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# Hi-Fi Choice No 21 Loudspeakers (4) by Martin Colloms

## Contents




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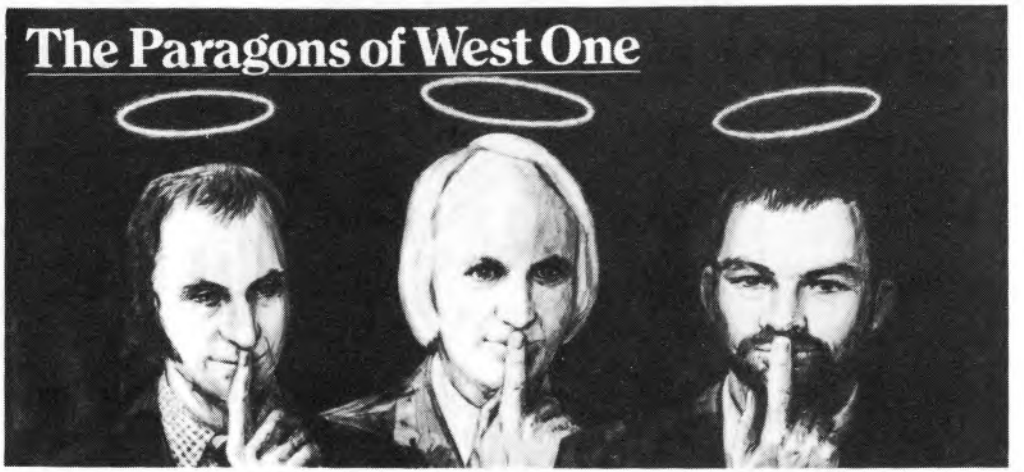
Typesetting and makeup arranged through:
Time Brokers, Upper Nordens, High Hurstwood, Near Uckfield, Sussex. Tel: Buxted 3168
Printed by Riverside Press Ltd.
Published by Sportscene Publishers Ltd., 14 Rathbone Place, London W1P 1DE. Tel: 01-637 7991/2/3
Distributed by Argus Distribution Ltd., 12–18 Paul Street, London EC2
US and Canadian distribution by Brilly Imports, 8086 Willow Glen Road, California 90046, USA

Hi-Fi Choice Series, Sportscene Publishers Ltd.



**Regrettably editorial resources are insufficient for us to reply to individual queries on the subject matter of this book and other volumes in the series.**

**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 comment.**

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This is the section of the book where I have the opportunity to make excuses about the project as a whole. But quite frankly I am not sure that many excuses need to be made. This volume is very much an extension of its predecessors, which have been increasingly well received. To counter the occasional criticism that we included too much reprint material in the last edition, we have done more than 40 reviews 'from scratch' this time, and carried out extensive retesting on about a dozen established models. Unfortunately our total available space is limited by the dictates of finance, so this has left room for only about a dozen straight reprints, although there are perhaps thirty or more other reviews from the previous edition where models are still available. It has therefore been necessary to restrict coverage on a number of these designs to a summary form, which is better than leaving them out altogether. I don't propose to give individual justifications for decisions to reprint, to summarise, or to re-test. But the decisions were not made lightly, and were based upon considerations such as general availability, and the number of other models included from the same manufacturer. And although the summaries do contain models which didn't 'make the grade', there are also a number of recommended models here, so they shouldn't be ignored.

With all the extensive re-testing, we have gone to quite a lot of trouble to try and maintain consistency of judgement between the different projects over the years. But it is worth pointing out that difficulties will always arise here, and that firm comparisons between the old and the new should be made only with caution.

Loudspeaker reviewing has always and always will involve controversy, and not without reason. Although we have considerable confidence in our test techniques, the choice of a loudspeaker remains a personal matter for the individual concerned, and is subject to a lot of influences, not the least of which is the room itself. Those acquainted with *Choice* will notice that there are rather more 'Recommended' models than normal, but I would hasten to point out that this does not mean we have 'gone soft' – quite the contrary, as standards have been 'toughened up' this time. The reason is not a lack of discrimination on our part, but more the fact that our sixty-six full reviews are something of a distillation from well over 100 models assessed during the current author's incumbency. Loudspeakers, particularly the cheaper models, have become noticeably better over the years, while we have also become more adept at avoiding the less likely models in the first place.

We have decided on this occasion to increase discrimination by expanding our recommendations to include extra 'Best Buy' and 'Worth Considering' categories. The former is restricted to models costing less than £350, while the latter includes models which may not perhaps be a first choice in value for money terms, but which nevertheless performed creditably and which therefore offer worthwhile alternatives with their own unique performance balance. Speakers come in all shapes and sizes to suit different circumstances and tastes, which is reason enough for spreading the net fairly wide.

It is important to note that all value for money judgements are based on the 'typical' prices which we publish. Nowadays prices fluctuate so rapidly that it may be necessary to re-interpret our judgements in the light of changing circumstances.

A great benefit of the *Choice* format is the formation of comparative value judgements across a wide range of competitive products. However, this has the disadvantage that the group tends to define a norm, against which an unusual design might be unduly criticised because of its 'differentness'. Speakers like the Quad *Electrostatic*, Linn *Isobarik* and Bose designs with their unusual distribution patterns are difficult to assess fairly in the context of the project as a whole, and are therefore best omitted.

Selecting models for inclusion in the first place becomes increasingly difficult, as more and more loudspeakers are offered on the market, and as the market itself fragments. We do attempt to establish 'ultimate' standards with a few expensive *exotica*, but generally try to concentrate on more popularly priced models, while giving as many manufacturers as possible a fair crack of the whip. Even ignoring the few manufacturers of note who failed for one reason or another to get product to us in time for our (rather early) deadlines, we ended up with rather more models than we could include. Rather than ignore them totally, they were tested at the same time, and these reviews will appear early in 1981 in *Hi-Fi for Pleasure*. Although presentation will of course differ, the reviewing conditions are substantially the same, so those interested will effectively be able to 'extend' their copies of *Hi-Fi Choice*.

# Editorial Introduction

To any accusations of prejudice, I would answer that some is inevitable and indeed desirable. Naturally we have to set some criteria of taste, and these are averaged across a number of experienced and demanding listeners. This is no bad thing, though we would always encourage readers to exercise their own discrimination rather than relying upon ours only. Though I don't really believe in a 'national taste' in loudspeaker's sound quality, I do suspect that the comparative ease of communication with British designers compared with Japanese or American equivalents does help us resolve any problems more easily, and it certainly helps us to get our hands on early samples of new and important models. However such improved feedback and its possible benefits have as much to do with the scale of the companies involved as in their country of origin.

*Paul Messenger.*

*Martin Colloms posing beside the 30ft test rig at James Moir Associates, used for all the new anechoic measurements.*

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**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 137 pages in all, gives all the basic data on the 67+ 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 27 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.

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## 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

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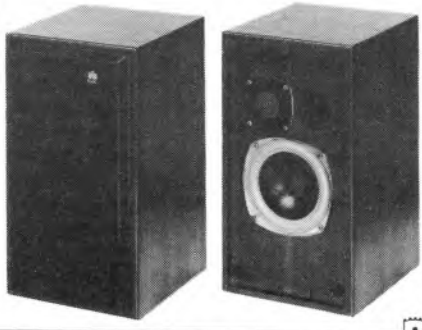

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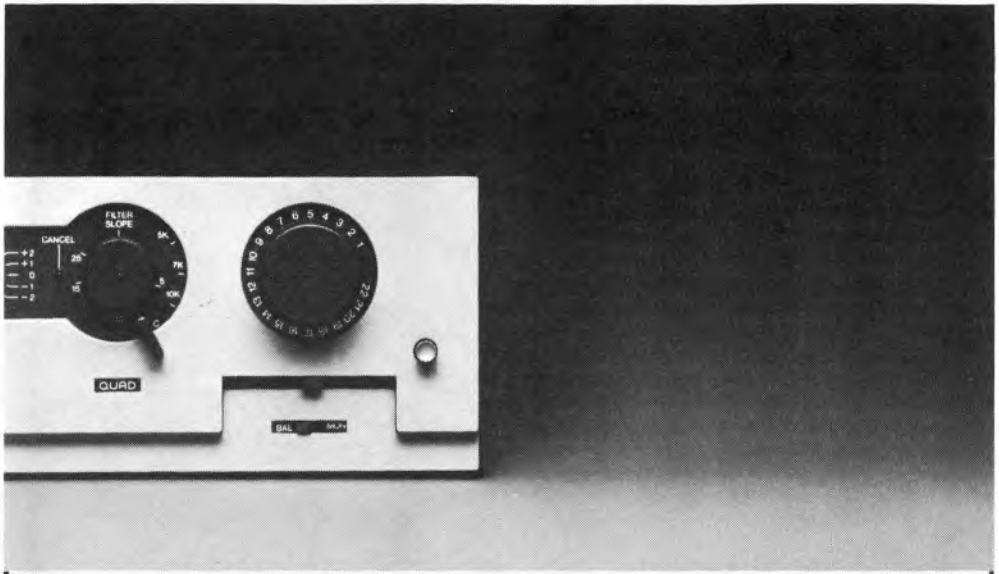


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hot air amongst enthusiasts and the specialist press. It is also extremely dangerous to assume that because a design uses a particular technique, somewhere along the line this confers either some sort of inherent superiority or a similarity to other 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

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 midband. Recording studios on the other hand are likely to be used predominately for rock music at much higher levels, and the quality of loud bass reproduction is likely to be

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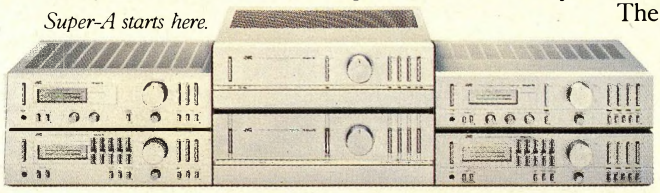

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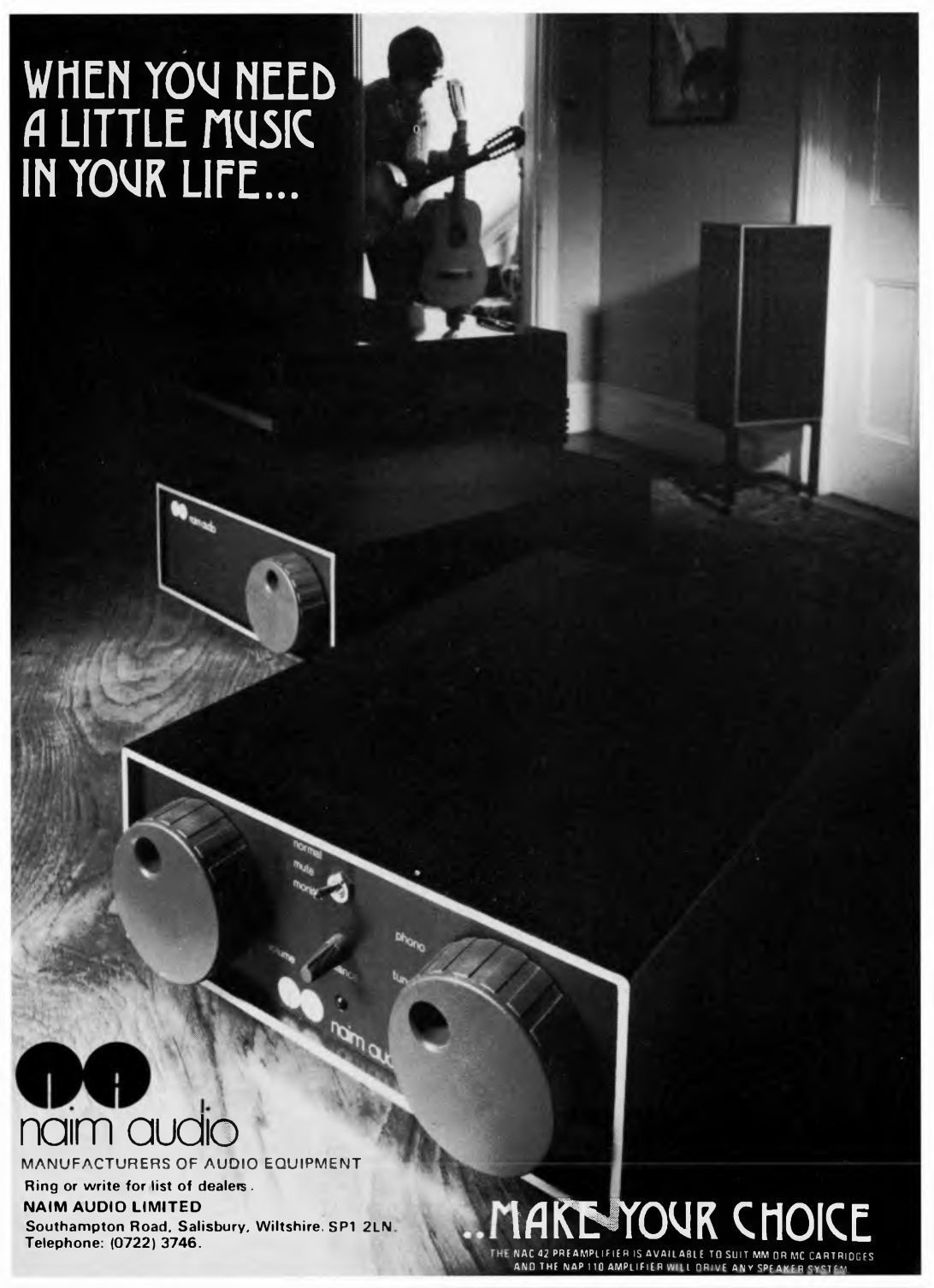
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considered more important than low midrange coloration, consequently quite different speakers like Tannoys and JBLs are commonly employed. This clearly shows that while this publication can help the reader to find models which suit his requirements, 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

*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

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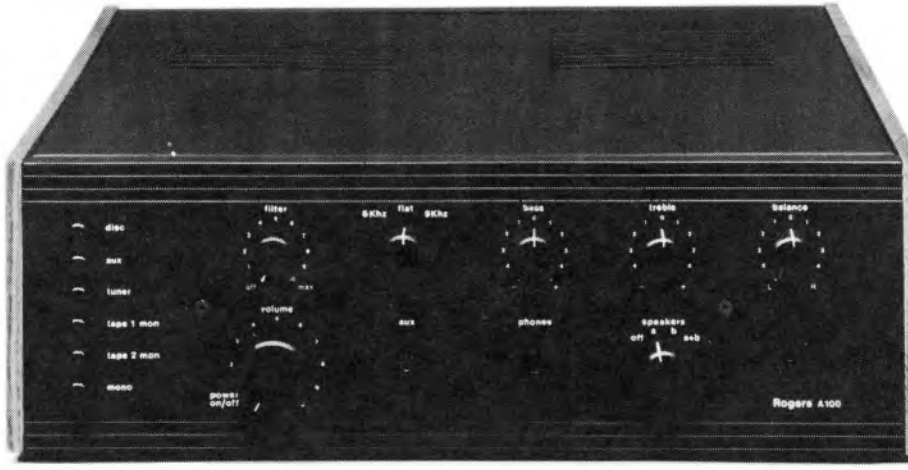


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party-type conditions, so if a system is used in the village hall disco one weekend, it will be no surprise to find burned out voice-coils and/or amps the next day.

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 ratingis 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.

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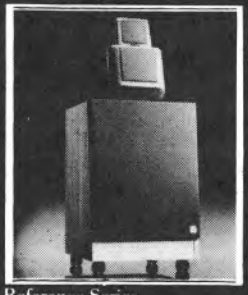

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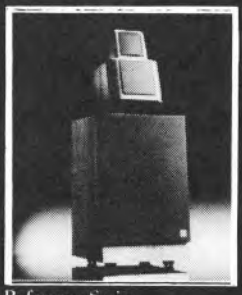

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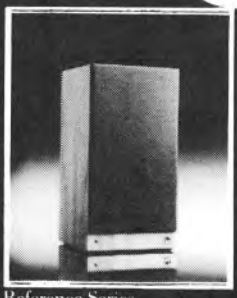

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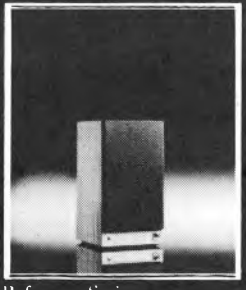

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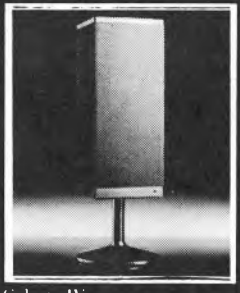

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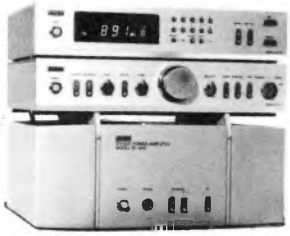

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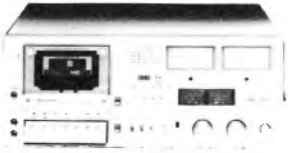

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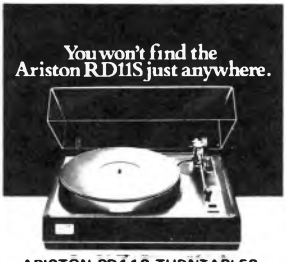


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WHILE some aspects of the review method have already been discussed in the *Consumer Introduction,* the *Technical Introduction* gives a complete description of the details relating to our latest series of subjective and objective evaluations. These 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.

## 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.

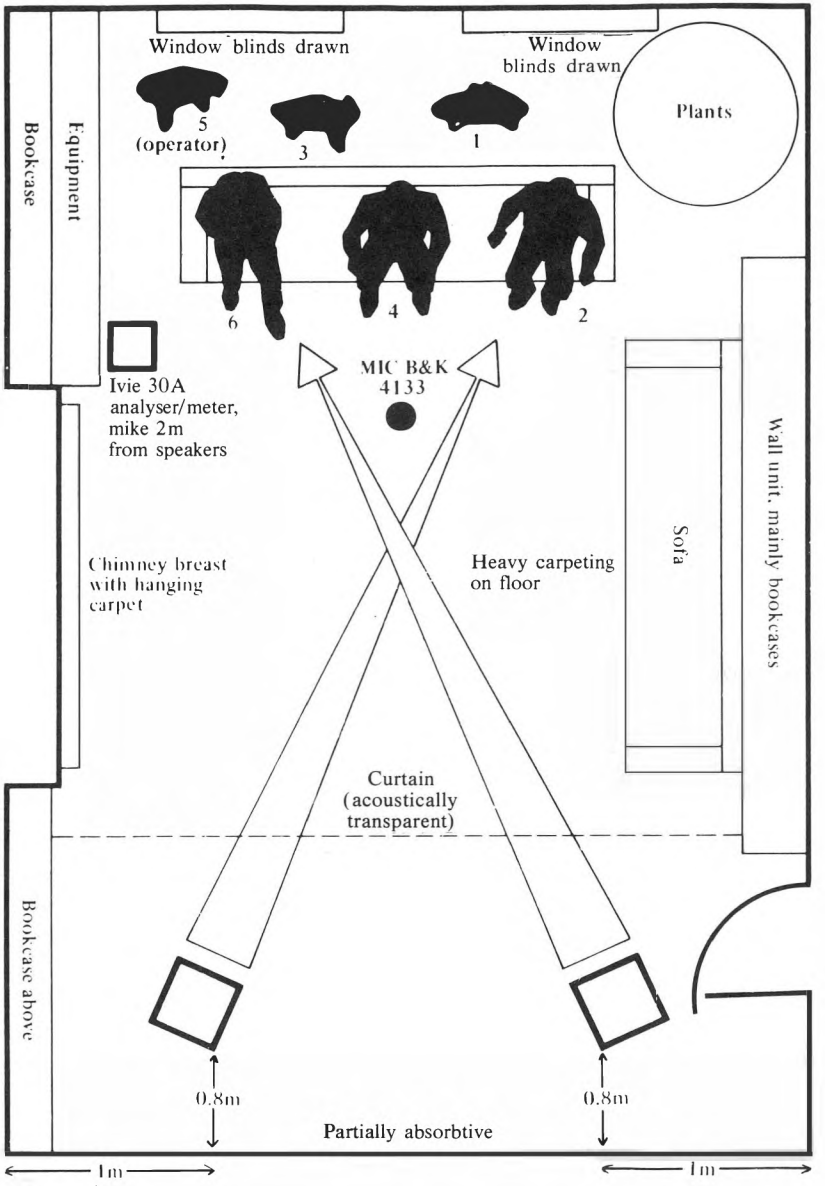
Even reverse copying was considered, in order to eliminate the usual phase shift accompanying most recordings. The actual recording environment itself is also important; it should be very 'dry', ie possess a very short reverberation time, the latter ideally measuring zero, which corresponds to true anechoic 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 comfortably




## 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 absortive furniture, two large Chesterfield sofas.

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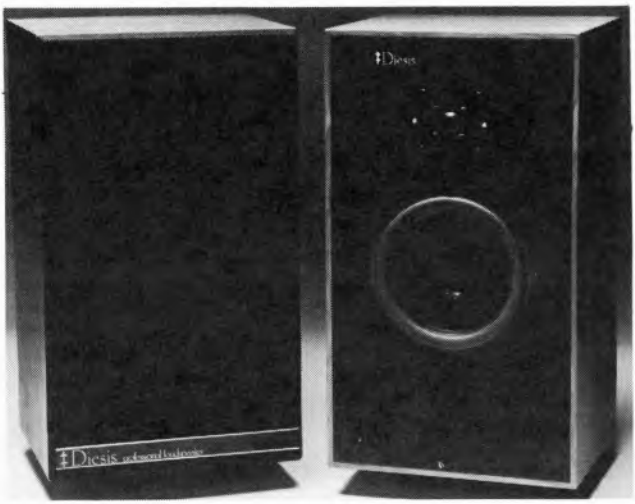


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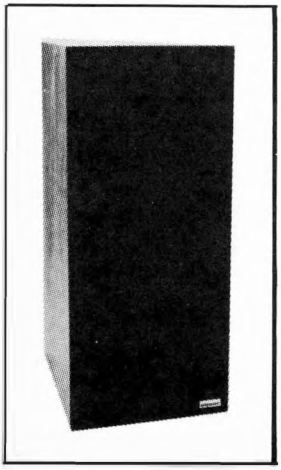

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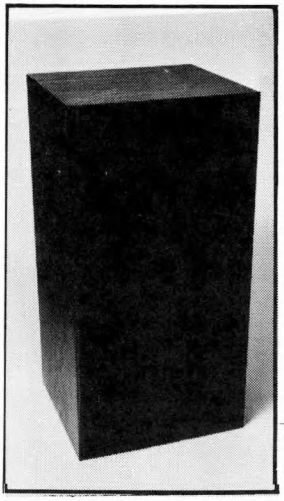

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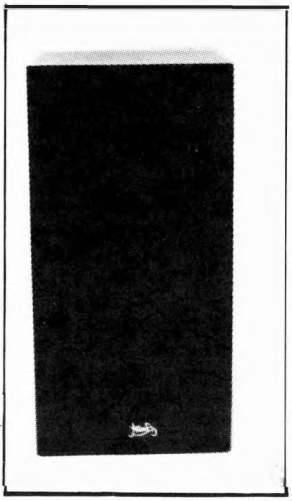

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accommodate the 6 panellists with a realistic distance between them and the test speaker, (2.5-3m) it was decided to use the room for all our listening sessions.

**The Test Procedure**

The test procedure adopted here involved continuously running the pre-recorded tape containing short verbal or musical phrases interspersed with blank sections, the latter filled in on test by the live performers. A carefully worked out entry sheet was provided for each panelist so that he or she could mark within an agreed scaling and framework of comments and characterisation. In addition to numerical scaling for accuracy or naturalness-of-reproduction, other factors such as coloration and frequency balance were also assessed. 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 2kHz-15kHz, 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, a live bass guitar was played 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 (45.7Hz) 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 110dBA 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 thought 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 session, 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.

**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 characteristations), 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.

Several amplifiers were auditioned for use in this test, and of these, the Naim 250 proved to be the most neutral. Peak levels were monitored to ensure that the amplifier was not clipped (the less discriminating high level tests were incorporated in the live-vs-recorded sessions). For the more recent tests a BGW410 was used to provide increased voltage headroom.

A reasonable balance of taste was presented by the program excerpts, which included large pipe organ, piano, violin, choir, female spoken voice, full orchestra, 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

The earlier measurements were undertaken at one of the largest anechoic chambers in Europe, which is located in the Government-owned Building Research Station, at Garston, Watford. For the newer reviews, due to difficulty in booking Garston, the facility of James Moir and Associates was used instead. Every attempt was made to use measurements generally believed to be of the greatest relevance to sound quality, and in fact, the combined lab resources of Moir and Colloms permitted new tests to be undertaken. Some of these were revisions and extensions of tests previously employed for *Choice,* while others were new. For example, swept second and third harmonic distortion at a nominal 96dB, 1m, as well as measurement at two critical frequencies at peak powers up to 100W.

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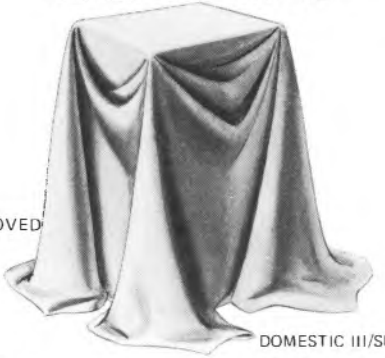

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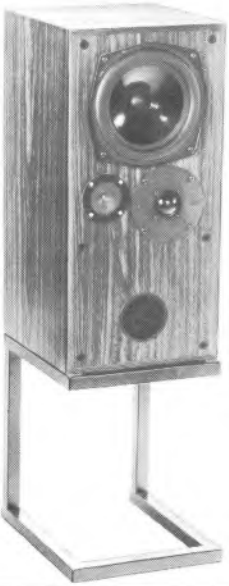

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This is considered a primary measurement, and seeks to present visually the forward radiating character of the loudspeaker, over a sensible forward solid angle and throughout the audible frequency range. Normally the fundamental response is that taken nominally on axis, usually between the mid and HF unit. In certain circumstances however it is measured on the axis corresponding to the level of the listener's ear when the speakers are correctly sited and mounted. The uniformity or agreement of response traces taken off and around the main axis with those measured directly on the prime axis represent a crucial aspect of speaker performance, which determines whether good stereo imaging is possible, and whether the speaker will sound markedly different on- and off-axis.

For the hearing-related 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 reflections, which are a product of the off-axis energy, adds to the direct sound from the loudspeaker.

The low frequency portion of the main characteristic response has been derived from an accurate sine wave analysis at 1m, frequencies above 200Hz representing the 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.

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 (for hi-fi purposes the Moir facility is accurate to 25Hz), and also gave a reference trace which coincides with the conditions of measurement used by most manufacturers. 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 readings could be scaled (see *distortion*), and the quoted lab sensitivity established.

A reflection-free environment was assured by taking the reference response in the open air (16–18°C ambient), the speaker being elevated by a pneumatic hoist some 7.5m above moderately irregular and partially absorbtive turf. The microphone was prealigned on a special jig before elevation, and a standard 2.83V was applied for the reference response (equivalent to 1W referenced to a nominal 8 ohm impedance).

**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**

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.)

**Constructional quality**

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

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

**Sensitivity and power rating**

From the reference curve, a mean mid-band sensitivity figure was recorded, this corresponding to the sound pressure at 1 metre from the enclosure, while energised by 2.83V (sine). A nominal 8 ohms draws 1 watt from this voltage, and lower impedances draw 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

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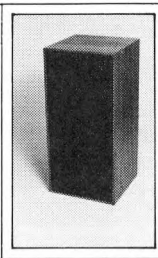

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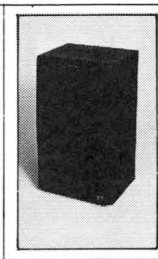

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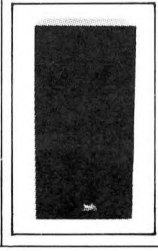

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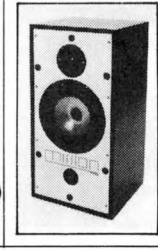

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instruments in-the midband, provided that its duration did not exceed 15 to 20 seconds. On highly transient signals a 500W peak could apparently be indefinitely tolerated if the mean power was low – in the case of the levels required to reproduce the 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. No chamber or site can be entirely 'anechoic'. With our latest open-air facility, the comparative proximity (at low frequencies) of buildings, trees and the ground was estimated to have added approximately 0.5dB to the free field response below 500Hz. With the smaller enclosures, the upper structure of the pneumatic hoist, as well as its small platform and the microphone gantry, all contributed small errors of the order of 0.5dB to 1dB in the midrange (from 300Hz to several kHz).
4. Peculiar to our situation, some losses occur in the electrical drive to the speaker *via* the extended hoist cable. The amplifier output was uncompressed, with a 0.4 ohm DC loop resistance, and some series line inductance. With one speaker, the 20kHz output was subject to a loss of 1.2dB, due to an unusually low HF impedance, but a 1uF termination capacitor on the speaker's terminals provided the solution here. 0.5dB of the loss at this frequency was actually attributable to the power amplifier used to drive the cable.
5. Choice of axis is also critical, since the response naturally varies somewhat with mike position on the frontal axis.
6. 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.

**Acknowledgements**

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 text checking.

Paul Crook, for invaluable assistance throughout the project.

Tony Faulkner, Audio Engineer, for loan of program material and panel service.

Monitor Audio Ltd., for loan of various sound cables.
Rotel, for loan of *RB5000* amplifier.
Sansui, for loan of *AU919II* amplifier.
Bill Stevens, of James Moir and Associates, for considerable assistance during the measurement phase.

**Listening panel**
John Atkinson
Caroline Atkinson
Trevor Attewell
Martin Colloms
Tony Faulkner
Alan Harris
Alan McGechan
Evelyn McDermott
Peter Mapp
Adrian Orlowski
David Präkel
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. 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; Monitor Audio heavy gauge twin speaker cable*
Ivie 30A sound level monitor/analyser.

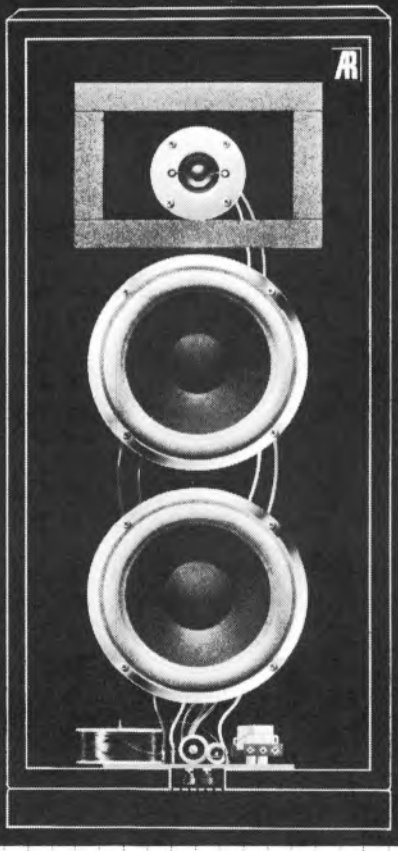
2. **Live-v-recorded tests**
Equipment noted above for domestic stereo tests (where relevant) plus:
B&K 4133 precision microphone
Ivie 1P mike pre-amplifier and 30A sound level monitor
Rotel RB5000 power amplifier (500W per channel – for percussion peaks)*.

**Instruments**
Classical acoustic guitar
Paiste cymbal — all loaned by
Flute — R. Cawkell
Side drum
Wood block zylophone
Male voice (R. Cawkell)

**Lab testing**
James Moir and Associates: 8m pneumatic hoist test platform*
James Moir and Associates: Tone burst gate unit*
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*

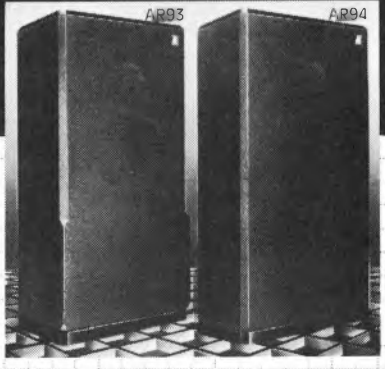
**Programme used for stereo listening sessions**
Live musician, instrument recordings (monaural technique, anechoic).
Arthur Wills, Ely Cathedral organ, crossed-pair mike technique, trial mastertape. (Pictures at an Exhibition transcription.)
Ron Goodwin orchestra 'Big Band', multitrack technique, mastertape of film score.
Elton John '21 at 33', multitrack technique, 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.

