparable with a normal speaker due to the doublet directivity, and furthermore, the 1m reference response was theoretically too close, risking proximity and integration errors. Approximation or not, the reading was below average at 84dB/W, the reference response meeting +/−2dB 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 ⅓-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 10–100 times better than usual but due to the speaker's protection circuit compression occurred at a 100W peak input;

however at 50W, just 3dB less, the pulse reproduction was simply too perfect to register measurements.

Due to the unusual directivity the room response is probably of marginal value, and certainly cannot be directly compared with the results for normal box systems. It is however included just for the record, but did not correlate well with the subjective data. The midrange at least is notably smooth, but the 60Hz prominence is more exaggerated than usual.

Sound quality

At risk of appearing to 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 'clothy' 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

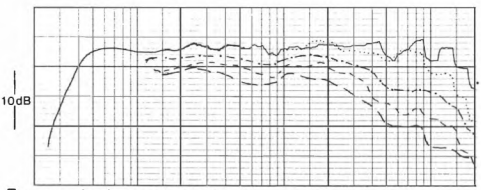
A speaker which must be auditioned at some length with neutral programme drive*, the *63* is probably the finest electrostatic in current production. It has frustrating limitations, and yet possesses a midrange and treble which are notably lacking in 'boxiness', 'nasality' and 'hangover' colorations. Utterly revealing of programme distortion, mike technique (or lack of it), as well as tonal balance in ancillary equipment, it sounds at its best driven to sensible levels on classical orchestral programme, but it will nonetheless make a good attempt at rock if treated with caution.

**We found the Linn disc playing system an unsuitable match for the* 63 *despite its fine showing in the latest* Turntable *issue.*

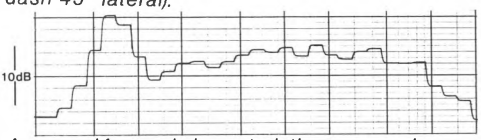
GENERAL DATA

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 ± 3dB (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

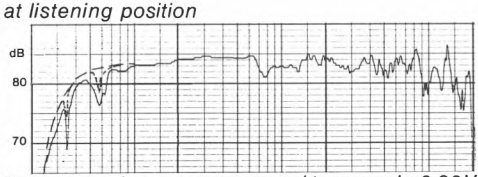
*see text



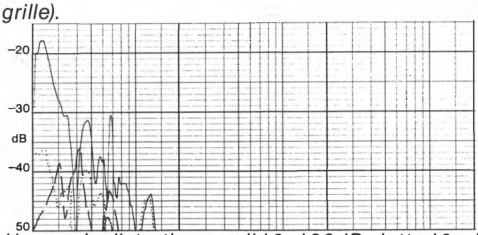
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



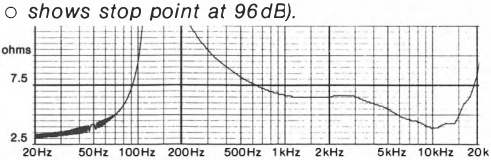
Averaged forward characteristic response in room at listening position



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, ○ shows stop point at 96dB).



Impedance (mod Z).

BEST BUY

B&W DM10.
CASTLE CLYDE/ KENDAL/CONWAY.
KEF CODA/CAPRICE/ CELESTE/103-2.
MISSION 727.
ROGERS STUDIO.
ARC 101 PASSIVE AND ACTIVE.

As well as the above best buys we stock other speakers of superior performance Quad ELS63, Heybrook, and the new ARC 050 also passive and active. Listen-and-get, 7 days to exchange no quibbles.

1st Floor
Rawson Square
Bradford 309266

Erricks' of Bradford

Open 6 days — please ring

Rogers

BRITISH HIGH-FIDELITY

Appointed dealers for KEF in Suffolk and North Essex. Models on demonstration include Celeste Caprice Carlton Cantor and Reference range.

NOW ON DEMONSTRATION AT:—

SYSTEM SOUND

91 North Street Sudbury Suffolk Tel Sudbury(0787)72348

We welcome Access

FINANCE AVAILABLE

BARCLAYCARD VISA

KLIPSCH SYRINX SME HELIUS STATUS

CLASSIC HAFLER SUGDEN QUAD DIAS ARCAM LINN GLANZ

B&W AUDIOMASTER HARBETH SWALLOW I.A.S. CASTLE

LOUDSPEAKERS COME IN ALL SHAPES AND SIZES

Which is perhaps as well, because so do ears and listening rooms. . .

With such an enormous number of speakers to choose from, and with requirements differing greatly from person to person and room to room, it would be helpful if there was somewhere you could go to audition a wide selection of the models available. To get expert advice to help you decide. To be able to try the most likely contenders at home in your own room with your own system, to make the final decision. There is!

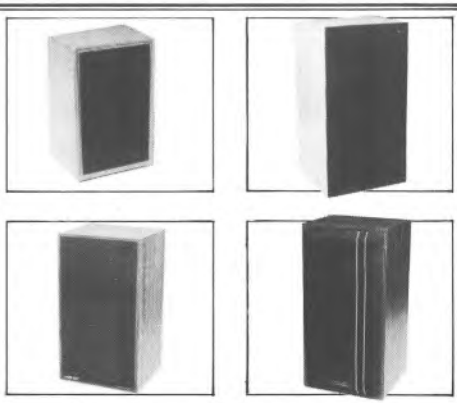
T R C

Where music matters most

3-5 King Cross Street, Halifax.

0422 66832

GRADO SUPEX DUAL THORENS QUANTUM



PLEASE RING OR CALL IN FOR INFORMATION AND/OR TO ARRANGE A PERSONAL DEMONSTRATION (PREFERABLY IN YOUR HOME)

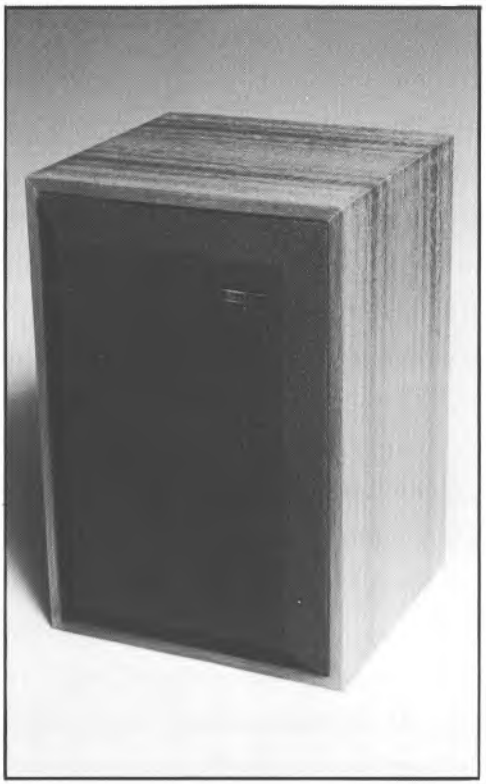
QUALITY HI-FI FROM LINN, MERIDIAN, NYTECH, ARC, A&R, MISSION, QUANTUM, SUGDEN, MORDAUNT-SHORT, SYSTEMDEK, THORENS, STD, HEYBROOK, DUAL, AIWA, NAKAMICHI, ELITE AND QUAD.

Available from:

RUNNYMEDE HI-FI
172a HIGH STREET, EGHAM, SURREY
Tel: EGHAM (0784) 35036

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 teek 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 +/−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 chipboard 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 +/−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° 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 98dBA 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 *RA8*s 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'.

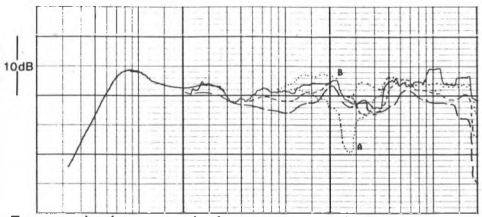
Below par on the commercial stereo sessions, the treble register emphasised hiss and occasionally added a tizzy quality. Detail was lacking and the stereo imaging suffered from a lack of impact and 'immediacy'. Even on stands the bass showed a 'one-note' undamped tendency, and could not 'play tunes'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

Summary

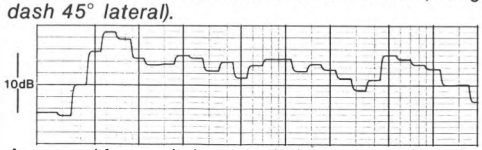
While this speaker is inexpensive and offers quite a lot of engineering and finish for the money, it is lacking in openness and immediacy resulting from poor phase control and a lack of presence, which in turn probably derives from the crossover design. If this area could be reshaped then R/A might have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

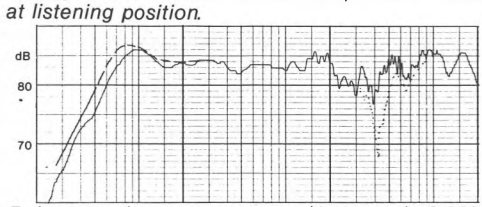
Size (h x w x d)	39.3 x 26.5 x 27cm
Weight	6.8kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(25)–50W
Recommended placement	open shelf or stand
Frequency response within ± 3dB (2m)	55Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	50Hz
Voltage sensitivity (ref 2.83V,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



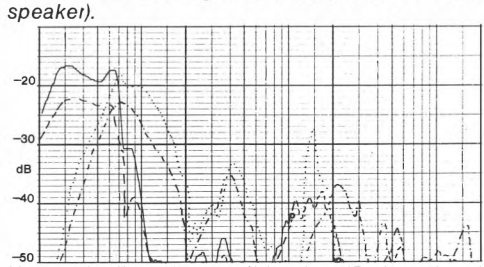
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



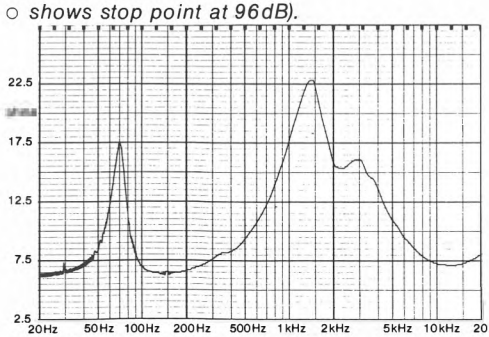
Averaged forward characteristic response in room at listening position.



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



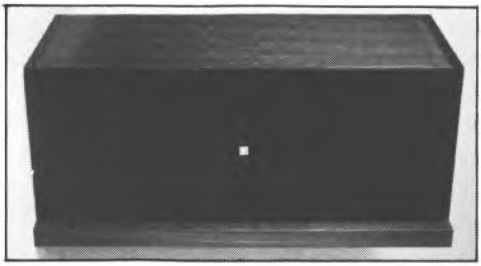
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).

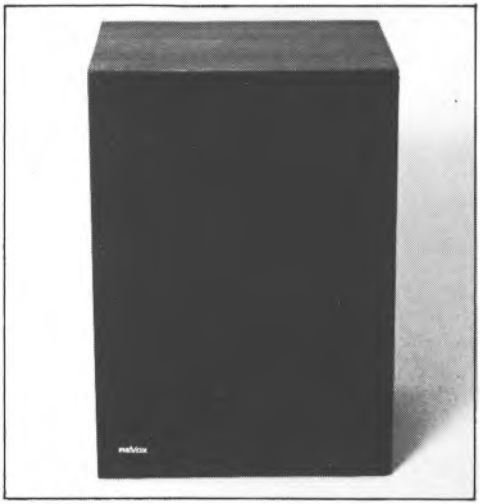


Impedance (mod Z).

Revox Triton

F. W. O. Bauch Ltd., 49 Theobald Street, Borehamwood, Hertfordshire WD6 4RZ. Tel (0865) 60844





The Triton is a rather specialised product, and was designed with the object of presenting a complete Revox hi-fi system as an integrated and substantial piece of furniture, while at the same time providing good sound from an unobtrusive speaker system. To these ends, two 'satellite' three-way miniature speakers for bookshelf mounting are supplied with a substantial floor standing cabinet which contains separate bass boxes on elaborate anti-vibration and isolating springs. A Revox turntable may then be placed and used on the surface of this bass cabinet – a location normally quite out of bounds in hi-fi terms.

The system is too complex to describe fully in this report, but essentially it comprises a very well finished and engineered product. For each channel a 250mm bass unit is mounted in the massively braced 45 litre sealed box, with the satellites containing a 170mm upper bass/midrange unit, plus a 37mm soft dome upper mid and a 19mm soft dome tweeter.

Lab results

Due to the specialised nature of this system's operation and room location the published responses need some careful interpretation. They were taken with each satellite on top of its respective bass enclosure, and while pair matching was considered very good, the satellite grille worsened the 3.5kHz suckout by 3–4dB, and either needs improving or perhaps leaving off altogether.

A good terminal voltage sensitivity was recorded, averaging 89dB, but the 4 ohm and hence just 'acceptable' amplifier loading impedance must also be taken into consideration. In free field the −6dB cutoff was measured at 55Hz, but the slow rolloff and floor mounted location will allow a worthwhile output down to 40Hz in practice. A 60W maximum rating was denoted by the bass power handling limit, and a healthy 103dBA plus should be available in typical rooms, provided that the amplifier can tolerate 4 ohm loading.

The *Triton* recorded a good rating for swept distortion at 96dB, 1m, and was particularly good at low frequencies, though second and third harmonic reached 1.4% in the midrange. It did not however react well to the 100W pulsed input test at 500Hz, recording 0.7dB compression and 5% third harmonic distortion; at 5kHz compression was a low 0.1dB, but 4% of second harmonic distortion was noted.

At 2m using ⅓-octave averaging, the main response was elevated 5dB above the fundamental bass response, confirming the design intention for close wall mounted satellites and near-wall positioned woofer units. Above 3kHz the response was rather lumpy, and while the vertical curve was satisfactory the lateral off-axis responses (both plotted) were asymmetric, and showed more variation than usual due to the driver layout.

Sound quality

Scoring 'average' on the truth to life comparisons, the *Triton* in an admittedly non-ideal location sounded moderately uneven in the treble range with a 'dulled' presence. The balance tended to mid prominence, but prior to rattling overload at 60W (8 ohm) input, the bass was quite deep and even.

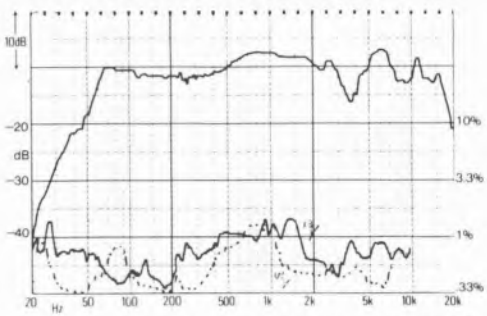
The performance improved on stereo programme, where the listeners felt that the imaging was well above average, with a promising rendition of detail

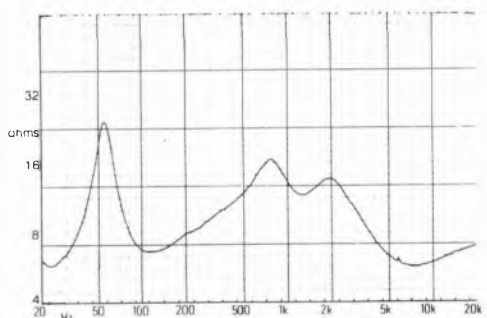
and good clarity. Colorations were well controlled with slight 'boxiness' and 'peakiness' in the treble register.

Summary

By its very nature this unique system complicates value for money judgments. To the question, 'can you buy a better sounding speaker for less?', the answer must be yes. But on the other hand, matching of unit style and brand is important to some purchasers, and this satellite plus subwoofer/hi-fi cabinet could well find favour on aesthetic grounds in many homes. As the sound quality is rated 'good', the *Triton* is worth considering, despite its rather high price.

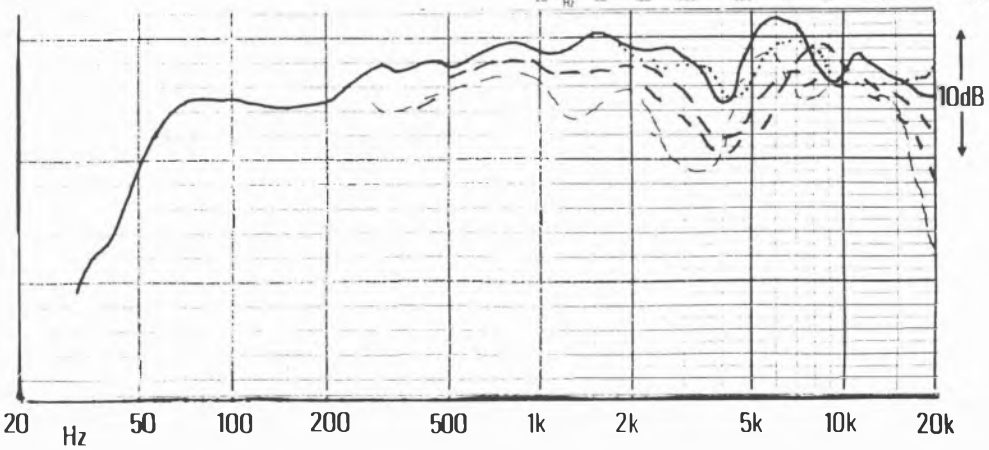
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).





Size (H. W. D)	90, 100, 40 (31, 41.5, 18.8) cm (inches)
Weight	98 (216) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15-60W
Recommended placement	special cabinet system and satellites
Frequency response within ±3dB (2m)	65Hz-20kHz*
Low frequency rolloff (−6dB) at 1m	53Hz*
Voltage sensitivity (ref 2.83V *ie:* 1 watt in 8 ohms) at 1m	90dB
Approximate maximum sound level (pair at 2m)	103dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	acceptable
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	above average
Typical price per pair inc VAT	£840

*see text on preferred axis and location



RECOMMENDED

Rogers LS3/5A

Swisstone Electronics Ltd., 4–14 Barmeston Road, London SE6 3BN
Tel 01-697 8511

Three companies are currently licensed to produce the BBC-specified *LS3/5a* design, namely Audiomaster, RAM and Rogers (together with the latter's associated company Chartwell). Current production samples from Rogers form the subject of this review, but the other manufacturers' versions should prove very similar. The closeness of the specification and the regular checks made by BBC engineers should ensure that this is amongst the most consistent loudspeakers commercially available.

The *3/5a* is a miniature sealed box system of some 5.5 litres volume. An elaborate and costly crossover is employed to equalise and balance the drivers to a strict licence specification, and transformer matching is incorporated for fine control of tweeter sensitivity differences. Two vertically aligned KEF drivers are used, namely a large magnet 110mm bextrene cone bass/mid, and a 19mm grille-protected dome tweeter. A felt tweeter surround is fitted to reduce diffraction anomalies, and the high quality cabinet is made from fully seam battened plywood with bituminous panel damping.

Lab results

In the crossover region a mild 1–2dB mismatch between left and right reference traces was noted, but elsewhere an excellent correspondence existed. A low 82.5dB sensitivity was measured with the −6dB point at 59Hz. The system resonance was placed at 75Hz, and the speaker was easy to drive, the modulus of impedance being typically 12 ohms and never falling below 8. Understandably the test level for third harmonic distortion was set at the lower 90dB level, and under these conditions an excellent result from 70Hz upwards was recorded.

At 1 metre the reference curve showed a very uniform midband, 200Hz–3kHz, with an equally uniform HF range, although this was mildly lifted by 1–1.5dB relative to the mid; upper bass was marginally exposed as a +3dB hump.

At 2 metres the characteristic responses were seen to be remarkably well integrated. All curves, 30° lateral and 10° vertical, conformed with that on axis to within 2–3dB throughout the frequency range.

Although smooth, the response was however characterised by a 3dB hump at 150Hz, with a related area of dip at 400Hz.

Sound quality

The table showed that the sound quality was above average on an overall basis, which is not only a good result for the price, but is also remarkable considering the speaker's diminutive size. No allowance was made for the latter during the listening sessions.

Rated well above average on the live sound comparisons, colorations were only of slight degree, and included 'tubby', 'edgy', 'bright', 'chesty', 'thin' and 'mid-recessed' effects. In general, however, its rendition of the live sounds was very good.

While imaging was very good, the subjective frequency balance would appear to have affected the speaker's stereo programme performance. The panel described slight to moderate 'hollow', 'edgy', 'fizz', 'sibilant' and 'metallic' effects, with a thinned mid-balance, and a light, 'plummy' bass.

Rogers LS3/5A

(partly re-assessed)

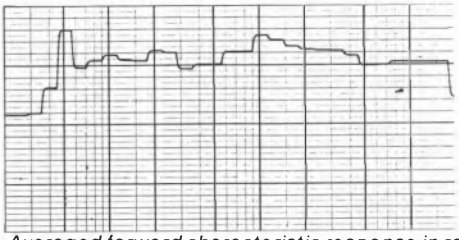
Little bass depth was perceived, although detail and clarity were both of a high order.

A further pair assessed in the last tests have allayed our fears with a better overall balance and fewer criticisms from listeners.

Summary

The intrinsic quality of this design has well enabled it to maintain its competitive market position, and its reputation as a miniature of monitor quality is undoubtedly justified. Sounding more natural on high stands clear of walls or corners, quite good results can also be obtained in open shelf location. Bearing in mind the limited bass power handling and loudness, the *3/5a* may nevertheless be recommended on the basis of its high sound quality for the price.

Size	30(12) H; 18.5(7.5) W; 16(6.5) D, cm(inches)
Weight	5.5(11.5) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 50W
Recommended placement	high stand (or shelf)
Frequency response within ±3dB (2m)	90Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	59Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	82.5dB at 1m
Approximate maximum sound level (pair at 2 metres)	93dBA
Third harmonic distortion (90dB at 1 metre)	very good
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good
Typical price per pair	£200

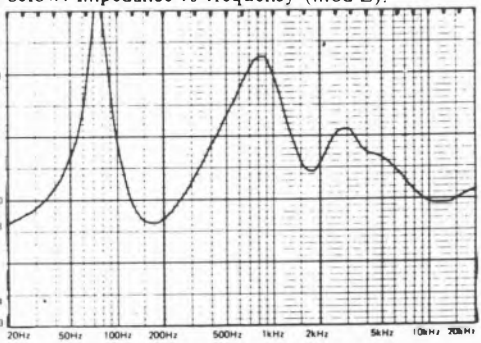


Averaged forward characteristic response in room at listening position.

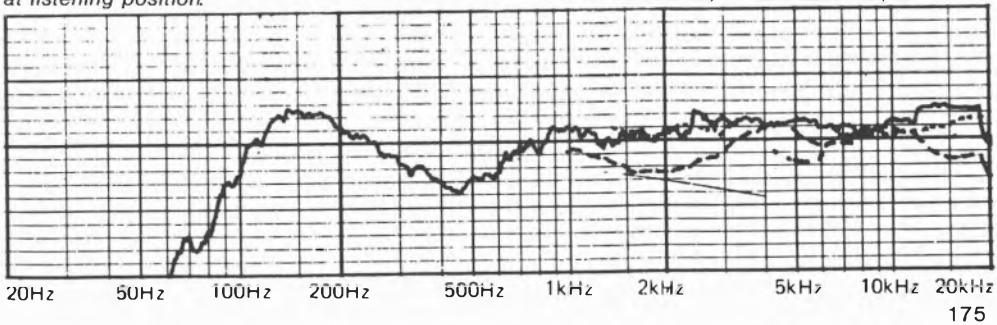
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

distortion measured at 90dB

below: impedance *vs* frequency (mod Z).

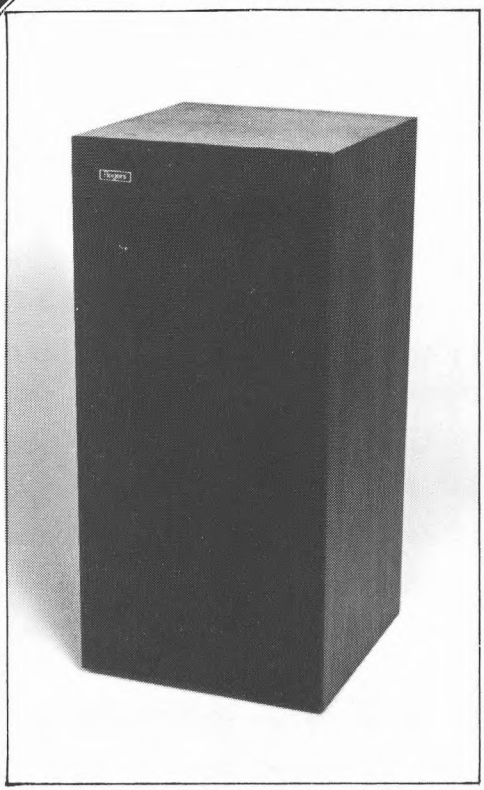


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



BEST BUY

Rogers Studio 1



Now in its second year, the *Studio* has undergone a few minor changes which make it worth another look. None of the alterations obsolete the original, and comprise slight modifications to the crossover, a revision of the detail construction of the main bass-mid driver, and a flaring of the reflex port exit. The cabinet tuning has also been shifted to a slightly lower frequency to account for the running-in of the bass driver resonance. Historically this design has evolved from the Rogers Export Monitor, a highly competent if unexceptional speaker, itself a relative of the original BBC *LS3/6* which Rogers manufactured for some years.