# What's So Special About The AR94?



* 3 way floor standing system with 3 drivers.
* Liquid cooled tweeter for high power handling.
* AR Acoustic Blanket™ attenuates reflections for smooth high end response.
* Vertical array for crisp stereo image.
* Dual front facing woofers to minimise wall dip.
* Two low range drivers acting as dual woofers below 350Hz. Crossover automatically rolls off lower bass driver leaving upper bass to reproduce midrange frequencies.
* Floor standing at bookshelf prices.
* Exclusive drivers designed and built by AR.
* High power handling ability — up to 125 watts per channel.
* Recessed terminals beneath avoid dangling leads.
* Full 5-year warranty on both construction and performance.
* No fancy frills — maximum value in technology and engineering.
* High-Tech styling with acoustically transparent black fabric.

## It's HIGH-TECH

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**AR**

# Acoustic Research AR94

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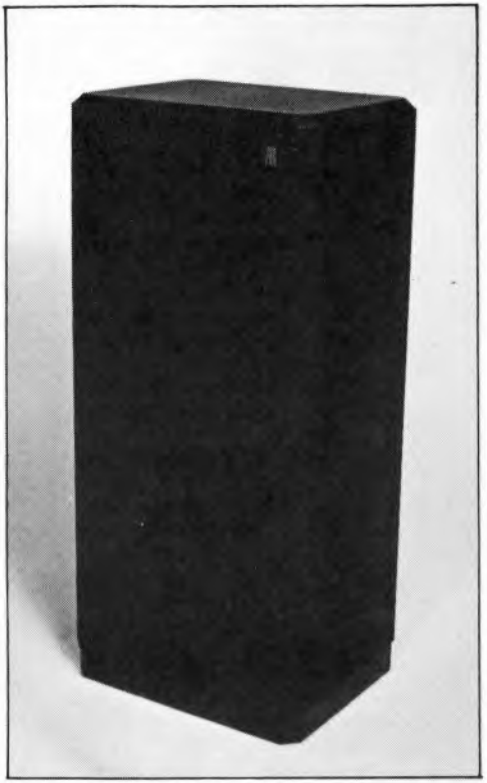


Costing around 60% of the price of the *AR92*, the *94* is nevertheless of very similar size and internal volume (50 litres). In fact, its bass driver is a 300mm equivalent, formed by two pulp cone 200mm units in parallel, which possess a greater effective area than the '92. The three units used are once again arranged in a vertical array, with the topmost 200mm bass driver also handling the midrange. High frequencies are reproduced by a 32mm cone with fluid cooling, and in the manner of the KEF *Concord IV*, the speaker is completely cased by a fabric 'stocking', with moulded top and bottom caps to complete the assembly. The enclosure, made of plain 200mm thick chipboard, carried no damping, and a polyester fibre fill is used for internal standing wave absorption.

The acoustic performance of the crossover is more sophisticated than the few electrical components might otherwise suggest. The lower bass unit is mechanically rolled off at mid frequencies, as was the upper bass-mid unit at its crossover point to the tweeter. A simple 6dB/octave feed to the latter is used, aided by the ferro-fluid damping.

**Lab results**

Pair matching was fine up to 1kHz, beyond which several areas of 1.5–2dB imbalance which could affect image stability were noted. With a system resonance at 47Hz and a quoted Q of unity, the effective free field −6dB rolloff was noted at 40Hz and would be further improved by floor mounting, as recommended. The frequency response was quite uneven, and was characterised by a presence band trough several octaves wide and several dB deep, while the tweeter showed a consistent 6dB peak at 18kHz, the latter within the range of many younger listeners. Characteristic axial responses apart, the off-axis family illustrated good control and uniformity, though the 15° vertical trace was shifted rather more from the reference line than average.

At 96dB, distortion in the midband was very good, and it remained good at lower frequencies. A distinct rising trend was noted above 5kHz however, 2nd harmonic reaching 1%, 7kHz and 2.5%, 8.5kHz. On 100W equivalent pulsed inputs – admittedly producing a high 110dB – the distortion at 500Hz had risen to 3%, 2nd and 2%, 3rd, despite the dynamic compression being held to 0.1dB. Likewise, though little compression occurred at 5kHz, a 1.5% third harmonic content was produced, three times higher than at 96dB.

The impedance was better than for the *'92* and rated 'average', with a typical value of 6 ohms and a worst case minimum of 5 ohms. The phase angles were also small above 100Hz and less than 25° throughout. At 89dB/W (8 ohms) the sensitivity was fairly high allowing use with amplifiers down to 15W.

**Sound quality**

Scoring a just 'acceptable' rating on live sounds, the *'94* suffered from a degree of 'boxy' coloration clearly audible on voice and acoustic guitar, for example. Some 'chestiness' and bass overhang were also apparent, exacerbated by the rather dull balance in the upper range. Bass power handling was good at 40W prior to overload, with a good low frequency extension for the price.

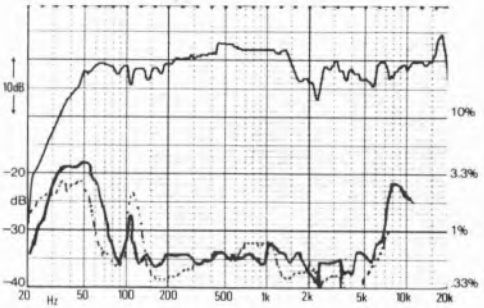
On the stereo sessions the ratings improved to 'average' for both overall quality and stereo

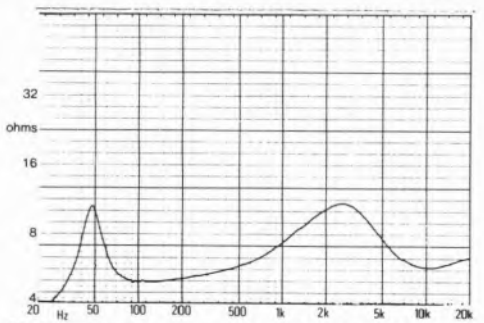
imaging, and it was clearly more stable as regards its imagery and smoother in sound quality than its more costly stablemate the '92. It was considered to possess good clarity and was liked by several panelists, while the colorations seemed less annoying using commercial programme material.

## Summary

In several respects the *AR94* has done quite well and should not be dismissed out of hand. The price was reasonable for a floor standing model possessing worthwhile bass extension and efficiency, as well as an acceptable sound quality. However the lack of neutrality and levels of coloration did not compare well with other similar and recommended models in this issue. An audition is nonetheless worthwhile, since it did sound better than the lab response indicates.

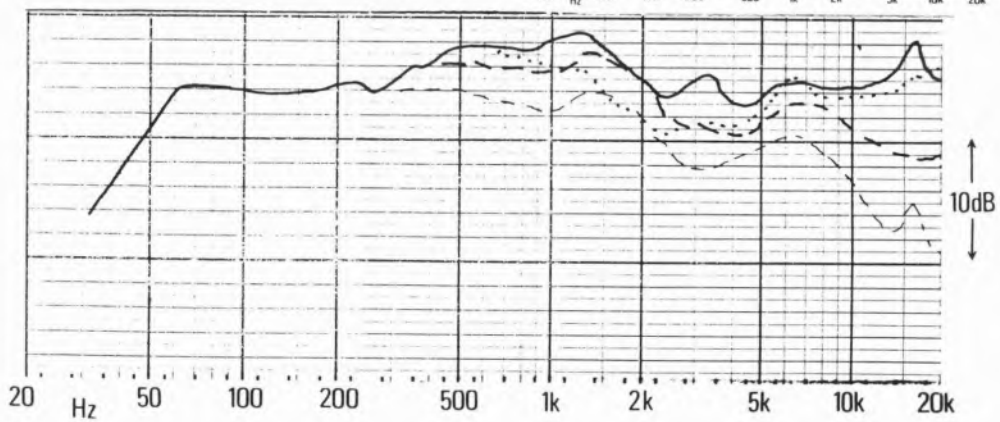
*Top: Frequency response, 1 m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*



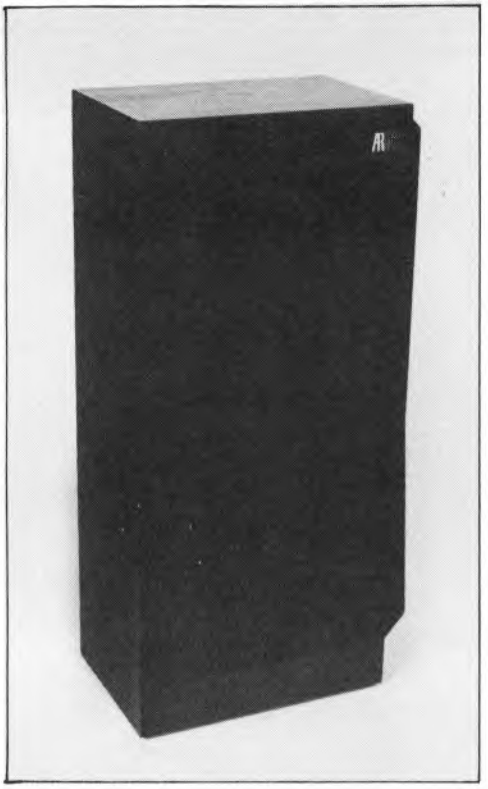

| | |
|---|---|
| Size (H, W, D) | 77.8, 35.5, 27.3 (30.5, 14, 10.8) cm(inches) |
| Weight | 20 (43) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 15–100W |
| Recommended placement | floor |
| Frequency response within ±3dB (2m) | 58Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 40Hz* |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 89dB |
| Approximate maximum sound level (pair at 2m) | 101dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | acceptable |
| Impedance characteristic (ease of drive) | average |
| Forward response uniformity | above average |
| Typical price per pair inc VAT | £235 |

*see text



# Acoustic Research AR92

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



Extending the range of AR speakers with a vertical driver format, the *AR92* is a medium sized floor standing system which uses three units. Front panel diffractions are reduced by a thick felt 'blanket' around the 19mm ferro-fluid-cooled dome tweeter and the 38mm ferro-fluid-cooled upper-mid dome. A dense pulp paper cone 250mm bass driver is simply loaded by the 47 litre sealed box enclosure.

Essentially of 12dB/octave form, the high quality crossover incorporates driver impedance equalisation sections, and offers switched attenuation of 0, −3 and −6dB for the mid and high range units. The crossover frequencies are placed at 0.7 and 7.5kHz. The dark walnut veneer is rather easily marked, but the internal construction in 200mm chipboard was quite rigid, with one cross brace. The location of the polyester fibre filling was not particularly inspiring, as it was resting on the potentially hot attenuator resistors.

**Lab results**

With a system low frequency resonance at 45Hz (Q quoted as 0.7) the impedance characteristic was rated as poor in an 8 ohm context, exhibiting dips to marginally below 4 and an average value of 5 ohms. With the controls in the −6dB position the result was better but at the expense of the frequency response. The reactive component was low, less than 25° above 100Hz.

Pair match was fine with an average imbalance held to within 1dB overall. The grille introduced no significant abberations, and the stated control variations of −3 and −6dB were confirmed. Though of a somewhat lumpy nature, the frequency response was considered to be quite uniform in overall balance, particularly in view of the recommended floor positioning. The latter also improved the noted −6dB low frequency limit of 50Hz.

In assessing the forward response characteristic the lack of uniformity in off-axis responses was less encouraging. The output proved quite sensitive to vertical axis mike positioning, particularly in the 5kHz region, while on the normal mid/HF plane a consistent dip was present, magnified by the otherwise good lateral responses. Consequently a listening position with the ear near the tweeter axis is suggested.

The distortion results were quite good at 96dB, though with more midrange third harmonic than I would have liked (1kHz, 2%); the low frequency distortion performance was however very good. With a nominal 100W, 8 ohms peak input (approx. 110dB at 1m) some non-linearity was apparent, with several per cent second and third harmonic distortion at 500Hz, although at 5kHz the results were fine. Nominal system sensitivity was high at 90dB, but is of course compromised by and related to the low impedance.

**Sound quality**

Rated 'average' on the live sound comparisons, the *'92* showed some subjective colorations, with a 'boxy' effect in the midrange and a 'notchy' dullness in the presence range. Some 'cupped hands' sound was also noted on voice, but the bass power handling was excellent, some 150W of bass guitar being recorded with quite good evenness, extension and clarity.

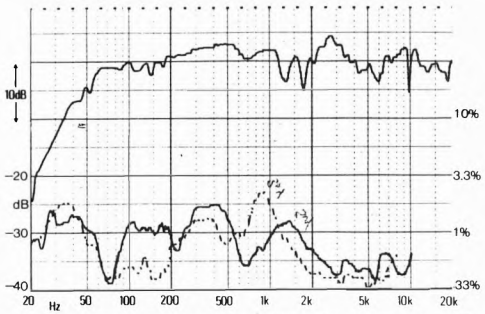
The *'92* unfortunately fared worse on the stereo programme, exhibiting a restricted image depth, a 'two dimensional' sound field, and a lack of upper

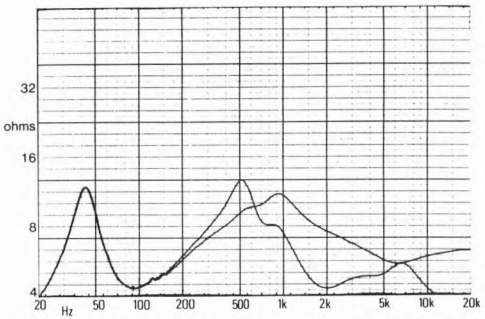
range positional stability. The midrange gave a hard effect and the 'boxy' 'wooden' sounds were still audible.

**Summary**

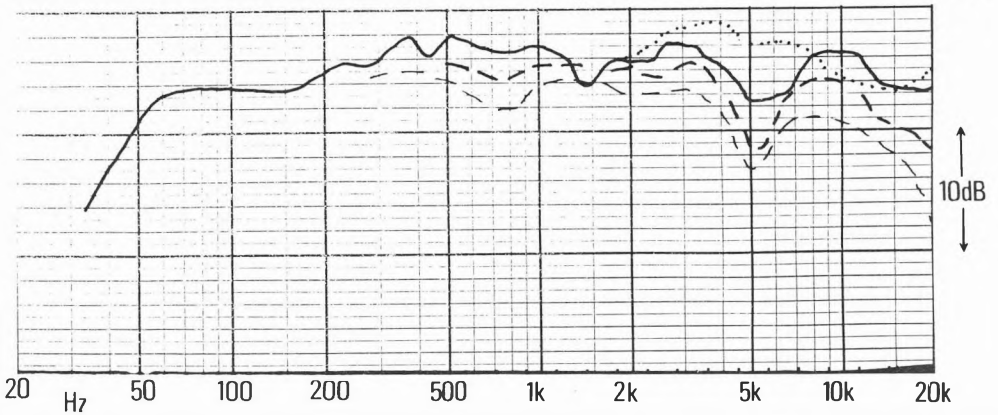
Costing close on £400, the *AR92* cannot be recommended, in view of its difficult amplifier loading and less than satisfactory technical performance and sound quality. In our view an integration problem exists in the presence range when this speaker is auditioned on a normal listening axis.

*Top: Frequency response, 1 m 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).*



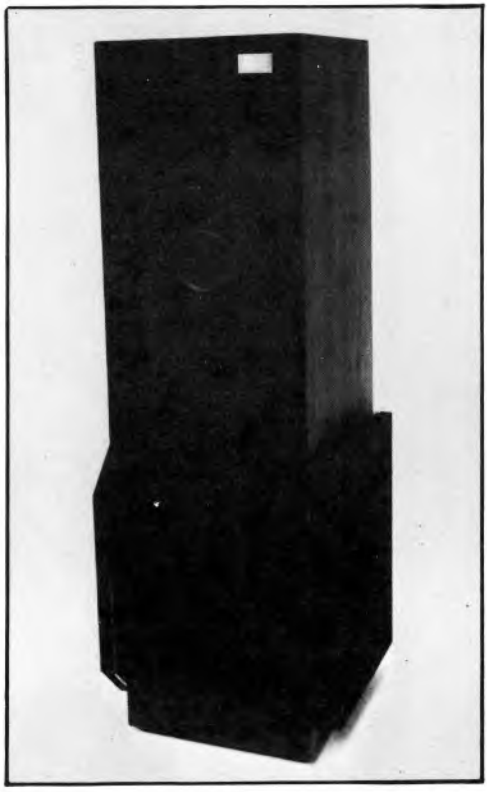




| | |
|---|---|
| Size (H, W, D) | 80, 35.5, 29 (31.4, 14, 11.5) cm(inches) |
| Weight | 21 (46) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20–100W |
| Recommended placement | floor |
| Frequency response within ±3dB (2m) | 55Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 50Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 90dB |
| Approximate maximum sound level (pair at 2m) | 102dBA |
| Distortion (96dB at 1m) | good |
| Distortion (100W peak) | acceptable |
| Impedance characteristic (ease of drive) | poor |
| Forward response uniformity | above average |
| Typical price per pair inc VAT | £390 |



# 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

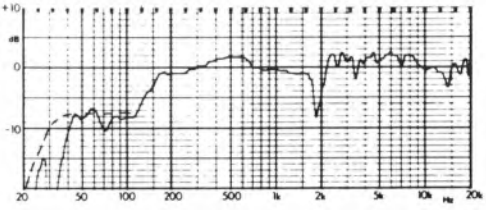
On the live sound comparisons the *'90* was rated as average — somewhat disappointing considering its price. While detail was quite good, the sound was judged mid-prominent with some boxiness and a mild dulling of transients. The bass register was powerful and deep but not very 'explicit', while the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

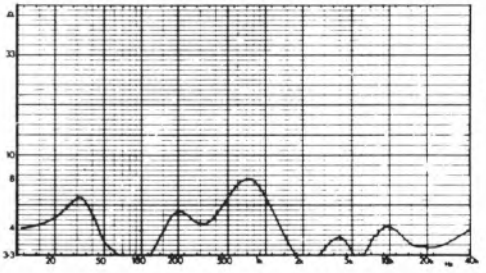
## Summary

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.

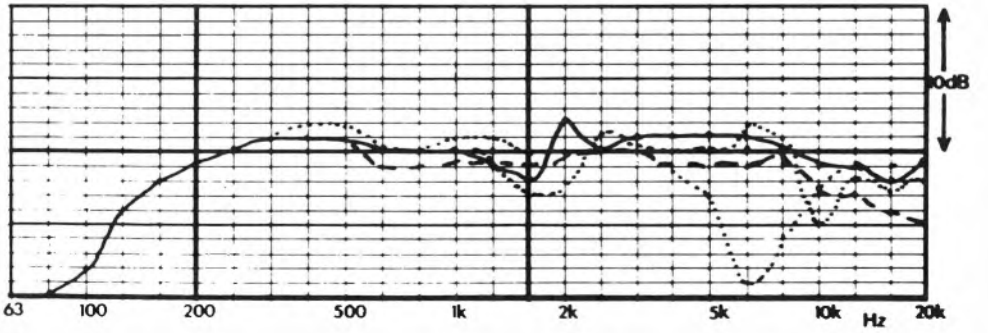
| | |
|---|---|
| Size | 108(42.5) H; 37(14.5) W; 38(15) D; cm(inches) |
| Weight | 37(82) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 15–300W |
| Recommended placement | on floor back to wall or greater than 6m from wall |
| Frequency response within ±3dB (2m) | 125*Hz to 20kHz |
| Low frequency rolloff (−6dB) at (1m) | 30Hz* |
| Voltage sensitivity (rel 2.83V, ie 1 watt in 8 ohms) | 90dB at 1m |
| Approximate maximum sound level (pair at 2 metres) | 105dBA |
| Third harmonic distortion (96dB at 1 metre) | v. good<br>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 | £780 |




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

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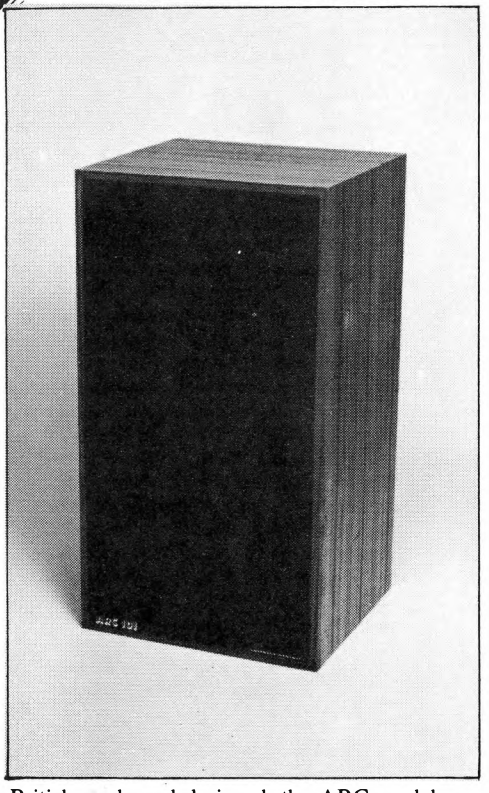
Tel 061-865 6494



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

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with good smoothness and fine driver integration. Found to be a touch 'reedy' on organ, and also slightly aggressive, it was also agreeably transparent and direct; stereo imaging was undoubtedly good, with a fine depth and ambience where appropriate. The bass was notably dry, even and extended for a system in its class, and dynamics were also well reproduced.

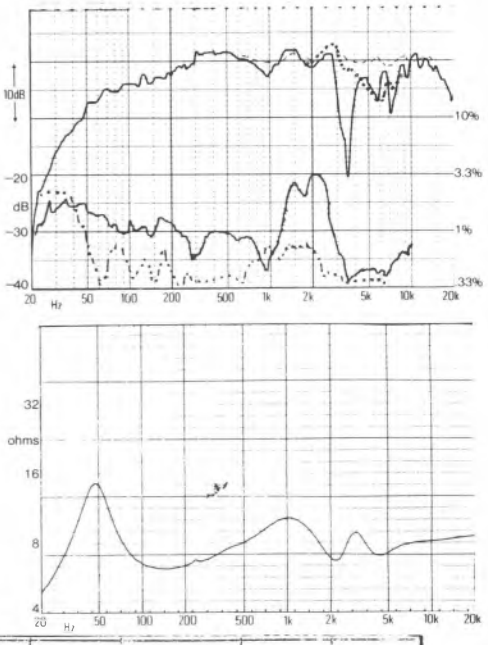
**Summary**

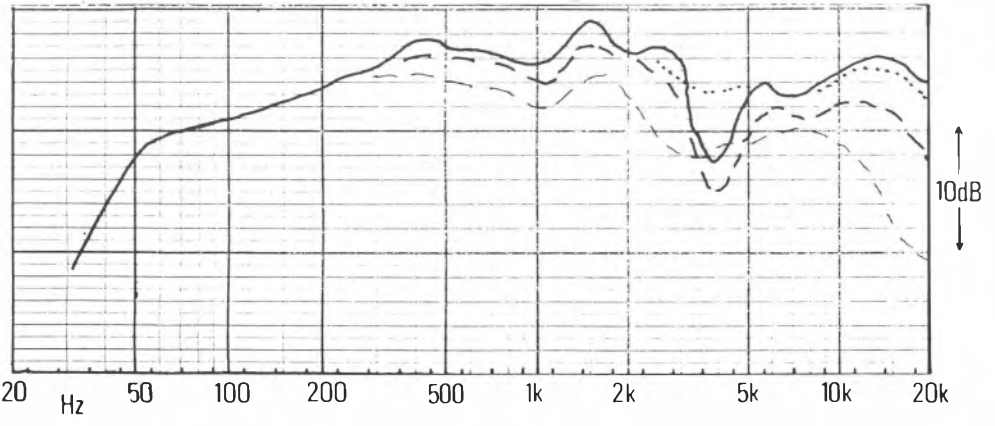
Deserving a highly recommended tag, ARC have shown that specialised pulp cone technology can produce a reasonably efficient and compact speaker possessing a good subjective bass performance and fine stereo as well as a lively, transparent and relatively neutral sound. A particular feature is the need for close to wall positioning, which may well be a convenience for owners who do not wish to move speakers out for use or leave them well clear of walls, as is ideally required with most stand systems. Furthermore, the easy option for 'active' future upgrading should not be overlooked.

| | |
|---|---|
| Size (H, W, D) | 56.5, 31, 28 (22, 12, 11) cm(inches) |
| Weight | 12 (26) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 15–150W |
| Recommended placement | 0.3m from wall on shelf or stand |
| Frequency response within ±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 | £275 |

*see text

*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).*



Presenting one small improvement that every speaker in this publication could benefit from – Mitsubishi's System 4. It's a complete 50W per channel stereo system cleverly crafted in miniature – a dramatic saving in size that has no reflection on the performance – nor on the long list of Space Age features.

For instance, the illuminated tuning scale that changes from white to green to indicate when you're perfectly in tune, the touch sensitive 'tuning lock' and the LED signal strength display. The tape deck features full metal tape compatibility, Automatic Pause Spacing System, 'Soft-touch' logic switching, LED peak level indication and Dolby NR – all with an amazing level of just 0.05Wrms Wow and Flutter.

Speaking figuratively, the ultra-wide dynamic range pre-amp with built-in head amplifier features a 100dB Signal to Noise ratio whilst the power amplifier boasts a Total Harmonic Distortion figure of only 0.008% (50W – 3dB).

Which, when you size it all up, merely confirms Mitsubishi's reputation – when it comes to Hi-Fi, nothing sounds better.

# It's a Mitsubishi

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

MITSUBISHI AUDIO

# A LITTLE LATER THE PROBLEM STR

Records are cut by a sophisticated lathe, whereby the cutting stylus is driven across the surface in a straight line.

Logically, the proper way to extract the resulting encoded signal would be to track the record in a similar fashion.

Yet, it's a fact, most decks have a tone arm that operates from a fixed pivoting point and moves across the record in an arc.

This results in harmonic distortion, a loss of high frequency and an inward directed force on the tone arm.

No anti-skating device can be expected to put completely right what is basically a compromise on other decks.

By far the simplest solution would be to duplicate the original tracking process.

Have a straight arm travel along a lateral rail.

Simple solutions aren't always easy answers.

Early attempts by other manufacturers came up against a basic problem.

Their conventional drive motors didn't adapt to linear use and caused excessive noise and vibration.

But still, to us at Pioneer, the concept of a lateral travelling tone arm was hard to ignore.

We knew that if we could overcome the snags, we'd have one of the best decks in the world.

Perhaps, even a place all to ourselves in the Guinness Book of Records.

The days of silent motoring.

With the PL-L1000 we became the first manufacturer to use a linear motor to drive the arm across the turntable.

Solving the headache caused by motor vibration, simply by generating a motive force without the intervention of mechanical parts.

Using magnetic coupling to convert electrical energy directly into a linear drive force.

In terms of hi-fi sound, the result is almost unheard of.

An exceptionally high signal-to-noise ratio of more than 78dB (DIN B).

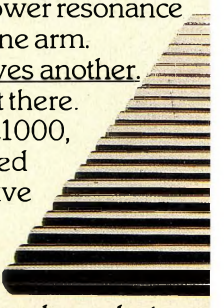
Together with an exceptionally low level of acoustic howl.

As well as, lower cross talk and distortion, due to insignificant lateral pressure.

Less tracking error and lower resonance due to shortness of the tone arm.

One good turn deserves another.

Not content to leave it there. We've added to the PL-L1000, our finest Quartz controlled the DC motor to direct drive platter.



Based on our unique Stable Hanging Rotor™ system, it improves balance by reducing platter wobble and allows for a much slimmer plinth profile.

With exceptional 0.025% WRMS wow and flutter.

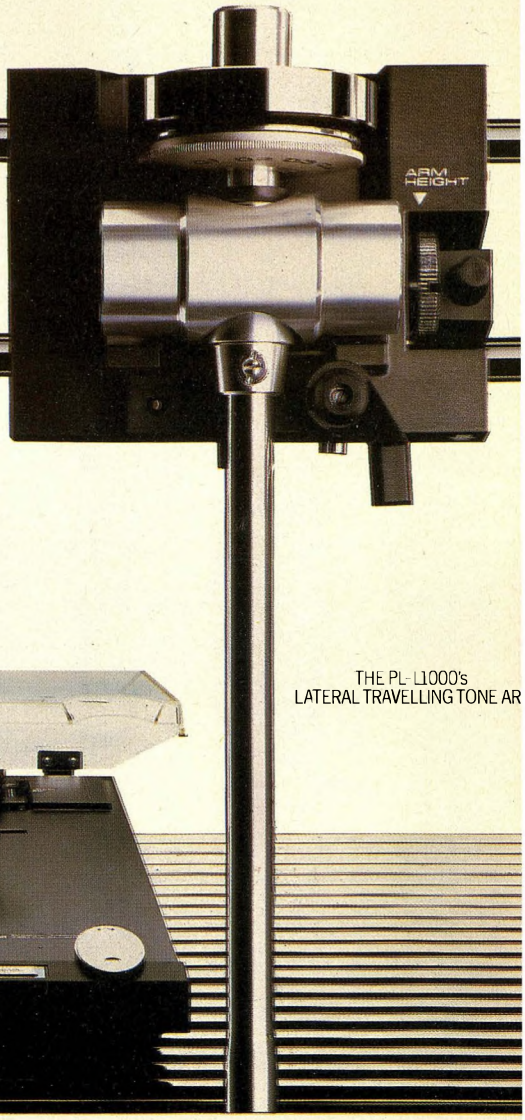
# AL THINKING SETS AIGHT.

All controls, including the arm traverse dial, are designed to be outside the PL-1000's dust cover.

So, each time you use them, you don't expose the platter to dust and particles in the air. And we've put it all together in an insulated cabinet with a 3mm thick aluminium die cast plinth, to ensure high resistance to acoustic feedback.

More lateral thinking needed.

Having read what was behind our thinking. It's now your turn to think laterally how to cope with the line running along the top of the coupon.




THE PL-L1000's
LATERAL TRAVELLING TONE AR

To: Pioneer High Fidelity (GB) Ltd., P.O. Box 108, Iver, Bucks. SL0 9JL. I'd like more information on the PL-L1000 turntable. Please send me the Pioneer catalogue and a list of dealers.

Name_____

Address_____

PIONEER®
Everything you hear is true.

HFC 2

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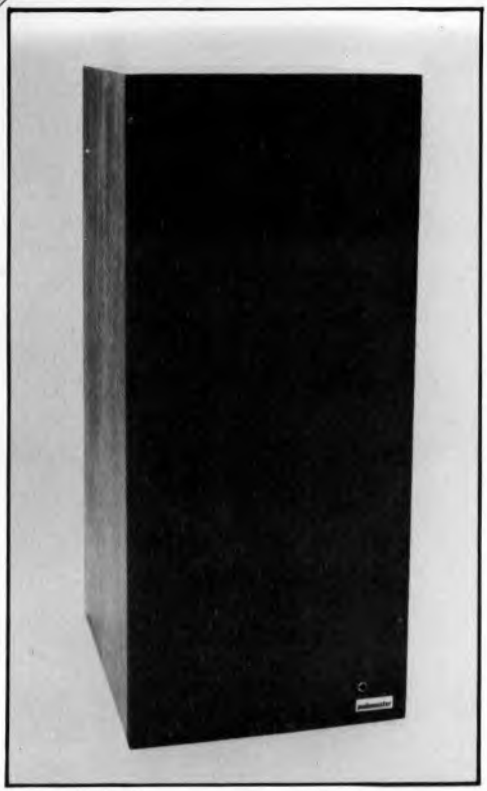
# Audiomaster MLS4

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

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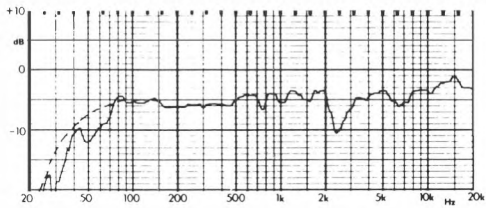
exceptional; lateral positioning was fine, but some depth loss was noted, giving a 'flattened' impression.

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.

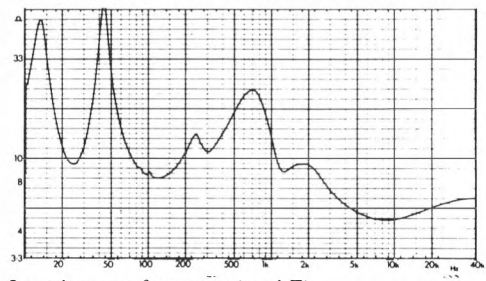
**Summary**

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.

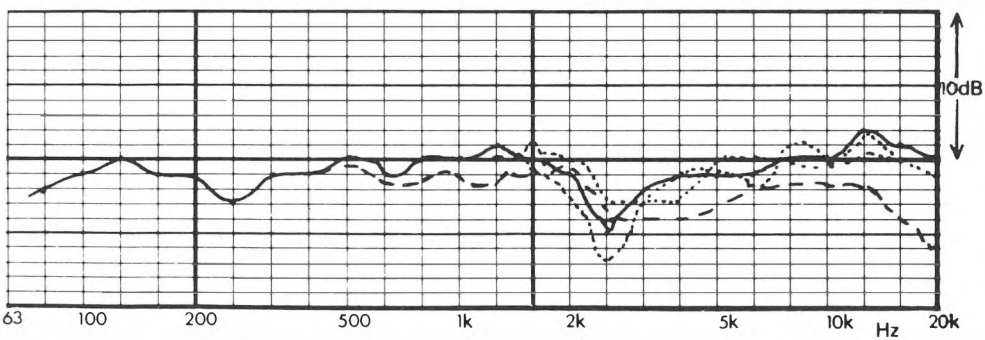
| | |
|---|---|
| Size | 62.5(24) H; 27.5(11) W; 31(12) D; cm(inches) |
| Weight | 14(30) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 15–150W |
| Recommended placement | 25cm stand, clear of walls |
| Frequency response within ±3dB (2m) | 80Hz to 20kHz |
| 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)




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

RECOMMENDED

# B&W DM12

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

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

The bass/mid driver uses a massive ceramic magnet mounted on a die-cast 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

RECOMMENDED

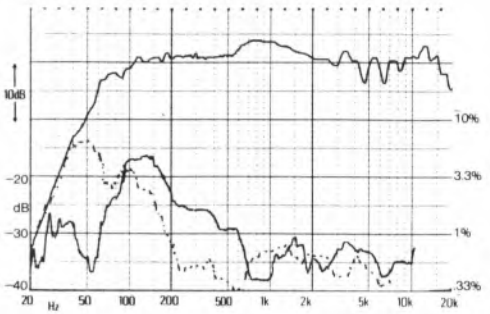
delineated, the low bass was deficient in power.

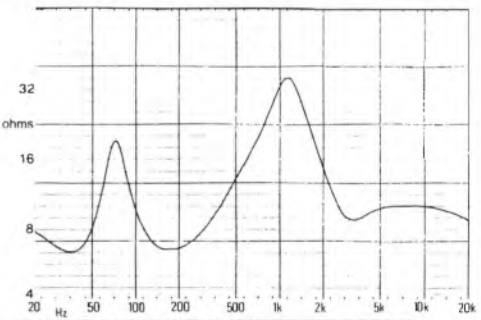
On the stereo sessions the speaker sounded 'large' for its size, though bass notes were still subdued. Coloration was moderate with some midrange bias and 'boxiness', plus a slightly 'dulled' treble, this countered by a degree of extra zip in the higher ranges, which tended to bring out surface noises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

**Summary**

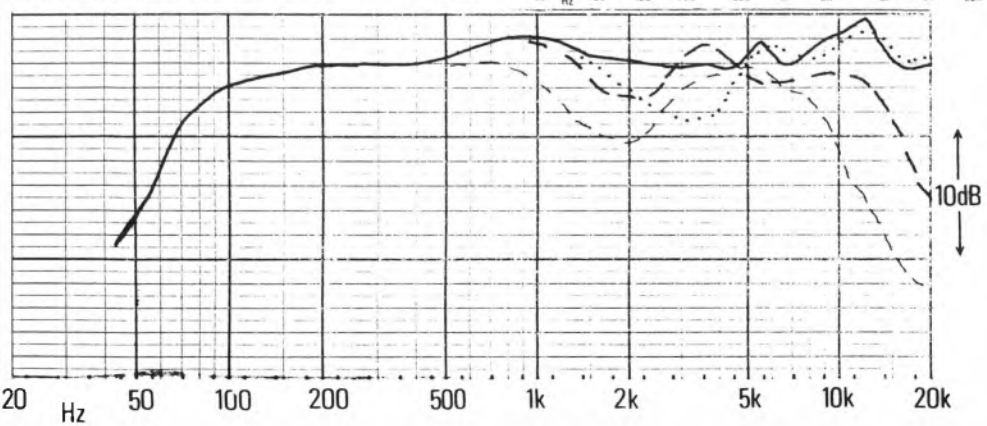
The subjective performance of this model was uneven, mainly due, we feel, to the charted response trends. However, the results were good for the size of enclosure and in relation to its price of just under £200. Construction and appearance were both very good, and the protection provides a further plus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

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




| | |
|---|---|
| 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 | £190 |



# B&W DM7 II

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

The original *DM7* was examined two issues ago, and achieved only limited success in the tests. A highly engineered design, the improvements offered by the new version do not involve radical changes, but rather relate to the resilient driver mounting, the 24dB/octave crossover design (possessing 14 high quality elements) and the inclusion of electronic protection. As before, the vertical driver array comprises a 200mm bass-mid unit with a fine die-cast frame and massive magnet assembly, a matching ABR passive bass radiator and a wide dispersion 26mm fabric dome tweeter mounted on the top plate. The bass-mid cone is of B&W's own doped polyamide fibre weave.

A substantial integral stand assembly is still provided with this speaker, but the acoustic contour control of the *Mk I* has been deleted and the power handling improved. Substantially constructed, considerable internal bracing is used, and the chipboard enclosure is heavily damped as well as lined with acoustic absorption.

One sample failed during tests, the fault being traced to a detached slide-on tag from one of the LF unit teminals. Internal examination also revealed that some of the bitumen damping pads were not particularly well bonded to the cabinet walls, but otherwise the construction quality was very good, though the front trim was rather sharp-edged.

**Lab results**

Except for a minor error around 5kHz the pair match was very good, and as with the *DM12* the performance was judged better with the grilles in position. At nearly 88dB/W the *DM7* was usefully sensitive, and the very good impedance characteristic in no way compromised this, with an average value of 10 ohms.

Not inappropriately for its low stand mounted location, the LF response was stepped down by 3dB or so below 100Hz, but was then well extended to a fine −6dB point at 36Hz. Undoubtedly smooth, the forward characteristic response showed excellent driver integration and dispersion, and the speaker should therefore prove consistent over a wide range of listener positions. The presence range tended to be depressed by a few dB or so, leaving the upper treble as an isolated prominence; comparatively judged as a whole, the treble was slightly depressed relative to the remarkably flat major midband section.

At 96dB the distortion levels were very good, with the 2nd harmonic under excellent control. Using 100W pulsed drive, 0.4dB of compression was occurred at 500Hz, with approximately 1% of 2nd and 3rd harmonic distortion also generated; however the performance at 5kHz was fine.

**Sound quality**

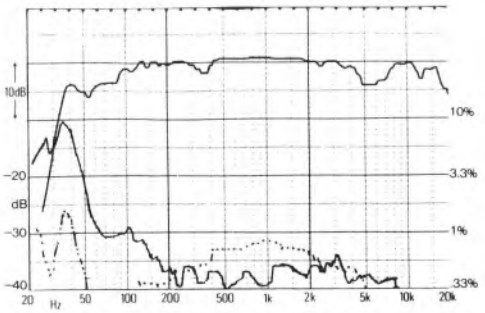
The *DM7 II* scored an 'average' on the comparisons with live instruments. The general character was fairly neutral, but voice reproduction seemed a trifle 'shut-in' and 'boxy', while unevenness in the treble range was also noted, and more openness was needed in the presence range. Percussion possessed a mildly leaden quality. The bass register was quite good, with a 40W average power handling and fine extension on fundamental notes, but a slightly 'tubby' coloration was noted in the upper bass which detracted from the precision of the transient attack.

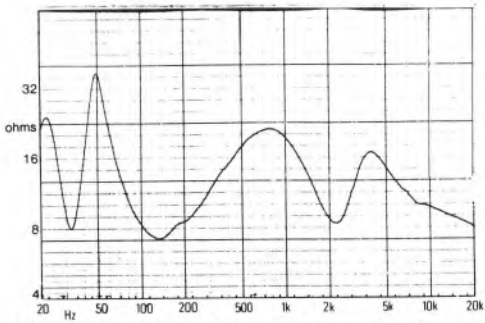
From the stereo programme results the system clearly gave good imaging with quite good presentation of stereo depth. Some 'hollowness' was audible, however, particularly on piano, and several listeners also commented on a slightly 'scratchy' treble which emphasised surface noise. On general program an 'average' rating was denoted.

## Summary

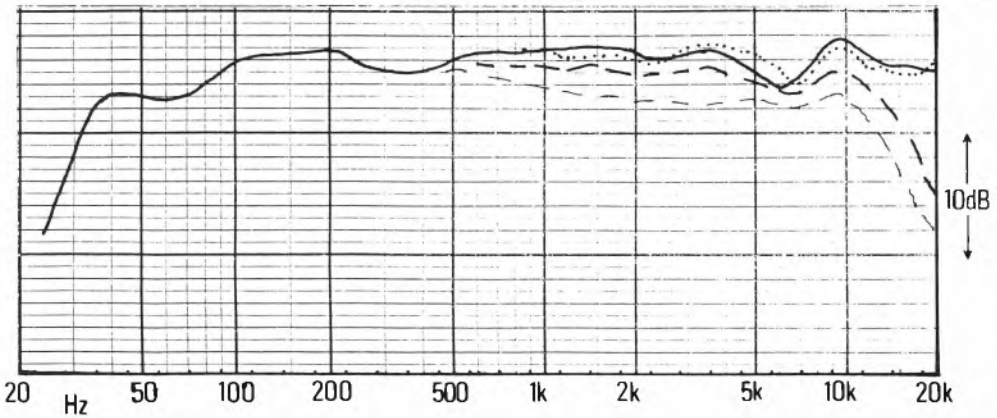
This well engineered speaker offers a useful sensitivity and extended bass, contained in a slim floor standing model with integral stand. Stereo imaging was good, distortion generally low, and the frequency response quite smooth. Although the subjective results were reasonably good in context, they cannot justify recommendation in view of the approximate £400 price tag.

*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, 27, 28 (35, 11, 15) cm (inches) (inc stand) |
| Weight | 29 (61) kg (lbs) (inc stand) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20–150W |
| Recommended placement | on integral stand |
| Frequency response within ±3dB (2m) | 55Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 36Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m | 87.5dB |
| Approximate maximum sound level (pair at 2m) | 105dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | good |
| Impedance characteristic (ease of drive) | very good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £380 inc stand |



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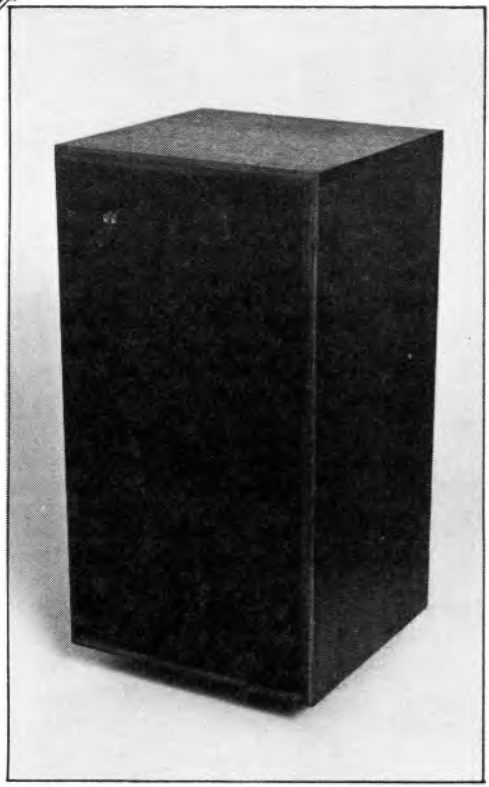
# Castle Kendal II

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

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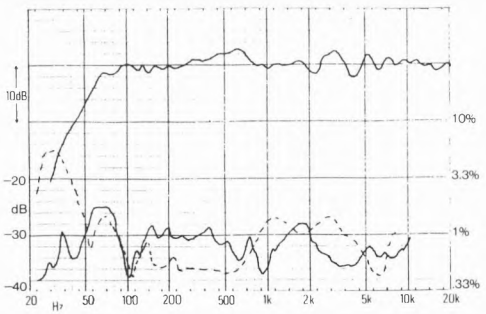
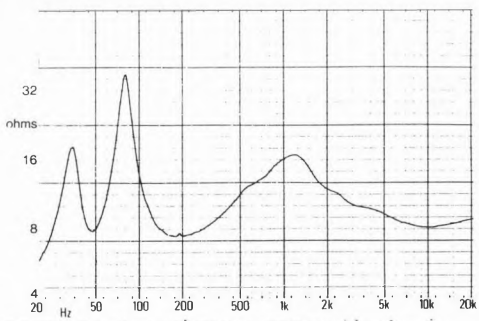
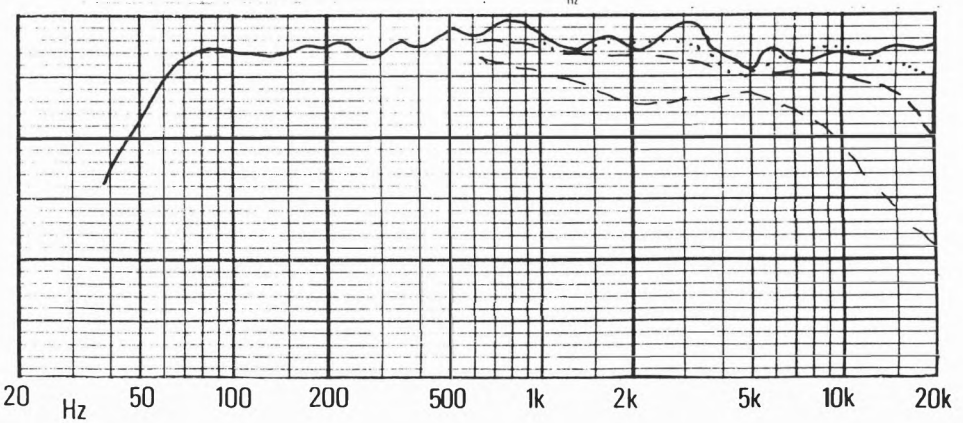
rather better balanced than our test samples, but even accepting the performance of the latter, a recommendation is still indicated. The combination of modest size and high constructional quality together with good efficiency and bass, plus generally good sound reproduction combine to merit best buy 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 ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*



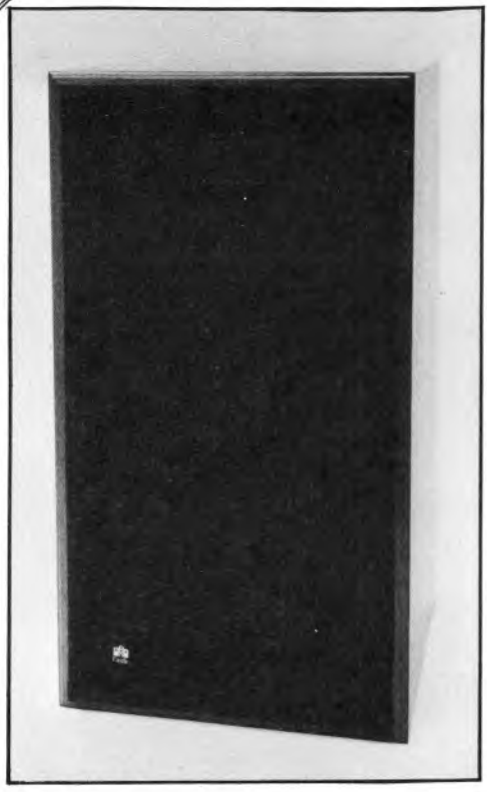

| | |
|---|---|
| Size (H, W, D) | 52.5, 29, 28 (20.5, 11.5, 11) cm(inches) |
| Weight | 10 (22) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 10–100W |
| Recommended placement | open shelf or stand |
| Frequency response within ±3dB (2m) | 60Hz–20kHz |
| 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 | £155 |



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 dic cast frame, and finally, the Castle cone/dome mylar tweeter, nominally 30mm in diameter.

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

**Lab results**

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

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

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

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

**Sound quality**

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

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

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

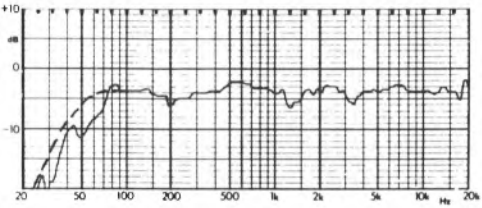
Driven to high levels it did not sound 'loud' in the fatiguing sense, and performed well on solo piano and heavy rock program alike. Mild criticisms centred around a slightly 'fizzy' HF register, plus a trace of mid 'wiriness' and hardness; overall the panelists were favourably impressed.

**Summary**

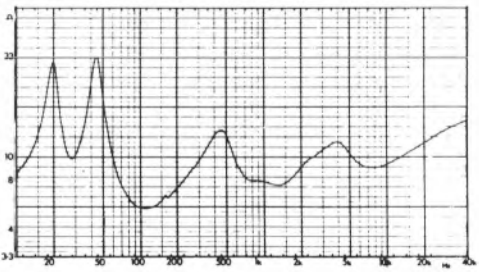
Once again Castle have come up with a very strong competitor, and like its smaller brother the *Richmond,* the *Conway* has done well in our exhaustive tests. Relatively easy to drive and of normal sensitivity, it proved quite uncoloured and showed good dynamic range and stereo, plus fine detail rendition, with a clean extended bass and low distortion. Dispersion was excellent, and at just over £250 the *Conway* can be strongly recommended as fine value.

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

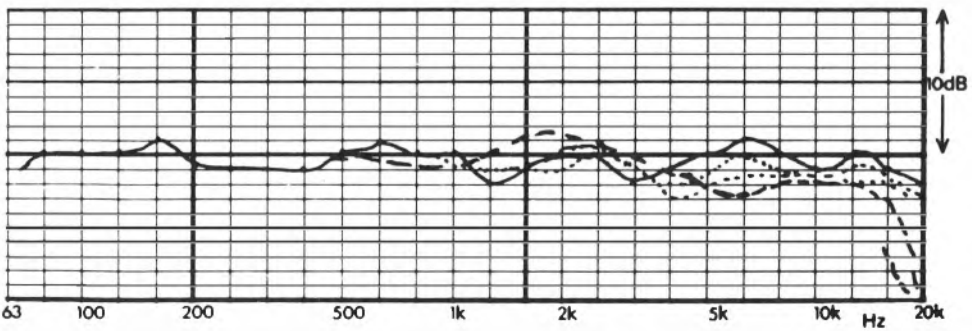
| | |
|---|---|
| Size | 63.4(25) H; 27.5(11) W; 31(12) D; cm(inches) |
| Weight | 18.5(41) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20–200W |
| Recommended placement | on stands clear of walls |
| Frequency response within ±3dB (2m) | 63Hz to 20kHz |
| Low frequency rolloff (—6dB) at (1m) | 38Hz |
| Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) | 86.5dB/W at 1m |
| Approximate maximum sound level (pair at 2 metres) | 103dBA |
| Third harmonic distortion (96dB at 1 metre) | v. good |
| | 50Hz–3%, 100Hz–0.3%, 1.5kHz–1%, 6kHz–0.5%, typically 0.3% |
| Impedance characteristic (ease of drive) | average |
| Forward response uniformity | excellent |
| Typical price per pair inc. VAT | £275 |




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




Impedance vs frequency (mod Z)




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

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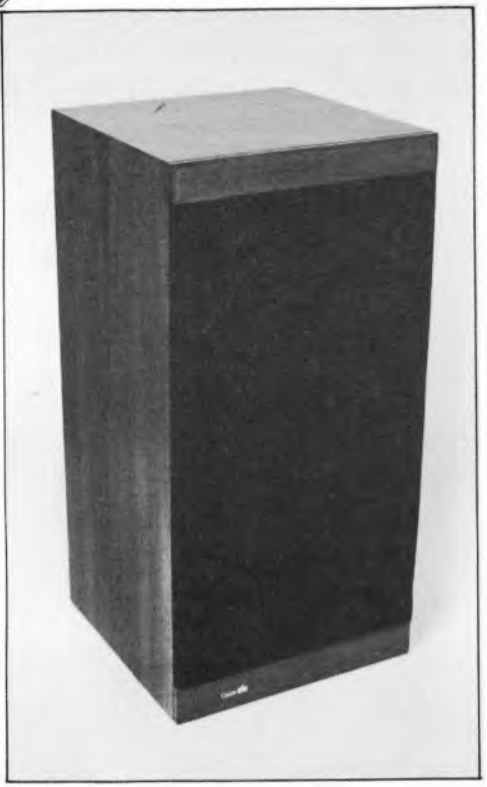
# Castle Howard II

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



This substantial speaker comes packed in a wooden crate, and is supplied with a matching trolley stand. The internal volume measures 90 litres – approximately double the size of the average system– and the enclosure is reflex loaded *via* a high acoustic power capacity tunnel port of 80mm diameter and 75mm depth. The cabinets come in 'mirror image' pairs, with the vertical driver array consisting of two 200mm bass units plus a 100mm mid and 30mm tweeter. The last two are essentially ring radiators, and are displaced from the centre line in order to reduce diffraction effects. The bass units have dense doped pulp cones with high power 33mm diameter motor coils, and internal fuses are provided on the 13-element high quality crossover. These easily survived a 200W peak programme input and are only intended to protect against gross abuse. The enclosure is built from 20mm thick chipboard with thin bituminous damping and some bracing.

In some respects the *Howard* may be regarded as a scaled-up version of the *Conway* three-way design, but with double the low frequency capacity.

**Lab results**

Possessing a similar sensitivity to the *Conway* of 86.5dB/W, the *Howard* exhibited a much improved low frequency bandwidth with a remarkable 29Hz −6dB rolloff point. Pair matching was very good, typically 0.3dB and only occasionally reaching 1dB, while the foam grille produced no adverse effects.

The axial sine wave was remarkably flat, meeting tight ±2.5dB limits from 35Hz to 20kHz, and although a slight mid emphasis was apparent, the overall trend was very smooth. Despite its size the set of off-axis responses was very tidy, showing good driver integration and indicating that the speaker is not too critical of listening axis.

Driven to 96dB the distortion characteristics were classed as excellent, particularly so at low frequencies. It also performed well on a 100W peak input, where no compression or distortion increase was detected at the critical test frequencies (less than 0.1dB), despite an axial s.p.l. of the order of 107dB, 1m. The impedance curve was rated as easy to drive, being a genuine 8 ohm type with a 6.5 minimum, and with typical phase angles in the 10–20° range. The sensitivity can thus be fully exploited by all 8 ohm rated amplifiers.

**Sound quality**

Unfortunately the *Howard* proved disappointing on the live sound comparisons, scoring only an 'acceptable' rating. The frequency balance sounded richer and heavier in the listening room than the responses might have suggested, with voice showing some 'boxiness' and 'tube-like' coloration, as well as a mild 'chesty' effect. The coloration levels were undoubtedly moderate, but the balance exaggerated the dull effect.

However on stereo programme, where no absolute comparative reference is available, the panel quickly became accustomed to the sound, awarding the *Howard* quite high marks. Although exhibiting some loss of depth and transparency, the imaging was fairly good, but the overall character, while superficially smooth, did show some 'hard' and 'grainy' effects, and some

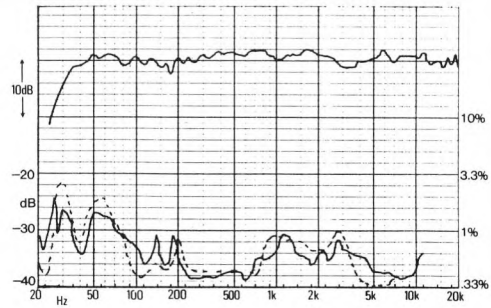
RECOMMENDED

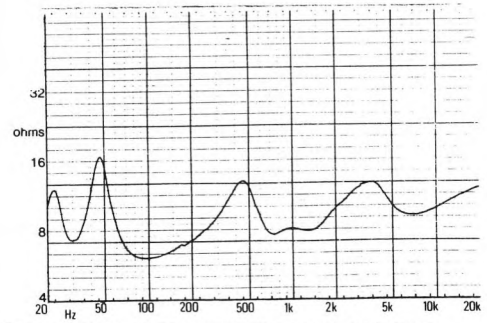
panelists felt these could prove fatiguing in the long run. At times the good bass extension sounded a trifle oppressive in our room.

**Summary**

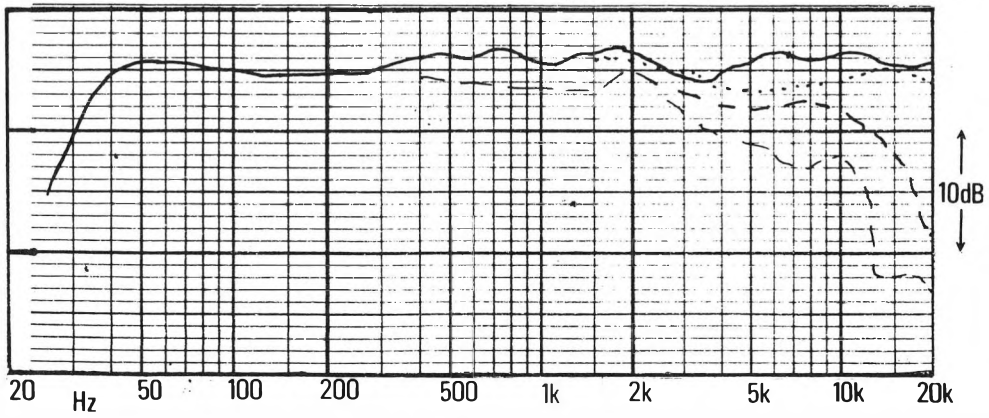
The *Howard* is not a complete success. At under £500 it offers a good stereo sound quality plus extended if possibly over-abundant bass, and a rather rich quality – perhaps the antithesis of the Mordaunt-Short *Signifer?* Power handling was good, and the response commendably uniform, so while it is worthy of recommendation, its character (less neutral than the *Conway* for example) suggests that a careful audition should be undertaken before purchase.

*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).*



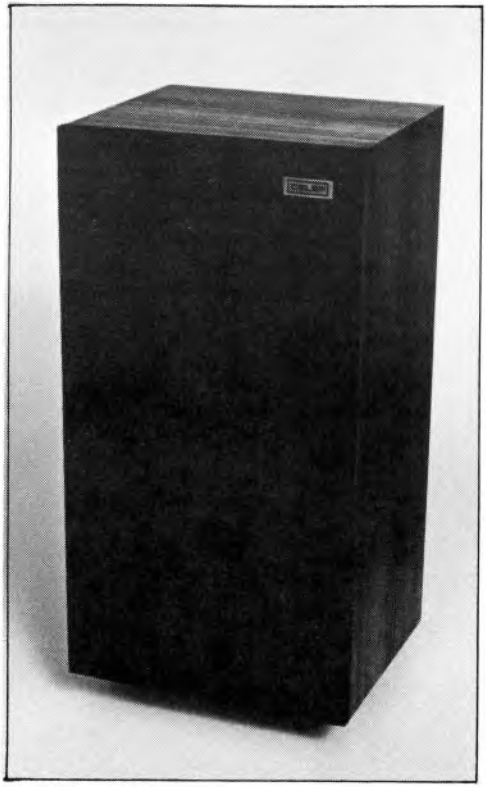




| | |
|---|---|
| Size (H, W, D) | 80, 40, 42 (31.5, 16, 16.5) cm(inches) |
| Weight | 28 (62) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–200W |
| Recommended placement | integral stand |
| Frequency response within ±3dB (2m) | 33Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 29Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m. | 86.5dB |
| Approximate maximum sound level (pair at 2m) | 105dBA |
| Distortion (96dB at 1m) | excellent |
| Distortion (100W peak) | very good |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £475 inc stand |



# Celef Monitor II

Celef Audio Ltd., 130 Thirsk Road, Borehamwood, Hertfordshire
Tel 01-207 1150



This loudspeaker has quite a long history; indeed the curve printed on the brochure is dated January 1974! A relatively compact 24 litre enclosure, the Monitor is a two-way system employing a version of the established KEF *B200* bextrene cone mid/bass driver, together with an Audax 25mm soft dome tweeter. The KEF unit operates up to the crossover at nominally 3kHz, and is loaded by a 62mm diameter tunnel port (the earlier version was resistively damped, the port being filled with fine tubes). In our samples the inside of the port was pressed firmly against the acoustic foam lining, this undoubtedly serving to provide extra damping. The system was well finished in American walnut and the crossover network of some nine elements made use of normal rating components. Full bituminous panels were employed for the cabinet wall damping, though strangely the thick grille had no internal chamfer, the absence of which is known to worsen edge diffraction effects.

**Lab results**

Pair matching was excellent with no significant imbalance between left and right hand systems. Sensitivity at 86dB was about average for a bextrene coned system, and the −6dB bass rolloff point was at 50Hz, which is quite low considering the size. Third harmonic distortion was very good at 96dB, 1m, and with typical values in the 0.4% region, it was still only 0.9% at 100Hz, with a moderate 2% at 60Hz.

The power handling at low frequencies was judged good, 50W or so of electric bass guitar being accepted without audible distress. However some compression was noted on the high level rock test where the maximum level achieved, although still ample, was nonetheless a trifle low by the standards of this report. Easy to drive, the impedance curve rated as a 'good' amplifier load, not falling below 6.6 ohms and typically measuring 8.

The reference response on axis at 1m, while a trifle lumpy, essentially met ±2.5dB limits from 65Hz to 20kHz, excepting for a small trough at 3kHz. At 2m using ⅓-octave analysis the correlation with the 1m sine response was good, exhibiting a smoothing of the minor irregularities and allowing a clearer view of the generally rising trend with increasing frequency. The drivers were clearly well integrated through the crossover region, and the off-axis curves were well controlled, showing that this speaker is not over-critical of listener axis.

**Sound quality**

An average rating was achieved on the live sound comparisons, with the treble range judged to be a little rough and bright with added sibilance, while the midband seemed boxy and coloured, particularly on voice, and the presence range was depressed. While high levels of bass guitar were tolerated the panel did not favour the resulting quality.

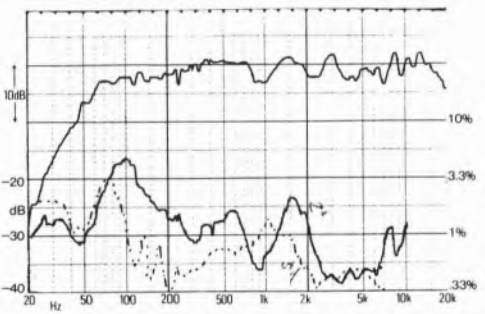
The *Monitor's* rating was similar on the stereo tests. Imaging on occasion showed promise, but inexplicably it lacked depth and frequently disappointed the panelists. Moderate coloration, 'hardness' and 'boxiness', plus treble unevenness and emphasis were all apparent, and while on the plus side clarity was often quite good and orchestral works were handled satisfactorily, the

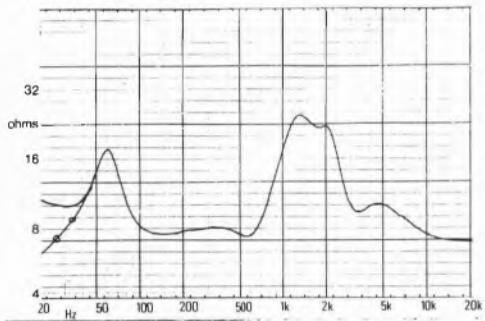
results on solo piano were not as good.

**Summary**

The *Monitor II* was a competently designed speaker of excellent finish and good engineering quality. Its performance was well balanced and showed no significant failings apart from some peak distortion in the midrange at a 100W equivalent programme rating. However the main bass/midrange driver is beginning to show its age in terms of its properties of coloration and transparency, and it is these failings which appear to have been largely responsible for its overall 'average' rating for sound quality – good for the price, but insufficient to merit recommendation, though it is still worth considering.