Representing a classic two-way wide range system, the main driver is Rogers own die-cast frame 200mm unit using a light bextrene cone. It is related in general design to the original BBC unit, but large increases in the mechanical damage limit and the thermal power handling have been made, plus a reduction in distortion. The treble unit comprises the renowned Celestion *HF1300*, augmented over the final audible half octave by a version of the KEF *T27* (which has a well extended response to 30Hz).

A very high quality complex crossover integrates the drivers, and electrical connection is *via* a professional XLR connector which may not be too convenient for domestic use. The well-damped cabinet is finely veneered with the carcase made of Medite resin composite board. The 43 litre enclosure is tuned to approximately 40Hz by a large diameter, flared ducted port of high volume velocity. (The flaring served to reduce the odd chuffing noise caused by the 'wind' at the port exit.) It is perhaps almost unnecessary to note that the drivers are mounted vertically in line to give maximum lateral stereo image symmetry.

Lab performance

Updated by new response measurements for the reference curve, sensitivity, the room characteristic and distortion, the remainder of the data is carried over from the previous issue. The sensitivity shows a 2dB reduction in the latest samples, and is now a little below average at 84dB/W. As a result, the bass register has lifted a little in relative terms to make the system more bass heavy than before, the −6dB point extended to a fairly low 42Hz and the overall ⅓-octave response from 46Hz–20kHz at +/−3.0dB.

Incidentally both the Spendor and the Rogers show a characteristic irregularity between 14kHz and 17kHz. This limited effect is due to the awkward transition between the steeply falling rolloff of the *HF1300* and the entry of the supertweeter. In practice it can be heard, but is only a minor factor.

Comparing the new 96dB distortion curves with the previous ones, there has been no significant change at low frequencies, for example, 1.0% of 2nd harmonic at 200Hz is now 1.2%, but below this region 3rd harmonic has been noticeably improved. At 90dB (not plotted) the distortion was particularly good in the mid and treble bands. A wide dynamic range is illustrated by the competent handling of the 100W pulsed inputs, these showing only slight compression and negligible additional distortion.

The forward response at 2m showed fine integration and off-axis control, and the 300W estimated power handling allowed high sound levels of up to 104dBA for a pair. The system has become slightly 'richer' in balance over the year, as the reprinted ⅓-octave 2m response shows when its overall trend is compared with the new reference sinewave response.

Assessed by multiple room response averaging, the *Studio* shows a reasonably good characteristic from 100Hz to 10kHz, albeit with some emphasis between 600Hz and 800Hz. The treble fell quickly above 12kHz before recovering a little. While good output was present to 40Hz, the 60–80Hz region of the bass was rather prominent, suggesting some bass excess in the room.

Sound quality

Fully re-auditioned, the *Studio* sounded a little 'richer' and 'sweeter' than before, with an improved tonal balance in the mid register. However the bass was on the full side, and the system, would be improved by a 'dryer' 'sharper' balance here.

Surveying the overall results, the *Studio* has comfortably equalled the exceptional ratings achieved last time, so there can be no doubt concerning its overall sound quality. The bass can be driven to high levels, and though a little 'oppressive', had great power and was free from distortion. When compared with live sounds it appeared very smooth and relaxed, with mild 'chestiness' and slight 'boxiness' on speech. A bit on the 'dim' side, the occasional 'chirp' or 'fizz' could be heard in the extreme treble, though the main treble was considered very good.

On commercial programme it was felt to be subtle, clear, transparent and well-focused, with a fine stereo image depth. Slight 'heaviness' was noted in the bass but was not considered too damaging, and in fact there was more praise than criticism – a rare event in listening tests!

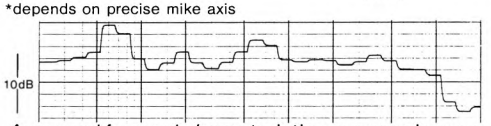
Summary

Despite or perhaps because of the minor changes, the *Studio* has kept the promise shown by the original samples. It is an exceptional performer by *Choice* standards, and if the bass balance is deemed acceptable, then there is little else to criticise. It offers a wide and smooth response, a high power capacity and dynamic range, plus a level of coloration and neutrality in the genuine monitor class. It was very well finished and engineered, and continues to be confidently recommended, the overall performance meriting Best Buy status.

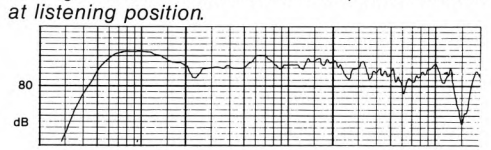
GENERAL DATA

Size (h x w x d)	63.5 x 30.5 x 30.5cm
Weight	14kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	300W
Recommended placement	open stands
Frequency response within ± 3dB (2m)	46Hz to 20kHz*
Low frequency rolloff (–6dB) at 1m	42Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	84dB/W
Approximate maximum sound level (pair at 2m)	104dBA
Impedance characteristic (ease of drive)	good
Forward response uniformity	very good
Typical price per pair inc VAT	£340

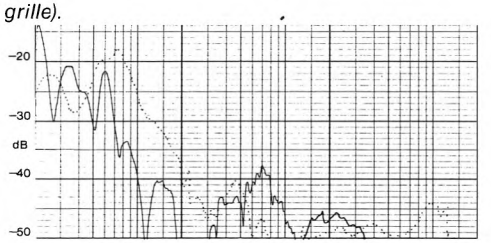
*depends on precise mike axis



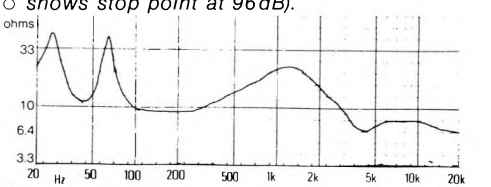
Averaged forward characteristic response in room at listening position.



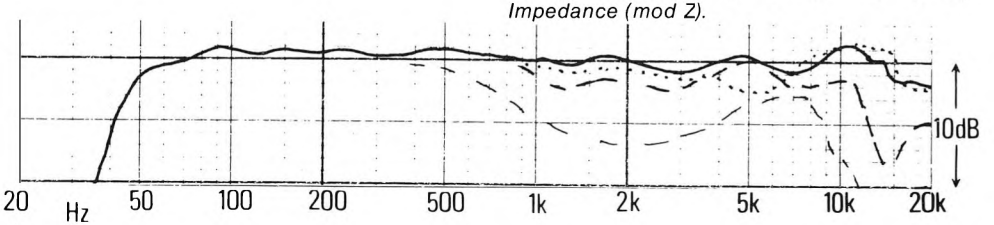
Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



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



Impedance (mod Z).

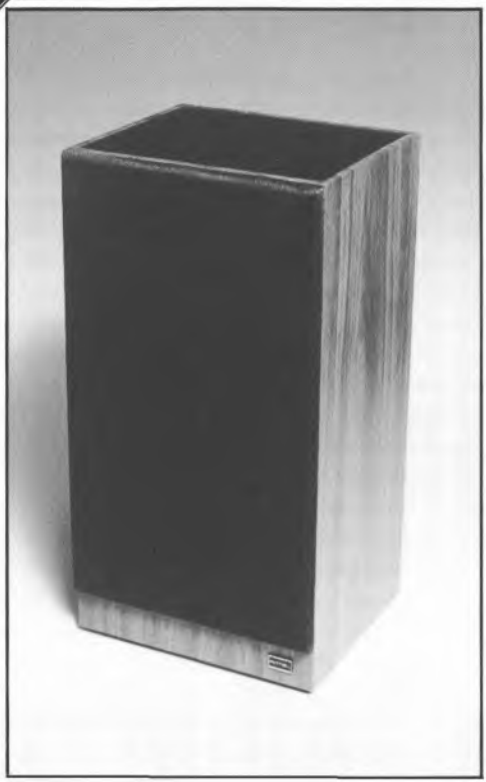


Forward characteristic response (⅓-octave @ 2m, solid axial, thick-dash 30° horiz., thin dash 45° horiz., dotted 15° vert.).

RECOMMENDED

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 12 mm 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 37 mm in diameter, with the box/vent resonance occuring 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 200 mm unit, a rigid damped pulp cone driver possessing a useful sensitivity. The vertical line up is completed by a 25 mm 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 1 m 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 2 m 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 ⅓-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'.

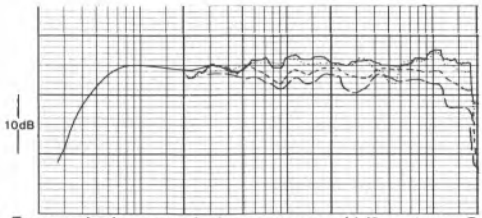
On recorded stereo programme the *915* made a good effort. Detail was evident throughout the tonally well-balanced range, and the image quality showed good stability as well as precision in the lateral plane. Residual coloration appeared to mask the full impression of stereo depth, and the sound stage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

Summary

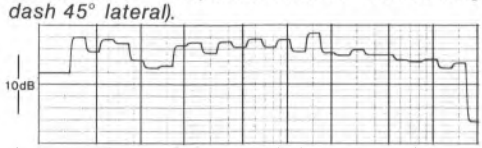
Well made and finished and possessing a quite natural neutral balance and a wide response, the *RL915* has done well enough to be included in the Recommended category at its price of a little under £200.00 a pair. Producing the best results on an open stand clear of the walls, Rotel have chosen this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

GENERAL DATA

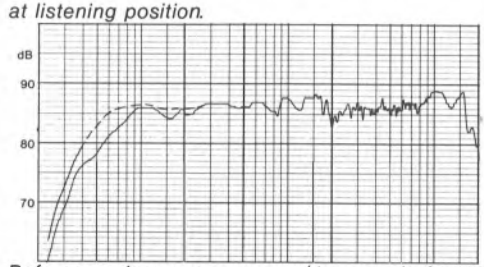
Size (h x w x d)	57 x 30 x 26.5cm
Weight	9.9kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–150W
Recommended placement	stand, clear of walls
Frequency response within ± 3dB (2m)	58Hz to 18kHz
Low frequency rolloff (–6dB) at 1m	43Hz
Voltage sensitivity (ref 2.83V, *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



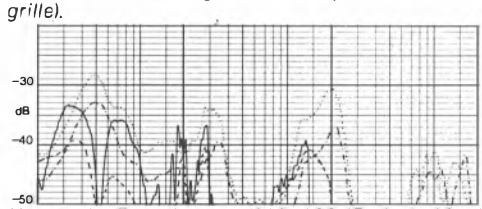
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



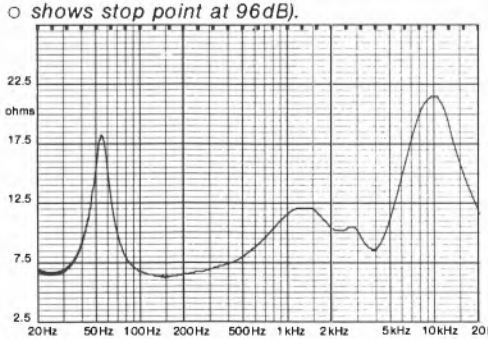
Averaged forward characteristic response in room at listening position.



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



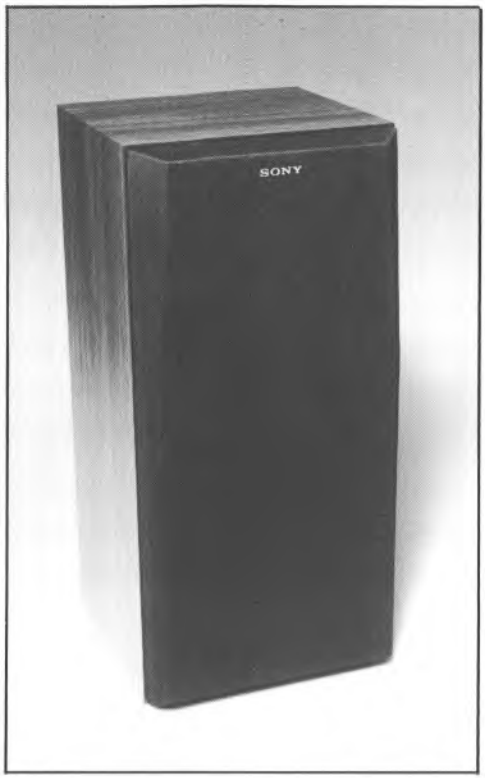
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod Z).

Sony SSE50 II

Sony UK Ltd., 134 Regent Street, London W1. Tel 01-439 3874



Sony have scored a continuing hit with the European-designed three-way *SSG1* system, so in an attempt to match the same standard in a lower price category they have introduced the *SSE50II*, which is also German built using European drivers. It is not an easy task to engineer a three-way speaker in an average sized enclosure for this sort of money, yet Sony have managed to do just that. Unfortunately the penalty in performance terms is plain to see from the following review findings.

A 25 litre enclosure sealed-box system, the external finish is a presentable walnut vinyl, with the carcase undamped 15mm chipboard. The drivers are neatly arranged in a vertical line in order to maximise the stereo potential (in marked contrast to a number of other Japanese manufacturers).

Sony clearly take this model seriously, as they can also supply a matching stand, with instructions to position the speaker near to the rear wall. However, in view of the system's frequency balance, this suggestion is inadvisable. The 200mm bass unit is built on a cast frame but is fitted with a light, flabby cone and an insubstantial magnet, which is confirmed by the poor bass damping. From 900Hz to 6kHz a 100mm doped-paper cone unit takes over, nominally the mid driver. The treble is allocated to a 19mm soft plastic diaphragm combination dome/cone. A moderate quality crossover is fitted, comprising only 5 elements; this is not usually sufficient for a full three-way design if the speaker outputs are to be properly 'married'. The front grille was felt unlikely to be favourable in diffraction terms, and accordingly curves were taken with it removed as well as in position.

Lab performance

At the outset the reference response for this design looked unpromising. The printed curve shows the deleterious effect of the grille (dotted), though the response with it removed demonstrated no great improvement. The sensitivity was judged to lie at a high 90dB/W with a bass rolloff at −6dB, 60Hz. The pair matching was satisfactory.

At 2m with ⅓-octave averaging the output was undeniably 'lumpy', but it had the makings of good lateral directivity. However the 15° vertical above response was poor with a serious phase-cancellation dip in energy at 2kHz. Above 2kHz the axial output was fair enough to 15kHz, but the 600Hz and 100Hz humps were rather severe in magnitude.

With a 50W power rating, the sensitivity enabled a fairly loud 102dBA maximum sound level for a pair, at which point the speakers sounded pretty loud. The 100W pulsed input produced a 0.5dB overload expansion at 500Hz, plus 10% 3rd harmonic distortion, though the 5kHz pulse was handled satisfactorily. The swept distortions at 96dB and 90dB were also satisfactory particularly at low frequencies, though the 3rd harmonic products in the mid-band were certainly worse than average.

Noting the system resonance at a high 70Hz, the impedance met the 8 ohm spec and is thus classed as a very good amplifier load. Turning to the room response, the bass and midrange 'lumps' were still present, and this also revealed a limited bandwidth, with little output from the speaker below 55Hz or above 14kHz.

Sound quality

The listening tests consistently indicated poor quality for this speaker; in fact sufficient coloration existed for it to be used as a model to show how

not to 'voice' a modern loudspeaker. To be fair the *SSE50 II* was not wholly dreadful, and in isolation might even appeal to some listeners. But when compared with the competition in its price range included in *Choice*, it had little chance of success.

Looking at the results in more detail, on the live sound comparisons comments along the lines of 'orange box', 'smeared', 'boomy', 'sibilant', 'chesty' and 'fruity' were not uncommon. Even the bass was of the 'one note' variety, with no fundamental power and a 'nasal', harmonic-enhanced character.

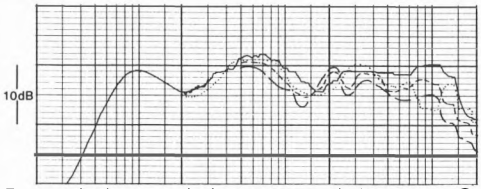
On the stereo sessions an artificial 'boxy' echo was added to much of the programme, and the sound could be 'hard', 'harsh', 'middy', 'boomy', 'unfocused', 'muddled' and 'nasal'. At least it was inoffensive, in the sense that some poor designs are also fatiguingly harsh. Stereo depth was minimal, and the measured effects of grille removal were barely audible in the general confusion.

Summary

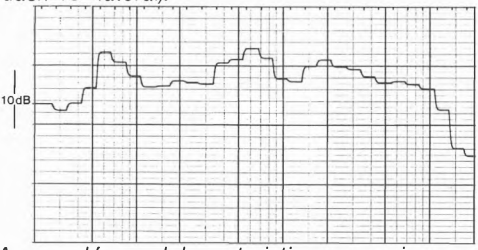
Inexpensive as this model is for a three-way design, it is not true hi-fi and is unworthy of the Sony brand label. Made to a price and not a subjective standard, a number of smaller and less expensive models in this issue easily outperform it, and with such levels of coloration, it cannot be recommended. It is hard to believe that the respectable *SSG1 II* comes from the same manufacturer.

GENERAL DATA

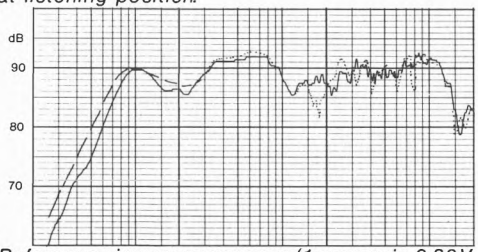
Size (h x w x d)	57 x 27 x 28cm
Weight	9.0kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–50W
Recommended placement	on stand
Frequency response within ± 3dB (2m)	see text
Low frequency rolloff (−6dB) at 1m	60Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	90dB/W
Approximate maximum sound level (pair at 2m)	102dBA
Impedance characteristic (ease of drive)	very good
Forward response uniformity	potentially good
Typical price per pair inc VAT	£100



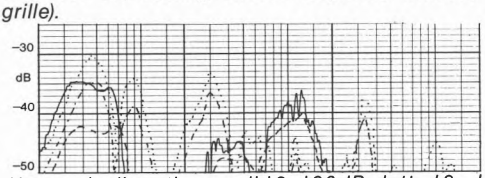
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



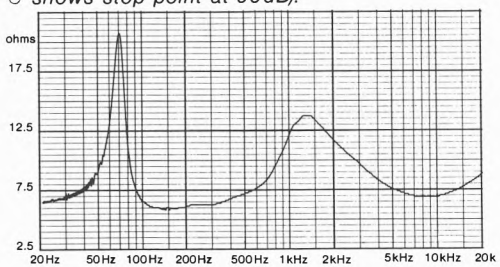
Averaged forward characteristic response in room at listening position.



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

Sony SSG1 II

Sony UK Ltd., 134 Regent Street, London W1
Tel 01-439 3874

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

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

Lab results

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

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

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 $^1/_3$-octave band (much as the human ear perceives the frequency response). the result was much tidier, in practice meeting +/–2dB 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

BEST BUY

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

Summary

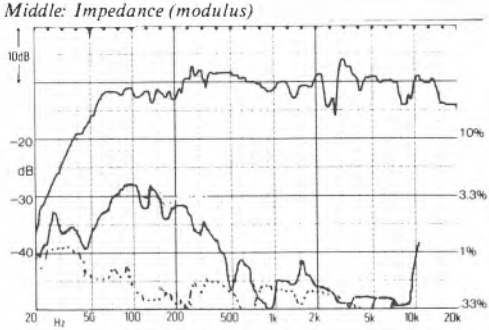
This good looking and well engineered system offered a fine all round subjective performance with firm bass amenable to lift if desired. A very high maximum sound level was attained with high sensitivity, excellently low distortion and an 'average' amplifier rating. Recommendation is clearly in order, but as the *GI* was on occasion a touch aggressive, personal audition would be worthwhile.

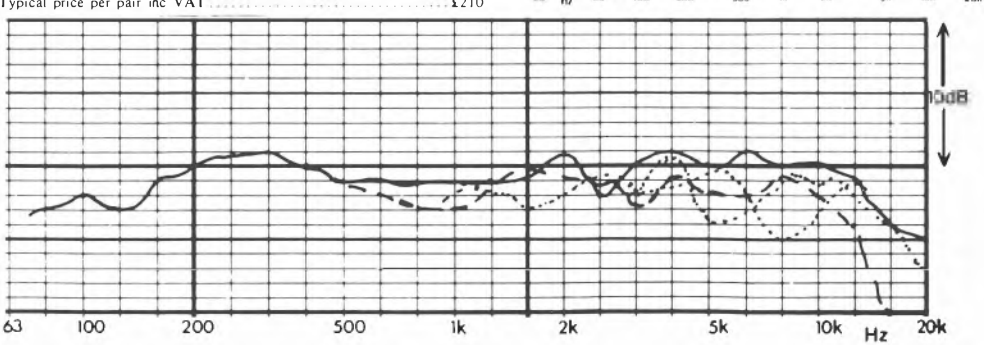
Note:

The *Mk II* version which was fully retested for the last edition offers minor modifications to improve the high power durability, but was otherwise very similar to the *Mk I.* It did well on the pulsed power test with a minimal increase in distortion, but performance was better with the grille off, the latter responsible in part for the 3kHz response irregularity.

Size	59.5(23) H: 33.4(13) W: 30(12) D: cm(inches)
Weight	13(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10–100W
Recommended placement	stand or open shelf
Frequency response within ±3dB (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

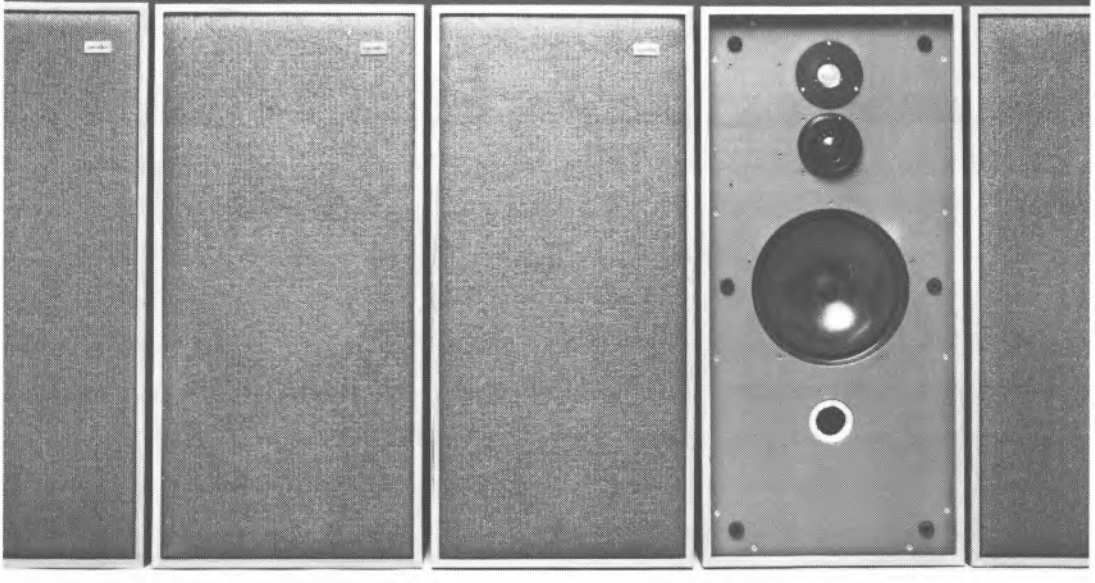
Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)





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

One of British Broadcasting's best kept secrets



Spendor speakers are the choice of professionals.
The British Broadcasting Corporation alone use over 600.
Unlike other manufacturers Spendor are unique in having their whole range in use with professional broadcasters.

Over 2,000 are in use with the following organisations:

Capital Radio — London, Piccadilly Radio — Manchester, I.B.A., and I.L.R. stations throughout the U.K., W.D.R. Cologne, Thames Television, London Weekend Television, Ministry of Defence, Radio Telefis Eireann (Dublin), Post Office Communications, Link Electronics, Alice Stancoil, Marconi, Neve, Dolby Laboratories, E.M.I., Pye T.V.T., Audix, Royal Opera House.

Now the secret's out, you know what the professionals use.

spendor
Sound engineering

Spendor Audio Systems Ltd.,
Station Road Industrial Estate,
Hailsham, Sussex BN27 2ER
Tel: Hailsham 843474

BEST BUY

Spendor SA2

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

A hard target to achieve, Spendor set out to complement the long lived *BC1* with a less expensive and more compact model, possessing higher sensitivity and greater power handling. Following extensive redevelopment the 200mm driver used as a midrange on the *BC3* and bass/mid on the *BC2* was deemed suitable for the *SA2*. The bextrene-cone unit was only finalised after interminable experiments to determine optimum flare, thickness termination and damping. In the *SA2* it is married to the popular 25mm soft dome Audax tweeter which is also used in the miniature *SA1*.

A true compact, the *SA2* is some 50cm high with an internal volume of 28 litres, reflex-tuned by a large port possessing a high acoustic power capacity. This is 75mm in diameter and has a slant cut internal duct to reduce higher order transmission modes in the tube. With a cabinet/driver resonance of 70Hz, the enclosure itself is tuned to 48Hz to generate a maximally flat response.