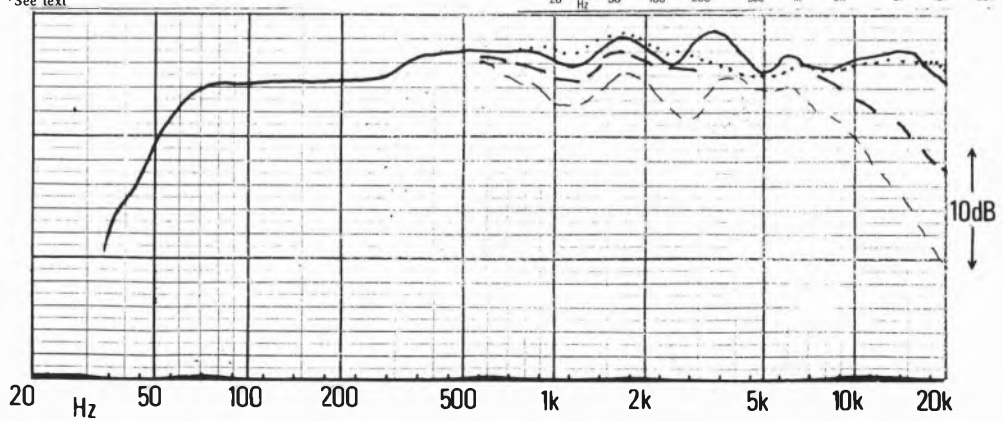
*Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*




| | |
|---|---|
| Size | 52(20) H; 27.9(9.6) W; 25.4(10) D; cm(inches) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–100W |
| Recommended placement | on stands clear of walls |
| Frequency response within ±3dB (2m) | 63Hz–20kHz |
| Low frequency rolloff (−6dB) at (1m) | 50Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) | 86dB/W at 1m* |
| Approximate maximum sound level (pair at 2 metres) | 102dBA |
| Distortion (96dB at 1 metre) | good |
| Distortion (100W peak) | acceptable |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £210 |

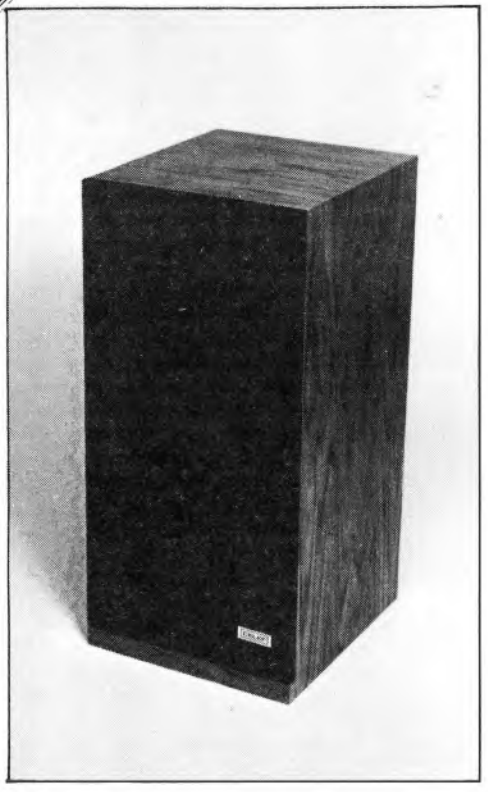
*See text



RECOMMENDED

# Celef Mini Pro HE

Celef Audio Ltd., 130 Thirsk Road, Borehamwood, Hertfordshire
Tel 01-207 1150



A medium-sized stand mounted speaker, the present *HE* design has evolved from a number of previous and very similar models that have been on the market for a few years now. The *HE* in the title is intended to denote high efficiency, but in the context of this report it was about average, at 87dB/W reference sensitivity.

A two-way system employing Scandinavian drivers, the well finished 33 litre reflex enclosure is loaded by a generous port some 63mm in diameter and 130mm in depth. Constructed of veneered chipboard, the cabinet is heavily doped by bitumen loaded panels and a thick acoustic foam lining, while the fairly thick 12mm grille baffle has no rebate to reduce diffraction.

The crossover is of fine quality, incorporating some 12 elements (including three resistors), and the vertical driver line up comprises a white coned Peerless polypropylene 200mm bass/mid unit, and the now popular 25mm soft plastic dome tweeter from SEAS.

**Lab results**

The 'efficient' sensitivity has been noted. Pair matching, while near perfect below 1kHz, was not particularly good above, where a typical 1–2dB imbalance was recorded. The grille was found to have a significant effect on the response, and undoubtedly gave a superior axial measurement when removed, this curve resembling more closely the dotted response given by the second sample we tried.

With a 200W maximum estimated power rating, the *HE* was capable of high sound levels of up to 105dB for a pair in a typical room. The −6dB rolloff point was fine at 48Hz, and above 150Hz the distortion levels were low at 96dB, 1m. The 2nd harmonic content of 5% at 80Hz was poorer than average, but fortunately this is quite innocuous in subjective terms. On 100W tone bursts the *HE* demonstrated negligible added distortion and maintained compression at less than 0.1dB for both test frequencies.

The sinewave response at 1m showed irregularities in the presence range adjacent to the 3kHz crossover point. These were ameliorated with the second samples, and in any case were dependent upon the measuring axis. For example, the 15° above axis response showed rather better integration so an ear position at or slightly above the tweeter level might be preferred, with grille removal also helping matters.

Assessing the characteristic response, the speaker was quite well balanced apart from the aforementioned presence anomalies, possessed very good lateral dispersion, and was considered a relatively easy amplifier load. The impedance phase angle did not exceed 30° and was typically 20°, with a minimum of 5.3 ohms measured at a relatively harmless 15kHz.

**Sound quality**

A weak performance was returned on live sound comparisons, despite good electric bass power handling of up to 90W average, (400W peak). Some distortion was detected on the bass test above 10W, traced to the driver surround tapping on the grille fabric. In general live transient sounds seemed a trifle 'blurred' and 'boxy', with a touch of chestiness on voice. Cymbal reproduction was unconvincing.

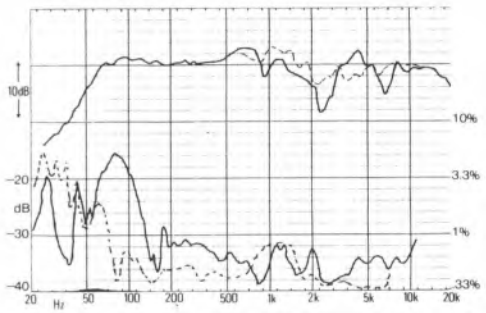
RECOMMENDED

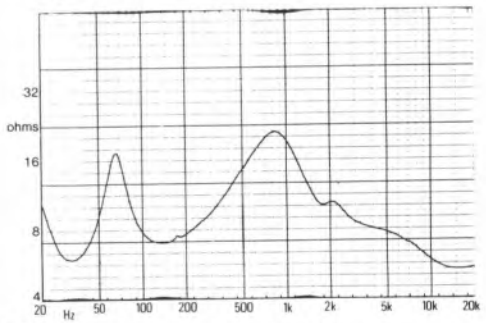
On the less critical stereo tests the *HE* fared rather better, delivering good stereo imaging with fairly good depth. It confused the panel since they were concerned about traces of coloration – hardness, 'loudness', lack of 'openness' and 'sparkle' – and yet were forced to concede that the overall subjective effect was good, and deserving of highish marks.

**Summary**

This is a well engineered speaker for the price, but technically it is flawed. While it gives a good impression that will be justly favoured by some listeners, others may prove more susceptible to its particular weaknesses and seek an alternative. Nevertheless the overall results do merit recommendation, despite the reservations expressed.

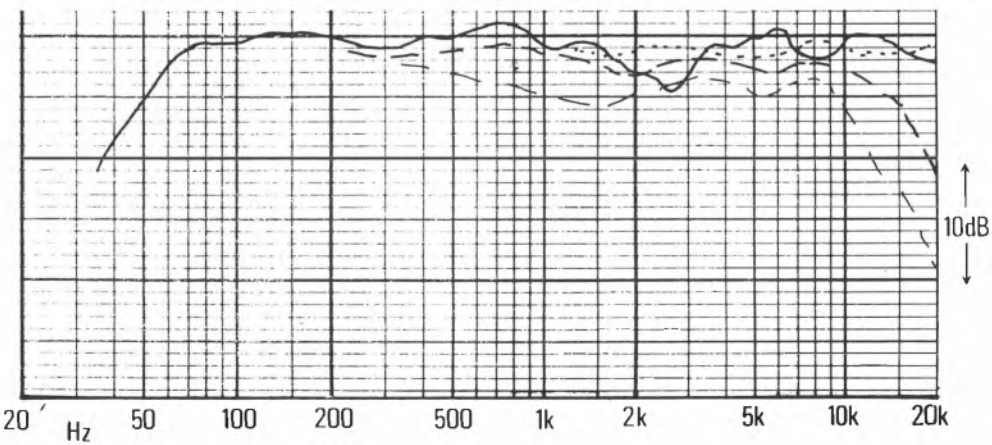
*Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ½-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*




| | |
|---|---|
| Size (H, W, D) | 58.5, 30.5, 28 (23, 12, 11) cm(inches) |
| Weight | 15 (33) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–200W |
| Recommended placement | 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 | 87dB |
| Approximate maximum sound level (pair at 2m) | 105dBA |
| Distortion (96dB at 1m) | good |
| Distortion (100W peak) | very good |
| Impedance characteristic (ease of drive) | average |
| Forward response uniformity | good |
| Typical price per pair inc VAT | £255 |

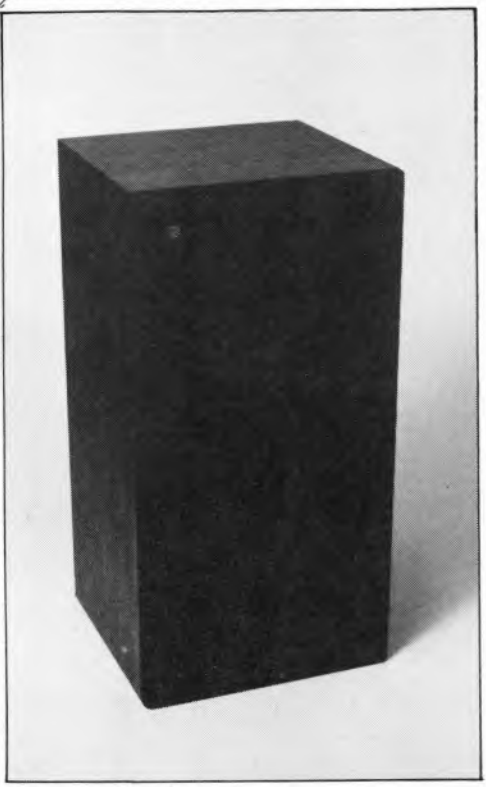
*2nd sample



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-

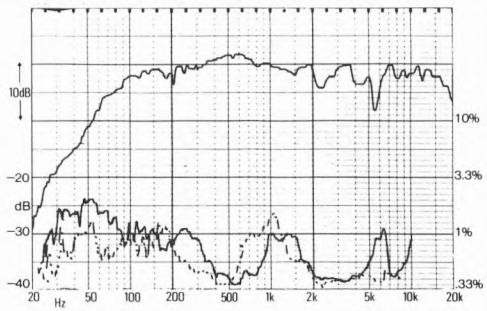
BEST BUY

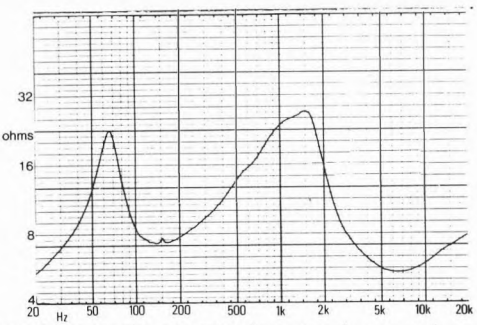
ance and a lack of openness and transparency, but still better than many other models in this report.

**Summary**

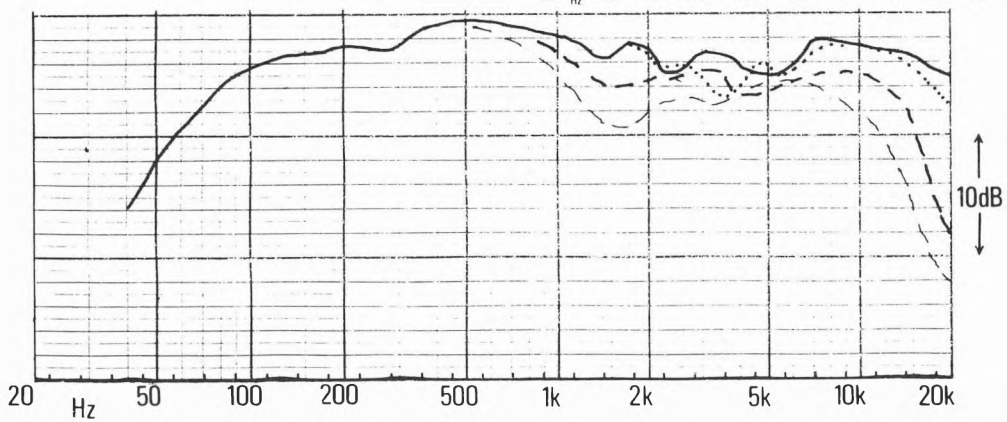
The performance and engineering represent good value for money, and the system was fairly easy to drive. It offered above average efficiency and sounded pleasant enough, so at a modest £110 a pair the *130* qualifies for inclusion in the 'best buy' category.

*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; dashed, 45° horizontal; dotted, 15° vertical).*



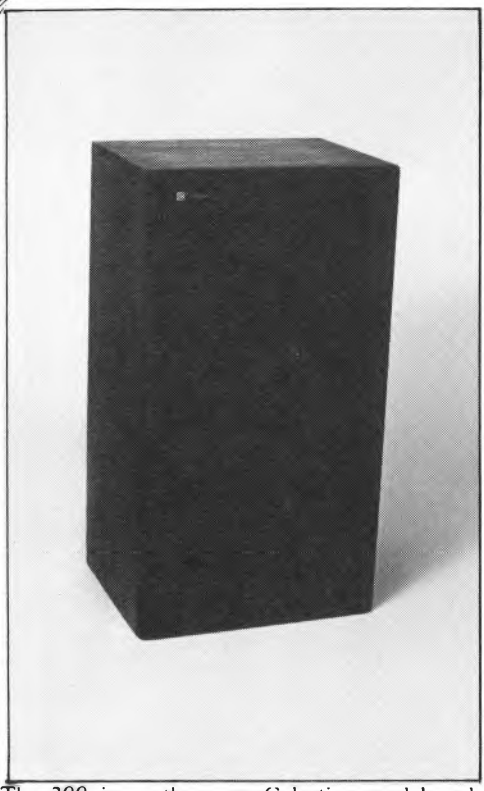

| | |
|---|---|
| Size (H, W, D) | 48.5, 25, 24 (19, 10, 9.5) cm(inches) |
| Weight | 7.7 (17) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 15–75W |
| Recommended placement | open shelf or stand |
| Frequency response within ±3dB (2m) | 77Hz–20kHz |
| 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 inc VAT | £110 |



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 ±1 dB, 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.

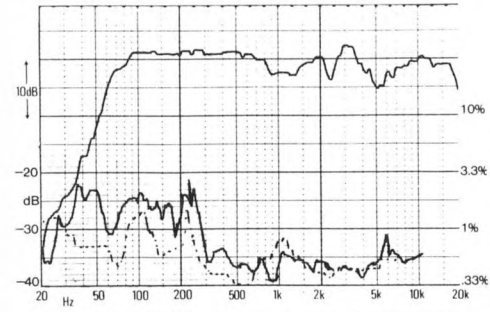
Further confusion was encountered on the stereo sessions, where this design pleased some panelists rather more than others. Despite its audible unevenness, the subjective clarity was good, with fair imaging, and a generally acceptable performance for the price.

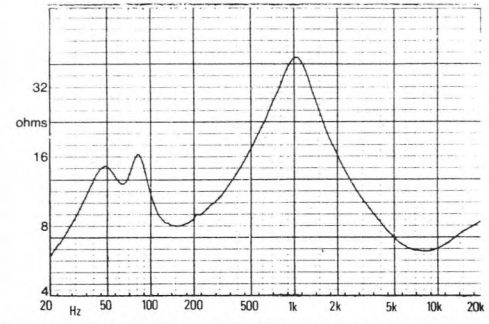
RECOMMENDED

**Summary**

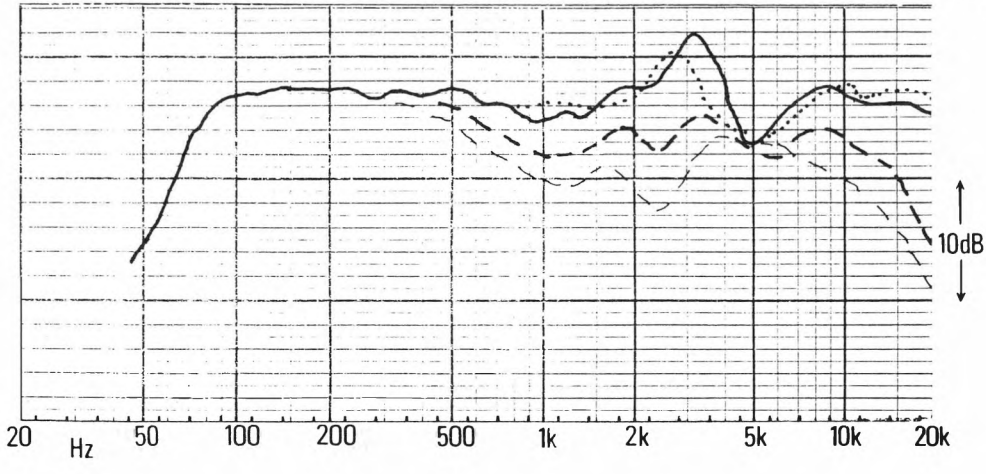
While clearly exhibiting some weaknesses, the *200* is a model worthy of audition. The sound is a little better than the arbitrary adjectives in the table might suggest, and technical quibbles apart, the line of rating it achieved justifies the price and merits a recommendation.

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



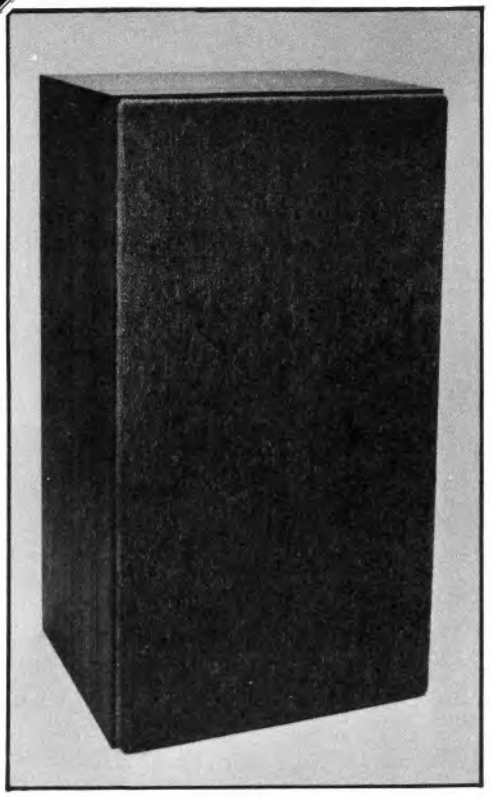

| | |
|---|---|
| Size (H, W, D) | 60, 33, 26.5 (23.5, 13, 10.5) cm (inches) |
| Weight | 12.7 (28) kg (lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 15–150W |
| Recommended placement | stand |
| Frequency response within ±3dB (2m) | 70Hz–20kHz |
| Low frequency 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 inc VAT | £185 |



RECOMMENDED

# Celestion 551

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



Unusual care has been taken over the appearance of this moderately dimensioned three-way system, in terms of the veneer colour and its matt oiled finish, the 'furnished' look of the special grille fabric, and the inclusion of an integral stand. Rarely found in a UK design, this speaker has a neat control panel fitted beneath the grille to provide independant calibrated adjustment of mid and treble from 2dB of lift to 6dB of cut. A vertical-in-line driver layout has been adopted, asymmetric for left/right mirror pairs. The pulp cone 250mm bass unit is reflex loaded by a tunnel port of generous 75mm diameter working with a cabinet volume of 63 litres, and at 600Hz a pvc impregnated 50mm diameter soft dome tweeter takes over to 4.5kHz, beyond which a new version of the 19mm mylar dome *HF2000* completes the lineup. The 16-element crossover is substantially constructed and includes fuse protection and a fuse-blown warning light. All the Celestion-made drivers are well manufactured.

No damping is fitted to the heavy enclosure, neither is the grille panel chamfered, but the enclosure cabinet did have beam bracing and a foam lining.

**Lab results**

Pair matching was to a good standard, within +/– 0.5dB limits overall. Sensitivity was fairly low at 86.5dB/W, but with a worthwhile –6dB low frequency point at 38Hz. Rated as very good on 3rd harmonic distortion, the worst figure recorded at the lowest frequencies was 1.6%, 56Hz, improving to 1%, 100Hz and holding typically to a fine 0.3% over the remaining frequency range at 96dB.

High powers were handled effortlessly, allowing a generous maximum level of 103dBA for a pair at 2m. In fact, up to 150W program of bass guitar and 200W of unclipped rock program sounded clean. Considered a good amplifier load and easy to drive, the *551* always measured greater than 6 ohms except with full midrange lift, the typical value being 8 ohms.

The axial reference response taken at 1m illustrated a +/3dB tolerance from 43Hz to 20kHz, although within these limits broad band level differences were apparent, together with a few irregularities, notably between 500Hz and 2kHz.

At 2m with $^1/_3$-octave noise averaging, a smoother but nonetheless similar trend was observed, while a shelf cut of some 3dB was also apparent over the whole treble range above 2.5kHz. The unchamfered grille panel was felt to produce some diffraction effects and the off-axis curves, although quite good, were not as tidy as for some models. Incidentally the chain-dotted line shows the effect of +2dB treble lift, thus confirming the specification; in fact, in well furnished rooms this system could well benefit from control correction to give '+1.0' mid and '+1.5' treble.

**Sound quality**

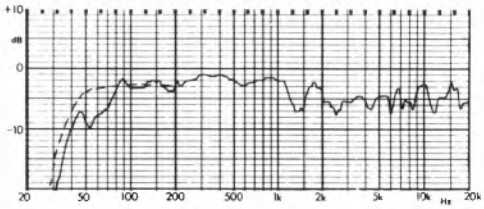
The *551* demonstrated a good performance on the live sound comparisons, partly because of its fine and powerful rendering of the electric bass guitar. However on occasion it did sound a trifle dull with some boxiness and nasality, and it fared worst on male voice, although the end result was still reasonable.

This promising rating continued through the stereo tests, and in our listening room the manufacturer's zero control settings were preferred, despite a mild dully effect. While comments were still made concerning a touch of shrillness and fizz in the treble range. Despite some moderate coloration this model nonetheless scored 'good' ratings for clarity, stereo and overall accuracy, and could be comfortably driven to produce high volumes. The bass was fine and attracted no adverse comment.

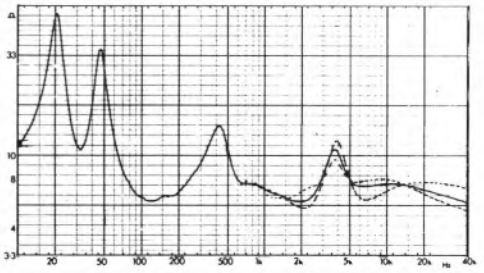
**Summary**

While no parameter proved exceptional, the *551* nonetheless possessed a sensible blend of qualities, and achieved a good standard of performance throughout the tests. Easy to drive with a clean extended bass, low distortion, moderate coloration and a generally neutral balance, it also offered good stereo and fine power handling. The controls added to its versatility, and although it cannot be described as a 'bargain' model, the engineering standard and the test results combine to indicate a recommendation, but with the proviso that prior audition is worthwhile.

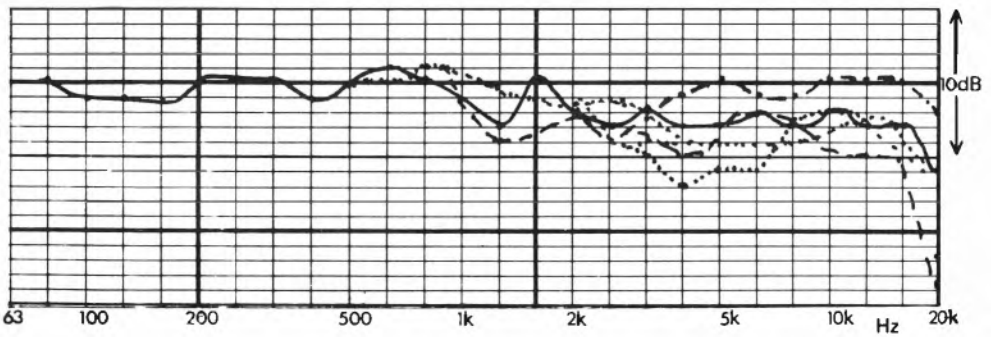
| | |
|---|---|
| Size | 72(28) H; 40(15.5) W; 32(12.5) D; cm(inches) |
| Weight | 25(55) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20–200W |
| Recommended placement | on stands clear of walls |
| Frequency response within ±3dB (2m) | 63Hz to 16kHz |
| 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 56Hz–1.6%, 100Hz–1%, typically 0.3% |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | good |
| Typical price per pair inc VAT | £360 |




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



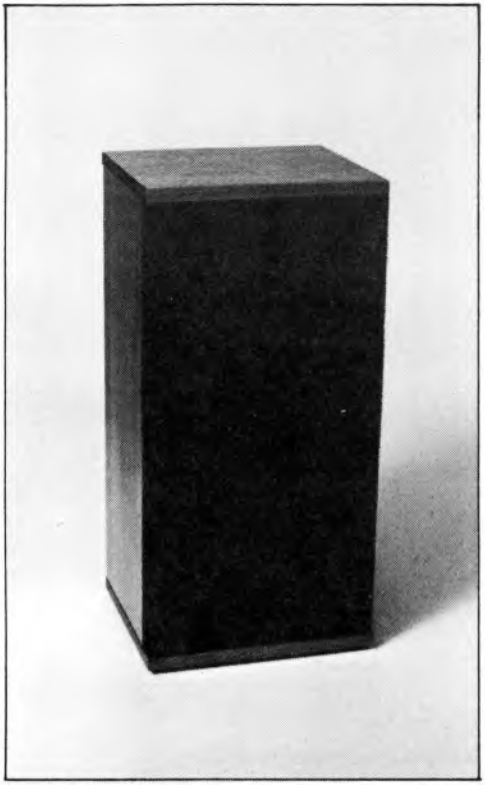

Impedance vs frequency (mod Z)




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

# Chartwell 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**

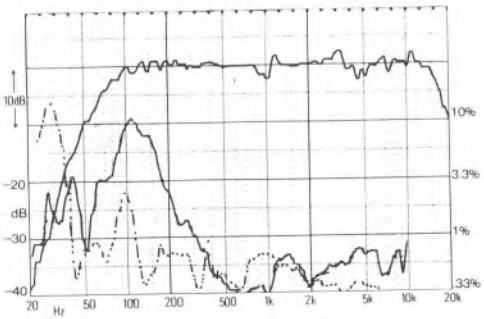
Achieving a 'good' rating on the live sound comparisons this speaker obviously could not compete with the larger models as regards bass reproduction, and it lacked both weight and power in this respect; however the bass quality was quite clean at moderate levels. Some 'boxiness' and 'nasality' were evident,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

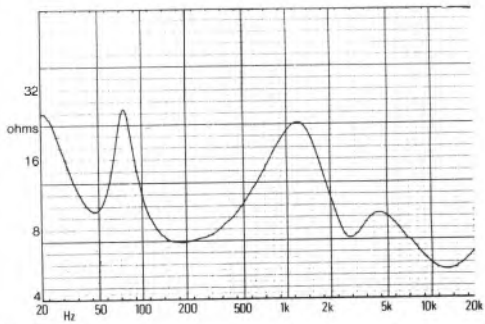
Results were poorer for the stereo sessions with an 'average' rating indicated overall; reasonable at the price but not as good as for the *Mk I*. Stereo imaging showed restricted depth and distortions of distance or ranging, while the subjective balance reflected a 'hard', almost 'metallic' quality 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.

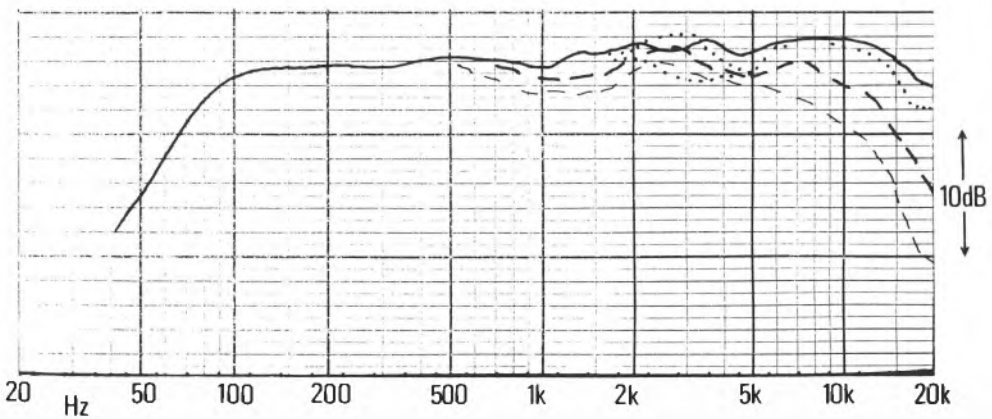
However the test results were distinctly poorer on sound quality than for its predecessor, which may have exhibited higher levels of coloration but also possessed a more natural frequency balance and perspective. The *110* is nonetheless reasonable value, and is worthy of consideration.

*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).*



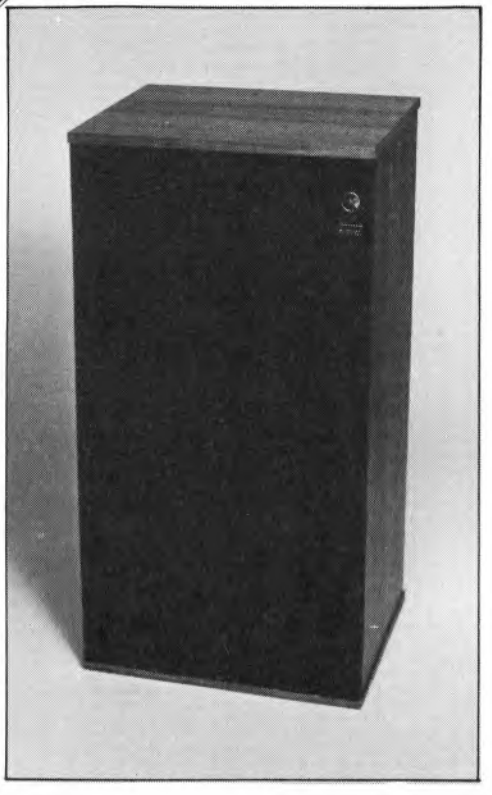

| | |
|---|---|
| Size | 46(18) H; 29(9) W; 21(8) D; cm(inches) |
| Weight | 7.5(16.5) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20–150W |
| Recommended placement | open stand clear of walls |
| Frequency response within ±3dB (2m) | 80Hz to 16kHz |
| 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 |



RECOMMENDED

# Chartwell PM210 II

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



Although designs bearing the same name and appearance were included in the previous issues, this is in fact an entirely new model, with a revised 200mm polypropylene copolymer cone and a grille-protected Audax 25mm dome tweeter

The crossover quality and general finish was beyond reproach as with the *PM110*. The *'210* enclosure looks larger than other models of comparable volume (47 litres) due to its greater width but reduced depth, the cabinet walls being bituminous-damped and the whole interior foam-lined. A 65mm diameter tunnel port reflex loads the system, the original 200mm unit on a die-cast frame now replaced by one of superior finish and accuracy. An optimal vertical-in-line format is employed for the two drivers and the complex crossover contains 16 elements.

**Lab results**

As found with the *PM110,* pair matching for the *'210* was quite remarkable, being of the order of ±0.25dB over the range. Sensitivity at 85.5dB/W was about average, and the low frequency rolloff was quite well extended at 43Hz.

While the third harmonic distortion levels were fine in the treble, parts of the midrange showed higher values than usual, for example, 1%, 1kHz and 0.5%, 700Hz; however, the low frequency values were normal measuring 0.8%, 100Hz and 3%, 50Hz. Low frequency power handling was undoubtedly good, the system tolerating up to 100W of bass guitar as well as comfortably handling up to 250W of wideband program, with a good 103dBA maximum level. The impedance curve gave some cause for concern however, due to a dip to about 5.5 ohms in the upper treble region, but little programme power will be present here. Below 2kHz the average impedance was about 15 ohms and should present no difficulty.

The frequency response was most impressive on axis at 1 metre, with a 'seamless' crossover region and meeting ±2dB amplitude limits from 50Hz to 18kHz. However despite such accuracy the 300–800Hz range showed a plateau lift of 1–2dB which may be significant. At 2m some integration of the forward response had occurred throwing the mild midrange plateau into relief. In terms of the forward response group this was somewhat emphasised by a degree of energy recession in the presence range from 2–4kHz. The poorest off-axis response was that taken 10° below axis, which indicates that the optimum listener position is on or slightly above the main mid/high frequency driver axis. Nonetheless, despite these criticisms, the characteristic forward responses were undeniably good.

**Sound quality**

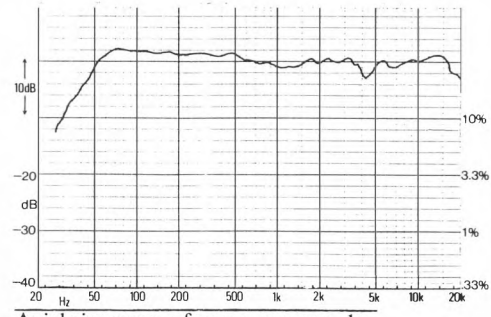
The score in the live sound comparisons was good, showing a real advantage over its half-size and -price brother, the *PM110 II.* The listening panel described several significant colorations, including 'boxy', 'nasal' and 'slightly muffled' effects, and the bass register was not felt to be particularly natural or detailed, notably in respect of the harmonics lying above the fundamental bass notes.

During the stereo panel tests, the results conflicted slightly, with the standard deviation in the scores being higher than usual. Overall it achieved a 'good' rating – slightly above that for the *PM110.*

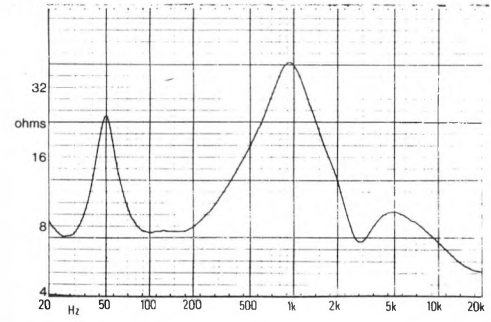
Stereo imaging was above average with quite good lateral stability and fair depth. The bass gave an impression of being under-damped and 'wooden', and moderate nasality and boxiness was also apparent in the midrange. Similarly the clarity of the system seemed dulled, and accordingly it was marked lower than average for this parameter.

**Summary**

Criticised in *Mk I* form, this latest version represents a real improvement in subjective performance, together with a better impedance characteristic, and now qualifies as a recommended model.

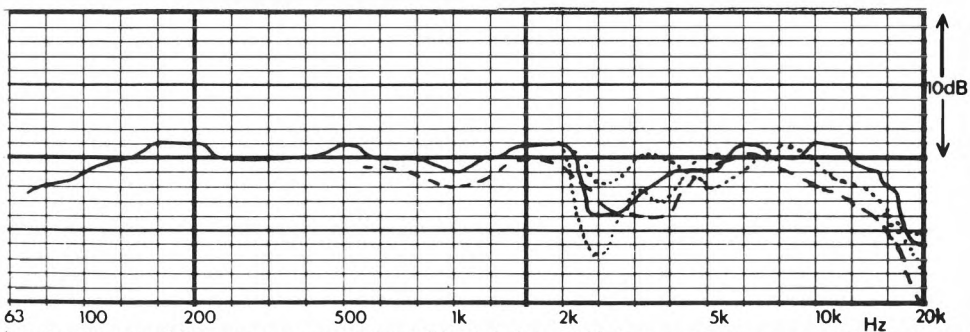



Axial sine wave reference response, 1m




Impedance vs frequency (mod Z)

| | |
|---|---|
| Size | 66(26) H; 34.3(13.5) W; 28.6(11.3) D; cm(inches) |
| Weight | 15(33) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–200W |
| Recommended placement | on stands clear of walls |
| Frequency response within ±3dB (2m) | 63Hz to 20kHz |
| Low frequency rolloff (−6dB) at (1m) | 43Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) | 85.5dB/W at 1m |
| Approximate maximum sound level (pair at 2 metres) | 103dBA |
| Third harmonic distortion (96dB at 1 metre) | good<br>50Hz–3%, 100Hz–0.9%, 700Hz–0.5%, 1kHz–1%, then typically 0.3% in the treble range |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £310 |




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

# Coles Nimbus

Coles Electroacoustics Ltd., Pindar Road, Hoddesdon, EN11 0BZ
Tel (09924) 66685/60060

Although of fairly plain appearance in a rather square-looking and shallow enclosure, the *Nimbus* is in fact a well-made speaker and demonstrates notable attention to detail.

Two vertically arranged drivers are employed, both manufactured by Coles, with the 200mm bextrene cone bass/mid unit loaded by the 25 litre sealed box. This driver is unusual in employing a glass fibre reinforced nylon chassis which is highly rigid, while a white soft plastic dome is used for the tweeter, material similar to that used in the popular SEAS model. The good quality five-element (plus one resistor) crossover divides the frequency range between the two drivers at about 2.5kHz. The plywood enclosure is damped by bituminous panels and has an acoustic foam lining.

**Lab results**

The sensitivity was a little below average at 85dB/W, indicating a 25W minimum power rating per channel. An average −6dB rolloff of 48Hz was measured with good overall pair matching, but the grille was found to affect the response significantly, its removal serving to reduce the depth of the axial response notches by 1–2dB at 2.2, 6 and 8kHz. The grille also attenuated the treble range by an average of 2dB above 8kHz. The impedance never measured less than 6.4 ohms, so the *Nimbus* qualifies as a good amplifier load, representing a genuine '8 ohm' speaker with a typical 30° phase angle.

The axial sinewave response suggested some underdamping at low frequencies, with a gentle rise to the midrange, while the crossover region was none too uniform and the high frequencies showed a premature rolloff. At 2m the ⅓-octave averaged response confirmed the trend, clarifying the overall treble band depression. Despite the lumpy characteristic the correlation with the off-axis curves was quite good, and so at least the dispersion was satisfactory.

Rated 'acceptable' on swept distortion the rise in third harmonic at 1.5kHz worried us, with the peak value being close to 3%; elsewhere however the results were quite good. Some compression was also noted on the 100W pulsed distortion test, where 0.5dB was recorded at 500Hz, and a fairly high 1dB at 5kHz. Despite such compression however the distortion showed no increase over the 0.3–0.4% level noted at 96dB. From these results a sensible power limit was set at 100W (in agreement with the spec), giving a modest maximum sound level of 98dBA in a typical room.

**Sound quality**

Scoring a reasonable 'average' when compared with live sounds, the subjective quality was dominated by a dull frequency balance. Coloration in the real sense was however quite low, and the LF range was quite clean and powerful, demonstrating fine power handling (50W average bass guitar!)

On the stereo sessions the same score was arrived at, but with a disappointing loss of projection and detail due to the 'over-warm' balance. Stereo imaging inevitably suffered as a result.

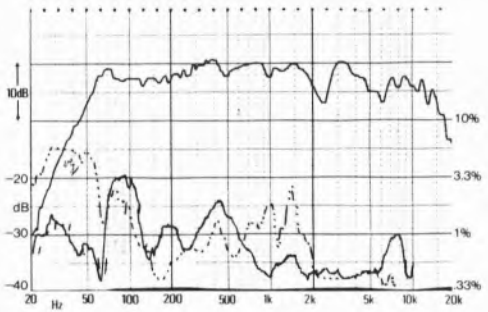
**Summary**

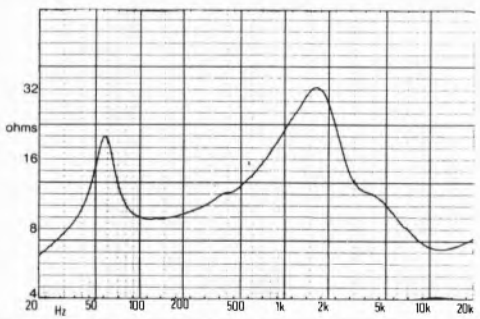
Although it is a pleasant enough sounding design, as it stands the *Nimbus* cannot be recommended.

### Note

After the main tests had been completed, Coles came up with an improved version of the tweeter which allowed a system realignment, and in their view gave an improved performance. A recent production pair were duly delivered to *Choice*, and were found to be approximately 2dB more sensitive, with a much corrected balance, and showing good openness and clarity. As such we now feel the Nimbus is worthy of consideration, but any more definite recommendation is impossible, since the new version was not subjected to the full test programme.

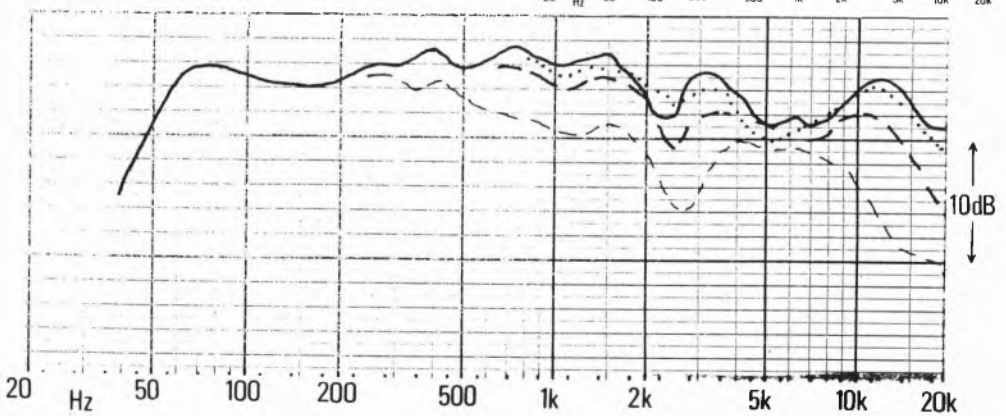
*Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*



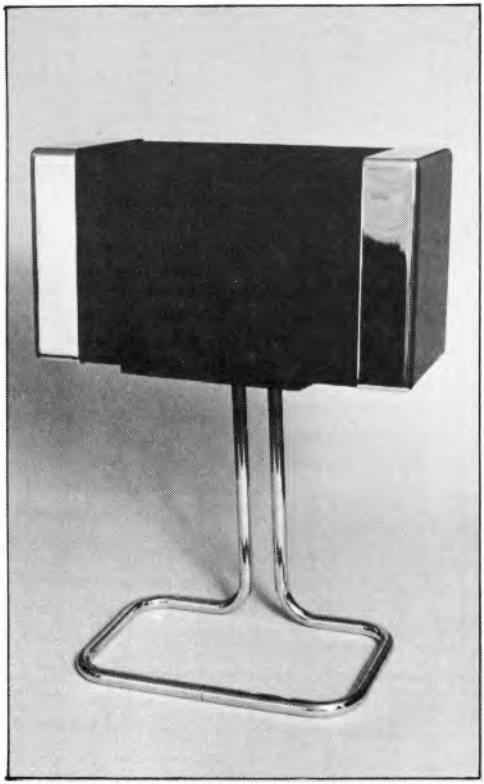

| | |
|---|---|
| Size (H, W, D) | 42, 32, 25.4 (16.5, 12.5, 10) cm(inches) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–100W |
| Recommended placement | open shelf on stand |
| Frequency response within ±3dB (2m) | 50Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 48Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 85dB |
| Approximate maximum sound level (pair at 2m) | 98dBA |
| Distortion (96dB at 1m) | acceptable* |
| Distortion (100W peak) | acceptable* |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | good |
| Typical price per pair inc VAT | £170 |

*may be slightly better on latest samples



# 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 at 50Hz, 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.

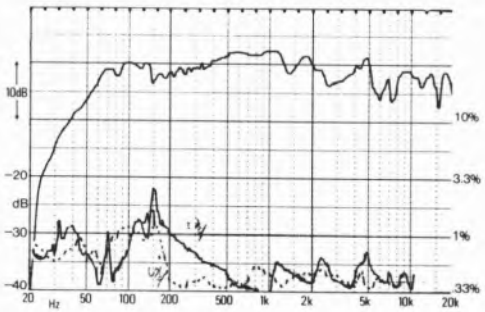
Conversely on the stereo tests the image quality was rated only 'average' with a lack of both depth and lateral precision. The performance was uneven, attracting widely divergent comments from the panelists, with some noting mild degrees of

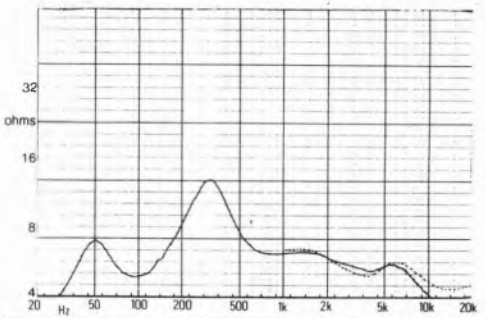
'fizz', 'hardness', 'nasality' and 'boxy' coloration. Despite the image problems, the overall sound quality was nonetheless 'good', and was approved by several listeners.

**Summary**

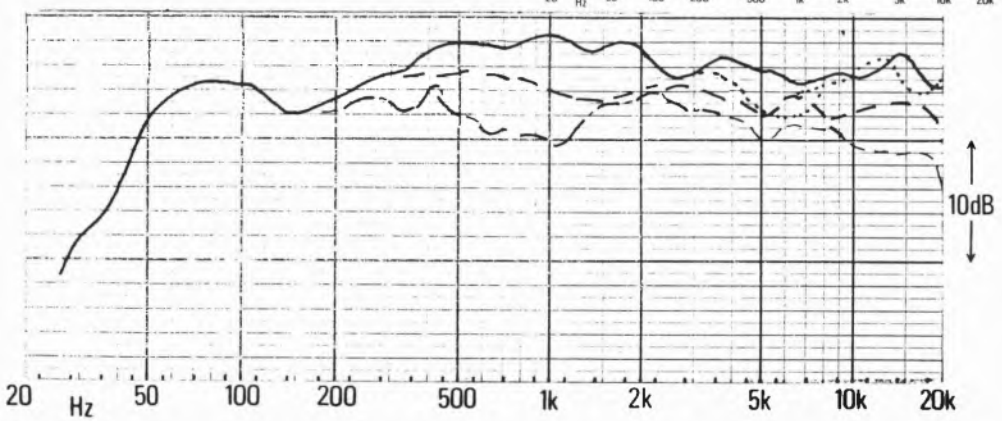
Rather expensive in terms of performance-*vs*-price, this speaker's inconsistent results indicate that some will love it and others reject it. I feel that the stereo weakness is a significant one, and it certainly affected its chances of a recommendation in this report, while the difficult amplifier 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, 1 m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2 m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*



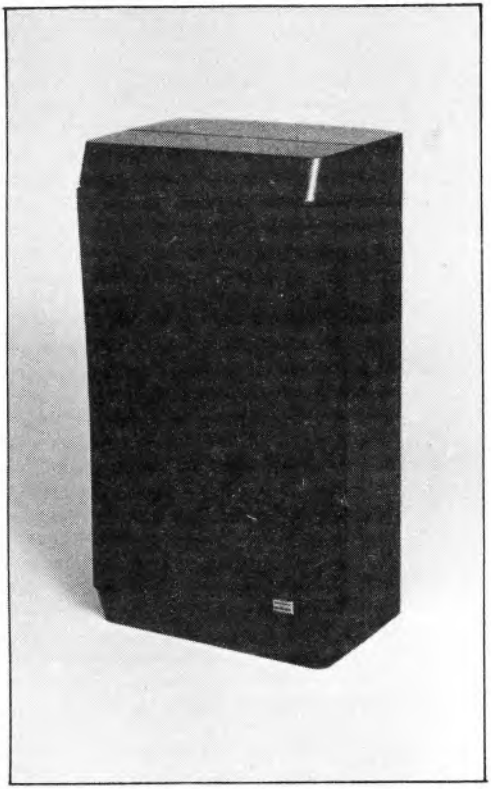




| | |
|---|---|
| Size (H, W, D) | 33, 60.5, 27 (13, 24, 10.6) cm(inches) |
| Weight | 20 (44) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–150W |
| Recommended placement | horizontal on open shelf or special stand |
| Frequency response within ±3dB (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.

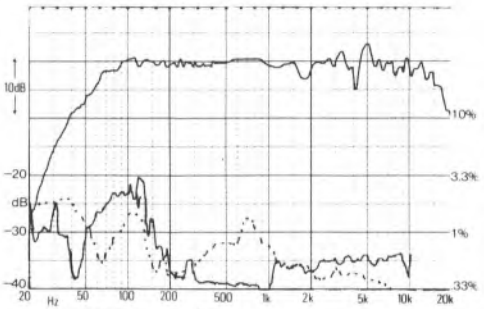
The stereo imaging definitely had problems, exhibiting a 'phasey' central focus and a perspective which varied strongly with listener position. I am sure that had the tweeter been mounted above the mid unit, better results would have been obtained; even so, the general sound quality on commercial programme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

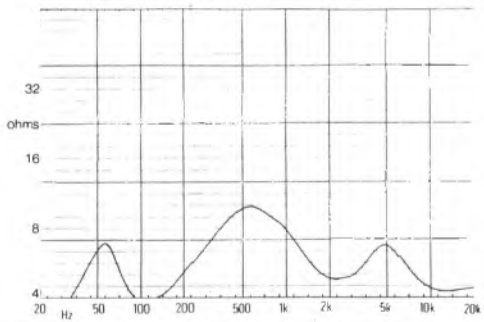
**Summary**

Despite the problems noted, this modern-looking

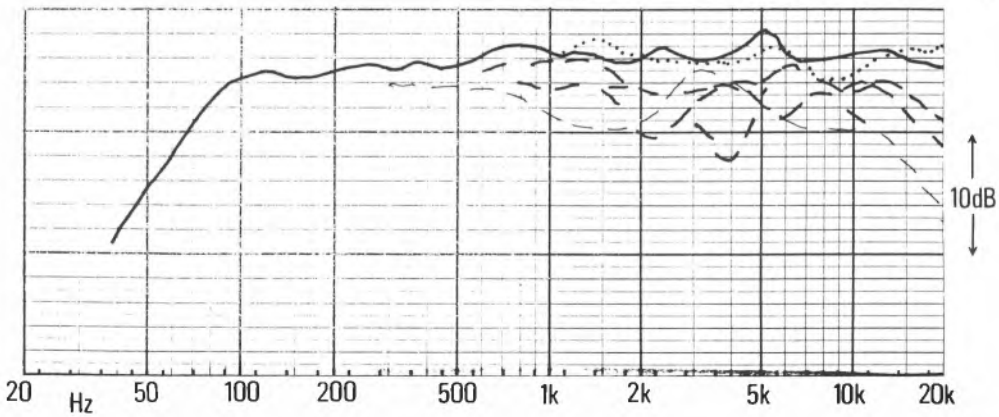
speaker was good enough to be worthy of consideration at its quoted price. Apparently a similar slightly larger model with the preferred vertical-in-line driver format is available, and perhaps this is also worth examining. If Grundig continue to build on the standard set by the *M1500* they could establish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

*Top: Frequency response, 1m sinewave, plus 2nd (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) | 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 |



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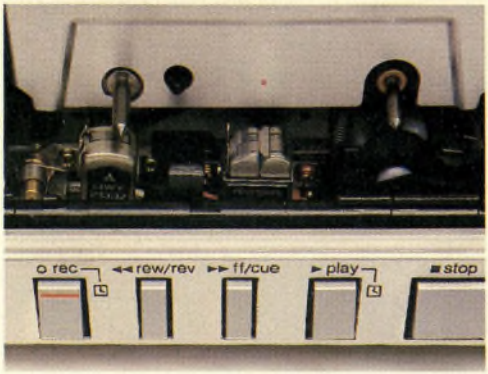


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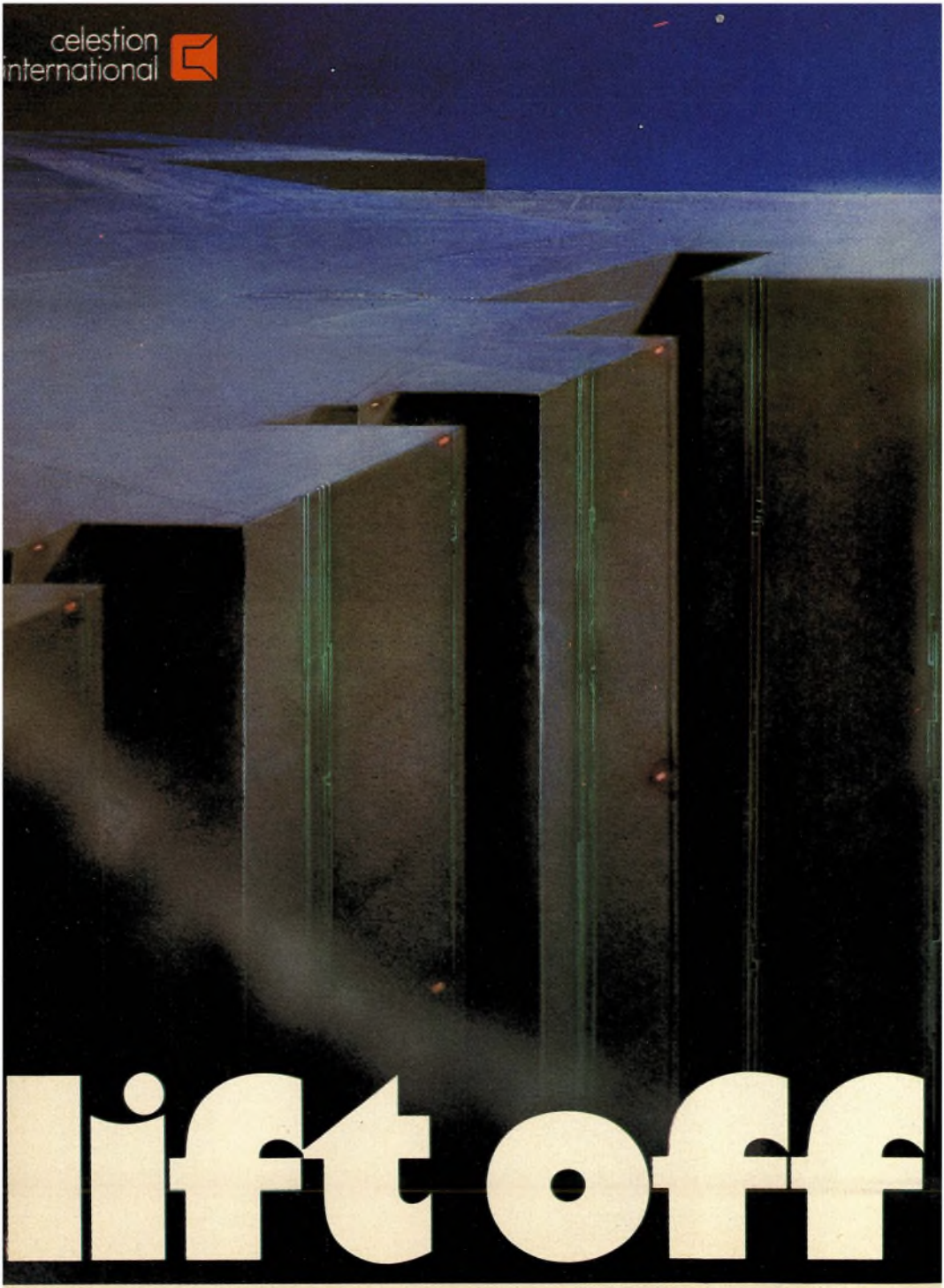


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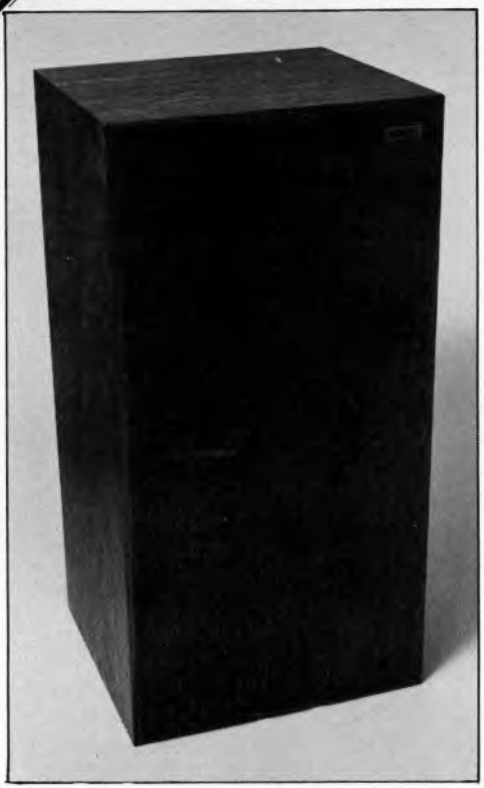
Harbeth Acoustics, 2a Nova Road, West Croydon, Surrey CR0 2TL
Tel 01-681 7676



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

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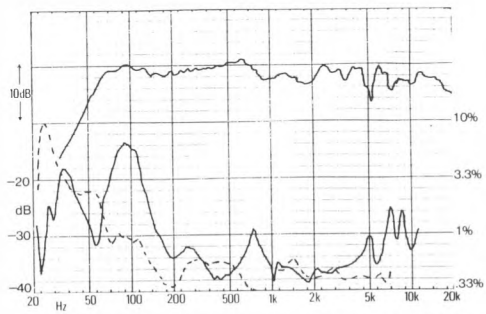
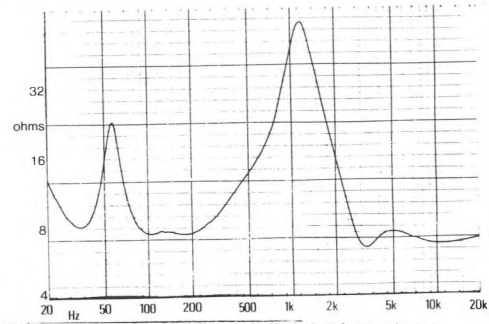
occasionally lending a slightly 'metallic' effect. The bass was also judged a trifle 'soft'. Stereo imaging was quite good with promising depth ambience, but sometimes the trebie region sounded displaced from the midrange – a function of the system's frequency balance perhaps?

*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).*

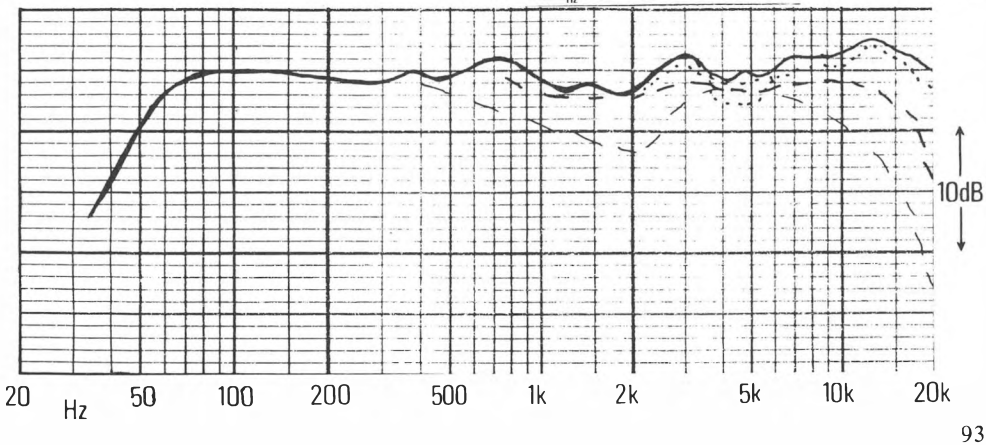
**Summary**
The standards of clarity and workmanship together with the low levels of coloration set this speaker apart from the common crowd, and it continues to maintain its position in the recommended listings. Possessing a fine overall sound quality, it offered an easy to drive impedance and above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




| | |
|---|---|
| Size | 63.5(25) H; 32.5(13) W; 30.5(12) d; cm(inches) |
| Weight | 13.5(30) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 15-100W |
| Recommended placement | on stands away from walls |
| Frequency response within ±3dB (2m) | 63Hz to 18kHz |
| Low frequency rolloff (—6dB) at (1m) | 44Hz* |
| Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) | 87dB/W at 1m |
| Approximate maximum sound level (pair at 2 metres) | 102dBA |
| Third harmonic distortion (96dB at 1 metre) | v. good |
| | 65Hz–2%, 100Hz–1%, 200Hz–0.2%, 500Hz–0.35%, typically 0.3% |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | v. good |
| Typical price per pair inc. VAT | £300 |

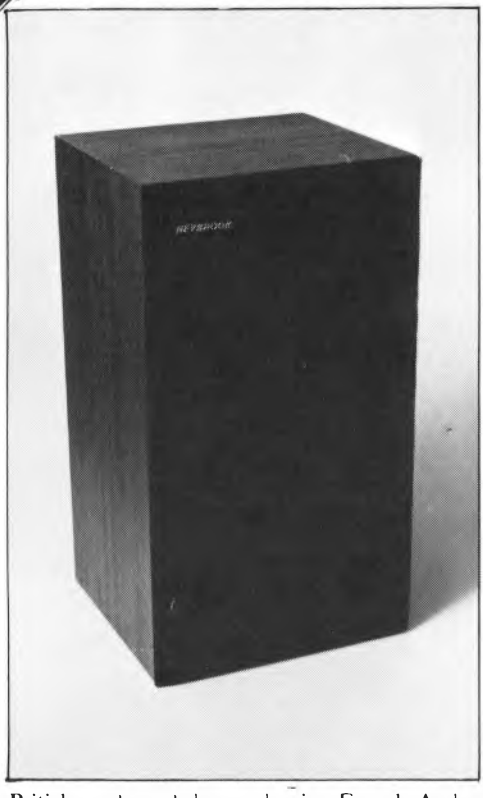
* Check text



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 0.5m away from the back wall of a listening room. This is a design showing great attention to detail; for example, the reflex port – a tube 105mm long by 28mm diameter – would be expected to suffer from audible distortion due to its small size, but by locating it on the cabinet rear and damping the exit with a soft foam ring, this is in fact kept to a minimum. The 12 litre braced chipboard cabinet is heavily damped by bituminous pads as well as a thick foam lining. The 25mm soft dome and 160mm bextrene cone drivers are mounted vertically in line behind the acoustically transparent low diffraction grille.

The good quality and complex crossover comprises some 13 elements including resistors, and is described as including phase compensation for the drivers to provide a smooth amplifier load.

## Lab results

Very good pair matching was exhibited with the discrepancies barely greater than the linewidth on a B&K chart. The lab sensitivity was rather low at 84dB/W suggesting a minimum of 30W/channel; with a 100W ceiling, a modest maximum sound level of 96dBA is possible in a typical room. The low frequency rolloff was nominally at 60Hz, −6dB, but some extension to 40Hz was apparent on the axial sinewave curve and this would be present in normal room conditions. Limits of ±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.

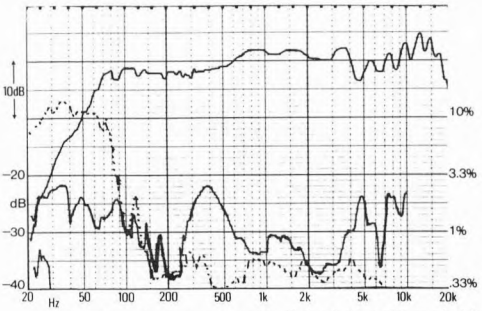
On commercial programme stereo imaging was good, with a fine representation of space and depth. Again the bass was more than satisfactory if

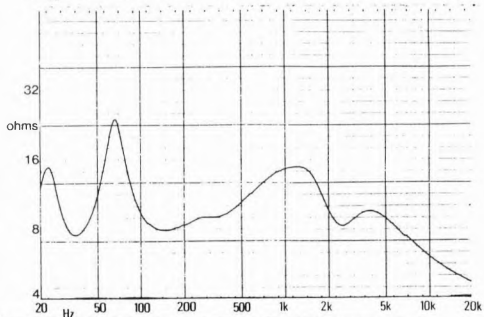
the speaker was not driven too hard, and the balance tended to openness with light sibilance, but in a smooth and acceptable manner.