A costly design to produce, the cabinet is a thinwall type made from the finest multi-ply, heavily damped by bituminous cladding and finely veneered. A sensible acoustic foam grille ensures minimum obstruction of the sound field emerging from the drivers. Built of close-toleranced components, the crossover uses low distortion radiometal-cored inductors and polyester capacitors, and the treble sensitivity is adjusted on production to a precise match by a tapped auto-transformer which is also part of the high frequency section. In total 8 elements are used, with electrical connection *via* the usual 4mm screw terminal sockets at the rear.

Lab performance

Comfortably meeting +/−2.5dB limits from 55Hz to 16kHz, the *SA2* showed an even and well balanced response at 1m. Sensitivity was higher than for the *BC1* at 86.5dB/W, which is about average for the group, and the bass response was moderately extended to 50Hz, −6dB. Pair matching was very good.

At 2m the response balance was exceptional, with +/−1.5dB a fair representation of range from 65Hz to 17kHz. Fine integration was demonstrated and the 30° response was still very good; only at 45° did the uniformity begin to break up, and this result holds out the promise of good stereo imaging.

Showing little compression on the 100W pulsed inputs, the distortion was moderate at around 5% of 2nd harmonic at both frequencies, while 3rd measured 0.7% at 500Hz and 2.0% at 5kHz. On steady state it remained at very low levels down to 50Hz even at 96dB, and the majority of distortion products charted are harmless second order ones. Low frequency distortion was particularly good for the size.

By complying with an 8 ohm spec the *SA2* was rated as a very good amp load, with a minimum impedance of 6.5 ohms 4kHz and an average value of 10.

Providing significant bass power down to 40Hz, the room averaged response suggests that the 60Hz region was rather prominent. The mid range possessed a gentle curvature with a 600Hz prominence, followed by a well-controlled gentle rolloff to the highest frequencies. This trend does not appear to correlate well with the anechoic response until the 45° off-axis curve is taken into consideration, whereupon some relationship between the anechoic and room responses can be recognised. With a 300W peak power handling the *SA2* proved capable of delivering high sound levels, while 20W per

channel was judged sufficient for satisfactory results in moderate domestic use.

Sound quality

The *SA2* succeeded handsomely in its objective of beating the *BC1* on bass power handling, surviving over 500W peak of direct injection electric bass guitar. Good fundamental power was present, and although some 'nasality' or harmonic emphasis was noted, with a touch of overhang, it scored above average on bass coloration.

Both live and commercial recorded sessions were competently dealt with, and a fine performance was delivered for the price. In character and balance it was felt to be 'lifelike', but some coloration was apparent, notably a low/mid 'boxiness', some muddling of detail in the upper bass, plus a slightly 'dulled' effect and some 'nasality' on voice.

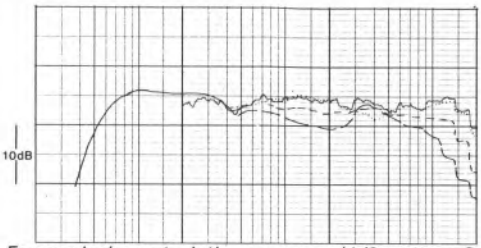
Stereo image quality was well above average, with well-focused central detail, wide precise lateral presentation, and good depth. It possessed a generally smooth character and revealed promising detail, but did not attain the level of transparency available from a *BC1* for example, and some clouding was noticed in the lower midrange.

Summary

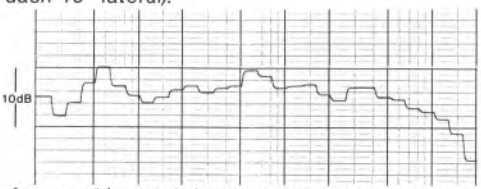
The *SA2* scores and performance justify Best Buy ranking. It possesses many attributes, notably a neutral, relaxed sound, fine stereo, excellent power handling and above average bass, plus excellent constructional quality and finish, as well as a reasonable sensitivity at a realistic price and in a highly compact form. It deserves serious consideration especially if a tidy enclosure of small dimensions is required.

GENERAL DATA

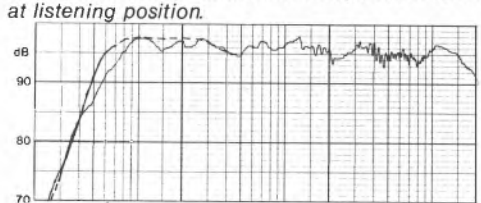
Size (h x w x d)	50 x 26.2 x 29.5cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–300W
Recommended placement	on stand clear of walls
Frequency response within ± 3dB (2m)	57Hz to 17kHz
Low frequency rolloff (−6dB) at 1m	50Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	86.5dB/W
Approximate maximum sound level (pair at 2m)	106dBA
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good
Typical price per pair inc VAT	£290



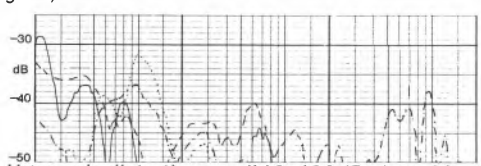
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



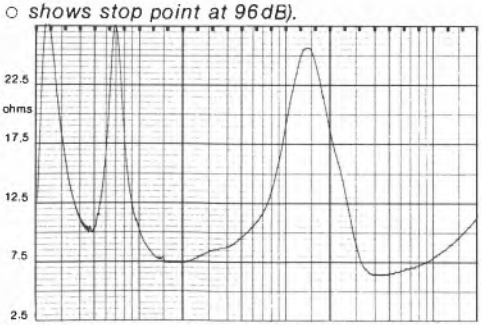
Averaged forward characteristic response in room at listening position.



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, ○ shows stop point at 96dB).

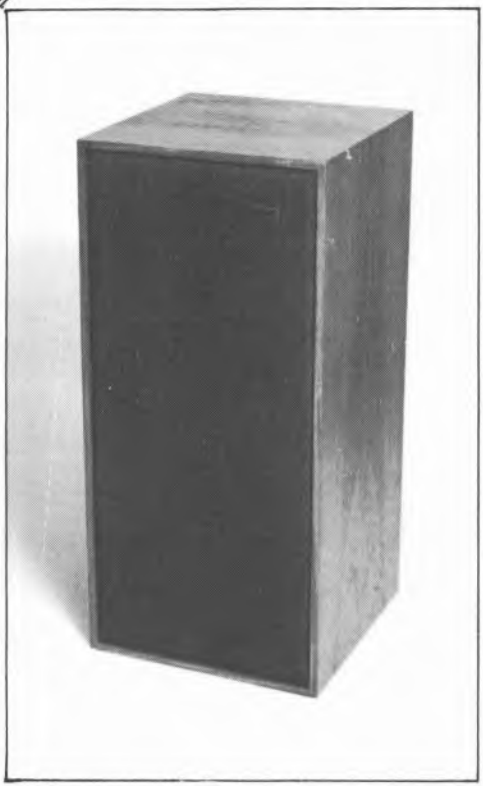


Impedance (mod Z).

BEST BUY

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 voume and uses two main drivers. The 200 mm 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 carcase 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 39 Hz. 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 150 Hz the satisfactory performance was unchanged, though the 4.4% 2nd at 200 Hz is still more than I like. However, below 150 Hz and down to 60 Hz, 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 3.4 kHz 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 +/−3dB 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 'leaden' 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.

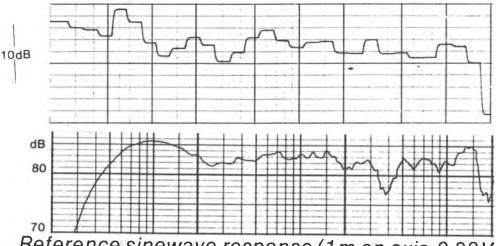
Summary

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.

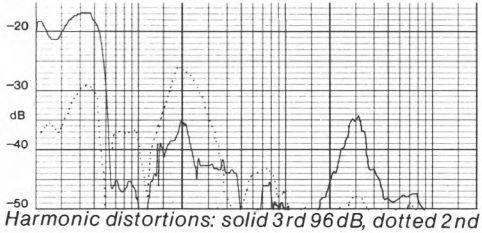
GENERAL DATA

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 ± 3dB (2m)	44Hz 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

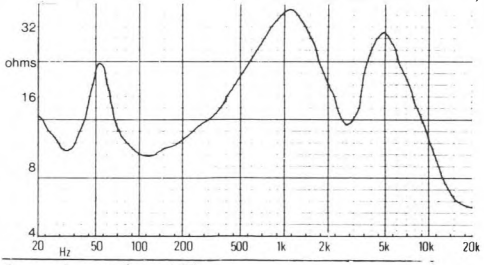
*depends on precise mike axis



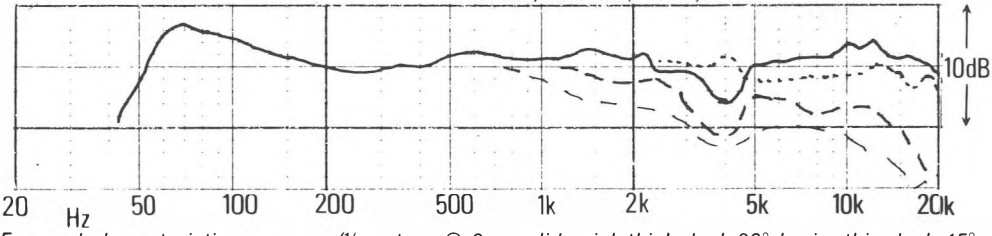
Reference sinewave response (1m on axis, 2.83V input shows sensitivity)



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



Impedance (mod Z).



Forward characteristic response (⅓-octave @ 2m, solid axial, thick-dash 30° horiz., thin dash 45° horiz., dotted 15° vert.).

RECOMMENDED

Spendor SA3

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

First seen in prototype form early last year, the *SA3* was designed in response to a requirement for a high sound level alternative to the *BC1* for use in broadcast monitoring in West Germany, and is still a rarity in UK shops. Spendor possessed the necessary technology to produce a wide frequency range 305mm bextrene cone driver capable of the required acoustic power, and this design was further developed for use in the *SA3*, working up to 2kHz. The range above is covered by a high power 34mm soft dome tweeter, a recently refined model from Audax.

The large 120 litre enclosure is intended for stand mounting and is fitted with a minimal diffraction foam grille. The system is reflex loaded by a large 80mm diameter short duct port. This review essentially covers the active prototype version which employs a 100W bass and 50W treble amplifier with an electronic crossover, the electronics built in to a removable tray at the rear of the speaker. A passive version of very similar performance is also available at around £890 a pair. Possessing a nominal 88–89dB/W sensitivity, it can be updated to active drive at a later date.

Lab results

A low −6dB point of 33Hz was charted showing the bass extension expected of such a large loudspeaker. The power headroom settings showed that a high maximum level of 110dBA should be available from a pair under normal conditions (and working on an estimated 200W programme handling capacity for the passive version, this should be capable of 108dBA but without the sizeable subjective overload headroom of the active model).

The distortion at 96dB 1m was judged excellent, with admirably low levels of third harmonic. While not strictly applicable, the pulsed distortion test was tried at two sound levels, namely 108dB and 98dB. At the former no distortion was detected, although a significant 0.6dB compression was measured at 5kHz and a negligible 0.1dB compression at 500Hz. Reducing the *s.p.l.* to 98dB gave a minimal 5kHz compression of 0.1dB.

On axis at 1m the response on the sinewave met close ±2.5dB limits from 35Hz to 16kHz. A touch of depression in the presence band, 1.5–2.6kHz, was apparent and was consistent in the 2m ⅓-octave characteristic, but a remarkable feature was the very good integration exhibited by this model despite the use of a 305mm bass unit, the diffraction slot in front of the latter believed to be partially responsible for this performance. However the upper treble did fall off a little earlier than usual at 30° of axis, due to the tweeter's larger than usual radiating diameter.

Sound quality

Rated as very good throughout the listening tests the prototype *SA3* confirmed its pedigree. A trace of mid 'richness' – almost 'plummy' effect – was noted, but the general accuracy and balance versus live sounds was highly rated. In our room the 60–80Hz range seemed a little heavy, but the bass was well differentiated and extended, as well as powerful and free of spurious noises.

Stereo imaging was very good, with high lateral precision and good depth ranging. Experience showed us that imaging continued to improve with distance, and we regard 3.5 metres as about the

RECOMMENDED

closest a listener should sit. The treble was exceptionally sweet, clear and transparent, while the midrange set high standards in terms of coloration and accuracy of balance.

Summary

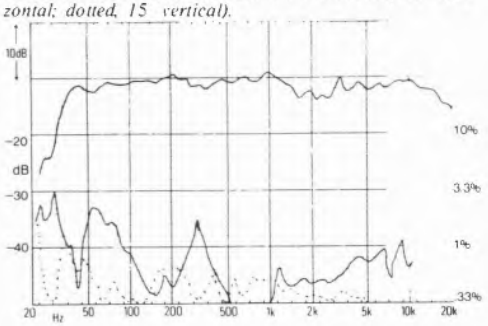
Joining that select group of accurate high performance systems, this fine and powerful loudspeaker intended for professional duties will, I am sure, find great favour on the domestic market as well. While in objective terms it does not quite possess the same midrange subtlety as the *BC1*, the system offers greater power handling, extended bass, superb dynamics, and a top-class treble. Voiced and balanced in the conscientious Spendor tradition, it is virtually handcrafted throughout and is highly recommended.

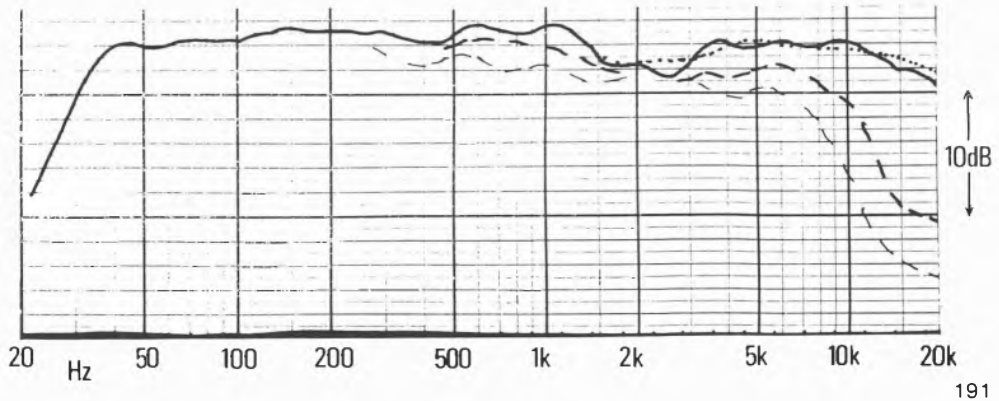
Production models in both active and passive configurations were auditioned just before press date, and these more than confirmed the exceptional promise indicated by the pre-production samples which we had fully assessed.

Size (H, W, D)	85, 38, 46 (33.5, 15, 18 cm(inches)
Weight	41 (90) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	active
Recommended placement	stand
Frequency response within ±3dB (2m)	33Hz–20kHz
Low frequency rolloff (−6dB) at 1m	33Hz
Voltage sensitivity (ref 2.83V, *ie* 1 watt in 8 ohms) at 1m	88/89dB/W passive*
Approximate maximum sound level (pair at 2m)	110dBA
Distortion (96dB at 1m)	excellent
Distortion (100W peak)	very good
Impedance characteristic (ease of drive)	active
Forward response uniformity	very good
Typical price per pair	£1656 active, £890 passive (not tested).

Prices were anticipated at time of review.

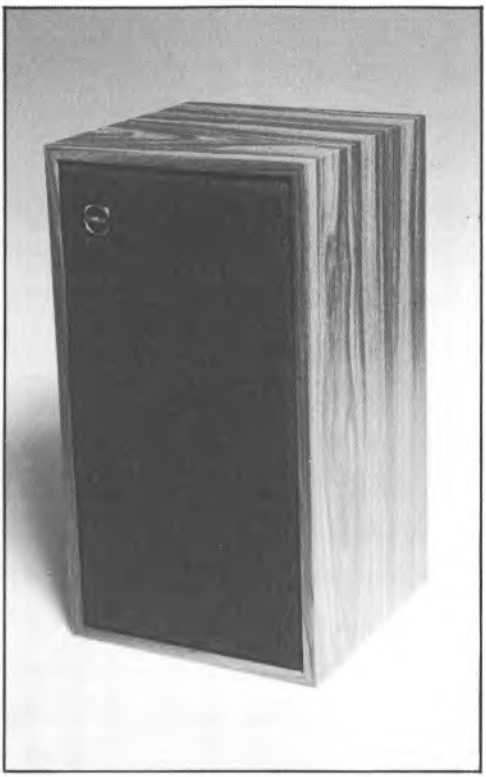
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).





Tannoy Stratford

First Floor, 77/79 High Street, Watford, Herts. Tel (09230) 48868



Tannoy have made a bold entry into the budget market with their new *Stratford* speaker retailing at around £100.00 a pair. A compact two-way reflexed system, with a 22 litre internal volume, the driver/cabinet resonance is located at 72Hz and the enclosure is tuned to 38Hz by a small ducted port, 47mm in diameter and 15mm deep.

The design incorporates Tannoy's costly pressure horn tweeter, a high sensitivity unit equipped with a well-tooled die-cast exponential horn. The bass/midrange is covered by a 200mm unit built on a steel frame and using a propylene cone; this low compliance driver is specifically designed for reflex loading, and is also in fact one of the highest sensitivity polypropylene units I have yet encountered at 90dB/W. Vertical-in-line driver mounting is used to provide good stereo imaging.

With all this technology it was disappointing to find that the crossover was unduly primitive, comprising as it did just 2 elements plus 2 resistors, which does not augur well for the off-axis integration. A sensible foam grille is fitted complete with a pricey-looking Tannoy badge, and spring clip terminals are used at the rear. The external finish is a 'dark walnut' grade of good quality vinyl.

Lab performance

The reference sinewave response demonstrated a 3–4dB step down in output below 600Hz, suggesting that the system had been optimised for shelf mounting which is not unreasonable in view of the price and size. The subjectively assessed sensitivity was about 90dB/W, significantly above average, and the response showed a lack of low bass with the –6dB rolloff point at 60Hz. Capable of up to 75W inputs, the *Stratford* could be driven to quite a high volume level of 103dBA per pair, though 10W per channel is ample for satisfactory domestic levels.

The 'phasiness' of the poor crossover design was shown by the pair matching variation, where the second sample (identical mike position) demonstrated an axial dip at 5kHz. Examination of the 2m characteristic responses for off-axis angles shows that this dip is strongly axis dependent, particularly in the vertical plane: a 3dB hump at 3kHz on axis rapidly becomes a 5dB dip with small changes of axis; the second sample could be brought in and out of 'focus' in a similar way.

This problem aside for the moment, the general trend suggests that the *Stratford* has some potential for a uniform output, and under room averaging conditions the speaker was certainly smoother, though the gentle mid prominence and the energy loss at 2–4kHz were still evident. The bass was even, if subdued a couple of dB relative to the midband, and the treble decay looked quite smooth after averaging.

Fed 100W pulses the speaker was beginning to overload at 500Hz, with 10% 2nd and 3.0% 3rd, but showed negligible compression. At 5kHz there was no problem, with 1.0% 2nd and 0.3% 3rd, and the swept distortion results were considered good at 96dB, with 3rd harmonic continuing to diminish down to 0.4% or less at 90dB. Mild 2nd harmonic only was apparent in the output from the treble unit.

Never falling below 7 ohms, the speaker comfortably met the 8 ohms specification, and was thus an easy load, allowing full exploitation of its rated dynamic capabilities even with overload-protected amplifiers.

Sound quality

The bass register was rated as average, with

moderate power handling, slight 'nasal' and 'lumpy' effects, and limited lower frequency extension. Compared with live sounds the *Stratford* did fairly well. A number of criticisms were made by the panel, describing 'fizzy' treble and excess sibilance, plus 'boxy', 'boomy', 'middy', 'dulled' and 'wooden' colorations. Nevertheless the result was promising at the price.

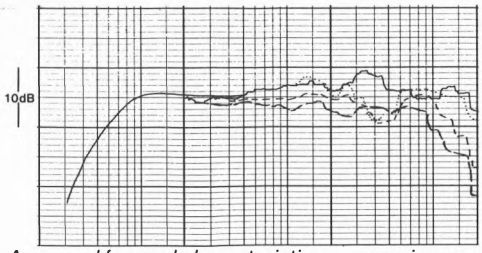
On the stereo session the speaker fared less well. The sound was 'thinned' in tonal balance with a 'brash' 'forward' quality accompanied by considerable 'boxiness' and 'woody' type cabinet readout. The treble was not particularly liked, having a 'zingy' 'sharp' effect, appearing rather concentrated and a trifle 'aggressive' in balance. Stereo was below average in image precision and depth effect, and worsened with wall mounting. However the latter helped to fill out the tonal balance better.

Summary

Elements of the *Stratford* hold promise, and perhaps a 'quieter' cabinet or more importantly a better crossover could make it a good system. As it stands its performance on commercially recorded stereo material was insufficient to merit recommendation despite its modest price, good finish and useful sensitivity.

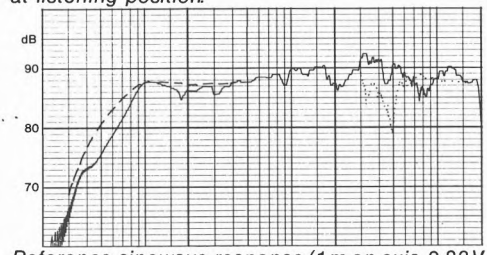
GENERAL DATA

Size (h x w x d) ..... 48 x 26.5 x 26cm
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)..... (10)–75W
Recommended placement..... open shelf
Frequency response within ± 3dB (2m) ..... 79Hz to 19kHz
Low frequency rolloff (–6dB) at 1m..... 60Hz
Voltage sensitivity
(ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m..... 90dB/W
Approximate maximum sound level (pair at 2m)..... 103dBA
Impedance characteristic (ease of drive)..... very good
Forward response uniformity ..... fairly good
Typical price per pair inc VAT..... £110

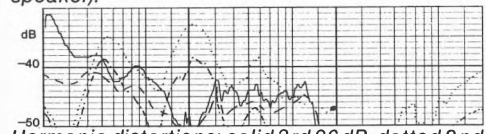


Averaged forward characteristic response in room at listening position.

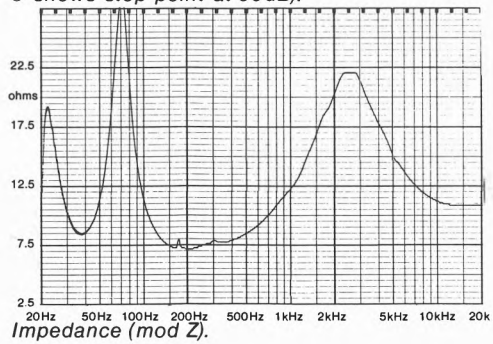
Averaged forward characteristic response in room at listening position.



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).

Tannoy SRM12X

First Floor, 77/79 High Street, Watford, Hertfordshire
Tel (0923) 48868

It is now some time since Tannoy has been represented in *Choice,* and on this occasion their entry is a substantial model from their professional range of high sound level monitors. This intended application should be taken into consideration, together with the fact that the speakers have been designed to be repaired on site (including the replacement of both bass and treble driver diaphragms). The *'12XR* is compatible with Tannoy's sophisticated electronic crossover system for bi-amplification applications.

A redeveloped version of the famous 305mm dual concentric driver is used, reflex loaded by a very rigid and well finished 80 litre enclosure which is suited to floor mounting. The heavy pulp bass cone is flared to form the outer section of a treble horn whose mouth lies down the centre pole pieces of the main driver, with the tweeter mounted at the back of this main unit. Theoretical virtues of this concentric design include good driver integration with perfect off-axis dispersion symmetry. A high quality crossover is used, and incorporates a variable treble output slope above 6kHz as well as variable treble energy levels above 1.5kHz.

Lab results

Pair matching was very good and typically to 1dB, except in the 1–3kHz range where poorer than average 2–3dB differences were noted. Sensitivity was very high at 93dB/W which, in conjunction with the 500W power handling capacity on unclipped programme as well as the good rating for amplifier loading, will permit an extraordinary maximum of 115dBA to be attained from a pair in a typical room – quite the highest for the issue. A true 8 ohms impedance was demonstrated with a good phase characteristic, and a lower value could only be obtained with the full treble boost on both controls. The −6dB cutoff at 50Hz was reasonable in view of the efficiency.

At 96dB (which only required a 2W input) the swept distortion results were pretty good, particularly at low frequencies, and the rise in distortion to 2% third harmonic at 800Hz–1kHz was not considered very serious. Fed 100W pulses to a 113dB level at 1m, no extra distortion was noted at 500Hz with only a mild 0.2dB compression, while at 5kHz compression was unpredictable, and although the second harmonic rose to 3% this is fair enough considering the output test level.

On axis at 1m the speaker demonstrated a rising response trend peaking at 15kHz. At 2m with ⅓-octave averaging this trend was confirmed, and Tannoy recommend that the speaker in fact be used with the stereo pair over-angled inwards by some 15° or more. As our lateral 30° off-axis response revealed a well balanced and integrated result, auditioning directly on axis is clearly not advisable. As promised by the concentricity, the dispersion was very good.