**Summary**

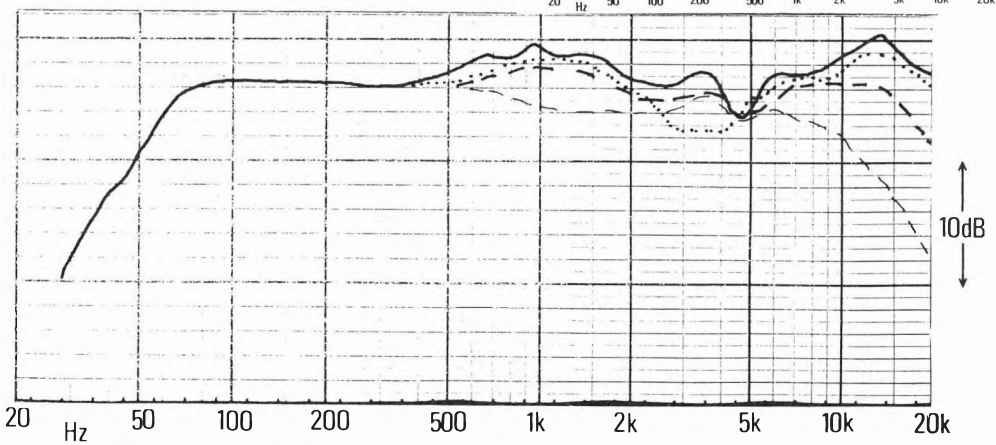
Although possessing a restricted maximum level and power handling, the *HB2* was a refined low coloration performer of compact dimensions. It gave a good overall sound quality as well as a consistent character throughout the frequency range, and is undoubtedly worthy of recommendation. This was Heybook's 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 | £170 |



# IMF Super Compact II

IMF Electronics Ltd., Westbourne Street, High Wycombe, Buckinghamshire HP11 2PZ. Tel (0495) 35576

This complex but compact loudspeaker comes in a beautifully crafted enclosure with an excellent veneer finish. It comprises a full three-way damped reflex system of some 25 litres internal volume, and the foam filled bass port is unusually large, possessing an approximate effective area of 120cm$^2$. As a result port distortion should be inaudible.

The bass register up to 375Hz is handled by IMF's own 200mm ribbed cone bextrene driver, the midrange to 3.5kHz is covered by another IMF unit, in this case a 100mm bextrene cone type, and the ubiquitous 25mm Audax soft dome tweeter completes the line-up. The tweeter and midrange units are laterally disposed above the bass unit. The system is in fact supplied in matched 'mirror image' pairs, to improve the lateral symmetry balance at the central stereo listening position. The chipboard cabinet is damped by bituminous panels, and some eight elements (plus resistors) are used in the crossover network.

**Lab results**

Exhibiting good pair matching, the terminal sensitivity of the *Compact* worked out at an average 86dB/W, and this is complemented by a good impedance characteristic. Only dipping fractionally below 6.4 ohms at 3kHz, it rated as an easy to drive 8 ohm load; interestingly, the lower reflex peak was entirely suppressed on the impedance curve, thereby confirming the very high damping at the cabinet volume resonance. A −6dB rolloff of 50Hz was obtained which is typical of the size and efficiency, and with a power input ceiling of around 100W, an average 98dBA maximum sound level is obtainable from a pair under normal circumstances.

A smooth and well balanced response was obtained on the 1m axis, using sine excitation. Third harmonic distortion levels were low though second harmonic content rose to 2% at 8kHz. Low frequency distortions were under good control at this high sound level, but the 100W peak input clearly caused trouble at 500Hz, with an expansion of 0.15dB (definitely indicative of crossover overload), plus 4% of second and 1% of third harmonic distortion; results at 5kHz were fine.

Examination of the forward characteristic responses shows that the bass region was stepped down by 2dB relative to the unusually uniform midrange, while the off-axis response dispersion was good in the vertical plane (15° above), the latter if anything preferred to the axial trend. Measured in both left and right lateral 30° directions, the responses were dissimilar and were classed as just 'average' for uniformity.

**Sound quality**

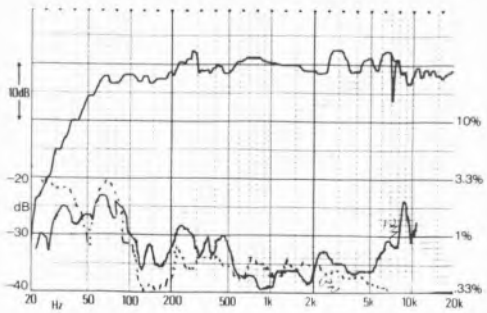
Scoring 'average' on the live sound comparisons, which is quite good for the price, the *Compact* demonstrated a remarkable power handling, tolerating 50W average or 250W peak of electric bass guitar with good evenness and clarity. Further up the band however the midrange was described as a trifle 'boxy', with some 'tunnel' and 'nasal' colorations, though it did exhibit a fair frequency balance.

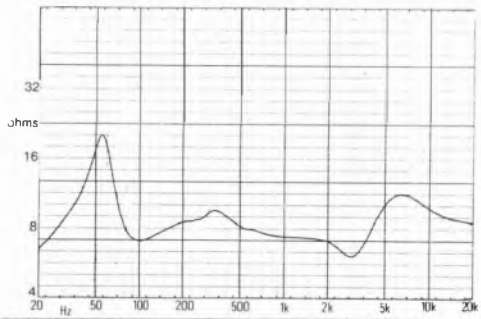
On stereo programme some 'hard' and 'loud' effects were noted in the midband with a blurring of fine detail. The stereo imaging was just average, exhibiting restricted depth and some mild anomalies in the central focus, while 'boxy' sounds were again commented upon.

**Summary**

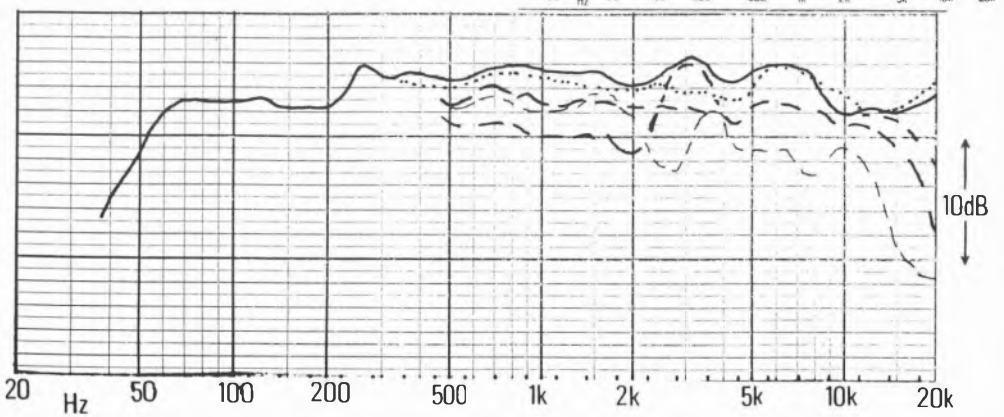
The *Compact* is worth considering, but overall, the subjective findings rather negate the obvious care that has been taken over its construction. It is a well designed product and possesses a reasonably extended as well as subjectively clean bass, but the end results lacked the stereo focus, clarity and aural cleanliness of the best examples in its price range, with the maximum sound level attainable restricted by the overall power handling.

*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).*



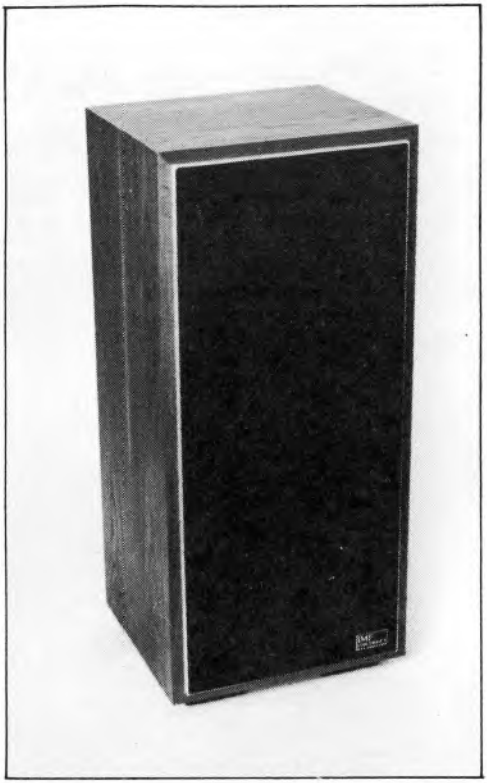




| | |
|---|---|
| Size (H, W, D) | 46, 28, 30 (18, 11, 12) cm(inches) |
| Weight | 10.5 (23) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–100W |
| Recommended placement | open shelf or stand |
| Frequency response within ±3dB (2m) | 55Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 50Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 86dB |
| Approximate maximum sound level (pair at 2m) | 98dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | acceptable |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | above average |
| Typical price per pair inc VAT | £205 |



# IMF TLS50 IIA

IMF Electronics Ltd., Westbourne Street, High Wycombe, Buckinghamshire HP11 2PZ. Tel (0495) 35576



This large floor-standing speaker comes complete with a special stand which tilts the system to produce the optimum forward axis for a normally seated listener. A complex and sophisticated system, the substantial internal volume is estimated at 82 litres and is partitioned to form a convoluted absorbent pipe or 'line', exiting via a large port on the lower section of the front panel. The port's large area (some 240cm²) ensures that no audible 'chuffing' should occur. The cabinet construction and general engineering quality is very good and finish excellent, the four drivers being arranged in a laterally asymmetric array. A special 200mm ribbed bextrene cone bass unit drives the 'line', and a 100mm bextrene midrange unit is loaded by its own absorbent tunnel. The treble is covered by two drivers, namely a 25mm soft dome Audax and an unusual 'super tweeter' from AKG. The complex high power crossover comprises 14 elements including two resistors, and divides the range at 375Hz, 3kHz and 15kHz. A response control fitted affects the 'presence' or upper-midrange.

**Lab results**

As anticipated from a medium efficiency (86dB/W) speaker of this size, the low frequency response was well extended, with the −6dB point charted at 34Hz. This unfortunately was achieved at the expense of a significant 6dB trough centred on 120Hz in the upper bass. With a calculated maximum power input of 150W per channel, a substantial 103dBA maximum level would be available from a pair, although notice should be taken of the 'poor' rating as regards amplifier loading. Typically measuring 8 ohms, the vital 0.6 to 3kHz range was close on 4 ohms which could compromise the maximum sound level obtained with a number of amplifiers. Considering the complex driver array, the pair matching was very good, and only deteriorated above 16kHz, with a 4–5dB discrepancy noted at 20kHz.

The distortion performance at 96dB was very good indeed, with excellent levels of third harmonic and insignificant second, particularly at low frequencies. The speaker was also entirely happy on the 100W nominal pulsed input, with compression held to 0.1dB at both test frequencies.

The ⅓-octave response at 2m showed that this speaker had an uneven performance with weak areas in the range below 500Hz, but great smoothness above. This was true on-axis and at 15° above the axis as well, but the lateral off-axis performance was only just acceptable, the left- and right-hand responses differing markedly from each other and from the axial trend. The provision of 'mirror image' pairs does not provide the complete answer to this problem.

**Sound quality**

The bass guitar power handling was very good, sustaining an average of 80W or some 200W peak with good extension, but some attenuation of upper bass harmonics was noted, producing a softened effect. Scoring an overall 'average' when compared with live sounds, the panel was unconvinced by the reproduction and yet found it difficult to pin down isolated faults, due to the system's smooth and integrated character.

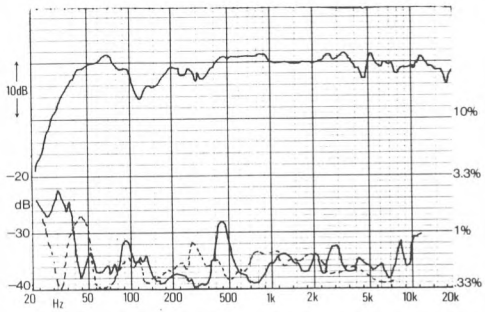
An average rating was also indicated on the

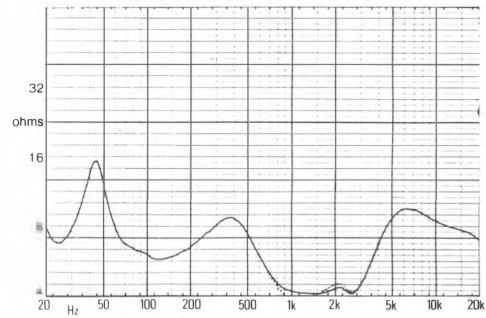
stereo sessions, where imaging proved unexceptional with a loss of central focus and restricted depth. While coloration in the obvious sense was under control, some residual masking of detail was apparent, with a hint of 'hardness' and 'harshness' in the midrange.

## Summary

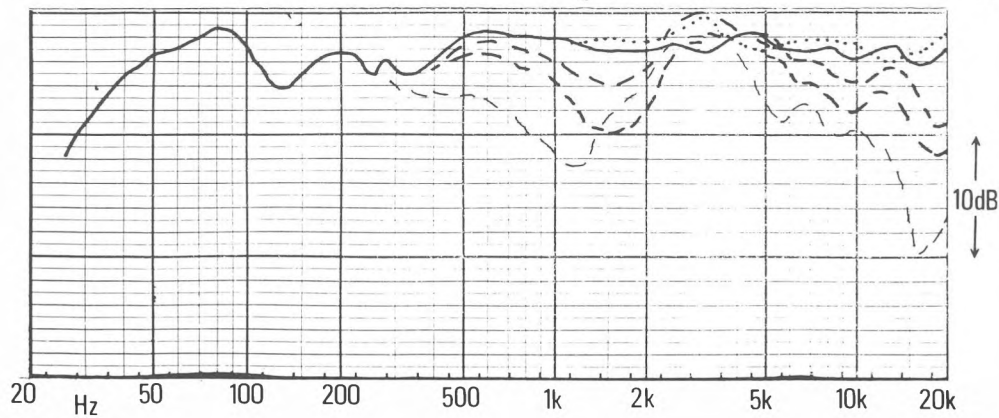
A large loudspeaker of extended bass and good power capacity, the *TLS50 II* did not present a very good amplifier load, and also possessed only moderate sensitivity. It was well finished and constructed and came with a matching stand, but despite the fine distortion results, the overall performance was unfortunately rather average. Since the price is fairly high, a recommendation is not appropriate.

*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).*



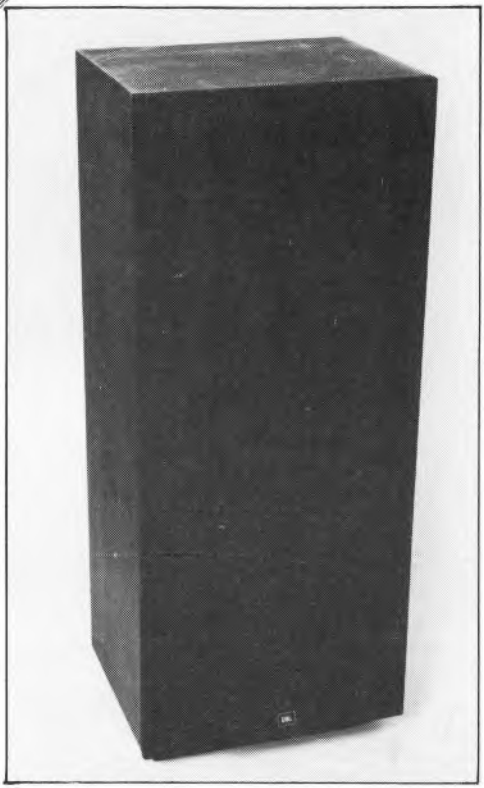

| | |
|---|---|
| Size (H, W, D) | 88, 35, 39 (35, 14, 15) cm(inches) |
| Weight | 27 (60) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–200W |
| Recommended placement | on stand supplied |
| Frequency response within ±3dB (2m) | 36Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 34Hz |
| Voltage sensitivity (ref 2.83V, *ie.* 1 watt in 8 ohms) at 1m | 86dB |
| Approximate maximum sound level (pair at 2m) | 103dBA |
| Distortion (96dB at 1m) | excellent |
| Distortion (100W peak) | very good |
| Impedance characteristic (ease of drive) | poor |
| Forward response uniformity | above average |
| Typical price per pair inc VAT | £520 inc stands |



RECOMMENDED

# JBL L150

Harman Audio UK Ltd., St. John's Road, Tylers Green, Buckinghamshire HP10 8HR. Tel (049 481) 5331



Since its original introduction, this imposing and costly floor-standing model has been subject to detail refinements, notably to improve the high frequency unit and the crossover.

Standing just over a metre high, the vertical driver line-up comprises a 305mm auxiliary low frequency radiator, plus a 305mm main bass driver, a 100mm mid unit and a 25mm dome tweeter. The three larger units have special impregnated pulp cones and the tweeter a hardened linen structure, with an aluminised coating. The auxiliary radiator reflex loads the 110 litre internal volume, the enclosure being constructed of dense chipboard with bracing and containing a fibreglass volume filling of good absorbent properties. Overall the standard of engineering and finish is very high, with the exterior veneered in a dark matt oiled walnut. Level controls are provided for mid and treble.

## Lab results

Of above average sensitivity at 89dB/W, the *L150* possessed a good 8 ohm impedance that can be fully exploited by amplifiers of up to 500W programme per channel. High sound levels – as much as 111dBA – are thus available from a pair, although as little as 10W would still provide a healthy 95dBA or so. As befits a large and costly model, the low frequency response was well extended, with the −6dB point charted at 33Hz. Pair matching was good with errors held to ±0.5dB except at the 1 and 6kHz crossover regions, where a −1dB error appeared.

This model sailed through the 96dB swept distortion test, displaying excellent levels of second and third harmonic, which even at 30Hz measured an aurally insignificant 3% (aurally insignificant that is in terms of such a low frequency). Some 3% of second harmonic distortion was generated on the 100W peak power input at 500Hz, but no additional third harmonic content was present, and at 5kHz the performance was excellent, showing less than 0.1dB of compression.

On axis at 1m with sinewave drive the speaker illustrated a wide and well balanced response, but with some minor irregularities at 1kHz and from 6–15kHz. ⅓-octave averaging at a 2m mike distance placed these in perspective, revealing the underlying energy trends. The bass was observed to be slightly 'dry' and gently tapering away, which is probably ideal for its floor mounted location; the mid-treble was pretty uniform, but the high frequencies rose somewhat above 15kHz. For a large speaker the off-axis dispersion pattern was remarkably good; assuming that coloration levels are low, this points to a stable and well-focused stereo image forming ability.

## Sound quality

A good rating was achieved when the *150* was compared with live sounds. Coloration was relatively low with a generally good frequency balance, but slight criticism was made of an uneven treble range as well as some loss of programme presence and a touch of mid-dominance. Bass power handling was superb, exhibiting great depth and precision and with the system sustaining an average of 250W of electric bass guitar without audible distress.

On the stereo tests, the sound was judged mildly hard with some 'boxiness' on piano, and a less than

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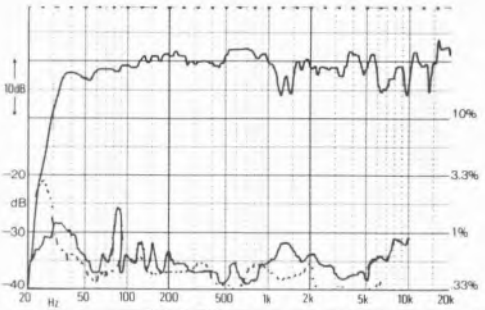
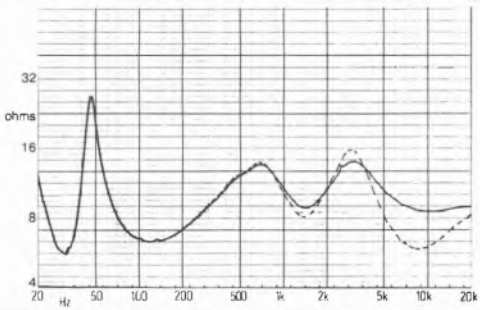
smooth high frequency range. Nonetheless good marks were accorded, with a high standard of image precision and a satisfactory depth impression, plus good clarity and attack. The bass was exceptionally deep and clean.

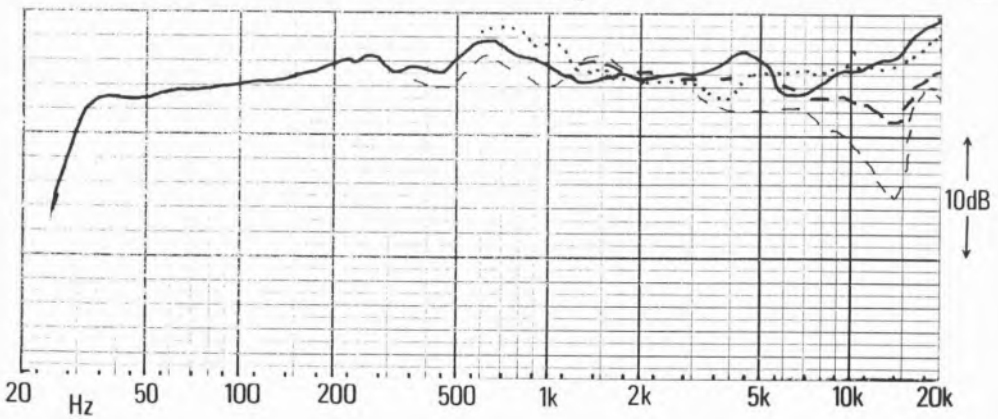
**Summary**

Although suffering from some transatlantic price penalty, the *L150* is still competitive and gives a good enough performance to merit recommendation. Factors such as its great power handling and exceptional bass, plus its sensitivity, easy amplifier loading and general level of performance all contribute to its success.




| | |
|---|---|
| Size (H, W, D) | 105.4, 43, 33 (41.5, 17, 13) cm(inches) |
| Weight | 36 (79) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 100–500W |
| Recommended placement | floor |
| Frequency response within ±3dB (2m) | 35Hz–18kHz |
| Low frequency rolloff (−6dB) at 1m | 33Hz |
| Voltage sensitivity (ref 2.83V, *ie* 1 watt in 8 ohms) at 1m | 89dB |
| Approximate maximum sound level (pair at 2m) | 111dBA |
| 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 | £1,000 |



RECOMMENDED

# JR Metro

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

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

**Lab results**

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

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

On axis at 1m the response, while generally smooth and balanced, showed signs of slight lumpiness on occasion, while the low frequency 100–500Hz range was a little subdued – again more suited to shelf mounting. Averaged over 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

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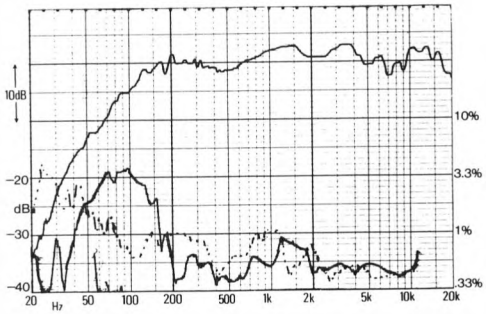
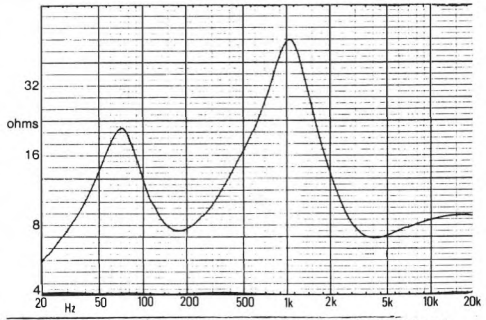
listening to a 'miniature', but it nonetheless did quite well overall.

**Summary**

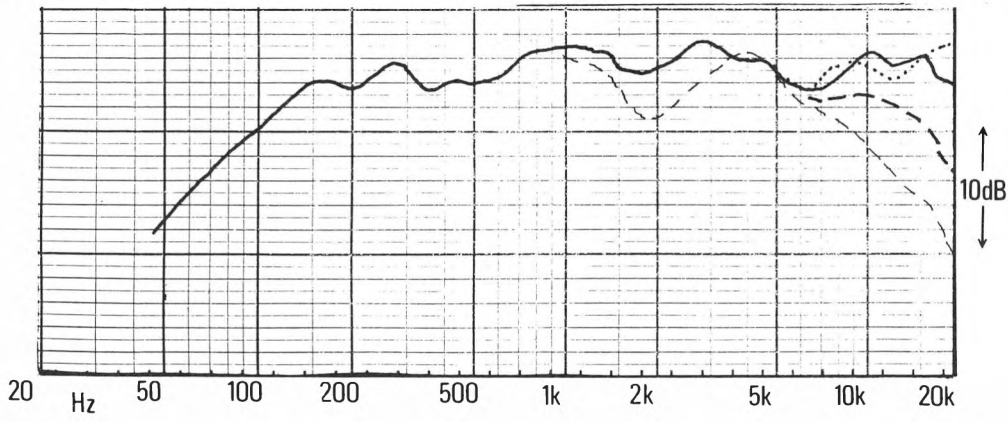
Irrespective of its size the *Metro* has done pretty well at the price, and is a well made and finely finished model, possessing moderate levels of coloration and a natural frequency balance. However its small dimensions do impose significant limitations in terms of sensitivity, power handling, bass 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 2.83V, *ie:* 1 watt in 8 ohms) at 1m. | 83.5dB |
| Approximate maximum sound level (pair at 2m) | 97.0dBA |
| Distortion (96dB at 1m) | good |
| Distortion (100W peak) | very good |
| Impedance characteristic (ease of drive) | very good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £110 |



RECOMMENDED

# JR 149

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

A frequently reviewed loudspeaker, the cylindrical *149* was examined in an early form in the first edition of *Loudspeakers*. Minor manufacturing improvements have since been put into effect, together with the introduction of an optional accessory, namely a sub or 'super' woofer. This, in the manufacturer's own words is intended to realise 'an accurate extension of bass response (30Hz to 120Hz) while the main system, relieved of the stress of extreme bass reporduction, gains in terms of distortion and power handling'. This review originally incorporated the first passive subwoofer system, which was something of a disappointment. The current version has now been assessed separately, and happily has shown distinct improvements.

**Technical details**

Formed from heavy gauge aluminium sheet, this rigid sealed enclosure uses thick particle board end caps with tensioning. The driver line up is similar to that used in the LS3/5A, using a KEF 110mm bextrene cone bass-mid and a 19mm plastic-dome treble unit. The crossover is also related to the 3/5a, although with a lower 3kHz changeover frequency. The cylindrical profile almost guarantees an excellent lateral dispersion.

**Lab results**

While matching was very good at within 1dB up to 11kHz, a 2dB discrepancy was noted above this frequency. Sensitivity was very low at 83dB, necessitating a decent minimum amplifier rating of at least 25-30 watts for satisfactory sound level. The low frequency range was quite extended at -6dB, 45Hz and the rolloff was quite slow. The *149* was also easy to drive with a minimum impedance of 7 ohms.

At an understandably modest 90dBspl the 149 gave very good third harmonic levels — at or below 0.5% distortion above 70Hz and a moderate 2.5% at 50Hz. The *149* demonstrated an even, well balanced response at 1m, albeit with some treble uneveness.

At 2 metres the average characteristic curves show a similarly good result. At 10° above axis a 5dB suckout appears at 5kHz, suggesting that the speakers should be at ear level or angled to direct axially. A superb 30° off axis response was also apparent.

**Sound quality**

On its own the *149* achieved an 'above average' sound rating — a fine result considering its quite modest price. An acceptably loud 98dBA maximum sound level was achieved, and though loud electric bass guitar was not within its capability, moderate levels of 10-15 watts average were tolerated.

The stereo image quality was of a high standard with good depth and spatial location. On the stereo programme tests the speaker fared well, with only mild degrees of coloration observed; notably tubby voice, and sibilance, together with 'tubey' and 'nasal' effects. The balance was felt to be a trifle hard and yet somewhat dulled.

On the live sound comparisons it did not score as well (this result in contrast to a similar test in HFP some 30 months before). Reinforcing the slightly dulled impression gained on the live

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tests, the comments ranged from 'muffled' to 'hollow', with again a slightly 'tubby' voice.

**Summary**

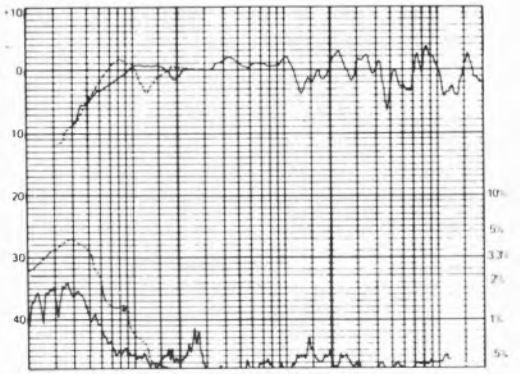
Despite a low sensitivity and low power handling capability, the *149* continues to score an impressive line of ratings.

| | |
|---|---|
| Size | 37(14.5)H; 23(9)W; 23(9)D; cm(inches) |
| Weight | 5.5(12)kg(lb) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 30 to 100W |
| Recommended placement | stand |
| Frequency response within ±3dB (2m) | 80Hz to 20kHz |
| Low frequency roll-off (-6dB) at (1m) | 45Hz |
| Voltage sensitivity (ref 2.83V, ie, 1 watt in 8 ohms) | 83dB at 1m |
| Approximate maximum sound level (pair at 2 metres) | 98dBA |
| Third harmonic distortion (96dB at 1 metre) | v. good* |
| Impedance characteristic (ease of drive) | good* |
| Forward response uniformity | v. good |
| Typical price per pair inc VAT | £145 |

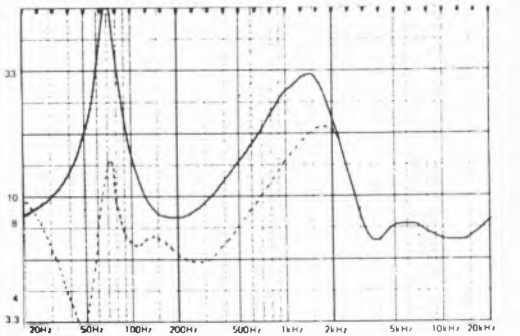
*See text

*distortion measured at 90dB*

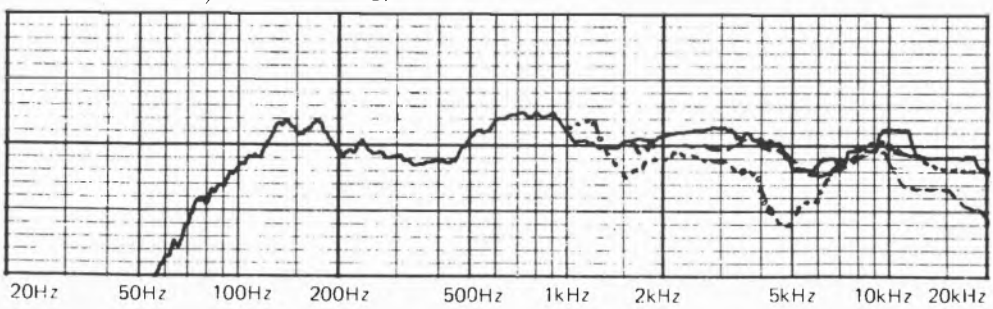
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref 0dB.)
(Ignore dotted curves).




below: impedance *vs* frequency (mod Z).
(ignore dotted curve).