Sound quality

It was difficult to ensure the correct off-axis position for all the listeners in the panel, and the results partly reflect this problem. Judged 'acceptable' on live sound comparisons, the midrange character was considered somewhat 'hard' and 'boxy' with a subjectively uneven and exaggerated treble exhibiting some aggressive effects. It appeared a touch weak on fundamental notes, but the bass was clean and even, accepting up to 500W

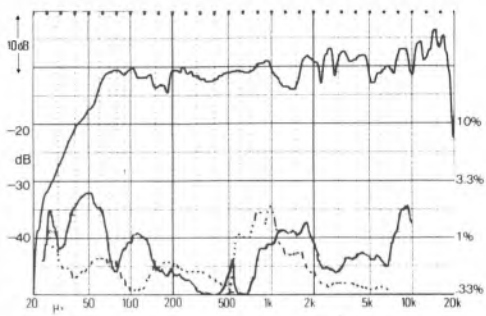
peak gracefully and producing colossal acoustic power.

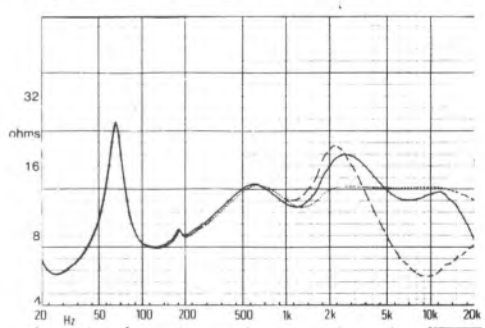
On the stereo programme tests some midrange coloration was present which restricted the stereo depth, while lateral positional focus was none too precise. Piano reproduction was a trifle 'wooden' and the treble register tended to show up noise and clicks more than usual.

Summary

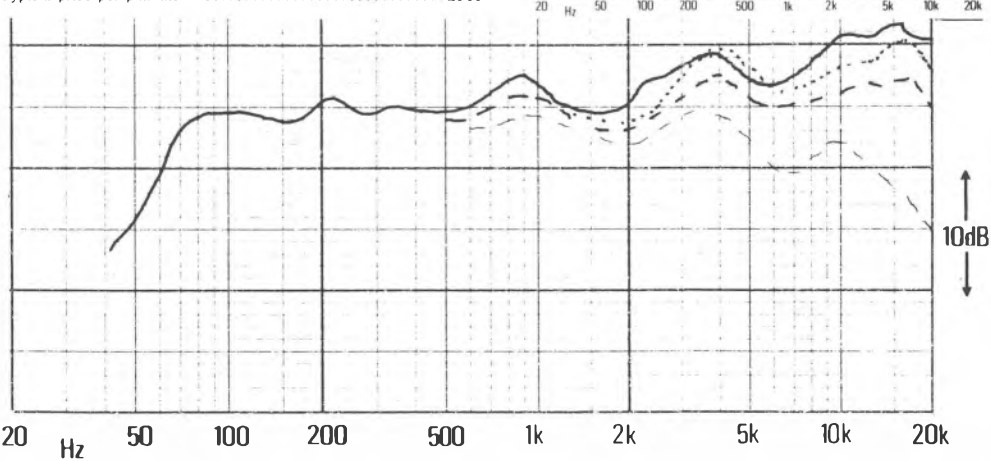
This design was rather out of place in the context of the project as a whole, since its virtues of easy drive, very high sensitivity and high acoustic level capabilities are not the factors uppermost in the minds of a panel accustomed to the more subtle and refined reproduction afforded by domestic hi-fi systems. It cannot be recommended for domestic use on a price-*vs*-performance basis, but conversely this judgment cannot be extended to its intended studio application.

Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



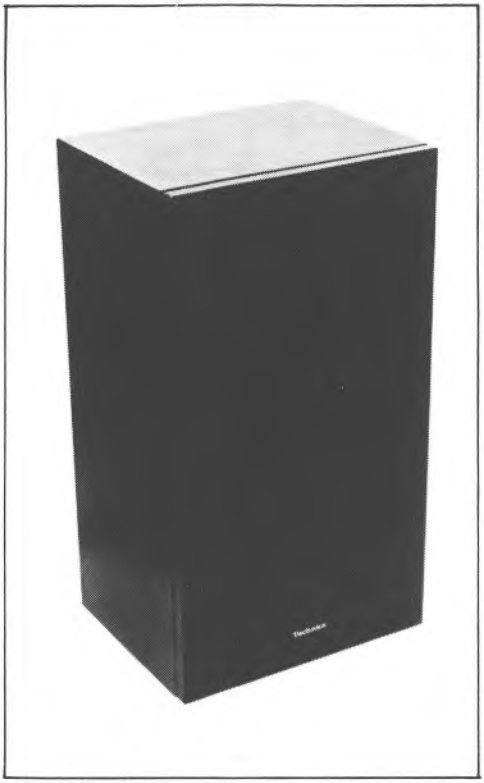


Size (H, W, D)	85, 44.5, 27 (33.3, 17.6, 10.7) cm(inches)
Weight	30 (66) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	5–500W
Recommended placement	floor
Frequency response within ±3dB (2m)	50Hz–6kHz
Low frequency rolloff (−6dB) at 1m	50Hz
Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m	93dB
Approximate maximum sound level (pair at 2m)	113dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	good
Impedance characteristic (ease of drive)	good
Forward response uniformity	above average
Typical price per pair inc VAT	£560



Technics SB10

Panasonic UK Ltd., 300–318 Bath Road, Slough, Berks SO1 6JB. Tel Slough 34522



Released early in 1980 in a blaze of publicity, the *SB10* is the prestige model from a new range of minimum time delay speakers, all using flat diaphragm drive units.

A three-way 64 litre sealed box system, the bass unit has an overall diameter of 320mm and uses an alloy honeycomb-core piston diaphragm, driven by a large 160mm diameter motor coil. This crosses over to a honeycomb disc midrange unit of 80mm diameter, while above 4kHz a sophisticated ribbon tweeter takes over, possessing a 20W sinewave power handling capability and claimed to operate up to 125kHz! Resettable circuit breaker protection is provided for both mid and treble units.

The high power crossover is essentially a 12dB/octave (electrical) type with provision on the front panel for boost and cut of both treble and midrange. The finish and engineering quality are very high and the presentation immaculate, but the grille frame was considered rather deep, and not particularly good in terms of front panel diffraction.

Lab results

While a fine pair match of generally within ±0.7dB was demonstrated, the grille was found to produce mild response anomalies, notably at 1.3kHz and 3kHz. The sensitivity was just average at 86dB/W but the low frequency range was surprisingly extended to 33Hz, −6dB, and with a 100W rated power handling, a satisfactory maximum level of 99dBA is obtainable in a typical room. A textbook 8 ohm nominal impedance was recorded so the *SB10* rates as a good amplifier load and is easy to drive.

Over some parts of the range the distortion levels at 96dB 1m were excellently low, but the speaker was let down by the performance of the ribbon tweeter from 2kHz upwards; 3% of second harmonic plus 2.5% of third were found in a fairly critical range (3–6kHz), and while the third harmonic production at 6kHz may not in itself be particularly important, the consequent intermodulation products are. Technics in Japan have informed us that these results were not atypical, and a second pair tried gave very similar results. The 100W peak input also gave trouble at 5kHz, where a serious 0.4dB expansion appeared with 5% second and 2.5% third harmonic distortions; at 500Hz however results were near perfect.

On axis at 1m the response was not as flat as the claimed near perfect pistonic drivers would have had one believe. A small mid plateau existed between 300 and 900Hz, followed by a dip (grille induced) plus a depressed treble presence band; the high frequencies recovered smoothly with some peaking at 12kHz. ⅓-octave analysis smoothed things a little, though the depressed lower treble region and the gently uneven response remained. Although mild, these broad irregularities are nonetheless significant. The off-axis responses were however quite good.

Sound quality

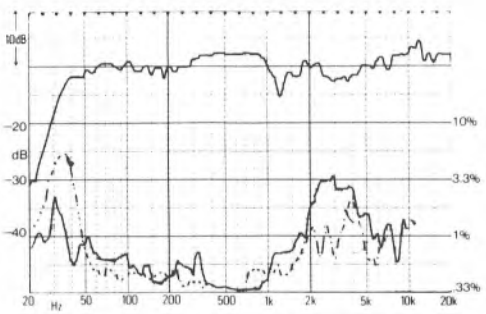
This design was considered fairly good on the comparisons with live sounds including speech. The output appeared somewhat 'flat' and 'withdrawn', with a loss of transient attack and some excess midrange 'fullness', while the bass was not quite firm enough, although it showed fine even extension and withstood 200W peak of electric bass guitar.

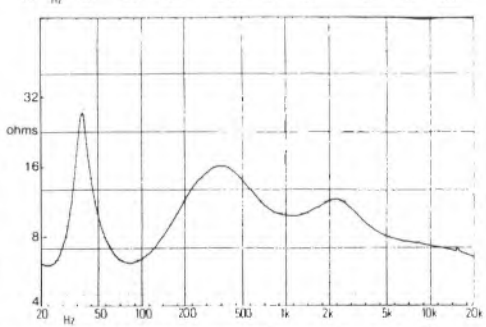
On stereo programme the results were close to the group average, which was disappointing considering the price. The stereo image performance was surprisingly weak, with lateral positioning anomalies and restricted depth, while the treble range was not particularly liked, some panelists specifically noting audible distortion.

Summary

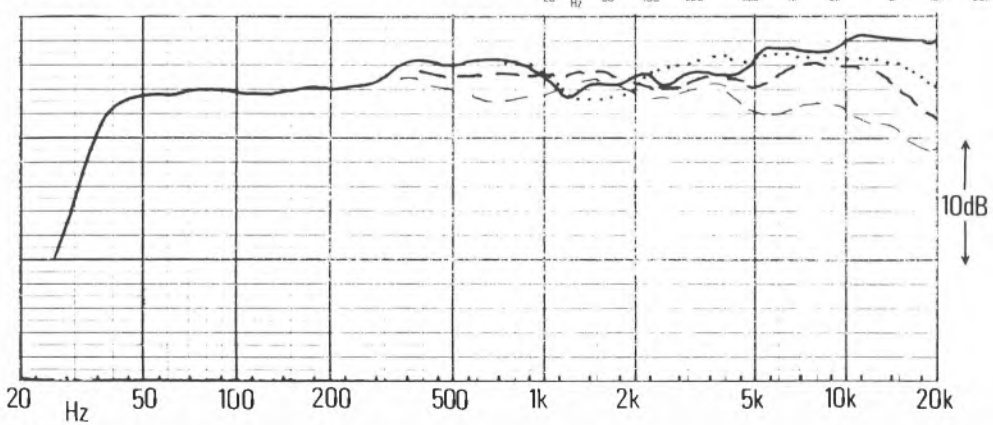
This speaker is a classic example of the ends not justifying the means; specifically, the subjective results do not justify the application of costly and externally impressive engineering and modern technology. The problems noted in the lower treble are not the only cause for concern, and despite the extended bass and excellent finish, on sound quality grounds this model cannot be recommended at its high price level.

Top: Frequency response, 1 m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).





Size (H, W, D)	71.1, 40.2, 32 (28, 16, 12.6) cm(inches)
Weight	32 (70) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25–100W
Recommended placement	stand
Frequency response within ±3dB (2m)	40Hz–210kHz
Low frequency rolloff (−6dB) at 1m	33Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	86dB
Approximate maximum sound level (pair at 2m)	99 dBA
Distortion (96dB at 1m)	acceptable
Distortion (100W peak)	acceptable
Impedance characteristic (ease of drive)	good
Forward response uniformity	above average
Typical price per pair inc VAT	£600



RECOMMENDED

Toshiba SS50GB

Toshiba House, Frimley Road, Frimley, Camberley, Surrey GU16 5JJ
Tel (0276) 62222

The *SS100GB* has been inexplicably withdrawn since its fairly good showing in last year's *Choice,* only to be replaced by the *SS50GB.* In the event the *100*s performance was more or less matched by this smaller and less expensive model. A sealed box system of 28 litres internal volume, this system uses three drivers, namely a 200mm damped pulp cone bass unit, a 90mm damped pulp cone midrange and a 25mm grille-protected soft dome tweeter. All the drivers come from Audax, and indeed the system design originates from that company's UK subsidiary. A good quality 10-element crossover divides the range at 700Hz and 3.5kHz, and although a vinyl print synthetic veneer is used, it is quite presentable.

Lab results

The pair match for this system was satisfactory within ±1dB, but the grille attenuated the output by 1.2dB above 1.5kHz, and also increased the severity of the plotted response irregularities. The sensitivity was 2dB above spec. at a useful 88dB/W with a reasonable −6dB LF rolloff at 55Hz. The 50W maximum power handling limit permits a fair 100dBA to be obtained from a pair under domestic conditions. Although specified at 8 ohms impedance we did not quite agree with this figure, rating the *'50* as an average amplifier load, with a midband minimum of 5.5 ohms, 800Hz.

On axis at 1m our sample showed signs of a uniform and well balanced response marred by an energy loss near the upper crossover at 2.5kHz. When averaged by ⅓-octave analysis, the speaker showed good dispersion characteristics, well controlled driver integration and a generally good mid-treble balance. The 2kHz trough remained however, and during the preparation of the review we queried this with the manufacturers. They informed us that in the designer's opinion this was unusual, that the 10dB depth we found was more typically 3–4dB, and that steps would be taken to maintain this better performance.

Driven to 96dB at 1m the distortion characteristics were satisfactory; the weakest third harmonic results of any significance were 1.5% at 800Hz and just under 1% in the 200–500Hz range. Second harmonic distortion was rather poorer, reaching 3% at 1.3kHz, 300Hz and 80Hz. Conversely it survived the 100W peak inputs at 500Hz and 5kHz with little complaint, exhibiting negligible compression or additional distortion.

Sound quality

Rated 'average' on live sounds, the Toshiba was considered rather 'boxy' and 'nasal' with a 'thick' tendency, probably due to the measured loss in the presence band. Up to 50W of electric bass guitar was tolerated with fair evenness.

On stereo programme the ratings improved to 'good' and were most promising for the price. Imaging was laterally stable, with reasonable depth and quite good detail despite the loss of presence, and while it was judged a little 'dull' on balance, most panelists felt that at the same time it sounded smooth and pleasant.

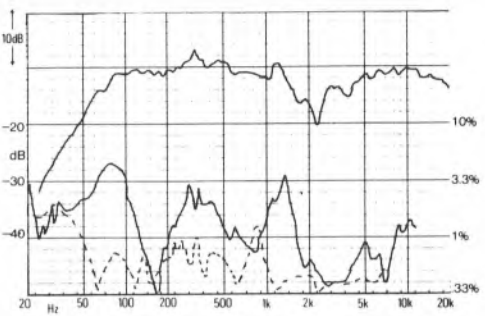
Summary

This is a surprisingly civilised three-way system with a good all-round performance at a competitive price. We have only slight hesitation in awarding it a 'best buy' rating, the reservation relating to the

Toshiba SS50GB
(revised and reprinted)

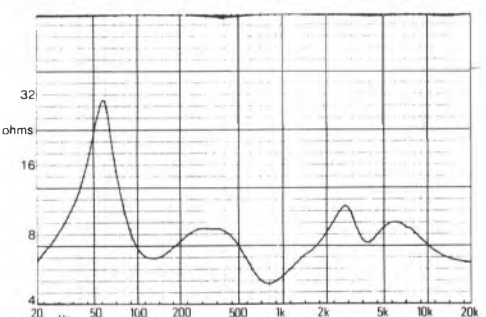
frequency band notch. But if this was atypical as the designer promises, then normal production with a shade better presence band should be even better.

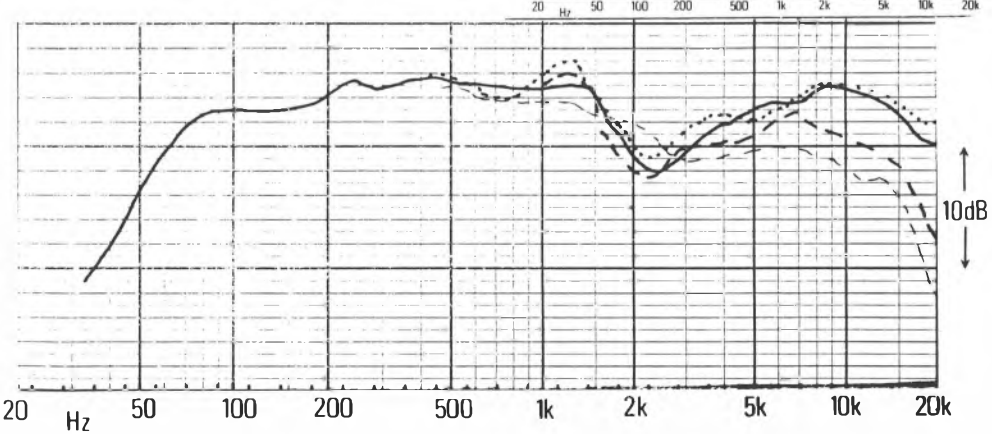
Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB
Middle: Impedance (modulus)
Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



Size (H, W, D)	53.3, 28.6, 28.7 (21, 11.3, 11.3) cm(inches)
Weight	11.3 (25) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15–50W
Recommended placement	open shelf or stand
Frequency response within ±3dB (2m)	65Hz–20kHz*
Low frequency rolloff (−6dB) at 1m	55Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	88dB
Approximate maximum sound level (pair at 2m)	100dBA
Distortion (96dB at 1m)	good
Distortion (100W peak)	very good
Impedance characteristic (ease of drive)	average
Forward response uniformity	above average
Typical price per pair	£145

*on best axis





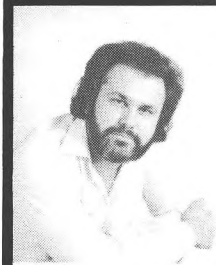
Now ELLIS MARKETING offer the ARISTON RD80 + LINN BASIK Arm & Cartridge AT £179 COMPLETE!!

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

HI-FI CHOICE

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

HI-FI CHOICE



I believe that a combination of the ARISTON RD80 + LINN BASIK arm and cartridge to be one of the finest turntable set up on the market today. I urge to you to come in with your favourite records and listen to a demonstration. I'm so convinced you'll agree that this could be "the beginning" of a new era in sound. SINGLE SPEED ONLY, 2 SPEED AVAILABLE AT £10 EXTRA.

ELLIS MARKETING
SPECIALIST HI-FI & VIDEO CENTRE

79 HIGH STREET, SOUTH NORWOOD, LONDON SE25
01-653 4224
LATE NIGHT OPENING UNTIL 8 pm ON TUESDAYS
SECURICOR DELIVERY

EM

To: ELLIS MARKETING, 79 HIGH STREET, SOUTH NORWOOD, LONDON SE25.

MAIL ORDER COUPON

Please rush an RD80 + LINN BASIK. I enclose cheque/Access/Barclaycard/American Express/Diner Club Number..... Carriage £4, UK only.

Name .....

Address .....

.....

CAPITALS PLEASE BG 1

DECISIONS, DECISIONS!

STRATFORD OXFORD CAMBRIDGE

FROM TANNOY.

HiFi critics and music enthusiasts alike have praised the Tannoy Oxford and Cambridge Loudspeakers for their superb, clean and realistic sound reproduction.

Now the new Stratford joins the range to provide you with a choice of three Tannoy Loudspeakers from around £100 to £170 a pair. All three Loudspeakers will give you superb sound with a craftsman quality of construction and finish, and offer outstanding value for money.

Decisions have never been harder to make, so ask your HiFi dealer to let you hear the Tannoy Stratford, Cambridge and Oxford—The Loudspeakers that could alter your opinion on small speakers.

TANNOY®

The Name for Loudspeakers

Tannoy Products Ltd.,
Rosehall Industrial Estate, Coatbridge, Strathclyde ML5 4TF

HFY 82

Please send me details on the Stratford, Cambridge and Oxford Loudspeakers, with list of dealers

Name _____

Address _____

_____

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 96dBA 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 foward 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.

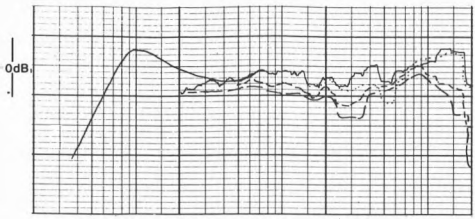
The midrange character of the sound was felt to be a long way from reality, with a poor frequency balance, and with numerous colorations described including 'tizzy', 'boxy', 'honky', 'disjointed', 'peaky', 'ragged', 'thick', 'harsh', and 'chesty' effects. There seemed to be hardly any programme or sound where some departure from the hoped for standard did not seem quite obvious to the listening panel.

Summary

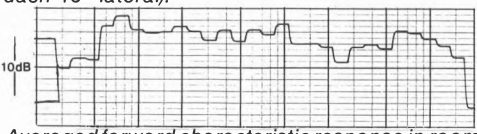
Admittedly inexpensive, this compact offers average sensitivity, poor power handling, limited dynamic range and a significantly below average sound quality. The sound is dominated by a 'boom and tizz' tendency, and the *Laser 60* cannot match the level of competition set by worthwhile new models from 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

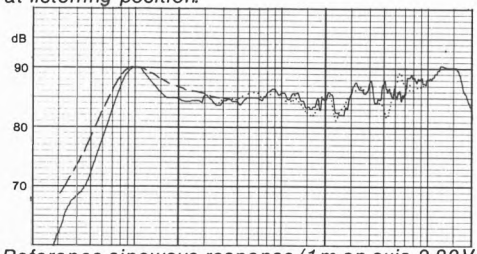
Size (h x w x d)	41 x 26 x 23cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–30W
Recommended placement	stand
Frequency response within ± 3dB (2m)	130Hz to 12kHz
Low frequency rolloff (–6dB) at 1m	55Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 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



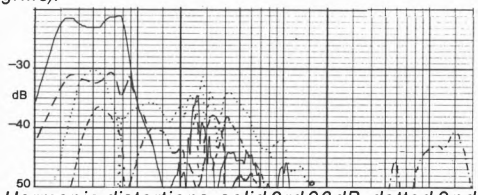
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



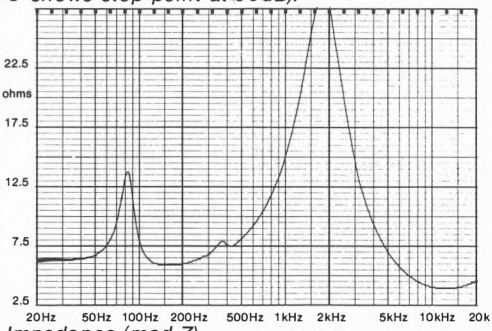
Averaged forward characteristic response in room at listening position.



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



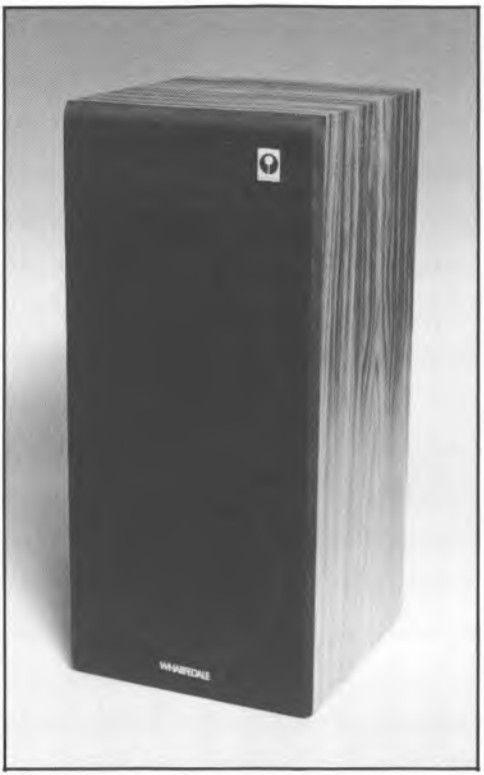
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod Z).

Wharfedale Laser 120

Rank Hi-Fi, Highfield Road, Idle, Bradford BD10 8SF. Tel (0274) 611131



Wharfedale's low/middle priced *Laser* series just missed the last issue, so two models are included this time, with the *120* representing one of the larger models in the series, costing around £160.00 a pair. It offers something along the lines of the KEF *Concord*, namely a fairly compact vertically oriented enclosure suited to stand mounting, using two 200mm bass/mid drivers plus a soft dome tweeter.

The tweeter is Wharfedale's own 19mm unit, using a low molecular weight polyamide diaphragm equipped with ferrofluid cooling/damping. The two 200mm units use mineral filled polypropylene cones and do not operate wholly in parallel, the lower driver covering the bass only and being progressively rolled off towards the midband frequencies. The good quality crossover network comprised 6 elements plus one resistor, while the rear terminals are simple screw type without 4mm sockets.

Internal volume is approximately 33 litres, and the rather 'live' 15mm chipboard cabinet has no panel damping, merely a polyester fibre filling. The grille was suspect, being constructed of a 17mm thick panel devoid of rebate or chamfer, but the external finish was presentable in a wood-effect vinyl laminate. As this model is intended for use in free space on proprietory stands, it will not perform well if left on the floor near a back wall.

Lab performance

The axial reference curve in fact refers to the response with the grille removed, and showed some interesting effects. The speaker looked good from 200Hz to 2kHz, but was spoilt by a 4dB bass hump and a 3–4dB plateau-lifted treble, with connotations of 'boom and tizz' subjective effects. Adding the grille (not shown) increased the presence loss and added a 5dB peak-to-trough disturbance at 5kHz, which the speaker could well do without. The mean sensitivity was set at an average 86dB/W, with a −6dB point at 40Hz, which is quite extended but is achieved at the expense of obvious underdamping in the low frequencies.

At 2m the 15° above axis response worsened the axial notch at 4kHz, so the system should be used fairly near ear level. The overall frequency range had a 'lumpy' tendency, and this was clearly reinforced off-axis. This characteristic was also brought out in the room averaged assessment, where an obvious 'triple humped' energy output may be seen, centering on 60–80Hz, 600–800Hz and 6kHz.

The impedance dipped to 3.8 ohms at 10kHz and neared 5 ohms at low frequencies, so the *120* is not an easy amplifier load. Furthermore amplifiers with sensitive protection circuits may not operate to their full potential with these speakers.

The swept distortion graphs looked remarkably complex and showed evidence of significant 3rd harmonic products at both 90 and 96dB sound levels in the mid and lower-mid bands. At 90dB, 100Hz, 3rd harmonic reached 5.0%, which is a trifle high, but the 1.0% odd distortion between 5 and 10kHz is 2nd order and hence not too important. The 100W pulse was successfully dealt with at both 500Hz and 5kHz, the distortion products averaging 1.0% which is similar to the steady state values.

An interesting feature of this speaker's non-linearity was the frequency shift which occurred in the distortion maxima between the 90 and 96dB measured power levels. In fact I suspect an error in the drafting of this curve, whereby the

trace coding for the 3rd and 2nd harmonics has been transposed at the 96dB level.

Sound quality

This speaker survived the live sounds surprisingly well, due we believe to an artificial advantage gained from its known treble shelf lift. A number of criticisms were however noted, including a 'whistly' 'sibilant' top end, 'boom', 'tizz', 'loud', and 'hollow' effects plus bass overhang as well as 'harsh' and 'edgy' colorations. Despite all this the *120* was nevertheless surprisingly clear and detailed.

The low frequencies were powerful despite the upper bass excess, and also showed good extension comparatively free of subjective distortion, so rating above average. Up to near 400W of bass input was possible without audible signs of distress.

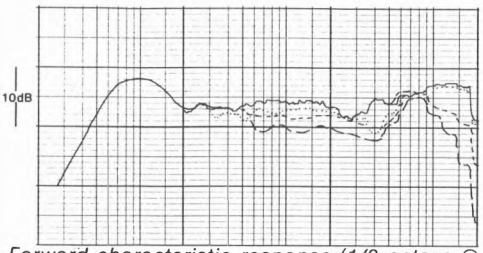
On the stereo sessions the results were poorer. The treble emphasis did not pass unnoticed, with exaggerated 'hiss', 'sibilance' and 'edginess'. The frequency response sounded 'lumpy', particularly on classical programme, though the system was substantially better liked on rock material. Stereo showed poor focus and detail, improving slightly with the grilles removed.

Summary

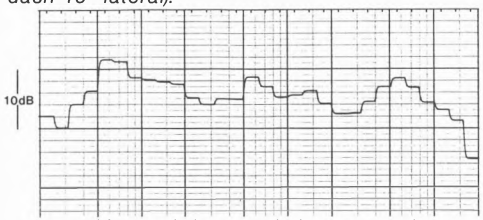
When driven hard this speaker could sound impressive, but in hi-fi terms its performance was only at an average level. Frequency imbalances and colorations have spoilt the brew, and do not provide competition for the better designs in this class. Although the recipe did not find favour with the *Choice* panel, the *120*'s tendency to 'boom and tizz' might well help to sell the product, and with its above average bass performance for the size and price it may be worth trying.

GENERAL DATA

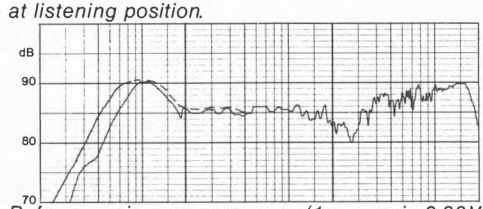
Size (h x w x d)	61.5 x 28 x 30cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–250W
Recommended placement	on stand, clear of walls
Frequency response within ± 3dB (2m)	130Hz to 17kHz
Low frequency rolloff (–6dB) at 1m	40Hz
Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m	86dB/W
Approximate maximum sound level (pair at 2m)	104dBA
Impedance characteristic (ease of drive)	fairly difficult
Forward response uniformity	good
Typical price per pair inc VAT	£180



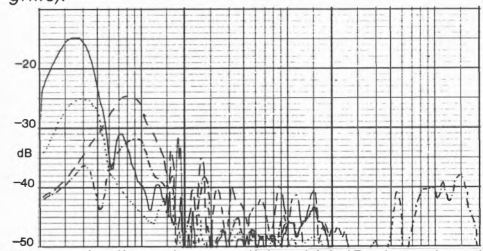
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



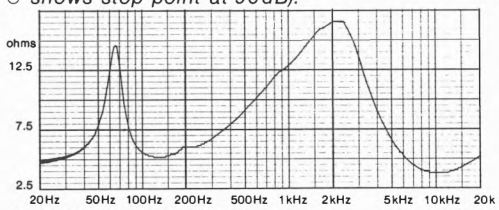
Averaged forward characteristic response in room at listening position.



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

Wharfedale TSR108.2

Rank Hi-Fi, Highfield Road, Idle, Bradford BD10 8SF. Tel (0274) 611131

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 47 Hz, 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 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 1m 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.

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.

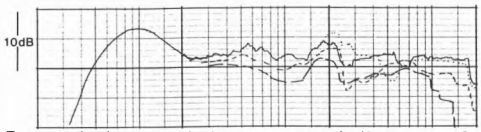
On the stereo programme the bass extension was appreciated despite the upper bass richness, and aside from a rather 'slow' bass character, this model seemed to be comparatively free of vices. Stereo image quality was well above average with good precision (especially with the grille off) as well as promising depth. Although mild 'plummy' and 'boxy' effects were noted, these were not serious.

Summary

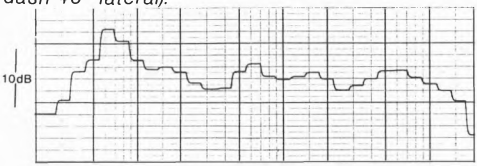
Though the new *TSR108* has a lower sensitivity and the bass is less even and well defined, it offers a near monitor class standard of mid and treble quality at an attractive price, and must be one of Wharfedale's best yet in terms of its overall sound quality. Easy to drive, well finished in natural veneer, and capable of decent sound levels, the *108* moves into the Best Buy class in its latest *Mk II* version.

GENERAL DATA

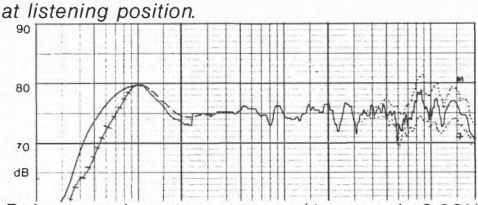
Size (h x w x d)	57.7 x 31 x 28.8cm
Weight	14kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(20)–150W
Recommended placement	open stand clear of walls
Frequency response within ± 3dB (2m)	130Hz to 18kHz
Low frequency rolloff (–6dB) at 1m	40Hz
Voltage sensitivity (ref 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



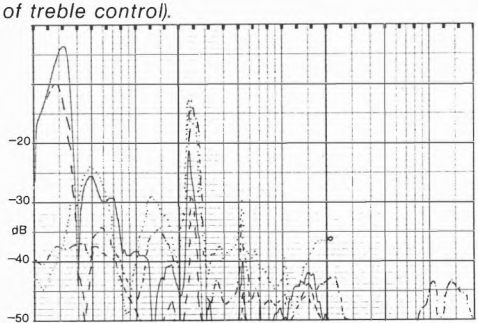
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



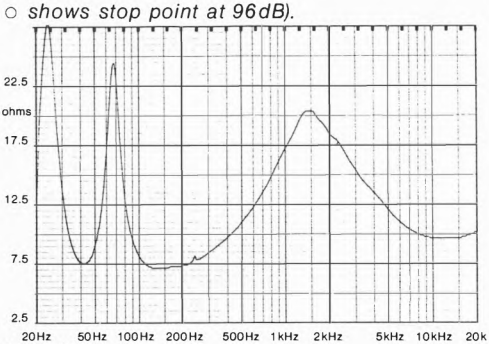
Averaged forward characteristic response in room at listening position.



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, ○ shows stop point at 96dB).



Impedance (mod Z).

RECOMMENDED

Yamaha NS1000M

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

A relatively compact loudspeaker that can be used on stands or on a substantial open shelf, it is very sturdily constructed. While tests were conducted with the controls set 'level', we subsequently came to the conclusion that the '10 o'clock' position for the mid control gives the most pleasing balance, and that the listener should be on the mid axis, as an above axis position imparts a response suckout in the presence region.

Technical details

A sealed box design, a 300mm bass driver operates up to 500Hz crossing over to a 85mm beryllium-dome mid unit with a hollow pole piece and an absorbent chamber. At 6kHz another beryllium driver takes over — a 30mm unit with a phase correcting assembly.

Lab results

Pair matching was excellent at 0.5dB up to 12kHz, and within 1dB beyond. A high (particularly for a sealed box design) 90dB sensitivity was recorded, with the —6dB LF point at an early 50Hz, despite the system resonance being placed at 40Hz. (This proves that the low frequency end is overdamped, and permits bass lift to be applied.)

A minimum impedance of 4.8 ohms was recorded at 120Hz, the typical value being 6, and with low reactive effects the system gained an 'average' loading classification. Above 200Hz the distortion on the third harmonic readings was below threshold. It rose gently at the lower frequencies to a still fine 0.6% at 100Hz, 1.2% at 50Hz and a maximum of 3% at 30Hz.

The 1 metre sine wave response was very even from 60Hz to 16kHz, but showed a mild mid prominence (this controlled by the 10 o'clock mid setting), with the early but slow low frequency rolloff clearly visible.

Out at 2 metres the 10° above response showed why the mid unit should be at ear level, or at least angled towards it. A mild hump at 300Hz was visible on axis, together with a slightly prominent 500Hz to 12kHz range. The HF was uniform to 16kHz, rolling off slowly beyond, but on the 30° lateral axis, the uniformity was fine, showing excellent integration in this plane.

Sound quality

The *NS1000M* matched its previous high quality ranking, even if it has not achieved quite the same level of commendation. Overall a 'very good ' sound quality was denoted, going a long way towards justifying the high price.

It performed best on the live sound comparisons, reaching a high 107dBA, and accepting a 500W peak input without audible breakup. It showed excellent power handling on electric bass guitar, with up to 75 watts average tolerated without distortion, and while the bass character was lacking some warmth on the 'E' string, an even and powerful output was obtained. The mild colorations noted were 'dull', 'hard', 'tizz', and 'middy', together with a 'thin' balance.

Scoring 'above average' on the stereo sessions, this Yamaha exhibited fine imaging

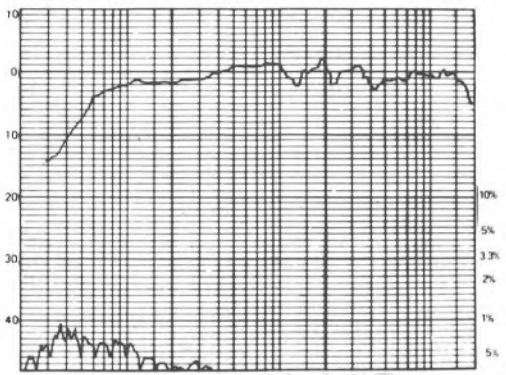
RECOMMENDED

and excellent rendition of musical detail. Some panelists were sensitive to a mid prominent hardness and brittleness which is a known feature of the *NS1000M*, and cannot be wholly alleviated by adjusting the mid control. Colorations were more readily perceived under these conditions, and included mild 'cup', 'nasal', 'hard' and 'presence dull' effects, with slight 'tube' and 'fizz' comments also apparent. One panelist felt that it might prove fatiguing.

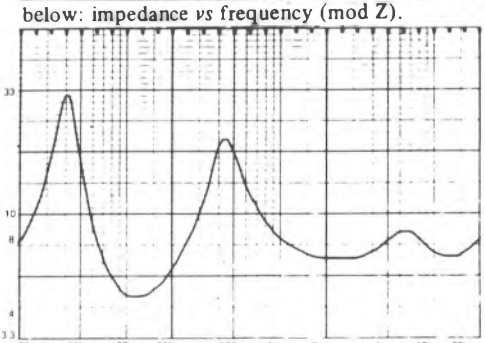
Summary

The *NS1000M* is clearly a fine if expensive loudspeaker. It gains a recommendation despite its price, but with some reservations concerning its potential hardness and fatiguing properties — not severe, but sufficient to excite comment by one or two panelists. It can offer high volumes, with very clean if overdamped bass, and is both beautifully engineered and constructed.

below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.

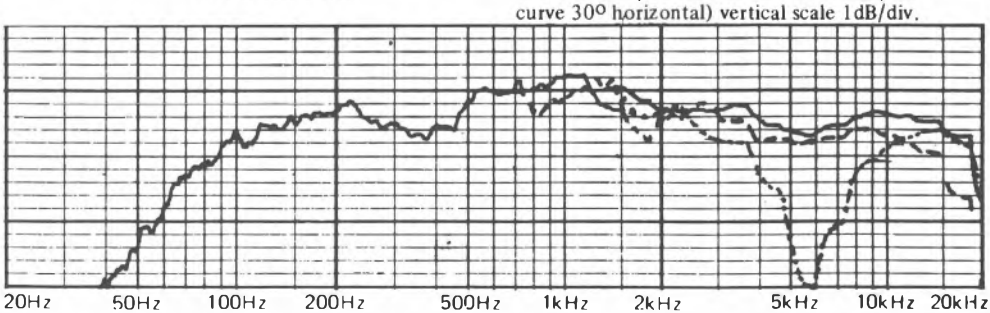


below: impedance *vs* frequency (mod Z).



Size	67.5(26.5) H; 37.5(14.7) W; 32.6(12.8) D; cm(inches)
Weight	31(68.2) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20 to 200W
Recommended placement	high or tilted stand
Frequency response within ±3dB at (2m)	80Hz to 16kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	90dB at 1m
Approximate maximum sound level (pair at 2 metres)	107dBA*
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good* (see text)
Typical price per pair	£550

below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



A TOE IN THE WATER...

FROM THE MOST COMPREHENSIVE GUIDE TO BUYING HI-FI EVER PUBLISHED

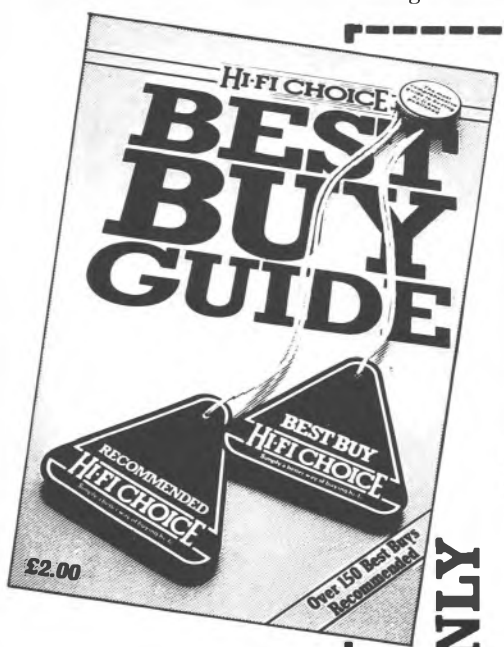
If you're a regular reader of the hi-fi monthlies you'll certainly have noticed our advertisements for *Hi-Fi Choice*. For almost five years now, *Hi-Fi Choice* has been regularly publishing what amounts to the most comprehensive guide to purchasing hi-fi in the world.

That's a big claim, but, as our regular readers and subscribers will know, it's a true one. Many kind words have been lavished on the *Hi-Fi Choice* series by 'rival' publishers, often in print. Testimonials from readers are sometimes lavish enough in praise to make us blush. But we have problems and we're honest enough to acknowledge them. In short, our 'Readers Digest' size makes us difficult to find on newsagents shelves; our publishing schedule (five times a year) makes life complicated and we're an expensive publication at £2.00 per copy.

In order to combat some of these difficulties we have produced the *Hi-Fi Choice Best Buy Guide*. It isn't a replacement for the whole series. But it does contain scores and scores of comparitive reviews of the vast majority of models which have been awarded a *Hi-Fi Choice* 'Recommended or 'Best Buy' tag in the past eighteen months. In fact over 150 Best Buys are Recommended.

If you are considering making a hi-fi purchase in the near future, it could save you a small fortune. And if you have never read *Hi-Fi Choice* before it will probably come as a pleasant revelation. Authored by some of Britain's finest audio technicians with fascinating introductions and clear conclusions on real value for money hi-fi, it offers you a way of dipping your toe in the water without purchasing our entire range. We're confident that when you've tested the temperature you'll join us for regular swims in the deep end.

Available from most good newsagents or by using the coupon below.



SEND £2.00 ONLY

Name _____

Address _____

_____

_____

U.K.

I enclose a cheque/PO for £ _____ payable to Sportscene Publishers Ltd. Allow 3 weeks for delivery. Mail coupon to *Hi-Fi Choice* Offer, 14 Rathbone Place, London W1P 1DE. If you don't wish to clip this coupon please send your order, clearly printed, together with your remittance to the above address.

SUMMARY REVIEWS

Shortage of space, and the need to encourage our regular readers by filling each *Loudspeaker* book with plenty of new reviews of up to date models has meant that we have data on many speakers which are still available, but whose reviews we can no longer print in full. These are therefore included as summaries for extra guidance to those who may be reading this book for the first time. Inclusion in *Summaries* does not necessarily imply that the product is in any way inferior to those accorded full reviews. Though we naturally prefer to reprint our 'best buys', other factors such as the number of reviews included from the same manufacturer enter into the decision making. Some models included may no longer be manufactured, but may still be available in shops or of interest to secondhand purchasers.

Audiomaster MLS1 (£125)
Probably the most neutral of the 'baby/budget' loudspeakers, this model was highly rated three editions ago and slightly downrated on re-audition subsequently; we understand that the speaker has now reverted to its original specification and performance. Even disregarding the price, the sound quality was rated 'good' with stereo imaging particularly so, though sensitivity, maximum loudness and bass extension were naturally limited.

Audiopro B2-50 Subwoofer (£400)
Though we consider the add-on subwoofer approach is neither the cheapest nor the best route to quality hi-fi, there is no denying its domestic unobtrusiveness. The *B2-50* was found to be very well designed and engineered, providing extension to 20Hz (−3dB) and a maximum output of 99dB (1m) before overload. The system merits the use of high quality main loudspeakers, and we found 70Hz was the best crossover frequency. Albeit rather expensive, this subwoofer clearly delivered the goods.

B&W DM7 II (£400)
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 competant rather than inspired performer at its £400 odd price tag.

Castle Richmond II (£105)
A firm recommendation from three editions ago, the *Richmond II* could be regarded as a scaled down *Kendal II* (or *vice versa*), which is reviewed in full in this issue. The usefully high sensitivity (90dB), suits it well to budget systems, and has not been obtained at the expense of low frequency extension or a 'difficult' low impedance. Sound quality rated good overall with some criticism of a 'thin', 'bright' balance, so shelf mounting is perhaps appropriate as recommended by the manufacturer.

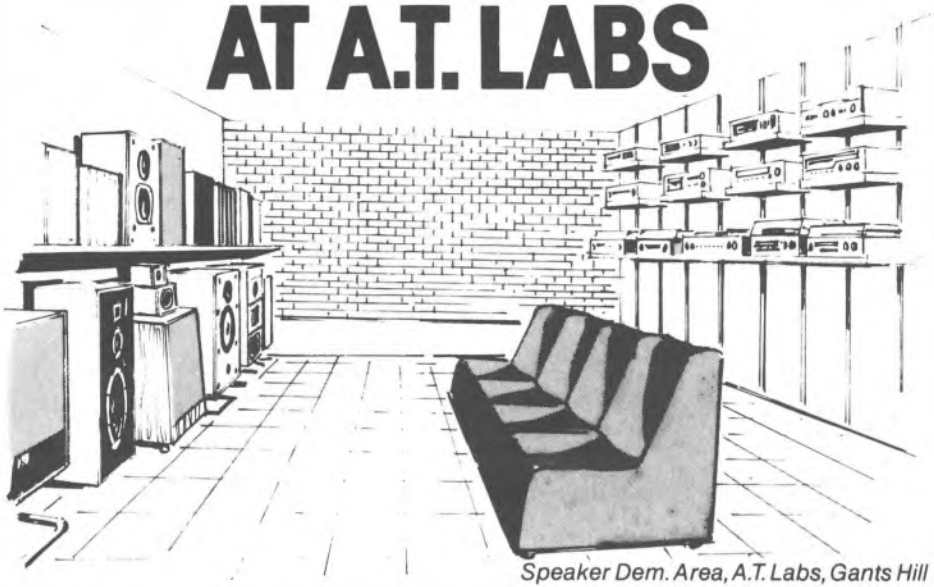
Castle Howard II (£550)
In many ways this model is an enlargement of the established *Conway II*, and has exceptionally well extended bass. Despite this advantage, in other respects the *Conway* was somewhat preferred, both in terms of neutrality and overall balance, the *Howard* tending to sound rather 'rich', with perhaps an over-abundance of bass in the listening room. Despite the slight reservations with respect to its cheaper stablemate, the *Howard* merits recommendation.

Celestion 551 (£440)
This quite expensive and large loudspeaker gave a very well-balanced overall performance. Although it was not exceptional in any particular respect, there was little to attract criticism, the balance being a trifle 'dull' but with slight treble 'fizz'. Construction quality was good, and versatile balance controls are fitted. Not a bargain perhaps, but a design which merits recommendation nonetheless.

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.

Coles Nimbus (£170)
Our initial tests on this model were not particularly encouraging, though the overall package was pleasant enough if a trifle expensive. However, after these tests had been completed, a second pair was delivered which showed improved balance and sensitivity, sufficient to indicate that the model may merit consideration, even though our findings are somewhat inconclusive.

LISTEN TO THE BEST BUYS IN STYLE AT A.T. LABS



Speaker Dem. Area, A.T. Labs, Gants Hill

However valuable the reviews in 'Hifi Choice' are, there is no real substitute to auditioning speakers with your *own* ears. That's where A.T. Labs come in. At our two stores, you can take your time and listen to a wide selection of top brands in relaxed and pressure free surroundings. Our comparators will enable you to obtain an instant indication of the different sound characteristics between models utilizing a varied line up of ancillary equipment. Guard against an expensive mistake with a visit to A.T. Labs.

We stock speakers by:

Acoustic Research		Linn	
Celestion		Lentek	ProAc
Celef	Dean	LNB	Quad
Chartwell	KEF	Meridian	Rogers
Coles		Mission	Spendor

a.t. Labs

ILFORD 01-518 0915
442-444 Cranbrook Road, Gants Hill, Essex IG2 6LL
Monday to Saturday 10.00-1800

ENFIELD 01-363 7981
191 Chase Side, Enfield, Middlesex EN2 0QZ
Monday to Saturday 10.00-18.00

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.

IMF TLS50 IIA (£520)
This large loudspeaker has extended bass and generous power handling capabilities, but presents a somewhat difficult amplifier load and has below average sensitivity. The response was very smooth above 500Hz, but rather uneven in the upper bass/lower midrange. Though smooth and integrated, the sound quality was felt to be only average, with some loss of stereo 'focusing' and masking of detail, which is a slight disappointment in a speaker at this price level.

IMF TLS80 II (£830)
This large, heavy design gave 'good' overall sound quality, with a particularly well-extended bass and a generally smooth, pleasant character, though with some coloration and only average stereo imaging. The ease-of-drive was only acceptable, and the sensitivity was about average, though high power amplifiers can be used without worry.

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. This design only just failed to achieve recommendation.

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.

JR 150 (£235)
A 'scaled up' version of the original *149*, which has now been re-assessed in Mk II form, the *150* did not quite achieve the same standard, rating consistently average throughout the listening tests, with good though not exceptional stereo capabilities. The responses showed a broad presence trough with recovery thereafter, characteristics which were reflected in the listening panel comments. Sensitivity and ease-of-drive were both average.

JR EX1 Subwoofer (£275)
Though our general findings do not indicate that the subwoofer is the ideal route to hi-fi, the *EX1* gave a basically good performance – much better than a predecessor which we had tested – and is best suited to smallish satellite speakers, as it offered little assistance to speakers capable of reasonable output to 50Hz. Maximum output was 103dBA, and the –6dB point at 30Hz. The tested version used the *EX1* electronic crossover to reduce the low frequency signals received by the satellites, helping integrate the subwoofer and improving power handling; a cheaper *LPA* version is also available.