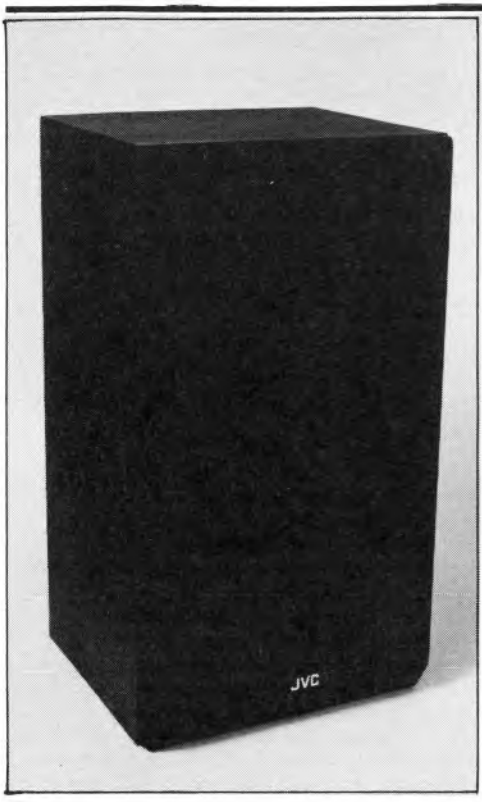



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horiztontal) vertical scale 1dB/div.



# JVC Zero 5

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




This well-built and impressively presented speaker was supplied with an information pack outlining the advanced technology employed in its design. Such features include a high sensitivity twin ribbon tweeter whose total radiating dimensions are similar to the infinity *EMIT* at 10 x 52mm, and computers have been used to plot the waveform propagation from the drivers as well as the diaphragm motion of the 100mm cone/dome mid-range unit. System crossover frequencies are set at 500Hz and 5kHz, this 50 litre enclosure being reflex loaded by two excessively long and bent tunnel ports, which possess an unfavourable length to diameter ratio, their 57mm apertures backed by an overlong 300mm duct.

The overall engineering was to a good standard, with an interesting curved deflector behind the bass radiator to break up standing waves. Unfortunately the grille form was likely to worsen diffraction effects and although the literature promised good response curves, we were unable to match these one hundred per cent.

**Lab results**

The overall pair matching was good, being held to within ±1dB. A high 94dB/W sensitivity was recorded with a −6dB point at a satisfactory 63Hz, and the distortion was excellently low, as is often found with high sensitivity models. (In fact third harmonic distortion is often proportional to input power and not to sound pressure levels.) Never exceeding 1%, the values for the *Zero* 5 were typically in the region of 0.3%. Power handling was correspondingly large, the system attaining a deafening 107dBA for a 200W/channel programme input, and on bass guitar alone it withstood a massive 150W program, suggesting discothèque applications!

Though specified as an 8 ohm model, the impedance dipped to just below 5.5 ohms at 100Hz or so, denoting an 'average' amplifier load rating. The curve revealed the strange tuning of the enclosure: whereas the closed box system resonance is at 60Hz, the speaker is not actually reflex tuned until a low 20Hz.

The axial response of this costly design was also worrying, and made it difficult to characterise trends in the normal sense of the word. A relatively early bass rolloff, a suckout at 200Hz and irregularities from 1–4kHz were all apparent, as well as an erratic treble range thereafter. The situation was a little improved at 2m, helped by the more forgiving nature of ⅓-octave averaging. The bass range was revealed as an isolated region around 80–150Hz with the 630Hz–1.3kHz mid-range also dominant. A serious energy loss was apparent from 2–5kHz, with the higher frequencies exposed as a prominence centred on 10kHz. The off-axis dispersion was also potentially unpromising with the 15° vertical output much poorer than average (in fact the 30° lateral curve was no worse). Clearly the system axis should be at ear level.

**Sound quality**

An 'average' ranking was denoted by the live sound comparisons, with a good power handling on bass guitar. The bass quality was judged somewhat muddled and 'boomy', and the overall sound as 'boxy', 'hard' and 'dull' to a noticeable degree.

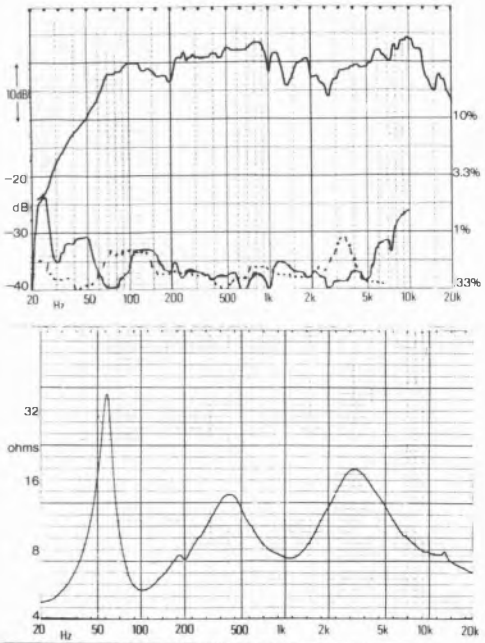
Virtually no improvement was evident on the stereo programme tests, and unfortunately nearly

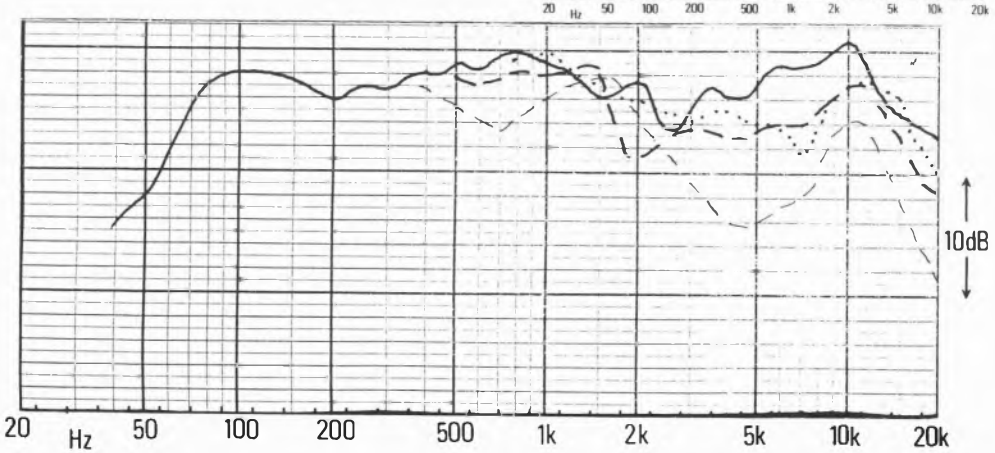
all the coloration characterisations given as guidelines to the panelists were applied to some degree, including 'hollow', 'cuplike', 'nasal', 'honky', 'fizzy' and 'hard'. Stereo imaging was reasonably good with fair lateral dispersion and stability.

**Summary**

This model was reviewed in the last issue, where it did rather badly, exhibiting clear crossover integration problems. JVC indicated their belief that such a performance was atypical of current production (some fifteen months later) and offered a new pair for retest. Those who can compare the current results with those in the last edition may verify that it is in fact much improved. Possessing an essentially average sound quality at an above average price, it nonetheless offers a high sensitivity sufficient for amplifiers down to 5 watts per channel, and it can also produce high sound levels. It misses recommendation but was worth retesting in the light of the almost hopeless performance of the original samples.

*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).*

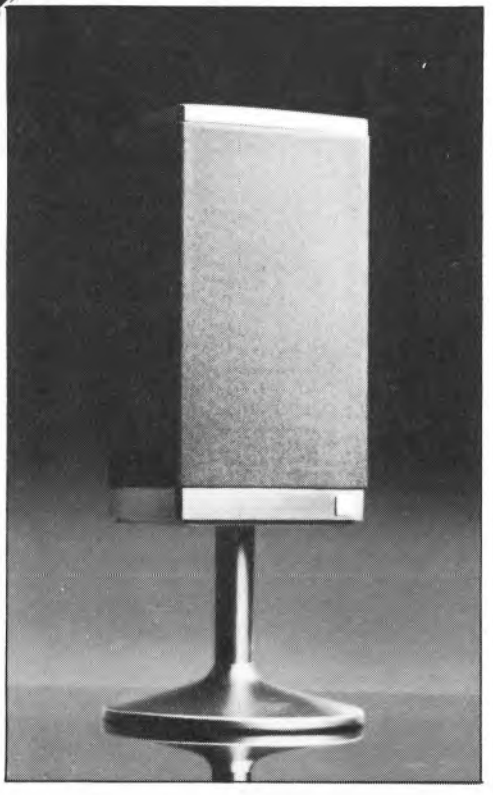


BEST BUY

# KEF Celeste III/IV

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



The original *Celeste* was a slim bookcase model which by today's standards contained the unlikely combination of a *B139* 13 x 9 inch wedge diaphragm woofer, and a version of KEF's still current 52mm high frequency unit. Now in *Mark III* form, the new speaker bears no resemblance to the old, and comprises a vertically oriented enclosure wrapped in black fabric, with a small matt finish plinth which contains the crossover and a special socket for accepting the pillar stand directly. While rather sombre, the whole has a tidy appearance and is well finished, the stand fitting firmly into the special base. Internally the system comprises the grille-protected version of the Audax 25mm soft dome tweeter selected for its efficiency, while KEF's own new 200mm doped pulp cone unit covers the bass/midrange, working in a sealed box volume of about 20 liters. With a five-element crossover of good quality, the enclosure contained some acoustic absorption material, but no panel damping.

**Lab results**

In general the *Celeste* offered an excellent pair match to 4kHz, above which there were 1dB differences of a minor nature. The voltage sensitivity was about average, although usefully above that offered by comparable bextrene types, and in no way compromised by the impedance; never falling below 7 Ohms, this was typically 12 ohms, and thus represented a good amplifier load. The -6dB bass rolloff was measured at 55Hz. Rated as very good on third harmonic distortion — particularly so for a small box — the results were typically in the 0.2-0.3% region, with fine values of 1%, 100Hz and 3%, 65Hz. Power handling was considerable, and up to a 100dBA sound level could be generated, the system accepting comfortably 250W/channel on rock program and some 35W on solo bass guitar.

Measured on axis at 1m, the response met +/-3dB limits from 65Hz-20kHz, though it was not without some mild mid prominence from 250-550Hz, coupled with a presence loss and a rather lumpy treble. Moving out to 2m, the curve showed better integration, though the treble range remained uneven with a prominent 12-16kHz region. The poorest off-axis response was that taken 10° below axis, reflecting a listener position that is unlikely to be adopted with this small enclosure if stand mounted. At 10° above excellent integration was demonstrated on the vertical axis, while the 30° off-axis lateral curve was also good; in fact, the response overall was pretty flat for the price.

**Sound quality**

The Celeste was promisingly consistent over the range of live sound comparisons bearing in mind the price level involved, and it scored an 'average' rating. Possessing a slightly 'presence dull' and moderately 'boxy' character, coupled with a trace of 'edginess', in practice the panel made only mild criticisms of the sound, while the bass register was felt to be firm and reasonably well defined.

Stereo program with a much wider frequency range resulted in a similar 'average' rating. It scored quite well on grounds of clarity, and while some loss of depth was apparent, most panelists

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thought the lateral stereo was to a good standard. Despite characterisations of boxiness, wiriness and a mid emphasis, the sound was not considered unpleasant.

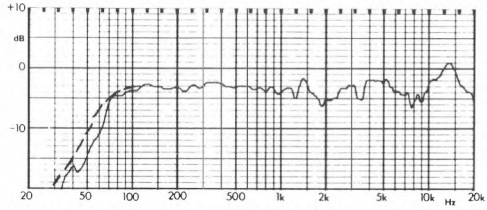
**Summary**

Of modern appearance, this compact and well finished speaker offers a clean bass register and good clarity, as well as an easy amplifier load and good dispersion in the forward plane. Maximum sound levels were high, third harmonic distortion very good and although the sensitivity was fairly low, it was nonetheless usefully above average for this size of enclosure. The overall sound quality was essentially average but the price was well below the group mean, and as such, the *Celeste* is worthy of recommendation.

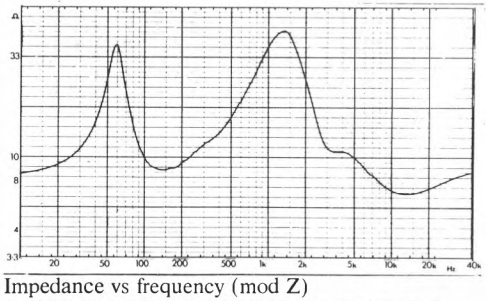
**Update**

Our comments regarding the sombre appearance have clearly been taken to heart, as the acoustically identical *Celeste IV* has now arrived offering two colours in moulded end plates and no less than seven alternative grille 'sleeves', which may be swopped to match room decor.

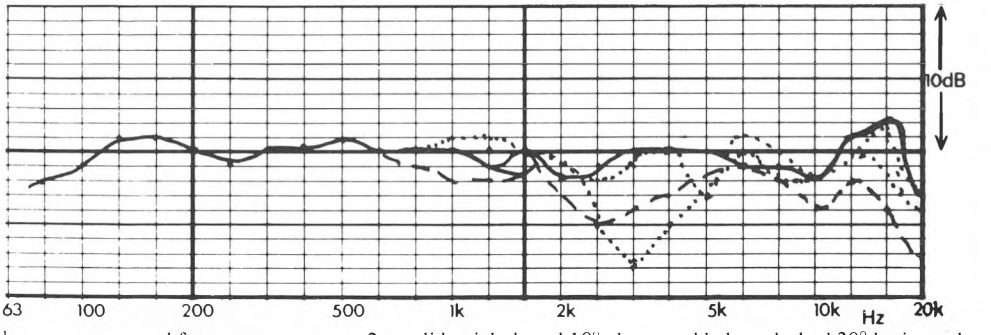
| | |
|---|---|
| Size | 50.5(20) H; 26.5(10.5) W; 23(9) D; cm(inches) |
| Weight | kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 15-200W |
| Recommended placement | on matching pillar stands or open shelf |
| Frequency response within ±3dB (2m) | 63Hz to 20kHz |
| Low frequency rolloff (—6dB) at (1m) | 55Hz |
| Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) | 87dB/W at 1m |
| Approximate maximum sound level (pair at 2 metres) | 100dBA |
| Third harmonic distortion (96dB at 1 metre) | v. good |
| | 65Hz-3%, 100Hz-1%, 500Hz-0.15%, 2kHz-0.6%, typically 0.2-0.3% |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | v. good |
| Typical price per pair inc VAT | £120 |




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



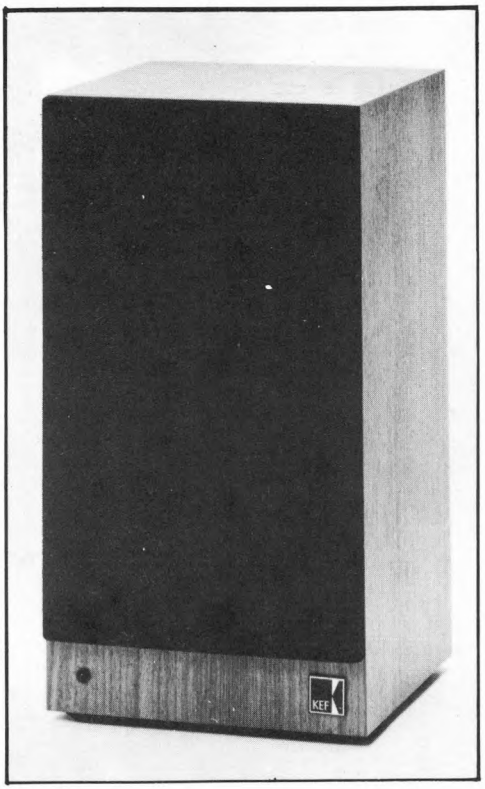

Impedance vs frequency (mod Z)




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

# KEF R101

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



As this brand new model is similarly proportioned to the established BBC *LS3/5a,* comparisons are perhaps inevitable, the more so when it is realised that KEF make the drive units for both systems. They share a common tweeter, the *T27,* but the *R101* uses a new design of 110mm bass/mid driver, with a shorter coil and improved roll termination. Other special features include an advanced electrical protection circuit which computes voice coil temperatures and overload conditions, acting to cut back power until overdrive is reduced. A flexible mounting for the bass unit is also employed, to control a specific driver/cabinet coloration. The 6.7 litre plywood enclosure is filled with polyester wadding and the complex crossover contains 13 elements plus a total of 400$\mu$f in series with the bass arm to provide the third order low frequency response target. Close tolerancing and fine engineering were evident throughout.

### Note

Our samples were taken from the first 50 pairs produced, and during our tests KEF pointed out that the bass driver may have been too firmly tightened on the flexible gasket, thus impairing its function. Accordingly we were able to audition a second pair briefly. All measurements however relate to the original samples supplied. For the current edition new samples were supplied, examined, and auditioned. Results throughout were so similar that little revision to the text was necessary.

### Lab results

The pair match was excellent, typically +/− 0.25dB, which thus justifies KEF's computer grading policy. Sensitivity was also exactly on target at a very low 81dB/W, while the −6dB point at 60Hz was quite low for a speaker this size. Driven to 96dB (high for a small box, but good power handling is claimed), the third harmonic distortion was rated as very good. Even the 3% recorded at 70Hz was fine, it being typically 0.3% elsewhere. Incidentally, quite correctly, during this test the protection circuit engaged, operating on continuous sine wave inputs of greater than 7W, ref 8 ohms. On power handling the *R101* survived 35W of solo bass guitar and some 200W peak of wideband programme, the low efficiency restricting the maximum level to some 96dBA per pair at 2m. The impedance curve essentially illustrates a 9 ohm speaker, thus rating the *R101* as a comfortable amplifier load.

On axis the curve at 1m did not meet the provisional +/−2dB specification (defined in fact for a 2m measuring distance), as −3/+4dB limits were required to contain the range from 80Hz to 20kHz, this referred to the 81dB line. The treble range was however as anticipated. At 2m with $^1/_3$-octave averaging the curve looked better, though the moderate treble uneveness was still apparent. The off-axis curves were excellent with the response in the 10° below position still satisfactory, while all the other curves tracked within 1.5dB of the axial frequency response.

### Sound quality

With so much good engineering going for it, the

results of the listening tests were rather disappointing, and this was true of both pairs evaluated.

On both live sound comparisons and the stereo test sequences a just 'average' rating was calculated. It was difficult to condense the panel comments, but essentially on the live tests they criticised the *R101* for a 'tubby' 'small box' sound, with some 'fizzy' and 'nasal' effects, the whole somehow lacking in authority.

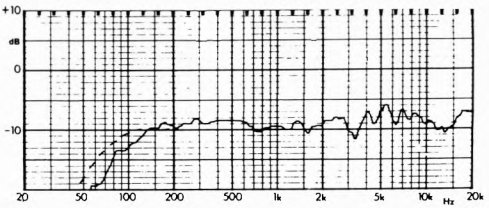
On the stereo programme the clarity was quite good, but stereo depth and space were deficient, even though the lateral placement was very precise. A sibilant thin quality was noted, with a boxy rendition of piano. The second pair did appear less coloured than the first, however, reflecting the softer fixing tension of the bass driver, presumably to the correct design specification.

**Summary**

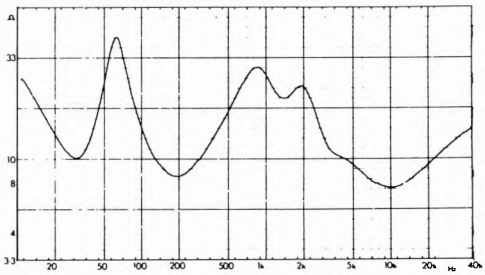
Despite a good technical performance, this diminutive and inefficient speaker possessed a balance of response and coloration which resulted in far less favourable subjective results than for its established relative, the *LS3/5a*.

Nevertheless it must be said that an average subjective rating is no disgrace for such a compact system, and the power handling as well as the protection systems were certainly unusual. An audition is thus worthwhile, as the *R101* certainly merits consideration, though the subjective panel findings were again insufficient to place this model amongst the recommended miniatures.

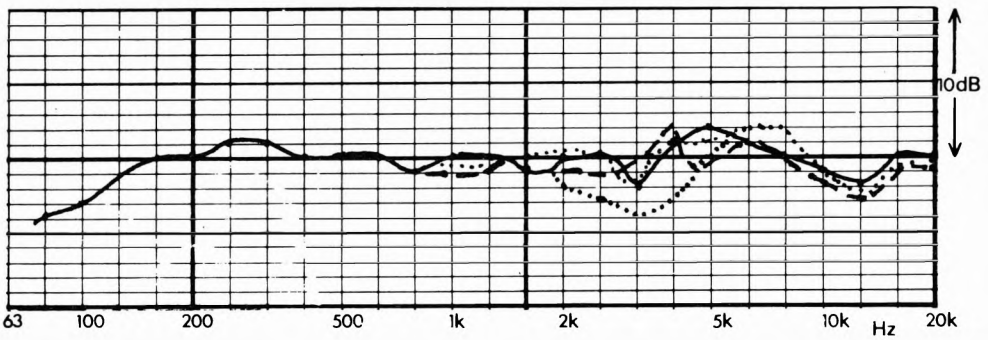
| | |
|---|---|
| Size | 34.5(13.5) H; 18(7) W; 19(7.5) D: cm(inches) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 50-100W |
| Recommended placement | on stands or open shelf |
| Frequency response within ±3dB (2m) | 80Hz to 20kHz |
| Low frequency rolloff (−6dB) at (1m) | 60Hz |
| Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) | 81dB/W at 1m |
| Approximate maximum sound level (pair at 2 metres) | 96dBA |
| Third harmonic distortion (96dB at 1 metre) | v. good<br>70Hz–3%, 100Hz–1.2%, 700Hz–0.3%, 7kHz–0.3%, typically 0.3% |
| Impedance characteristic (ease of drive) | v. good |
| Forward response uniformity | v. good |
| Typical price per pair inc. VAT | £185 |




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




Impedance vs frequency (mod Z)

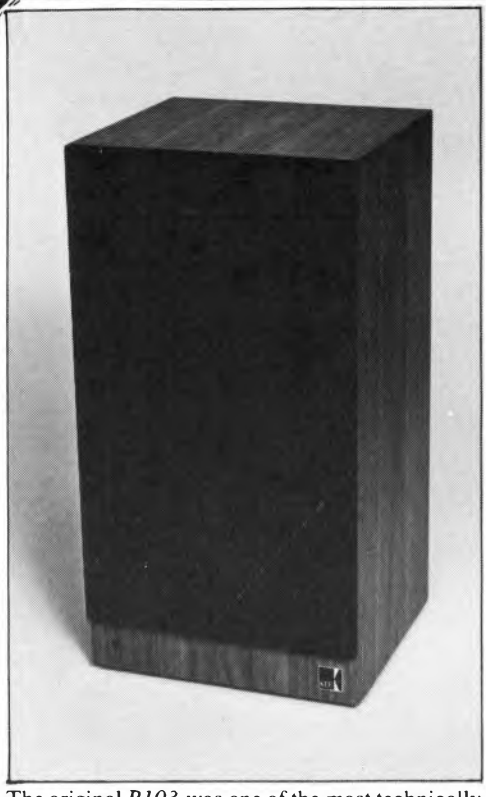



[1]3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

BEST BUY

# KEF R103.2

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



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

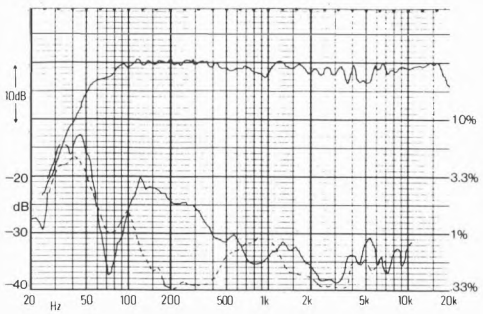
Scoring average on the live sound comparisons, the system was judged to have a mildly 'thickened' character, exhibiting some 'boxiness', and alternatively described as insufficient openness in the presence range. The bass was however fine with surprising depth and evenness, and it withstood 80W average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

BEST BUY

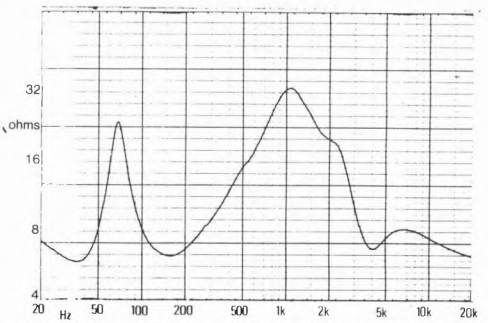
Piano and full orchestra were very well reproduced, and stereo imaging was to a good standard; the speaker tended to 'grow on' the panel slightly during the proceedings, which is an encouraging sign.

*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).*

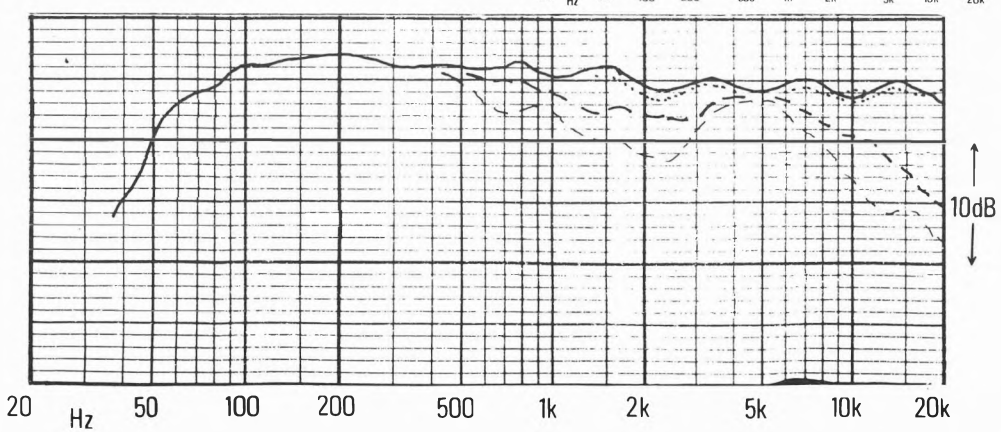



**Summary**

The *R103.2* was a strong performer, taking into account its above average sound quality and good stereo, plus its smooth slightly rich perspective and reasonable sensitivity. It also offered excellent power handling, moderate distortion, and surprising bass for its size. If the very good finish and engineering are taken into consideration as well as the comprehensive electronic protection, this is clearly the recipe for firm recommendation at a typical £250 a pair.




| | |
|---|---|
| Size (H, W, D) | 50.6, 26.5, 25 (20, 10.4, 10) cm(inches) |
| Weight | 8.6 (19) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–200W |
| Recommended placement | open shelf or special stand |
| Frequency response within ±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 | £255 |



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°.

**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.

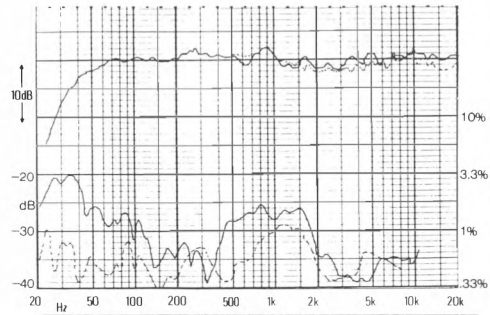
On the stereo tests the imaging was probably the

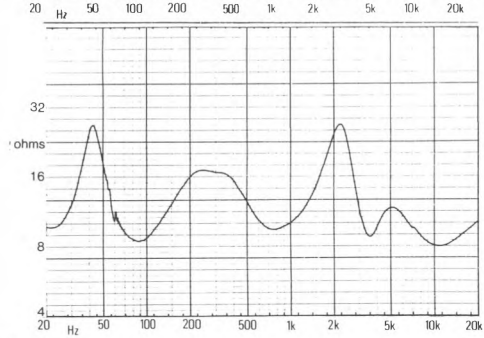
# KEF R105.2

(fully re-assessed)

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.

*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).*

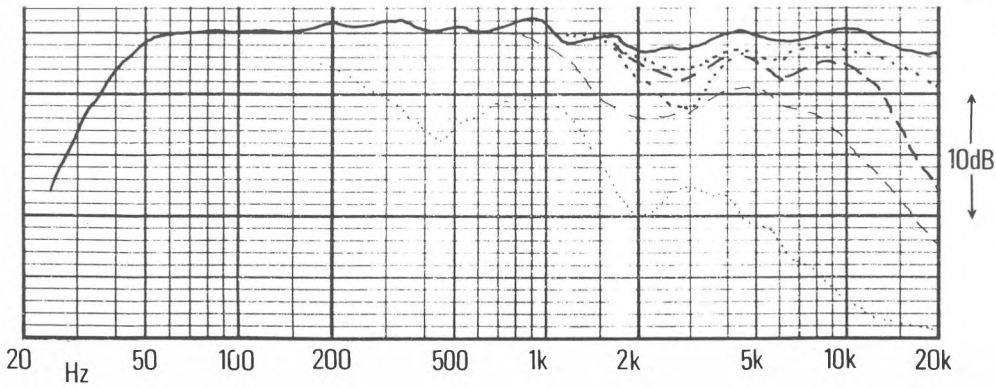



## Summary

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

| | |
|---|---|
| Size (H, W, D) | 96.5, 41.5, 45.5 (38, 16.3, 18) cm(inches) |
| Weight | 36 (80) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–300W |
| Recommended placement | floor |
| Frequency response within ±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 |



BEST BUY

# KLH 317

Webland International Ltd., 4 Cromwell Place, London SW7 2JJ
Tel 01-584 7735


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.

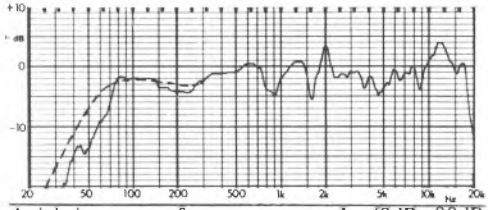
**Summary**

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.

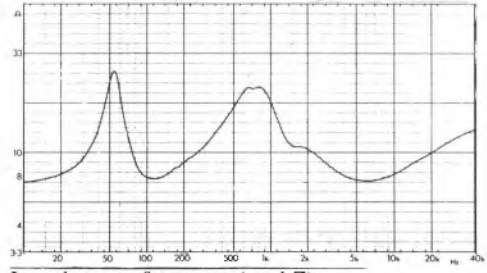
Essentially the *317* offered trim dimensions, a good appearance and high maximum levels, as well as usefully high sensitivity and a very good amplifier loading. The sound was generally neutral and relatively free of coloration, with clean, powerful bass and low distortion — all at attractive price. 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.

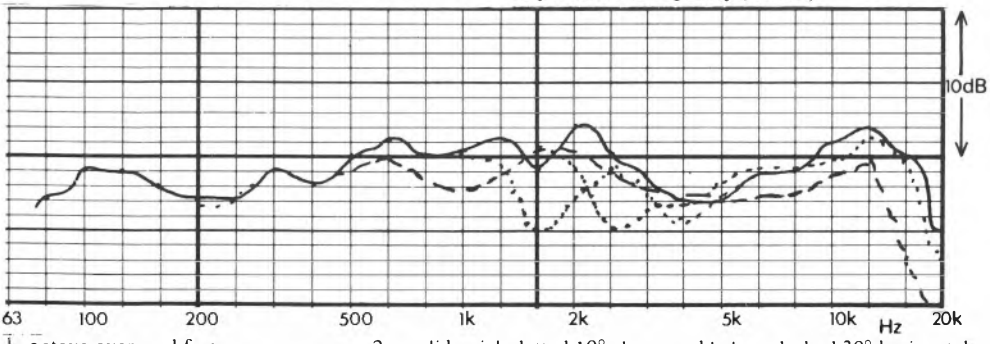
| | |
|---|---|
| Size | 58.5(23) H; 30.5(12) W; 25(10) D; cm(inches) |
| Weight | 13.2(29) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 10-100W |
| Recommended placement | stand or open shelf |
| Frequency response within ±3dB (2m) | 80Hz-18kHz |
| Low 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 | £150 |




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

# KLH 3

Webland International Ltd., 4 Cromwell Place, London SW7 2JJ
Tel 01-584 7735

Providing a strong contrast to the other KLH system in the report the *3* is twice the price and one-third the size of the *317*, and instead of the latter's 250mm pulp bass/mid cone, uses a 160mm polypropylene driver with a massive magnet; high frequencies are handled by a 25mm fabric dome tweeter. The crossover divides at 3kHz, *via* a rather simple three-element (plus one resistor) network.