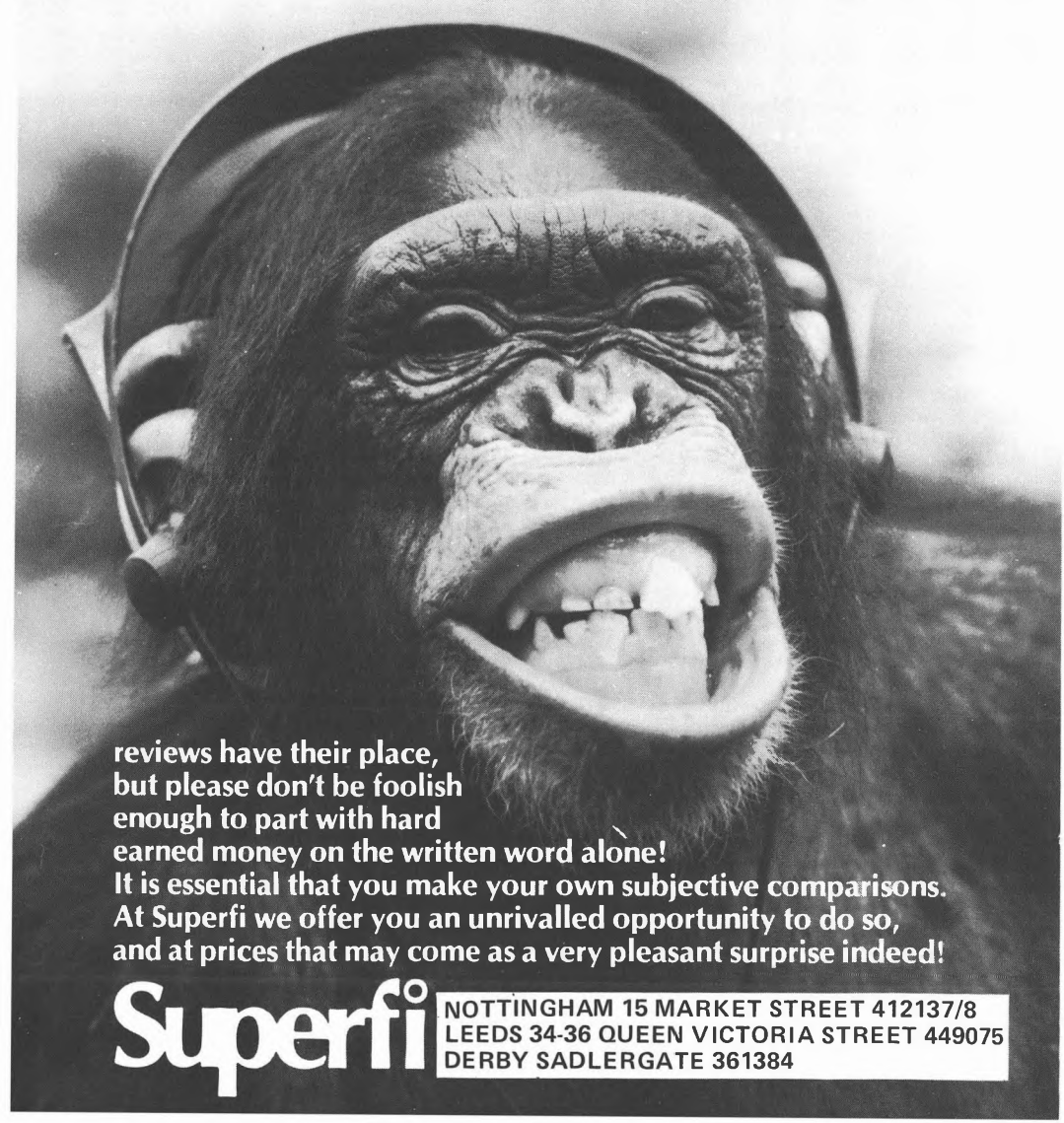
JVC Zero 5 (£400)
Tested on two separate occasions, our latest experience of this model showed a considerable improvement over the original samples. It has extremely high sensitivity (94dB/W), and very low distortion and power handling, but showed a somewhat uneven frequency response particularly in the crossover region. This uneveness resulted in only an 'average' sound quality rating, with numerous colorations noted, but it is nevertheless a lot of loudspeaker for the money for those whose priorities centre on sheer loudness.

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 well below average price. Frankly it has only been 'summarised' to make room for KEF's new generation of models.

KEF R101 (£185)
KEF's variation on the 'mini-monitor' theme has sophisticated electronic protection circuitry and computerised drive unit matching. Technical performance was fine, though the sensitivity was very low 81dB/W and bass extension was naturally somewhat restricted by the small enclosure volume. 'Average' sound quality was a trifle disappointing, with criticisms of some coloration and a rather 'thin' sound, which suggest that this model merits consideration, but not our firm recommendation.

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

"you read it son... ....we'll play it"



reviews have their place,
but please don't be foolish
enough to part with hard
earned money on the written word alone!
It is essential that you make your own subjective comparisons.
At Superfi we offer you an unrivalled opportunity to do so,
and at prices that may come as a very pleasant surprise indeed!

Superfi

NOTTINGHAM 15 MARKET STREET 412137/8
LEEDS 34-36 QUEEN VICTORIA STREET 449075
DERBY SADLERGATE 361384

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 MA9 (£110)
This compact 12 litre two-unit model gave a reasonable technical performance for its modest price, marred by a 'stepped' frequency response, with a broad depression through the lower treble, and a slightly awkward impedance characteristic. Sound quality was not too encouraging, and although by last years' standards it was quite reasonable value, the general improvements in low cost speakers make this a less competitive prospect now.

Monitor Audio MA84 (£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 frequency response, with midrange prominance and depressed presence. The sound quality was quite promising, but marrred by 'dullness' associated with the frequency response. Overall the *84* merits consideration but not recommendation, and may suit some systems.

Mordaunt-Short Festival 2 (£135)
The recent introduction of Mordaunt-Short's *series 3* models will presumably gradually replace the *series 2*s, but they will be around a while yet, possibly at advantageous prices. This was a 'Best Buy' model in the last edition, with its generally good overall performance and fine finish for the price. Though not perfect by any means, it was nevertheless a very well-balanced model.

Mordaunt-Short Pageant 2 (£200)
Above average in sensitivity and easy to drive, the *Pageant 2* is a well-balanced design, if not quite the class leader it was when it first appeared. Coloration is now somewhat more obtrusive than in some of its immedate competition, though detail rendition is excellent and imaging precise, so it still merits consideration.

Philips 489 (£149)
This medium sized three-way design offers good sensitivity and amplifier loading, low distortion, and quite good frequency balance. Unfortunately it was not liked much on the listening tests, rating below average due to criticism of colorations.

Pye 6484 (£70)
This very low-priced three-way system suffered somewhat from the economies of its design, reflected in significant technical and sound quality reservations. The inadequate crossover and system integration gave rise to unacceptable levels of coloration.

RCL Reference (£75)
This modestly priced 'miniature' showed significant limitations in both technical and subjective performance, but gave a sufficiently well-balanced result to merit recommendation at its very modest price. However better low-priced speakers are now available, and the RCL is now rather less competitive than it was last year.

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 *J11*s 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 competant 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 competant design that tends to suffer a little in comparison with the cheaper *SSG1 II*.

Spendor SA1 (£200)
Essentially Spendor's version of the mini-monitor concept, the *SA1* gave a good technical performance throughout and was also rated 'good' overall on the listening tests, with only slight criticisms of balance and colorations. The speaker was easy to drive and handled power well, though sensitivity was low at 82dB, so high level outputs are not easy to achieve. In every respect this design represents a viable alternative to the *LS3/5A*, with a generally similar but subtly different performance. For its size, power handling and bass extension were unusually good.

Studiocraft 330 II (£165)
This model proved to be a disappointment when

compared to its predecessor, and showed a distinctly uneven frequency response particularly in the presence and treble regions. Its virtues included high power handling capabilities, sensitivity (92dB) and good ease-of-drive, but the sound quality was rated as only acceptable.

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 program 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.

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.

Visonik David 502 (£100)
The smallest speaker we have ever examined, the *David*s can by no means be dismissed out of hand, for although bass extension was severely curtailed and the 'light', 'thin' balance resulted in an overall sound quality rating of only acceptable, the stereo imaging was praised, and where 'invisibility' is an important criterion and the speaker can be located on the wall or amongst books, it represents a quite respectable compromise.

Wharfedale E20 (£170)
The smallest of the extravagantly styled E series, this 30 litre enclosure follows the *E* philosophy in possessing extraordinarily high sensitivity (95dB/W), but with the limitations of curtailed bass extension (−6dB, 70Hz), a rather uneven frequency response, and just average distortion and power handling. Listening test results were somewhat below average, but the unusual blend suggests that this design may well suit certain applications quite effectively, though it cannot be recommended universally.

Wharfedale E70 (£385)
Despite the very high 94dB/W sensitivity, the *E70* did not particularly like being driven very hard, while the asymmetric array of drive units 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, the design achieved its high sensitivity at the expense of limited bass extension and output; nevertheless some critical listeners continue to find significant merit in the overall result.

Yamaha NS590 (£300)
This model gave a very similar standard of performance as 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 which are sufficient to preclude recommendation.

While a review project on this massive scale can be extremely taxing for the author, it also has its compensations. One of the major problems facing any reviewer is undoubtedly that of maintaining a consistent standard against which to base opinion and judgment. The sheer quantity of product involved in *Hi Fi Choice* means that a reference is provided by the mean standards of the group as a whole, and furthermore one has a wide spectrum of performances available, ranging from arguably some of the very worst, to some of the best. Such a richness of data permits consistency of assessment far ahead of that which is possible from an individual or more limited group survey.

The size of the test group also allows the reviewer to probe more deeply than usual into the many facets of loudspeaker performance, by using highly accurate and elaborate lab facilities, and running carefully planned programmes of listening tests under calibrated conditions. For the latter a variety of material was used, including many live sounds. The greatly increased expense of such a test programme is impractical on a single review basis, but has become an essential part of the philosophy, standard and procedure of the *Choice* projects.

In addition to producing the individual reports, we set out to investigate certain aspects of sound quality that relate to speaker performance. Some of these were discussed in previous editions, and are repeated here for completeness, whereas others are based on new test techniques. For convenience, they are grouped under subheadings in the text.

Peak power distortion

The newly introduced peak power distortion test provided some interesting results. Above the budget range, most speakers are specified as accepting up to 100W or more of unclipped programme. Using a voltage input equivalent to 100W, 8 ohms peak, a small number of speakers passed this test without detectable compression (<0.1dB) and with no significant distortion increase over the standard 96dB measurement level taken at a 1m distance. Most recorded moderate compression of the order of 0.1–0.4dB, with slight distortion increases to around 1% which was still considered pretty good, while a few appeared to be in real trouble.

Working on the basis that the ideal result is for no change, and at worst a mild compression on peaks might occur, any expansion is clearly against the rule, and those speakers which behaved thus also provided unacceptably high levels of distortion. In a few instances, the maximum power limit in the tables was in fact defined by such a failure, and not by the usual maximum subjective loudness or the subjective power handling limit on bass guitar.

The usual failure mechanism involved saturation of the magnetic core in the crossover inductors, but smaller losses were also due to dielectric imperfections in inexpensive capacitors possessing insufficient voltage rating. Crossover saturation has a strong effect upon the impedance characteristic, usually by reducing it. This in turn may cause premature amplifier clipping/overload or trigger its protection circuitry, thereby further magnifying the power-distortion problem.

Low frequency power handling

It was necessary to get some idea of the full power bass performance on peaks, as the pulse tests for high level distortion did not extend to low frequencies, and the steady swept tone measurements at 96dB gave an indication of static distortion at only moderate power levels.

As noted in the *Technical Introduction*, a high quality electric bass guitar was used for this purpose, *via* direct injection into a large power amplifier. The results were interesting, in that the transient qualities plus subjective power and 'attack' in the bass region could be readily assessed by the listening panels. Perhaps surprisingly, speakers of similarly rated power handling and size behaved very differently on this test. Some drivers 'knocked' or 'cracked' (in an acoustic not a literal sense) with only a few tens of watts (50W peak input), while others sustained 100W average (250W peaks) before any subjectively serious noises or distortions were produced. In addition, small ports (50mm dia or less) tended to 'chuff' audibly on quite low inputs of only a few watts, while distinct rattles or buzzes were noted with other systems due to loose internal wiring or inadequate driver and crossover fixing.

In our listening room at least, the speakers with a uniformly extended free field bass response tended to sound a little 'bottom heavy', and this result would appear to suggest that an extended response, but with an output gently tapering away below 150Hz, is nearer the ideal for the typical medium sized stand-mounted enclosure. This being true, more designers could opt for a low frequency alignment with greater electromagnetic damping, and this would allow a welcome boost in mid and treble efficiency.

KJ Leisure Sound

The Sound Approach to Hi-Fi

Can we 'Sound Off' a little about the current trend for reducing the enthusiast market to one budget system?

We agree that the NAD/DUAL/MISSION system is excellent value for money and offers really good performance, but hi-fi doesn't stop there – there are many more products available to the discriminating listener that offer superior performance – albeit mostly at a higher price.

We refuse to subscribe to the trend that it's not worth spending more than the cost of the NAD system – which is the overall impression we get from reading certain sections of the hi-fi press. There are many fine products to be auditioned and which, if blended properly into a system, will give a very satisfying performance – the value is in the personal pleasure you derive from listening to them.

(A Mini Metro will get you there – but a Rolls Royce does it much more pleasantly).

We stock most of the better buys identified in this magazine and many more products besides. In fact we stock most of the major brands and a lot of the lesser known. Neither have we forgotten the need to offer good value for money, whether that be on 'Special Offers' or in giving competitive prices on regular lines. In fact, we prefer to meet or beat any other genuinely offered prices.

Sound us out sometime!

Luxman LX33 Valve AmP

30 Watts pure Class A

At long last an integrated valve amplifier at a price you can afford. A performance that's silky smooth, warm yet open – if you can't get on with transistor amps and you like the smoothness of valves then audition this one. It's a modern 'state of the art' valve design with inexpensive valve replacement.

This amplifier is available *exclusively* from KJ. so visit your most convenient branch for a demonstration.

(by mail – carriage free)

Vital Statistics – Size 17¾"w x 6¼"h x 12¾"d; Weight 42lbs approx. (heavy); Price: **£399**

KJ Leisure Sound
The Sound Approach to Hi-Fi

BARCLAYCARD VISA

CROYDON
89 London Rd.
Tel: 01-686 1343

HARROW
340 Station Rd.
Tel: 01-863 8690

LONDON EC4
53 Fleet St
Tel: 01-353 7935

LONDON W1
48 Wigmore St
Tel: 01-486 8263

UXBRIDGE
278 High St
Tel: Uxbridge 33474

WATFORD
101 St. Albans Rd
Tel: Watford 45250

Open Monday–Saturday 9.30–5.30. Late Night Thursday (Wigmore St.) until 7pm. (Fleet St. closed Saturdays)

Stereo imaging

This is one area where the use of new techniques is claimed to have enhanced subjective image accuracy, these variously described as 'linear phase', 'time delay compensated' or perhaps 'minimum phase'. In practice, such labels can only approximate to the truth, but claims advanced by several of their proponents suggest that only a speaker using these methods can deliver accurate stereo imaging, assuming they are fed with 'accurate' programme. Since stereo itself is essentially an illusion, this argument is rather weak to begin with. Nevertheless, great care was taken during this project to investigate whether such special techniques were effective. To this end we used original mastertapes of the highest quality using top class, crossed-pair microphones and correctly azimuthed on replay. Furthermore, the recording engineer/producer who actually mastered the tapes was present in the central front row position of the listening panel.

There was little evidence from the results to show the specific stereo enhancement of these 'time' or 'phase' compensated systems, for although some were very good, others were below the average standard set by their respective price group.

However other factors showing good correlation with high stereo image quality were identified. Key factors included low levels of coloration and delayed resonances, with excellent integration of the respective driver outputs through the crossover regions, both as regards phase and amplitude. Good uniformity of dispersion over the forward listening angles, including lateral dispersion symmetry, was also important, together with low distortion levels, a wide dynamic range (particularly in the midband), plus an adequately wide response bandwidth. Last but by no means least, the frequency balance should sound neutral and even when subjectively assessed in the listening room. While this often results from a flat measured anechoic response, in the case of medium-sized enclosures such a relationship is not as well defined as is usually supposed.

Taking a loudspeaker with a prominent treble range, a musical instrument with an extended harmonic range such as a violin will be reproduced with an altered spectral balance and will sound 'close', as if it were close to the microphone used to record it. While this might give an exaggerated impression of detail, it also distorts the natural perspective; the main body sound with the associated ambience and reverberation will be at one volume level and associated distance plane, while the harmonics will be reproduced louder than they should be, and are pushed forward in the image plane. Such an effect tends to mask ambience, and compresses the image so that the balance is 'thin' and two-dimensional – in the plane of the speakers themselves.

Coloration is a sort of unwanted, unmusical hangover remaining after the real sound has passed on. There are many characterisations such a 'hardness', 'boomy', 'boxy', or 'fizzy', these appearing as a sort of 'noise' heard between the two speakers. Its lingering quality effectively reduces the dynamic range of the reproduced sound so that it masks the low level stereo clues such as hall reverberation, ambience and the back row musical instruments in the sound stage.

Thus if levels of coloration are low enough and the frequency balance is accurate, sounds will be reproduced with the harmonics in their correct proportions. Subjectively the whole sound can then occupy its natural position in the depth dimension of the stereo image.

So far we have discussed image depth, but other factors also influence locational effects. A speaker with fair coloration can still give relatively accurate stereo provided that the sound directed at the listener from each speaker integrates; that is balances or matches well at that position. However if the apparent frequency (and phase) response of a speaker alters greatly with small changes of listening angle, and furthermore is entirely different in the left and right hand directions, there is no way that a stereo pair is going to sound balanced and matched. Clearly this positional effect depends heavily on the phase and amplitude matching between the sounds from the left and right speakers, and without exception, those speakers which exhibited significant lateral asymmetry of radiated output gave degraded locational information.

Tied in with this symmetry question is that of driver integration, or alternatively the consistency of the output over a sensible range of forward radiating angles. If the speakers were well matched in the first place, those possessing high slope crossovers in general showed excellent integration and output uniformity, giving consistently good stereo location effects. Conversely most systems incorporating much simpler crossover networks, with consequently wider overlap regions, possessed erratic forward responses and unpredictable stereo.

A further factor which cannot be fully explained relates to the enclosure width. It is clear from the panel results that the narrower the enclosure, the

greater the accuracy of source location. Hence most of the very small boxes gave good stereo, as well as those larger enclosure such as the Spendor *BC1* which were still relatively narrow, and particularly the *R105*, whose structure narrows progressively with increasing frequency.

Part of the answer must lie in the mixing of the sound wavefronts arriving at the listener. The narrower the cabinet, the more closely it approaches a point source or spherical wavefront generator; in fact, as we are discussing vertically aligned systems, the term 'cylindrical waveform generator' would be closer to the mark. Such wavefronts mix uniformly at the listener, with listener displacement from the central stereo position resulting in only minor changes in perceived frequency response. However from acoustic theory we know that the broader cabinet is more directional over particular frequency ranges, and hence more critical of listener position, and with such systems, an off-centre seat results in an imbalance of the sound mix from the two speakers, thereby degrading the stereo image quality. At higher frequencies diffraction theory informs us that the edge of the grille and cabinet act as secondary sound sources thus imparting distortions to the propagated wavefront, and further confusing the imaging, from the wider enclosure.

The broader systems often sounded spacious; for example on multi-miked recordings, but blurred and expanded the images of smaller instruments. Speakers with marked lateral asymmetry sometimes exhibited remarkable image distortion – a violin ascending a musical scale gave an impression of a rapid lateral shift off-stage, as its pitch traversed a crossover region. In fact, a speaker system with an extended lateral array of many drivers will usually suffer badly even if the general sound quality is otherwise favourable.

Frequency response and coloration

While some speakers demonstrated fine frequency response characteristics, they did not invariably sound good, particularly if coloration was in evidence. On the other hand, virtually all the systems which scored highly possessed relatively flat frequency responses devoid of any broad band spectral imbalances. This confirms my belief that an essentially flat frequency response together with the least possible coloration are the prime requirements of a good loudspeaker. I should point out in this context that a flat response should not be taken as a single trace taken at one metre on a particular axis; rather it refers to the total uniformity of response radiated in a sensible forward angle of say ±10° vertical and ±30° lateral.

Grilles

In each edition one tends to find some common problem area which runs through the project. This year the prime contender was the damaging influence on sound quality of many grilles. We have seen suspect grilles in previous issues, but never in quite this abundance. For possibly 50% of the new models it was found worthwhile to check the measured and subjective performance with and without the grille fitted, which was not only a nuisance but rather time consuming as well.

In far too many cases the designer had achieved good results for the 'naked' system, only to add a clumsy grille panel whose effect on sound quality had not been adequately checked. Models from the larger companies such as KEF, Celestion, Wharfedale, AR, Sony and KLH are among the offenders. It is no accident that a large number of the good grilles are made of foam, which is not only less expensive but is usually sonically vastly superior to the typical thick chipboard cut-out covered with woven cloth.

In general the excuse given by the larger companies is that foam grilles are 'passé' and 'only suitable for music centre products', and that the public demand solid grilles. Yet if the public realised what quality sacrifices were involved with the use of such grilles, they would surely be happy to accept foam or any other suitable material. And if the cosmetic argument holds, how do up-market products from companies such as Linn, JR, Spendor, ARC, Mission Heybrook and Harbeth succeed when using sensible foam grilles? For many of the offenders, the changes brought about by the removal of the grille produced as dramatic a change as a substantial cartridge upgrade!

Subwoofers

This topic generates a lot of interest, but only in a few cases does it actually lead to purchase in the UK. Naturally one of the main points against the use of a subwoofer is the fact that most good speakers have an adequate bass performance, so the addition of a subwoofer may not only complicate the issue and increase expense, but also provide little improvement in overall sound quality.

Their application is therefore effectively restricted to exceptional speakers of limited bass power handling, to augment small satellite speakers, or as an adjunct to a system where low bass is missing but considered essential.

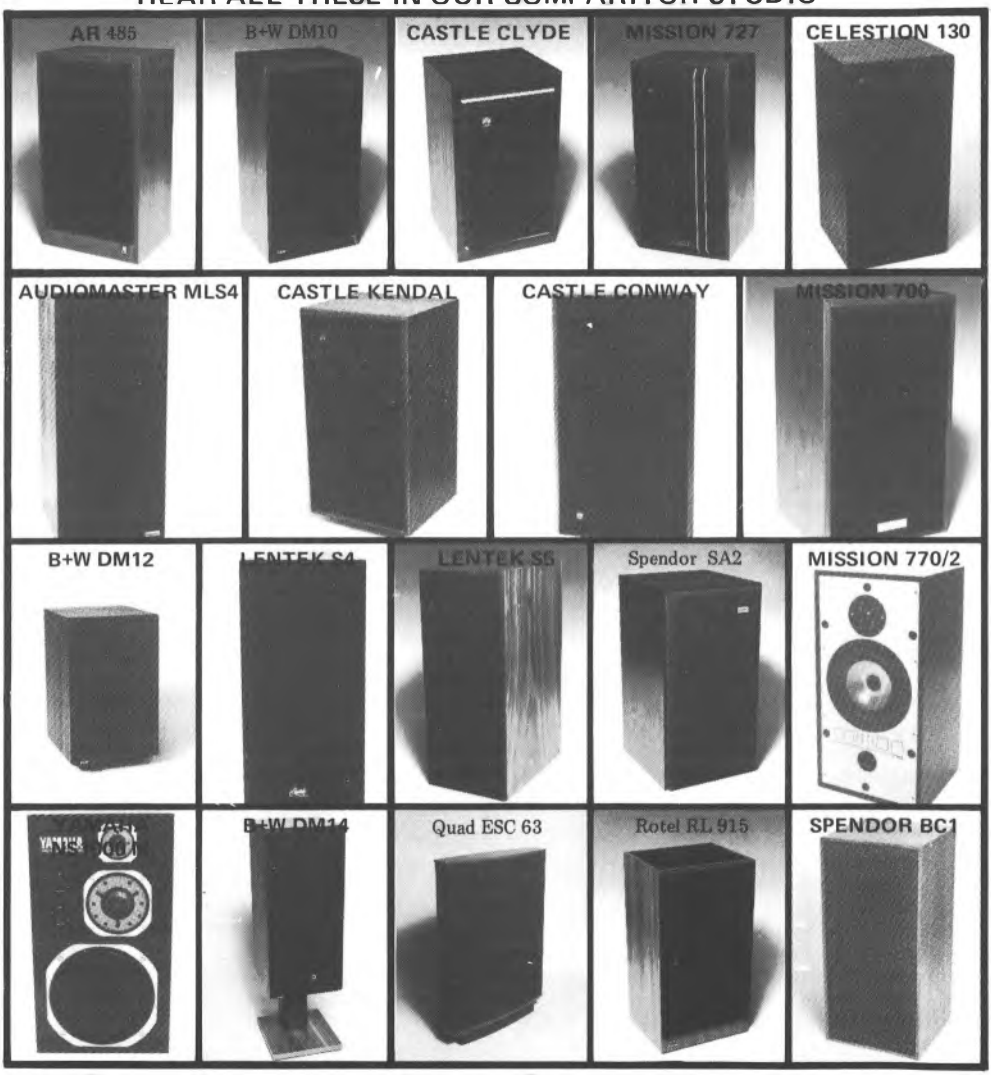
In the first instance, a subwoofer would 'stretch'

COSMIC

EST 1962

MONDAY - SATURDAY 9am - 6pm. SUNDAY 2pm - 7pm (phone first).

HEAR ALL THESE IN OUR COMPARITOR STUDIO



Mail Order available on selected items — Securicor delivery, £4.00 per item.

244-256 STATION ROAD, ADDLESTONE, WEYBRIDGE, SURREY.

TELEPHONE WEYBRIDGE (0932) 54522/51753/43769.

a speaker such as the new Quad *63*, allowing it to handle wide power bandwidths and thus increase available sound levels. It would enable the *63* to make a more effective attempt at rock-orientated programme, and would also help to restore the loss of the bass which occurs when the speaker is placed nearer than a meter from a rear wall. We tried such a combination (using the Audio Pro *B240*), and this gave good results when the programme strongly warranted the use of a subwoofer. On less demanding material however it provided little benefit; if anything its feeling of 'slow' bass extension detracted a little from the light, elegantly 'open' upper bass/lower mid definition of the Quad by itself. Towards the end of the test programme the subwoofer was off more than on, and only really came into its own when direct cut records, certain church organ tracks and heavy rock were reproduced. In the context of the Quad's price, if there is money to spare then the subwoofer could be viewed as an interesting and occasionally valuable accessory, but not as a necessity.

At the other end of the speaker spectrum, the subwoofer may be used to augment the low frequency performance of some diminutive high quality systems, referred to in this context as 'satellites'. These may be desirable in their own right, but are more frequently chosen for their visual unobtrusiveness, and the intrusion of hi-fi boxes into the living room can be minimised because the subwoofer can be tucked out of sight.

However there are unfortunately very few satellites worthy of the expense of a subwoofer, so the problem comes full circle. Consider an enthusiast well pleased with the general performance of his system except for the fact that genuinely low bass is not available. If this is important, the price of an additional subwoofer may well be justified, and would be a logical addition.

Power handling and dynamic range

This is a contentious subject, as it remains difficult to quantify power handling subjectively, and our judgment is based on a number of objective as well as subjective factors. Great differences in power handling were found between competing models, with some clearly reaching a degree of overload with as little as a 30W peak input, while others effortlessly withstood 150–200W. (These ratings are of course peak programme ratings; 200W of continuous average power would destroy most of the review speakers in a matter of minutes.) Some systems even proved capable of accommodating over 1000W of peak power in the bass/midrange (this alarming level routinely available from the Carver *M400* in bridged mode if the load is approximately 8 ohms or greater).

Strictly speaking dynamic range cannot be specified for speakers. Where discussed in the reviews, it is a characteristic based upon the maximum sound level attainable – a product of power handling and sensitivity – assessed in conjunction with the cleanliness and clarity of the speaker output. Taken together one has a measure of the low level detail and transparency – if you like the 'noise' or 'mud' level – with respect to the peak sound output capability.

General comment

The inevitable preselection which accompanies the preparation of what has become a necessarily limited short-list of review models has this year provided the author with an embarassing number of Recommendations and Best Buys. Let it be said immediately that our standards are not slipping; rather the quality of the entry was comparatively outstanding on this occasion.

Once again models such as the KEF *Coda* have shown that standard technology if correctly applied, can produce fine results at a surprisingly modest price. In speakers as in good food, the cook often counts for more than the ingredients.

Polypropylene, hailed as the successor to bextrene, has found an honourable place in the heirarchy, but has not displaced the earlier plastics material. In fact, the Best Buy ratings for polypropylene so far have occurred in the lower price brackets. Bextrene still holds supreme in the more advanced groups, with examples such as the three models from Spendor, the Rogers *Studio*, and the KEF *R105.2* and *R105.4*.

Comparatively few three-way speakers have been successful. This is due to the considerably greater difficulty involved in getting such a design right. The number of variables involved in design and production increase well out of proportion to the 2 : 3 driver ratio.

The engineering *versus* cost equation appears to dictate that below £400.00 a pair, a quality two-way system is a safer choice than a three-way, and *Choice* have shown that a number of 'classic' two-way models do exist, all offering a satisfactory bass register, high sound level capabilities, good power handling, and exceptional sound quality in a box of modest dimensions at a moderate price. This generalised finding may go against the grain for some marketing men who subscribe to the philosophy that 'the more drivers the better'. In practice, we have found the reverse is usually the case.

MECCA.

One thing every hi fi enthusiast knows: you won't find the best equipment on every street corner. Even though you'll find a hi fi store in practically every high street. But then the true believer will walk past a thousand stores to reach Mecca. And not even notice his aching feet. He'll be too absorbed in the soul-salving sounds of the Audio T range. A triumphant litany of the very best names in hi fi, such as Quad, Tresham, Linn, A & R and Meridian. So that he can appreciate them to the full, demos are of course by appointment only. And after-sales service is similarly exclusive. All routes lead to West Hampstead station. Small wonder they call it the Jubilee Line.

AudioT

The Audio Consultants.
190 West End Lane, West Hampstead,
London NW6 1SQ. Tel: 01-794 7848
Mon-Wed 11-6 Thurs, Fri 11-7 Sat 10-5

BEST BUYS AND RECOMMENDATIONS

These are drawn from a review 'pool' of over 150 models going back from this through three previous issues. Furthermore a large number of new high quality models have in fact emerged during this latest edition's test programme.

A Best Buy classification implies very good value for money. Due to the inevitable law of diminishing returns, this classification ceases at the £350 a pair price level.

A Recommendation at below £350 indicates that a product is well above average, showing significant merit; in some cases and under certain circumstances, such a speaker might well be preferred to a comparably priced Best Buy model, depending on taste and the other components of the system. To be placed in the 'Recommended' class above £350 a pair implies a very high standard of performance which demands acknowledgement regardless of price. Again purchasers must make their own final decisions based on auditioning, hopefully assisted by the data we provide.

There is also a 'worth considering' category which includes those designs which have some merit but which cannot be recommended without reservations concerning one or more aspect of their performance.

Of necessity many of these value judgements are strongly related to current prices, and may need re-interpretation if significant changes occur, or if the reviews are compared in a different context, such as an overseas market. Please note that our published prices form the basis of our judgements, though they are invariably something of a 'guestimate'.

Best Buys & Recommendations £70–£150

If forced to choose only one model for classification as a Best Buy, it would have to be the **KEF Coda** (£79), a genuine hi-fi speaker of fine all round performance and very good value. Several others are also worthy of Best Buy status however, including some models from previous editions. The **KEF Celeste** (£120) is an earlier but still strong contender of superior finish and a 'furnished' style. The **Mission 700** (£115), brought forward from the last issue but also re-assessed, is a classy all-rounder possessing a usefully high sensitivity. The **Celestion 130** (£115) turned out to be one of this company's best budget designs of recent years, with a pleasant sound and offering an easy amplifier load. The **KLH 317** at its new competitive price (£120) remains in the listing, and offers an unrivalled maximum sound level and generally good quality for the price. Of the 'tinies' the new **Castle Clyde** (£80) is a smooth and sophisticated all-rounder, unusually at this price level, it possessed a real veneer finish. The **B&W DM10** (£90) is a competant and well balanced design offering good value for money. And at the top end of this price grouping, the **KEF Caprice** (£150) is one of the most subtle, smooth and neutral speakers made at a modest price, again offering a finely balanced performance.

Five speakers qualify for recommendation in this lowest price group namely the **Celestion Ditton 100** (£80), the **Castle Richmond II** (£105), the **Mordaunt-Short Festival 2** (£135), the **Toshiba SS50GB** (£130) and the **JR Metro** (£110), the latter distinguished by its small dimensions and being a true miniature of surprising 'poke'. The **Fesitval 2** is now gradually being replaced, but did very well in the last issue. The **SS50GB** should still be available and is one of the very few successful three-way designs at this price level. Established for a number of years now the **Richmond II** continues to set a good standard particularly for sensitivity and dynamic range, and is also well finished. The **Ditton 100** is a very respectable budget speaker with a lively and detailed character, better suited to shelf mounting than most.

£150–£250

Best Buys here include the established **Castle Kendal II** (£160), the **Monitor Audio MA66** (£180), the **Sony SSG1 II** (£210), the **Acoustic Research AR48S** (£250), the **Chartwell Rogers PM310** (£250), the **Mission 727** (£245) and the **Wharfedale TSR108 II** (£240). Taking the new ones first, the **MA66**'s position was assured by its smooth and likeable character despite some bass excess. The **PM310** is Chartwell's most competitive model for sometime now, representing fine value for money in both engineering and sound quality terms. Mission have scored another hit with their new **727**, a sensitive design which concedes little in subjective quality to their much more expensive *770 III*. Acoustic Research have at last got the price *versus* performance relationship right in the highly competant **'48S**. Both the **Kendal II** and the **SSG1 II** continue to deserve their high ratings, the former with an unusual combination of sensitivity and refinement, and the latter for engineering value, finish and confident dynamic range, its three-way lineup offering excellent power handling.

Recommended speakers in this price range comprise the BBC-designed **LS3/5A** (**Audiomaster** and **Chartwell/Rogers** licencees at £200), the **B&W DM12** (£200), the **Celestion Ditton**

200 (£190), the **Heybrook HB2** (£185), the **Spendor SA1** (£210), the **JR 149 II** (£160), the **Rotel RL915** (£190), the **Audiomaster MLS4** (£215), and also the **Audio Pro B240** subwoofer system (£240).

The **LS3/5A** soldiers on, currently made under three licensed brands and still setting an enviable standard for neutrality, stereo and musical detail from a tiny box, albeit limited in maximum loudness level. The **DM12** is a pleasant compact offering good power handling with full protection. The **Ditton 200** did well for the price in the last issue. Another small system designed for stand mounting, the **Heybrook HB2** is a relatively accurate speaker of fairly limited power capacity. The **SA1** is an insensitive compact, with remarkable bass for the size given a large enough amplifier. JR's new version of the **149** is an unobtrusive and distinctive model possessing good neutrality and remarkable stereo. The **RL915** is a welcome newcomer, with a clean bass and an open, lively sound. Audiomaster's **MLS4** continues to set a good standard in value terms, and offers decent bass extension. The **B240** is a relatively inexpensive subwoofer of excellent design and good performance.

£250–£350

Best Buys in this middle section comprise three established favourites, the **Castle Conway II** (£290), the **Rogers Studio One** (£340), and the **Spendor BC1** (£350), and they are joined this year by another model from **Spendor**, the **SA2** (£290). Except for the **Conway**, which is a well balanced three-way design of neutral bass and fine power handling, all the rest are essentially two-way reflex models. The **SA2** is a fine performer for the price and size, and is superbly made. The **BC1** offers unrivalled subtlety, neutrality, depth and detail in the mid/treble register, but is over-rich in the bass and has a more limited dynamic range. Closely approaching the *BC1* mid and treble, the **Studio** offers a higher maximum level and excellent power handling, but still possesses some bass excess.

Five models are Recommended, namely the **Harbeth HL1 III** (£340), the **B&W DM14** (£300), the **KEF 103.2** (£260), the **Mordaunt-Short Pageant 3** (£290) and the **ARC 101 A/P** (£320). Despite a price rise and slight reservations the **101** still merits inclusion in the Recommended listings, being one the few models balanced for near-wall mounting, and showing good power

handling as well as high overall quality. KEF's **103.2** has been rather outclassed by their new *Caprice* in sheer value for money terms, but continues to offer a fine relaxed presentation with excellent finish and full protection. The **Pageant 3** restores lustre to a famous design, and is a most welcome new three-way all-rounder. The **HL1 III** shows a subtlety in some regions of the mid-range which is hard to beat, and generally fits comfortably in the low coloration monitor class. The new B&W **DM14** is a finely finished model with matching pillar stands which performed well on tests, sounding lively and detailed with good bass, great power handling plus full protection and good engineering.

£350–£600 (Above Best Buy limit)
Eight models are included in this band on the basis of high performance on test; despite highish prices, on this basis they do offer value for money. They comprise the **Castle Howard II** (£475), **Celestion 551** (£380), **Mission 770 III** (£385), **B&W DM16** (£550), **Heybrook HB3** (£380), **Lentek S5** (£390) and **Yamaha NS1000M** (£570).

The **770 III** is a modestly dimensioned design of average sensitivity which comes complete with stands. Its neutrality continues to improve, and good power handling plus a wide dynamic range are among its attractions. Despite some slight reservations it is difficult not to recommend the **HB3**, because of the good impression it made on the panel, and it certainly deserves an audition. Lentek's new **S5** offers an above average sensitivity, good tonal balance and extended bass. The **Howard II** is a lot of speaker for the money, with a deep powerful bass, the price including stands. In an earlier issue the **551** set a standard worthy of recommendation and also comes with stands. The new fully-protected **DM16** is an unusual 'sloped-front' three-way design complete with matching furnished bases and giving a fine stereo performance. Brought forward from some years ago we have the evergreen **NS1000M**, still recommended due to its continuing competitive pricing.

Above £600
The **Audio Pro A4-14** does not really belong to this elevated price category despite its price tag of £750, as this includes full active power amplification, worth maybe about £400, which places the 'effective acoustic price' at around the £350 level. Capable of high sound levels and equipped with versatile controls, it can produce very impressive sounds from a very compact enclosure.

Both the **KEF R105** models – the **'4** (£650) and the **'2** (£850 inc. covers) are top class systems. The **'4** was particularly favoured on tests, but both provided exceptional stereo imaging. In character the **'2** is rather more 'classical' in balance, with extended bass, while the **'4** is more 'modern' sounding, with exceptional power handling and a more 'open', 'lively' presentation.

JBL's **L150A** (£1,000) is a high performance speaker offering a wide bandwidth and great dynamic range. A costly but compact design at £1,200 the **ProAc Studio 3** in the last issue gave a sufficiently high performance to ensure a confident recommendation; stereo depth was particularly good with fine dynamics, and a much cheaper version with savings made in the magnet systems is now available, with claimed near-identical acoustic performance. A large system of fine power handling available in active or passive formats, the **Spendor SA3** (£800, £1,400 active inc. power amplifiers) offers monitor sound quality and suits larger rooms very well.

Last but not least we have the new **Quad ESL 63** electrostatic costing around £1,000. While it cannot easily be compared with similarly priced moving-coil models due to its restricted power handling, limited basspower and unusual 'different' interaction with the room acoustic, it has qualities on speech and transients, which together with a general smoothness and integration are unsurpassed. On orchestral programme one can almost forget the speaker and the end result is free of the distinctive and unnatural sounds made by separate driver systems. However this model should not be purchased without prior audition.

Your best buy . . .

is of most concern to you. Rarely is it also the concern of the hi-fi dealer. Yet, Hampshire Audio is one of those rare Independent Hi-Fi Specialists who put quality and value first and foremost. Volumes abound on the whys and wherefores of this and that . . . black is proved to be white, and white black . . . but you still have to make a choice. Buying hi-fi should not be like betting on a horse, whether you study form in detail or just use a pin. On average the punter does not win because the odds are stacked against him. Test reports never show variability between different samples nor general reliability – good or bad – but these facts a good dealer learns from experience. In any event your requirement might be best met by a model not included in test reports. The risk is just not worth it, so approach Hampshire Audio if you have not already been recommended to come to us. In fact, recommendation we consider to be our most effective form of advertising (sorry Hi-Fi Choice and other magazines). Recommendations from those persons who really appreciate the joys of music are valued greatly for enjoyment is the final result of our endeavours. This we are committed to. Hi-Fi equipment is our only speciality and we stock nothing else.

Come and try us . . .

. . .at Hampshire Audio Ltd

8 & 12 HURSLEY ROAD, CHANDLER'S FORD, HANTS. TEL: (04215) 2827 & 65232

Your best buy . . .

We stock SELECTED items from:
ADC, Aiwa, AKG, AR, A&R, Ariston, Audioref, **Audio Technica, B&W, Beyer, Celef, Celestion, Chartwell, Crimson, Decca, Denon, Diesis, Dual, Dumpa, EAR, Electro, Elite, Entre, Gale, Ganz, Grace, Grado, Hadcock, Harbeth, Heybrook, Kit-Deck, Lentek Linn Isobarik, Linn Sondek, Maxell, Meridian, MFSL, Michell, Mirage, Mission, Monitor Audio, Monster, Nagaoka, Nakamichi, Nightingale, Optonica, Ortofon, QED, Quad, Quantum, Radford, RAM, RCL, Reference, Revox, Rogers, Sansui, Satin, Sennheiser, Spendor, Stanton, Stax, STD, Sugden, Supex, Swallow, Syrinx, Systemdeck, Tangent, Technics, Trio, TSR, Walker, Yamaha and others.**
ACTIVE SYSTEMS BY MERIDIAN, SWALLOW AND CRIMSON ON DEMONSTRATION

- OPEN THURSDAYS UNTIL 8pm
- OVER-THE-COUNTER AND PERSONAL EXPORT
- ALL EQUIPMENT CHECKED BEFORE SALE NO SEALED BOXES SUPPLIED
- OUR OWN TWO-YEAR LABOUR AND PARTS GUARANTEE
- EXTENSIVE FREE PARKING
- ACCESS AND BARCLAYCARD ACCEPTED BY TELEPHONE
- SPECIAL DISCS STOCKED
- COMPARATOR DEMONSTRATIONS IN THREE STUDIOS

All enquiries with SAE

. . .at Hampshire Audio Ltd

8 & 12 HURSLEY ROAD, CHANDLER'S FORD, HANTS. TEL: (04215) 2827 & 65232

New JR149 MkII

When we introduced the JR149 speaker it became famous for being one of the smoothest, most accurate and open sounding reproducers available. Now the new JR149 MkII constitutes a major step forward in the performance of small enclosures. Every aspect of design and performance has been examined.

The basic conception of the 149 has been retained, but many improvements have been made in the construction. Identical in size to the original, a different method of construction has resulted in an increased cubic capacity of 8 litres. This in conjunction with an improved bass loudspeaker gives a very low system resonance of 60Hz and more powerful bass response. To further improve the bass, the front baffle is a 16mm resin bonded ultra rigid board and the internal rod strengthening the top and base of the enclosure is a steel hexagonal rod twice as strong.

A new 5" bass unit of very advanced design featuring a new high temperature plastic diaphragm with the desirable properties of low mass, rigidity, yet highly self damping has resulted, with a very compliant outer suspension, in smooth uncoloured sound. An extra long voice coil of 13mm, a massive magnet and heavy gauge low resonant steel chassis give improved power handling and transient response.

The enclosure, which is heavily damped yet extremely rigid, does not radiate any appreciable sound of its own, consequently, with the wide and smooth polar response of the cylinder, the sound appears to come from space and not from the loudspeakers. This results in a very high degree of realism.

The tweeter also is of very advanced design, featuring a hexagonal wire voice coil for improved power handling and a patented magnet system resulting in a much faster response to signals. Using a small ultra lightweight diaphragm of 20mm, a superb polar response is maintained with a very smooth and uncoloured sound. High frequency detail is excellently reproduced without hardness or stridency.

To complement these two fine units a new cross-over was developed using large low distortion inductors for the bass section, air-cored inductor for treble, close tolerance resistors and low capacitors, all mounted on a circular printed circuit so arranged that no undesirable coupling occurs. The cross-over is resiliently mounted in the base of the enclosure for maximum acoustic isolation.

A pre-set control allows a 3dB adjustment of treble.

SPECIFICATIONS

Impedance:	8ohms
Efficiency:	84.5dB for 1 watt
Power handling:	30-100 watt programme
Cross-over:	Specially developed circuit crossing over at 2.2kHz to produce excellent integration over a wide angle.
Frequency Response:	40Hz — 25kHz
Pink noise:	½ octave response ± 2dB 75Hz — 20kHz
System resonance:	60Hz
Treble unit:	2cm dome with special magnetic circuit
Bass unit:	13cm high flux unit
Dimensions:	15" high 9" diameter
Cabinet finish:	Walnut

JR

Unit 5, Morewood Close, Sevenoaks, Kent. Tel: Sevenoaks 50952

OVERALL COMPARISON CHART

	Dimensions (metric) cm/kg				Bass enclosure internal volume litres	Max sound level in 100m³ at 2m/ pair	Lab sens at 1m 2.83V input	Low freq. rolloff (−6dB) Hz	Rec. min/max amplifier power	Overall frequency Response	Dispersion/ Distribution
	H	W	D	Wt							
Acoustat Model II	148	50	33	25	N/A	97dBA	82.5dB	32Hz	80-100W	average	poor
ADC MS650/MS10W	29(34)	22(44)	21(27)	6.8(18)	6(29)	100dBA	86.5dB	41Hz	20- 75W	average	v. good
Acoustic Research AR18S	42	24.5	17	5.9	9.9l	107dBA	89.5dB	60Hz	10- 75W	average−	average−
Acoustic Research AR48S	64	35.5	28	17.2	38l	105dBA	88dB	40Hz	15-100W	good	good
Acoustic Research AR90	108	37	38	37	90l	103dBA	90dB	30Hz	30-300W	good	good
ARC 050	40	24	21.5	7	11l	105dBA	86.5dB	55Hz	15-150W	good	good
ARC 101A/P	56.5	31	28	12	28l	106dBA	88dB	60Hz	15-150W	average	good
Audiomaster MLS4	63	28	31	14	40l	101dBA	85dB	37Hz	25-150W	good	v. good
Audio Pro 4-14	52	32	26	16	18l	109dBA	variable	30Hz	active	v. good	v good
Audio Pro B2-40 (sub)	52	37.5	37.5	18	28l	107dBA	variable	27Hz	active	v. good	—
B&W DM10	48.5	25	23.5	6.6	19l	103dBA	88dB	55Hz	15-100W	good	good
B&W DM12	35.5	22	27	9.6	12l	102dBA	86dB	60Hz	25-150W	good	good
B&W DM14	56.5	25.5	29.5		24l	104dBA	86dB	46Hz	20-200W	good	good
B&W DM16	65	33.5	42		45l	102dBA	85dB	44Hz	20-150W	v. good	v. good
Castle Clyde	37	21.5	22		9.8l	102dBA	89.5dB	64Hz	10- 50W	v. good	excellent
Castle Kendal II	52.5	29	28	10	30l	105dBA	89dB	52Hz	10-100W	v. good	excellent
Castle Conway II	63.5	34.5	35	18.5	55l	105dBA	87dB	38Hz	15-200W	v good	excellent
Celestion 100	33	21	18.5	4.4	7l	100dBA	88dB	76Hz	15- 50W	average	v. good
Celestion 130	48.5	25	24	7.7	20l	102dBA	88dB	60Hz	15- 75W	good	good
Celestion 200	60	33	26.5	12.7	37l	104dBA	88.5dB	58Hz	15-150W	average	average
Chartwell/Rogers PM55	35.5	19	16.5		6l	95dBA	83dB	65Hz	30- 40W	average	v good
Chartwell/Rogers PM110 II	46	23	21	7.5	13l	102dBA	86dB	63Hz	25-150W	good	excellent
Chartwell/Rogers PM310	56.5	27.5	28		32l	101dBA	86dB	47Hz	20-100W	good	v good
Dean Mini-Monitor	36.5	21.5	20.5		9l	96dBA	81dB	55Hz	50-100W	average+	good
Gale GS401A	33	60.5	27	20	40l	105dBA	88dB	50Hz	25-150W	good	average
Grundig M1500	55	29	22	10	26l	103dBA	89dB	50Hz	15-100W	good	average
Harbeth ML	34.5	21.5	19.5		9l	96dBA	84dB	70Hz	20- 50W	average	good
Harbeth HL1 III	63.5	32.5	30.5	13.5	50l	102dBA	87.5dB	46Hz	15-100W	good	v good
Heybrook HB2	41	23	23	8	12l	96dBA	84dB	60Hz	30-100W	good	excellent
Heybrook HB3	62.5	33.5	31		37l	106dBA	88.5dB	49Hz	15-200W	average+	good
JBL L112	62	33	34	22	43l	109dBA	88dB	43Hz	15-400W	good	average
JBL L150A	105.4	43	33	36	110l	111dBA	89dB	32Hz	10-500W	v. good	v. good
JR 149 II	38.5	23 dia.			8l	94dBA	82dB	57Hz	30- 75W	v. good	excellent
JR Metro	28	16	19	4.5	5l	97dBA	83.5dB	85Hz	30- 75W	good	excellent
KEF Coda	47	28	22	7	19l	104dBA	88.5dB	50Hz	10-100W	v. good	excellent
KEF Caprice	47	28	22	8.3	19l	102dBA	87dB	45Hz	15-100W	v. good	excellent
KEF R103.2	50.6	26.5	25	8.6	19l	103dBA	86.5dB	48Hz	25-200W	v good	v. good
KEF R105.4	93.6	35	38	22	40l	107dBA	85.5dB	46Hz	20-500W	v. good	excellent
KEF R105.2	96.5	41.5	45.5	36	70l	103dBA	85dB	33Hz	25-300W	v good	v good
KLH 317	58	30	25	13	20l	104dBA	89dB	55Hz	10-100W	average	good
KLH 160	49	26.5	22.5		19l	104dBA	85dB	49Hz	20-200W	average	good
Lentek S4 II	49.5	25	25.5	11.5	18l	99dBA	84.5dB	47Hz	30-100W	v good	v good
Lentek S5	66	26.5	41	21.5	48l	107dBA	88dB	44Hz	15-250W	good	v good
Linn Kan	30.5	19	16.5		5.2l	103dBA	87dB	70Hz	15-100W	average	v good
Marantz HD445	49	29	22	8.8	20l	105dBA	88dB	65Hz	10-100W	average	average−
Mission 700	46	26	25	6.5	22l	103dBA	88.5dB	66Hz	15-100W	good	average+
Mission 727	57	29	28	10.5	27l	106dBA	88dB	50Hz	10-200W	good	average+
Mission 770 III	59	30	28.5	12.7	35l	104dBA	86dB	45Hz	20-200W	v. good	v good
Mitsubishi DS 32B	61	32	33.5	19	45l	109dBA	90dB	45Hz	10-240W	v. good	good
Monitor Audio MA66	58	30	29		33l	101dBA	86dB	42Hz	20-100W	good	v good
Mordaunt-Short Pageant 3	62	26.5	30		25l	105dBA	86.5dB	41Hz	20-200W	v. good	excellent
Mordaunt-Short Signifer	81	38.5	33		70l	105dBA	86dB	33Hz	25-250W	v. good	v good
Pioneer HPM 500	57	32	33	12.2	38l	111dBA	89dB	45Hz	10-400W	average−	poor
ProAc Studio 3	68.5	30.5	33	30	51l	109dBA	86dB	42Hz	25-500W	v good	excellent
Quad ESL-63	92	66	27		N/A	99dBA	84dB	34Hz	25-100W	v. good	good
Richard Allan RA8	39.5	26.5	27	6.8	14l	98dBA	85dB	50Hz	25- 50W	average	average+
Revox Triton	94	106	46	98	45l	103dBA	90dB	53Hz	15- 60W	average	good
Rogers LS3/5A	30	18.5	16	5.5	5.5l	93dBA	82dB	59Hz	30- 50W	good	v good
Rogers Studio One	63.5	30.5	30.5	14	43l	104dBA	84dB	42Hz	25-300W	v. good	v. good
Rotel RL915	57	30	26.5	9.9	28l	104dBA	87dB	43Hz	15-150W	v good	excellent
Sony SSE50 II	57	27	28	9	25l	102dBA	90dB	60Hz	10- 50W	average−	average+
Sony SSG1 II	60	33.5	30	13	37l	105dBA	89dB	50Hz	10-100W	good	good
Spendor SA2	50	26.2	29.5		28l	106dBA	86.5dB	50Hz	15-300W	v. good	v. good
Spendor BC1	63.5	29.8	30.5		44l	98dBA	83.5dB	39Hz	30-130W	v good	v good
Spendor SA3	85	38	46	41	120l	110dBA	variable	33Hz	N/A	good	v good
Tannoy Stratford	48	26.5	26		22l	103dBA	90dB	60Hz	10- 75W	good	average+
Tannoy SRM12X	85	44.5	27	30	80l	113dBA	93dB	50Hz	5-500W	average	v. good
Technics SB10	71	40	32	32	64l	99dBA	86dB	33Hz	25-100W	good	v. good
Toshiba 00500D	60.6	60.6	38.7	11.2	29l	100dBA	88dB	55Hz	15- 50W	average	v. good
Wharfedale Laser 60	41	26	23		17l	96dBA	86.5dB	55Hz	20- 30W	average+	good
Wharfedale Laser 120	61.5	28	30		33l	104dBA	86dB	40Hz	20-250W	average+	good
Wharfedale TSR108.2	57.7	31	28.8	14	30l	103dBA	85.5dB	40Hz	20-150W	good	v. good
Yamaha NS1000M	67.5	37.5	32.6	31	55l	107dBA	90dB	50Hz	10-200W	good	v. good

OVERALL COMPARISON CHART

Coloration	Amplifier loading impedance	Peak distortion performance 100 W	Swept distortion performance 96 dB	Overall subjective quality	Stereo image quality	Truth to life	Typical price (stands)	Value judgement	
good	poor	excellent	good	good	good	average	£1000		**Acoustat Model II**
good	average	average–	good	average	v. good	good	£360	Worth considering	**ADC MS650/MS10W**
acceptable	average	average–	average	average–	average	average	£90	Worth considering	**Acoustic Research AR18S**
good	average	v. good	good	good	good	good	£250	Best Buy	**Acoustic Research AR48S**
good	poor	N/A	v. good	good	v. good	average	£690	Worth considering	**Acoustic Research AR90**
average	good	v. good	good	average	average	good	£200	Worth considering	**ARC 050**
good	good	good	good	good+	good+	average	£320	Recommended	**ARC 101A/P**
good	average	N/A	v. good	good+	good	good	£215	Recommended	**Audiomaster MLS4**
v. good	active	v. good	v. good	v. good	v. good	v. good	£750	Recommended	**Audio Pro 4-14**
good	—	—	excellent	good	—	—	£250	Recommended	**Audio Pro B2-40 (sub)**
average+	average	v. good	v. good	good	good	v. good	£90	Best Buy	**B&W DM10**
good	good	v. good	good	good	good	average–	£200	Recommended	**B&W DM12**
good	good	v. good	v. good	v. good	v. good	excellent	£300(inc)	Recommended	**B&W DM14**
good	average	excellent	v. good	v. good	good	good	£550(inc)	Recommended	**B&W DM16**
average+	good	average	v. good	average+	good	good	£80	Best Buy	**Castle Clyde**
v. good	v. good	average	good	good	average	v. good	£165	Best Buy	**Castle Kendal II**
v. good	average	N/A	v. good	v. good	v. good	v. good	£290	Best Buy	**Castle Conway II**
average	average	good	average	average	good	good	£70	Recommended	**Celestion 100**
average	average	good	good	average	average	average	£115	Best Buy	**Celestion 130**
good	good	v. good	v. good	average	average	good	£195	Recommended	**Celestion 200**
average+	v. good	poor	average–	average	good	good	£115	Worth considering	**Chartwell/Rogers PM55**
average	average	good	good	average	average	good	£195	Worth considering	**Chartwell/Rogers PM110 II**
good	good	good	v. good	v. good	v. good	good	£250	Best Buy	**Chartwell/Rogers PM310**
good	v. good	v. good	average–	average–	average+	good	£179	—	**Dean Mini-Monitor**
good	poor	good	excellent	good	average	v. good	£530	Worth considering	**Gale GS401A**
good	poor	good	good	good	average	average	£220	Worth considering	**Grundig M1500**
good	v. good	average	average	average	average+	good	£190	—	**Harbeth ML**
v. good	good	average–	v. good	good+	good	v. good	£345	Recommended	**Harbeth HL1 III**
good	good	average–	good	good	good	good	£180	Recommended	**Heybrook HB2**
good	average–	good	average	good	good	good	£380	Recommended	**Heybrook HB3**
average	average	v. good	v. good	good	average+	average	£700	Worth considering	**JBL L112**
good	average	v. good	excellent	v. good	good	good	£1000	Recommended	**JBL L150A**
good	average	v. good	average–	average+	v. good	good	£165	Recommended	**JR 149 II**
average	v. good	v. good	good	average	good	average	£115	Recommended	**JR Metro**
good	v. good	v. good	average	v. good	v. good	good	£80	Best Buy	**KEF Coda**
good	v. good	v. good	average	v. good	v. good	good	£150	Best Buy	**KEF Caprice**
good	good	v. good	good	good+	good+	average	£260	Recommended	**KEF R103.2**
v. good	excellent	v. good	average+	v. good	excellent	v. good	£650	Recommended	**KEF R105.4**
v. good	v. good	good	good	v. good	excellent	good	£860	Recommended	**KEF R105.2**
average+	v. good	N/A	good	good	good	good	£120	Best Buy	**KLH 317**
good	v. good	average	good	average	average+	good	£160	Worth considering	**KLH 160**
good	good	N/A	v. good	good+	good+	average	£310	Worth considering	**Lentek S4 II**
good	average	good	v. good	good+	good+	average	£380	Recommended	**Lentek S5**
average	average	good	average+	average	average+	average	£190	Worth considering	**Linn Kan**
average	good	average	average+	average	average	average–	£105	Worth considering	**Marantz HD445**
average+	good	good	good	average+	good	average	£115	Best Buy	**Mission 700**
good	v. good	v. good	average+	v. good	v. good	good	£245	Best Buy	**Mission 727**
good	average	v. good	excellent	v. good	v. good	good	£385	Recommended	**Mission 770 III**
average+	average	good	good	average+	average	average	£230	Worth considering	**Mitsubishi DS 32B**
good	v. good	good	good	good+	good	v. good	£180	Best Buy	**Monitor Audio MA66**
average+	good	average	average+	good	good	average	£290	Recommended	**Mordaunt-Short Pageant 3**
v. good	average	N/A	v. good	v. good	v. good	v. good	£630	Recommended	**Mordaunt-Short Signifer**
average	average	average	good	average	average–	average–	£170	Worth considering	**Pioneer HPM 500**
v. good	good	good	excellent	v. good	v. good	v. good	£1200*	Recommended	**ProAc Studio 3**
excellent	average–	v. good	v. good	v. good	v. good	v. good	£1000	Recommended	**Quad ESL-63**
average	v. good	poor	average–	average–	average–	average	£125	—	**Richard Allan RA8**
good	average–	average–	good	good	good	average	£840	Worth considering	**Revox Triton**
good	v. good	N/A	v. good	good	v. good	good	£200	Recommended	**Rogers LS3/5A**
v. good	good	v. good	v. good	v. good	v. good	v. good	£340	Best Buy	**Rogers Studio One**
average	v. good	v. good	average+	average	average+	average+	£200	Recommended	**Rotel RL915**
poor	v. good	poor	average	poor	average–	poor	£100	—	**Sony SSE50 II**
good	good	good	v. good	good+	good	good	£210	Best Buy	**Sony SSG1 II**
good+	v. good	good	good	v. good	v. good	good	£290	Best Buy	**Spendor SA2**
v. good	good	v. good	good	v. good	v. good	good+	£350	Best Buy	**Spendor BC1**
v. good	active	v. good	excellent	v. good	v. good	v. good	£1650*	Recommended	**Spendor SA3**
average–	v. good	average–	average	average–	average	average–	£110	Worth considering	**Tannoy Stratford**
average	good	good	good	average	average	average–	£560	—	**Tannoy SRM12X**
average	good	average–	average–	average	average	good	£600	—	**Technics SB10**
average	average	v. good	good	good	good	average	£145	Recommended	**Toshiba SS50GB**
average–	average–	average	average	average–	average–	average–	£80	Worth considering	**Wharfedale Laser 60**
average+	average–	good	average	average+	average	good	£180	Worth considering	**Wharfedale Laser 120**
good+	v. good	good	average	v. good	good+	good+	£240	Best Buy	**Wharfedale TSR108.2**
good	average	v. good	excellent	good+	good	good	£550	Recommended	**Yamaha NS1000M**

KENT

Canterbury Hi Fi Centre

WE STOCK AR, WHARFEDALE, AUDIOMASTER, CELESTION AND SPEAKERS THAT THESE CLOWNS DIDN'T HAVE THE NERVE TO REVIEW

21 The Burgate, Canterbury, Kent.

Tel 0227 65315

LINCS

THE CRITICS CHOICE

Main agents for: Linn, Ariston, Thorens, S.T.D., Michell, Heybrook, Nytech, Meridian, Mission, Classic, Quantum, Crimson, B & O, Technics, Optonica, Pioneer, Trio, Hitachi, Sansui, B & W, Celef, Dual, Castle, IMF, Sigma, Bose, Lentek, etc, etc.

64 A HIGH STREET, LINCOLN.

Telephone Lincoln 38 718

W MIDLANDS

FIVE WAYS HIGH FIDELITY

Carefully selected items from many suppliers including loudspeakers by

Audiomaster, B&W, Chartwell, Harbeth, Heybrook, IMF, JR, KEF, Klipsch, Lentek, Linn, LNB, Lowther, Meridian, Mission, Monitor Audio, Quad, Rogers, Spendor, Tangent, Tannoy.

Precision alignment of transcription equipment Machining facilities available.

12 Islington Row, Edgbaston, Birmingham B15 1LD.
9.30 - 6.00 Monday - Saturday
021-455 0667.

ABERDEEN

HOLBURN HI-FI

For the best in loudspeakers

We recommend and stock the loudspeakers listed below

B&W, Castle, KEF, Mission, Spendor, Wharfedale, Rogers, Celestion, JR, Heybrook and many more

HOLBURN HI-FI 441/5 HOLBURN ST
ABERDEEN (0224) 25713

LINCS

Rodger & Green

FOR THE BEST IN HI-FI AT PRICES YOU CAN AFFORD. AKAI, BOSE, DUAL, FISHER, JVC, MARANTZ, PIONEER, TRIO, TEAC, THORENS, SONY, STD, SANSUI. TECHNICS.

Stamford Hi-Fi
9 Red Lion Square, Sq
Stamford, Lincs
Tel: Stamford 2128

Kettering Hi-Fi
68 Stamford Road,
Kettering
Tel: Kettering 515266

Instant credit for Bank, Access, Barclaycard holders.

HERTS

DARBY'S

ARE NO. 1 IN ST. ALBANS

From the Celestion 100 to the Quad ESL 63 Darbys offer the best range in loudspeakers this side of your ears.

"PROFESSIONALISM WITH A SENSE OF STYLE"

W. Darby & Co.
Lockey House, St Peter's Street,
St Albans, Herts.
(56) 50961

N HUMBERSIDE

Simply Hi-Fi

The Soundwise People.

7 Mill Street, Prospect Centre, Hull, North Humberside
Telephone (0482) 29240
9 Flemingate, Beverley, North Humberside
Telephone (0482) 882696

Free demonstration of the following recommended loudspeakers:
AR, CASTLE, KEF, MISSION, SPENDOR.

EXPERT ADVICE FULL AFTER-CARE SERVICE

DEVON

Gulliford House Ltd

for

ARC HEYBROOK MERIDIAN AND ASSOCIATED PRODUCTS

By appointment at
Kenton Exeter Devon
Tel Dawlish (0626) 863604

Glossary

Active: Speaker systems which contain no crossovers and where the drive units are connected directly to power amplifiers.

ABR: Auxiliary bass radiator; a reflex type bass-loading system, which uses a speaker-like 'cone' without motor instead of a port.

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.

Axis: The axis of a drive unit is the direction of movement of the voice-coil. The fundamental measuring axis used for our measurements is midway between midrange and tweeter axes.

Anechoic: Without echo; a special room or 'chamber' with thick sound absorbing materials on all surfaces to prevent reflections.

Bextrene: A plastics material frequently used for bass and midrange cone materials.

Balance: The overall frequency response balance of a system.

Bituminous damping: A cabinet damping technique whereby heavy impregnated felt pads are attached to the internal cabinet surfaces.

Bass: The low frequency (LF) section of the audio range.

Coloration: A rather vague term which refers to localised and aurally-perceived distortions in loudspeakers (see Consumer Introduction).

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.

drive unit (driver): The term used to distinguish the loudspeaker unit itself, be it bass, midrange, treble or full-range in application, from the complete loudspeaker system which combines drive units, cabinet and crossover into a total design.

Doping: A technique involving the application of a liquid damping material to a driver cone in order to assist in controlling resonances.

dB (decibel): A unit of relative loudness; when referred to the complete audio range, the spectrum may be weighted (eg dBA, dB lin.)

Dispersion (diffraction): Describes the geometric pattern of the sound radiation from a speaker, which invariably varies with frequency.

Element: A component of the crossover which contributes towards controlling the system frequency response.

Efficiency: The amount of acoustic power delivered for a given electrical input power.

Ferro-fluid: A magnetic fluid which is introduced into the voice-coil gap to provide damping and/or improved cooling.

Hz (Hertz): 1 Hz = 1 cycle per second, and is a measure of frequency which corresponds to musical pitch (the higher the frequency the higher the pitch.)

HF: High frequencies.

Impedance: The electrical load presented to the amplifier by the loudspeaker. Measured in ohms for convenience, the modulus varies with frequency and is a combination of resistive and reactive components.

Integration: Used to describe the success with which the output from two drive units combine to give smooth output through the crossover region.

LF: Low frequencies.

Midrange: The central part of the frequency range, to which the ear is most sensitive.

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.

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.

Sealed-box: Also known as 'infinite baffle' loading, this is probably the most popular form of bass-loading technique.

Sensitivity: The volume of sound output for a specific electrical voltage input.

Transmission line: Complex in construction and hence fairly uncommon, this bass-loading technique has much in common with reflexing.

Tweeter: A small drive unit designed to operate over the high frequency range.

Woofer: A drive unit that operates over the bass portion of the audio range.

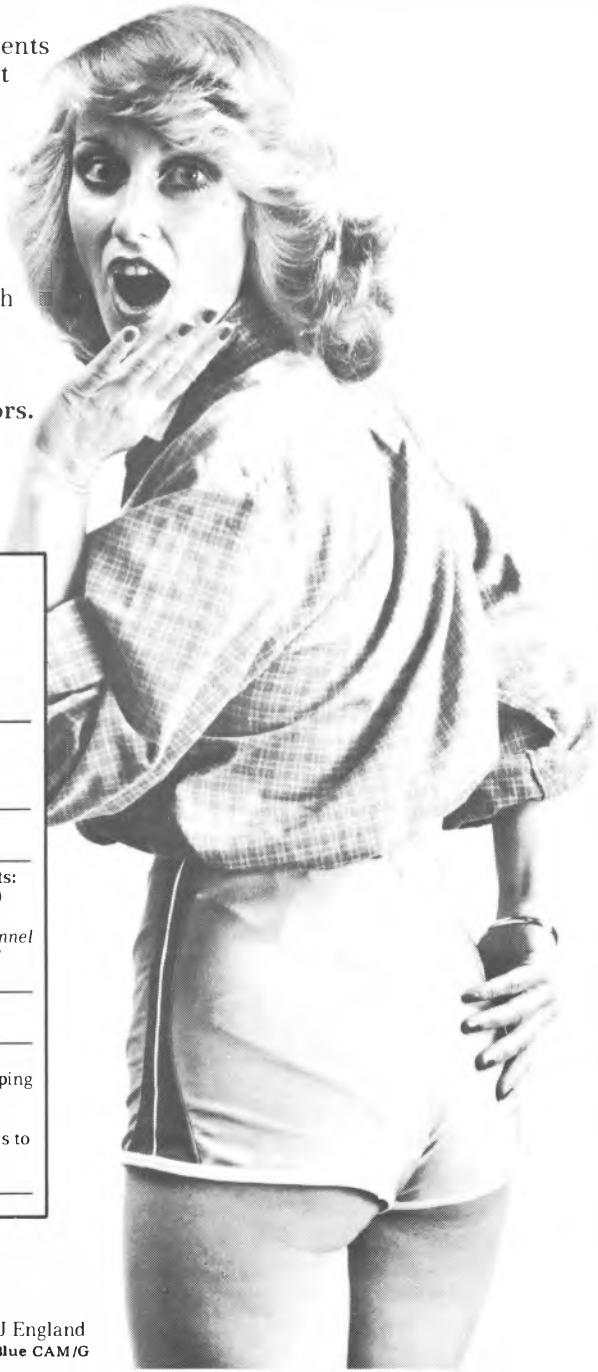
Feeling the Pinch?

Times are tough and improvements to your Hi-Fi system may be difficult to justify. But, just a moment: your prospects may not be quite so bleak with the new **Monitor Audio** 'Series 80' range of loudspeakers.

In fact the legendary Monitor Audio sound quality, first class engineering and exact pair matching can now be yours for much less than you imagine. Doesn't that sound great?

Find out more about the new MA18 and MA83 Reference Monitors.

Listen to an incredible sound at an affordable price!



NEW! Monitor Audio
MA66

Brief Specifications

Frequency response:
Within ± 2 dB
45 Hz to 22 KHz.

Three-way compact speaker.

Amplifier requirements:
Recommended 15–100 watts.
Note 120 watts per channel amplifier could be used with care.

Nominal Impedance:
8 ohms.

Construction:
Complex internal damping with foam lined sides. Longitudinal brace between two 8 in.drives to eliminate cabinet resonances.

Highly acclaimed by the press all over the world!

Monitor Audio Ltd
347Z Cherry Hinton Road Cambridge CB1 4DJ England
Telephone (0223) 246344 & 242898 Telex 817343 Blue CAM/G

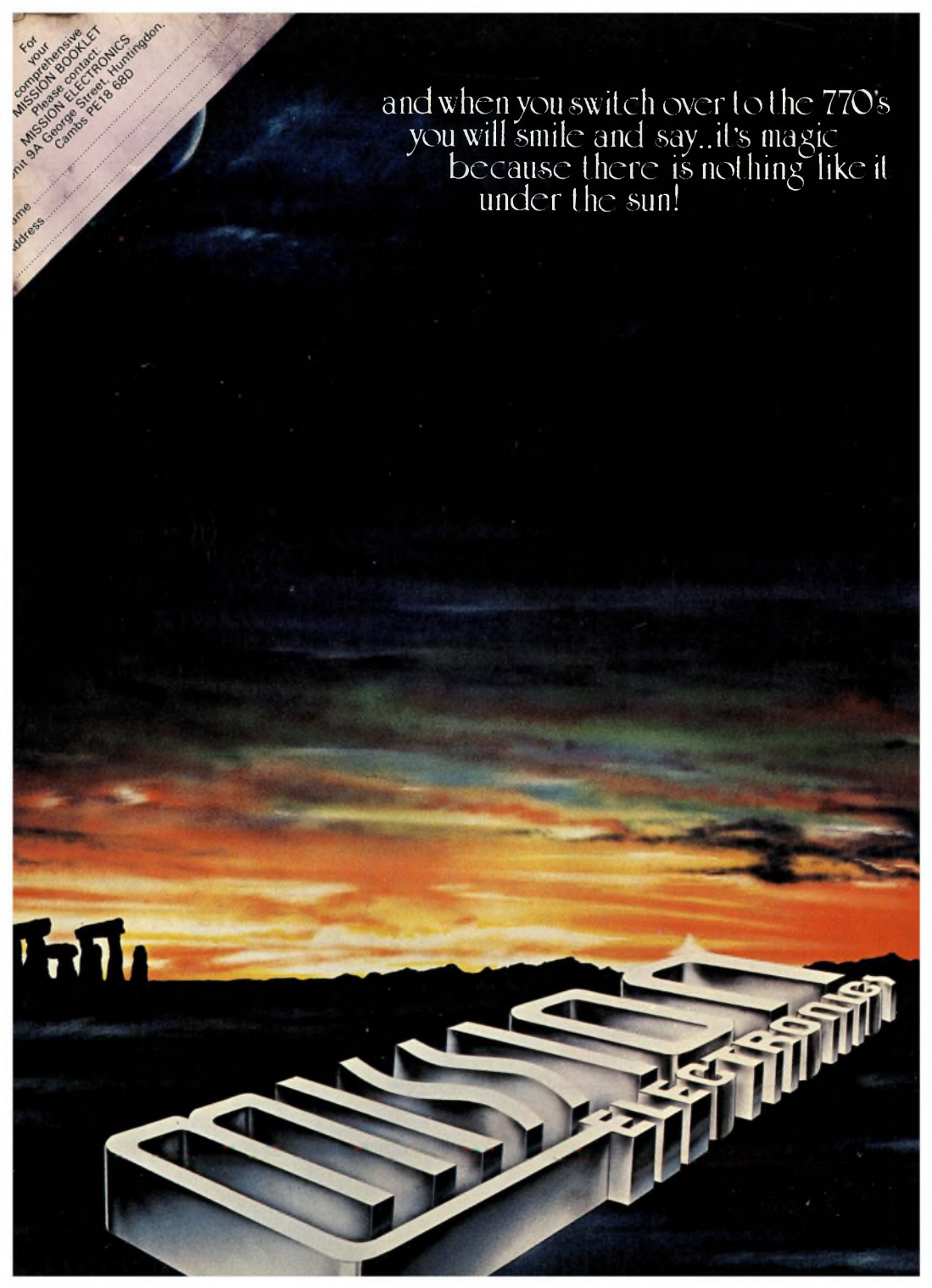
ADVERTISER'S INDEX

ROTEL hifi

Sound Sense from the experts

Rotel are leading experts in the field of sound equipment.
All our systems are engineered to an extremely high standard,
and components are interchangeable across systems.
We try, with each system to offer the best
possible value for money, a fact that all Hi-Fi fans appreciate.
If you haven't already given our Hi-Fi systems a hearing,
you might be missing a great deal.

FOR FURTHER INFORMATION WRITE TO: ROTEL HI-FI LTD., 2 - 4 ERICA ROAD, STACEY BUSHES, MILTON KEYNES, BUCKS


For your comprehensive MISSION BOOKLET Please contact MISSION ELECTRONICS 9A George Street, Huntingdon, Cambs PE18 6BD
and when you switch over to the 770's you will smile and say..it's magic because there is nothing like it under the sun!