As you will have guessed by now the *3* is the product of a different design philosophy which embraces the quest for low coloration, and more specifically a technique to produce a quart bass sound from a pint pot. The *3* is the smallest of a range of several such models and comprises an over-damped reflex tuned system designed to accept considerable bass boost from a matching equaliser at low volume levels, in order to achieve an extended bass. Necessarily possessing limited power handling, an analogue computer circuit in the equaliser progressively backs off the bass extension with increasing sound level. Hopefully this maintains a sufficiently low distortion level to defy subjective criticism, and relies for its effect upon the ear being comparatively sluggish in detecting a low frequency bandwidth varying with programme dynamics.

**Lab results**

With a sixth-order frequency alignment, the enclosure is tuned to a low 38Hz, the equaliser bass lift effectively altering the apparent impedance at low levels, depending on the degree of boost. Equalisation aside, the *3* comfortably rated 8 ohms, and was easy to drive. The terminal sensitivity was fractionally higher than claimed at 86dB/W, and the pair matching was quite good – to within 1dB overall. The grille did not significantly affect the responses.

Three low frequency possibilities are demonstrated by the 1m axial reference curve. The first shows the system without the equaliser switched in, and with a −6dB rolloff at about 70Hz. At a 90dB s.p.l. – equivalent to a typical room loudness of around 85dBA – the equaliser extended the response to 50Hz, and the distortion results refer to this main curve and not the higher 96dB s.p.l. used for most of the other speakers in the group. If the sound level was reduced to a rather modest 70dB 1m, a further extension in response occurred, with the −6dB point at just under 40Hz.

The axial response was quite good to 1kHz, above which point the output was rather ragged, with ±5dB peak-to-trough limits. At 2m the ⅓-octave characteristic did not greatly smooth the output, which was clearly rather lumpy. Crossover integration was weak, as the divergent off-axis responses indicated, the 15° above direction being preferable (*ie* speaker sited a little below ear level). Mid distortion was low, but even at 90dB the second harmonic had reached 8% by 100Hz, a level which I suspect is audible. The 100W peak input was however excellently handled both at 500Hz and 5kHz.

**Sound quality**

The *3* scored a straight 'average' throughout the listening sessions – no disgrace at its average price, and in fact a fair result in view of its size. Compared with life it sounded a little 'boxy' with a 'ringing' upper treble and a 'hollow', dulled presence range. Some port 'chuffing' was audible on the electric bass programme, and to put it kindly the bass itself was

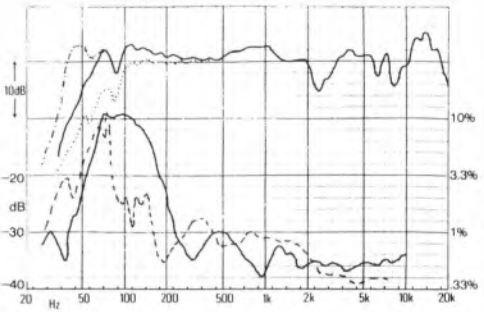
rather odd on percussive material, though the speakers did give a passable imitation on sustained organ notes, where the volume attainable belied the speaker's size.

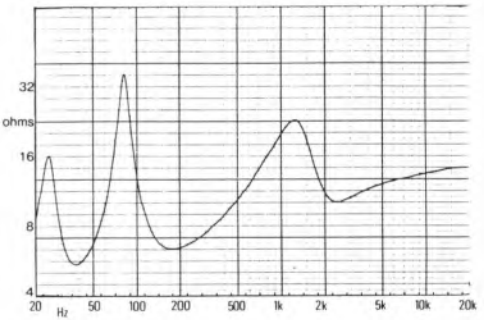
The uneven output did not help the stereo perspectives, and there was a 'peaky' upper range, and a loss of positional focus. Occasionally lumpy, the bass was sometimes convincing but was almost as often caught out. Coloration levels were just average.

**Summary**

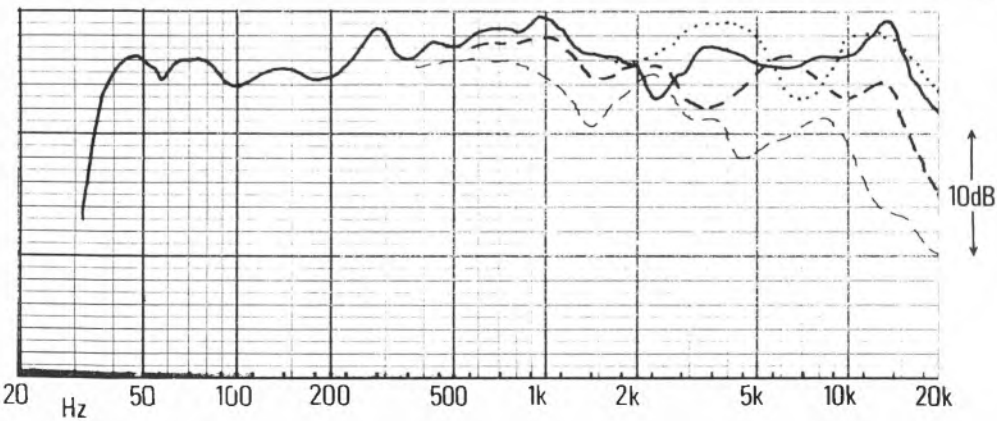
There are indications that with the larger systems the computer bass system could be effective, but the *3* was just too small for it to be successfully applied. Its crossover design was rather primitive, and the responses and integration should have been better, as the drivers themselves have good potential. An interesting design, the *KLH 3* is not however good enough to merit recommendation.

*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) | 32, 22, 15 (12.5, 8.5, 6) cm(inches) |
| Weight | 8 (17.6) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–100W |
| Recommended placement | open shelf or stand |
| Frequency response within ±3dB (2m) | 38Hz–18kHz |
| Low frequency rolloff (−6dB) at 1m | 38Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 86dB |
| Approximate maximum sound level (pair at 2m) | 101dBA |
| Distortion (96dB at 1m) | acceptable |
| Distortion (100W peak) | very good |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | above average |
| Typical price per pair inc VAT | £270 |



RECOMMENDED

# Lentek S4

Lentek Audio Ltd., Edison Road Industrial Estate, St. Ives, Huntingdon, Cambridgeshire PE17 4LE. Tel (0480) 62225

On first appearance this small UK built loudspeaker may seem rather expensive, but a closer look indicates that more than usual care is taken in its manufacture, and this is naturally reflected in the price. Specialist stands are available to position the speakers at the optimum height, and a useful instruction book is also provided. The superb finish is in American walnut, and the Company offers a 3 year guarantee.

**Technical details**

The *S4* is a two-way sealed box, again using drive units from Son Audax. A 200mm bextrene cone bass-mid range unit (specially modified) operates up to 2.5kHz, with a selected 25mm fabric-dome tweeter continuing the range to 20kHz. A complex 10-element close-tolerance crossover divides the signal spectrum with 18dB/octave slopes. The enclosure is rigidly constructed and carries damping panels.

**Lab results**

An excellent pair match was demonstrated, within 0.5dB throughout. Sensitivity was comparatively low at 84.5dB, with a −6dB, 47Hz LF cut off, the latter corresponding with the fairly high 65Hz system resonance. Driven to the full 96dB test level, and despite the high power input this required, the third harmonic distortion remained at the 'excellent' level over the whole range above 80Hz. More usual figures were recorded at lower frequencies; for example, 3% at 50Hz.

With an impedance value of typically 9 ohms, which never fell below 7, the *S4* is classified as easy to drive. At 1 metre, under sine wave drive, it demonstrated a very even response, which met +1, —3dB limits, 50Hz-20kHz.

At 2 metres a small hump at 700-800Hz was evident, but apart from this, the forward dispersion characteristic was commendably uniform, with excellent integration demonstrated over the 30° lateral and 10° vertical off-axis curves. The output rolled off a little above 13kHz; for example, at 30° off-axis the 20kHz point was 8dB down. The LF characteristic was very even and reasonably extended for this size of enclosure.

**Sound quality**

This model's basic neutrality and lack of distinctive character (in the most positive sense), made it a logical choice for one of the control checks used for frequent repetition in the test sequence. Throughout, it consistently ranked 'above average' overall.

Its 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

# Lentek S4

(revised and reprinted)

sounds were rather hard at this volume. Generally speaking, in comparison with live sound, it was a trifle bright.

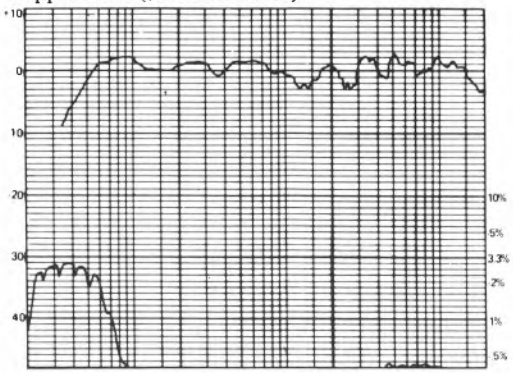

## Summary

This design packs an attractive performance into a small box. The clean and consistent lab results and above average structural quality indicate skilful production engineering, and while it is incapable of very high sound levels, at volumes within its compass a clean, wide-range sound is produced. It clearly gains a recommendation, albeit at a price.

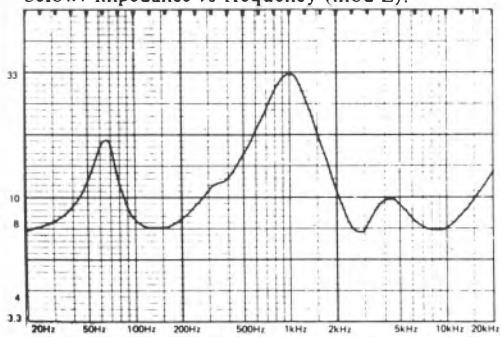

## Note

As we went to press we received samples of a modified *S4*, which gave greater transparency and less coloration, but at a higher price of £295 typical. Tentatively, and in the absence of full test data, the price rise would appear to be justified, and the design should continue to merit recommendation.

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

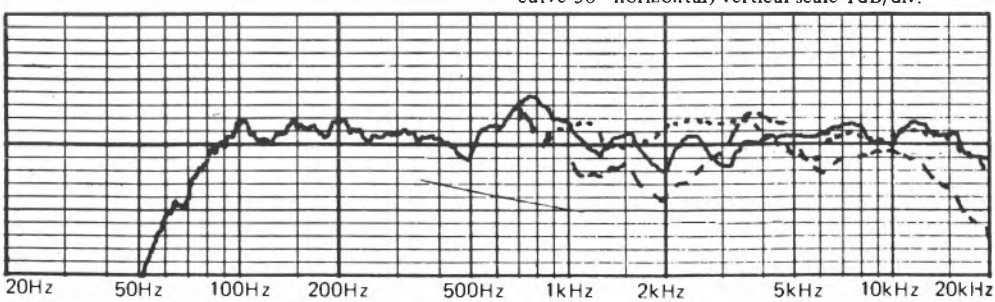



below: impedance *vs* frequency (mod Z).



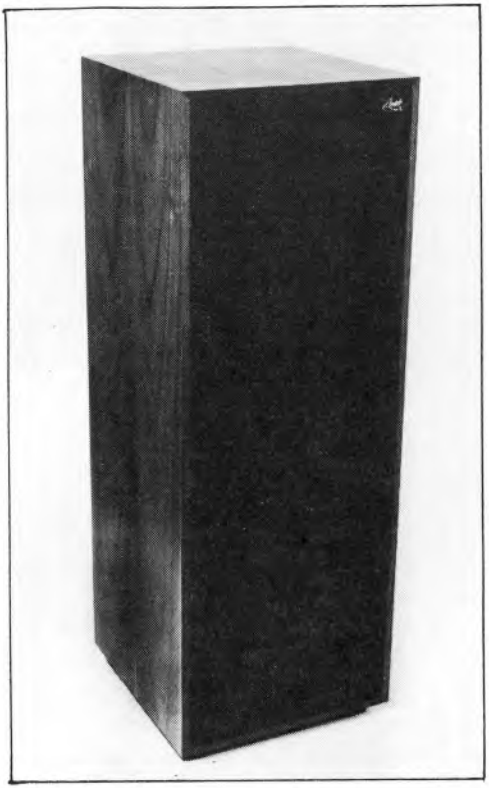

| | |
|---|---|
| Size | 49.5(19.5) H; 25(9.75) W; 25.5(10) D; cm(inches) |
| Weight | 11.7(25.7) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 30 to 100W |
| Recommended placement | stand |
| Frequency response within ±3dB (2m) | 70Hz to 20kHz |
| Low 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 | £295 |

below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



# Lentek Monitor X

Lentek Audio Ltd., Edison Road Industrial Estate, St. Ives, Huntingdon, Cambridgeshire PE17 4LE. Tel (0480) 62225



The *Monitor X* is an imposing three-way floor-standing speaker, too heavy for most persons to lift unaided as it weighs some 84lbs. The ideal position is spaced some 0.5m clear of adjacent walls and corners.

Its internal volume of 115 litres is convoluted in the form of a damped triangular labyrinth or 'line', with extreme low frequencies exiting from a fabric covered 150cm² port near the floor. Considerable internal bracing is employed, the enclosure being substantially constructed of 20mm double veneered board. It uses KEF drivers, and a complex 23-element crossover operating at 350Hz and 3.5kHz. The oval *B139* flat diaphragm bass unit is married to the midrange version of the *B110*, and the treble is covered by the *T27* polyester dome.

**Lab results**

The nominal sensitivity was a trifle below spec at 85dB/W, and from the bass power handling tests the maximum amplifier power was set at 70W, some 3dB lower than claimed. In consequence the maximum domestic sound level obtainable was lower than expected for the size at 97dBA, but should in any case prove adequate. The low frequency rolloff was well extended to −6dB 35Hz, and the gentle rolloff slope implied that in most rooms useful bass will be present somewhat below this point. In view of its marginally below average sensitivity it was felt this speaker rated a just 'average' amplifier load, with dips in impedance to approximately 4.6 ohms, 100Hz and 2.2kHz, exhibiting a generally low impedance throughout. For interest's sake the cabinet system resonance was checked and found to lie at 10Hz, which could present a problem in terms of increasing apparent rumble, due to its proximity to the typical arm/cartridge subsonic resonance range. However the system is probably too well damped for this to prove significant.

At 1m on axis the sinewave response showed a promisingly smooth characteristic avoiding the all too common 'line suckout' in the upper bass range. There was however a fall in output between 1 and 2kHz and a relative elevation of the upper treble; this was confirmed by the ⅓-octave response taken at the 2m measuring distance. For such a large speaker the off-axis responses were good, though a greater than usual lateral loss below 1kHz reflected the laterally asymmetric driver disposition. Distortion levels were very good at 96dB, and the 100W peak level at 500Hz was passed with only 0.2dB compression, with none detectable at 5kHz.

**Sound quality**

The fundamental judgments on truth to life accuracy were similar in basic character to those obtained for Lentek's much smaller *S4* system. The sound was somewhat dulled with some 'boxy' and 'spitty' effects, but the low frequency range showed good depth and evenness, being comparatively dry and well controlled. However audible distortion was present above a 75W peak on electric bass guitar, as if saturation had occurred.

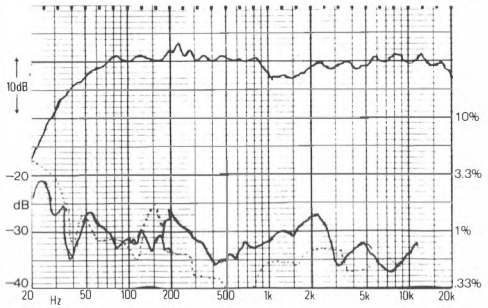
On stereo programme this design gave a rather flat two-dimensional impression, with a muddling of inner detail and a lack of transient attack. The frequency balance was 'lumpy' on some program and the scoring uneven, for while colorations were quite well controlled, the cohesion and transpar-

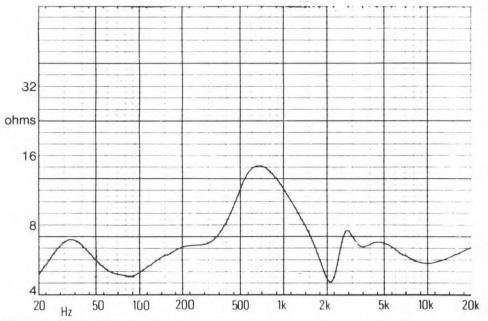
ency obtained with many other modern speakers was rather subdued here.

**Summary**

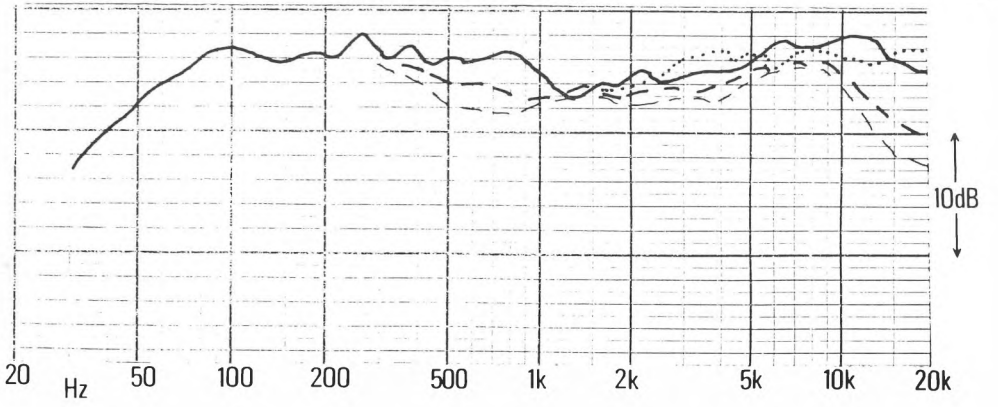
Despite its size and extended bass response, in terms of overall sound quality the *Monitor X* was less favoured than its diminutive but consistently recommended brother the *S4*. At the price, the limited low frequency power handling was a disadvantage, while the lowish sensitivity and just average amplifier loading did not help matters either. These criticisms notwithstanding, the sound quality was in any case not good enough to justify recommendation at the price level.

*Top: Frequency response, 1 m 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).*



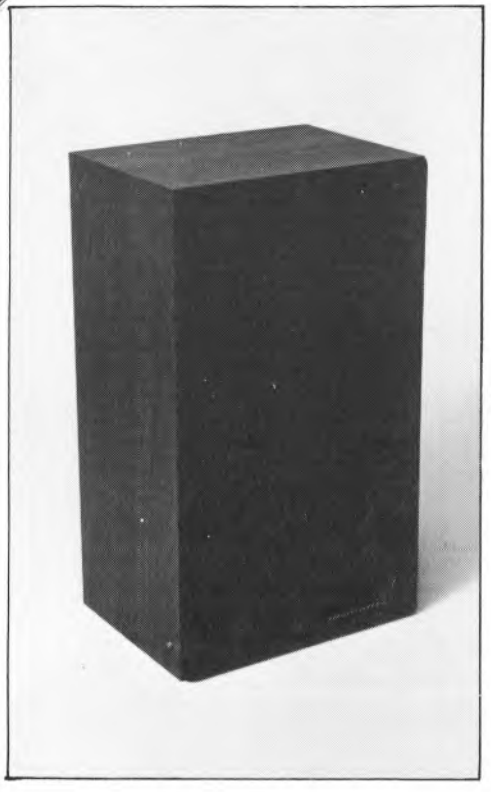

| | |
|---|---|
| Size (H, W, D) | 110, 40.6, 39.3 (42.3, 16, 15.5) cm(inches) |
| Weight | 38.2 (84) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–70W |
| Recommended placement | floor |
| Frequency response within ±3dB (2m) | 50Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 35Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 85dB |
| Approximate maximum sound level (pair at 2m) | 97dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | good |
| Impedance characteristic (ease of drive) | average |
| Forward response uniformity | good |
| Typical price per pair inc VAT | £490 |



RECOMMENDED

# Marantz SP445

Marantz Audio UK Ltd., 193 London Road, Staines, Middlesex
Tel (0784) 50132



Marantz have in the past shown a talent for producing good value products from what appear to be superficially unpromising constituents, the *SP445* 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

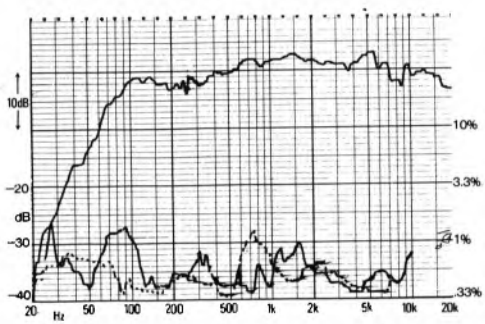
RECOMMENDED

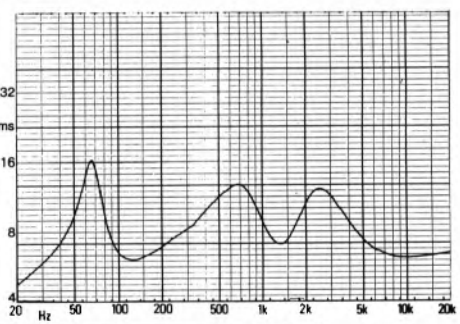
'forward' tendency, but most panelists found it surprisingly plausible.

**Summary**

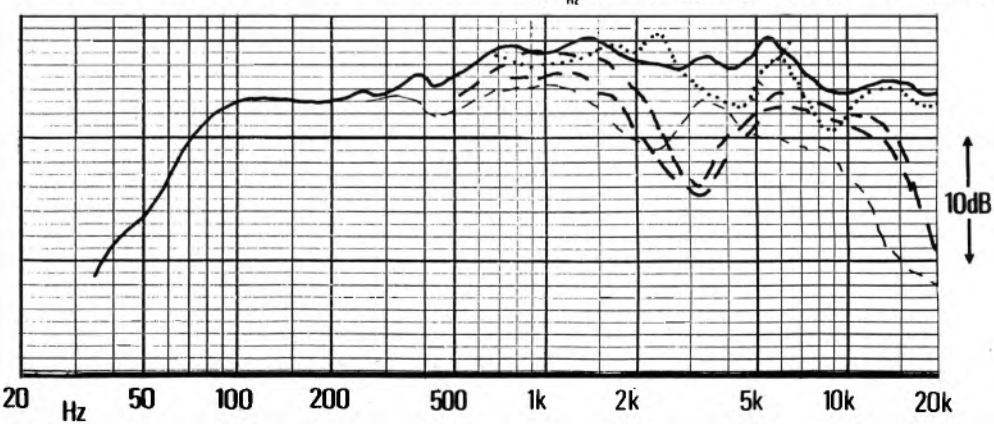
In real terms this speaker had few faults. At a low cost it offered a high sensitivity plus a good amplifier load, as well as high sound levels, a pleasantly balanced subjective response, and low distortion. It can be seen as a worthwhile if contrasting alternative to the low sensitivity, low coloration models, and is worth recommending. A better grille and a touch of improvement to the off-axis response, and, who knows, 'best buy' status might be achieved!

*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) | 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 | £100 |



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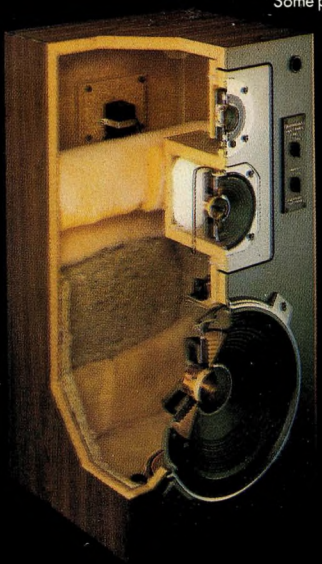

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BEST BUY

# Mission 700

Mission Electronics Ltd., Unit 9A, George Street, Huntingdon, Cambridgeshire
Tel (0480) 57151

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.

**Sound quality**

Scoring 'average' on live sound comparisons, the *700* was judged as offering a pleasant treble balance but with a loss of presence as well as a degree of 'boxiness' and midrange coloration on voice. The bass was reasonably good, and although 50W average on electric bass guitar was sustained before serious overload, some port 'chuffing' was apparent at 12W average, and fundamental bass notes were inevitably attenuated.

On the stereo tests it was more successful, ranking high in terms of stereo image precision and depth. The overall sound quality outperformed many larger and more costly models though it

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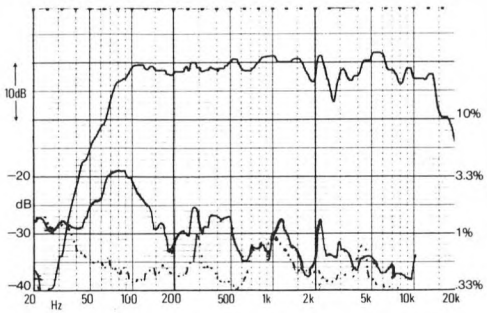
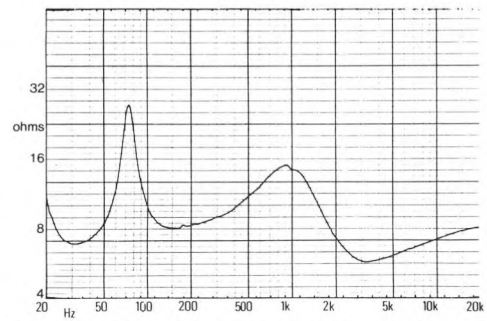
exhibited a slightly 'thin' subjective balance. It was considered quite clean and notably transparent, and was liked by almost all panelists.

**Summary**

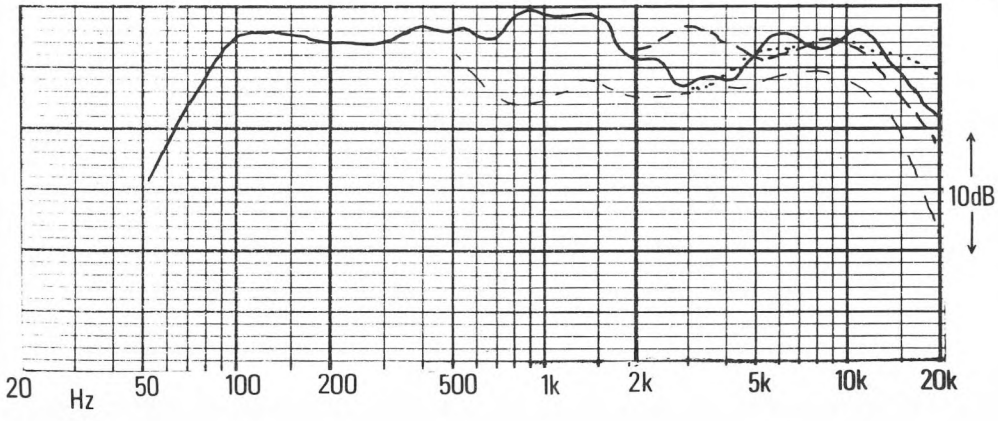
When the modest price is taken into account, this compact speaker can clearly be seen to have done very well, particularly as regards the stereo tests. It proved quite sensitive and easy to drive, and gave moderate distortion performance and quite good power handling. Unquestionably it rates as a best buy, and shows that Mission is capable of producing quality models at widely differing price levels.

*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) | 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 inc VAT | £110 |



RECOMMENDED

# Mission 770 II

Mission Electronics Ltd., Unit 9A, George Street, Huntingdon, Cambridgeshire
Tel (0480) 57151


Begun initially as a retest to clear up some loose ends remaining from the previous review, Mission informed us during the lengthy preparation of this issue that a more advanced *770* was under development. Accordingly we endeavoured to keep in touch in order that final assessment could be made using the latest model, which fortunately was the case. The data below thus applies to the very latest Mission *770* which incorporates a new bass/mid driver – still polypropylene but with a larger 33mm motor coil. Both thermal and bass excursion power handling margins have been increased, and the high order distortion which we previously noted at low frequencies has been eliminated.

A compact two-way model of 38 litres volume, it exhibits an excellent finish as well as fine construction quality. Reflex loaded by a small 55mm diameter tunnel port, a ferro-fluid damped synthetic dome tweeter is used for the high frequencies, and a relatively simple crossover of very high power handling capability is used. The foam grille helps to reduce diffraction effects from the cabinet panel.

**Lab results**

The sensitivity was higher than before and marginally above average at 87dB/W. The combination of high power handling and good impedance characteristic which makes for an easy amplifier load permits an estimated 200W peak programme power to be accommodated, enabling a generous 105dBA maximum sound level to be obtained in a typical listening room. The −6dB rolloff was noted at 55Hz – fairly typical for the size and efficiency, but higher than for the earlier model.

Virtually excellent second and third harmonic distortion results were obtained at 96dB, 1m, and even at low frequencies both harmonics were under 0.3%. The performance was also good on the 100W pulsed input, with perfect correspondence at 5kHz, but a mild 0.2dB compression with an accompanying 3% second harmonic content, but no increase in third harmonic was apparent at 500Hz. With a typical 10 ohm impedance value and a maximum phase angle of 52° at 1.5kHz – a harmless value due to the high 14 ohm modulus of impedance here – the *770 II* was notably easy to drive.

The sinewave response at 1m was agreeably smooth and well balanced, but showed a slightly overdamped bass (not such a bad thing where low stand mounting is involved). A slight forward tendency was also apparent in the upper mid and treble, with ±2dB limits sufficing from 65Hz to 16kHz. At 2m with ⅓-octave averaging the forward characteristic response consolidated, betraying the mild upper-mid bias of the frequency balance. The pattern of forward off-axis responses was very uniform, indicating excellent driver integration, and a good stereo potential.

**Sound quality**

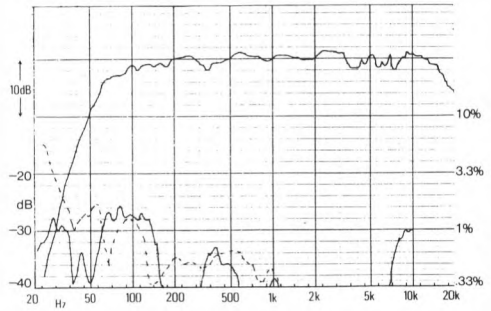
Achieving a 'good' rating the *770* bass guitar handling was extraordinary, sustaining 500W peak or 200W average with only moderate aural distortion; slight port chuffing could however be heard above 50W peak. The sound was considered open and explicit but with a degree of 'hardness' and 'sharpness' in the lower treble.

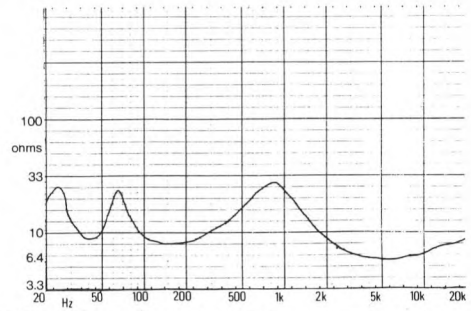
On the stereo sessions the imaging was only a little short of the top category, exhibiting good

# Mission 770 II
(fully re-assessed)

depth and excellent lateral image precision. On rock programme the *770* gave sharp definition to percussion and transients, but on classical strings a mildly 'wiry' and 'metallic' emphasis was present, exaggerating older recordings. Because of this panelists' reactions were a trifle mixed, but the overall score was still fine for the size and price of enclosure.

*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).*

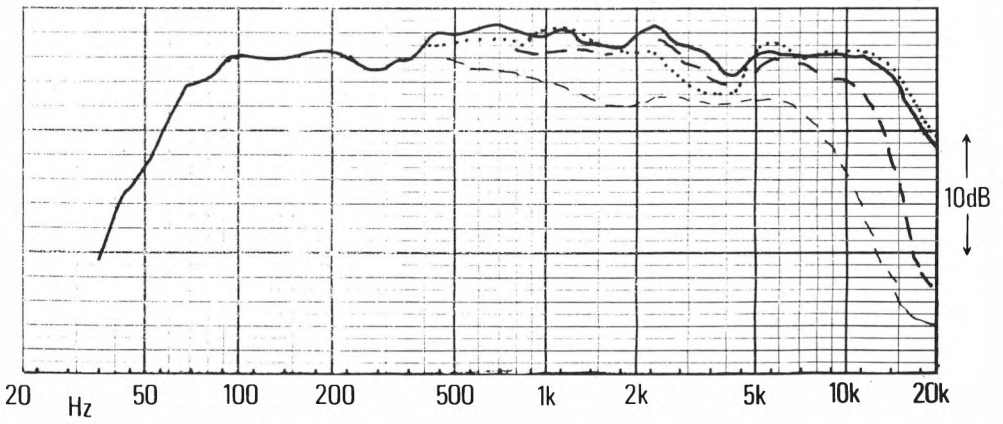



## Summary

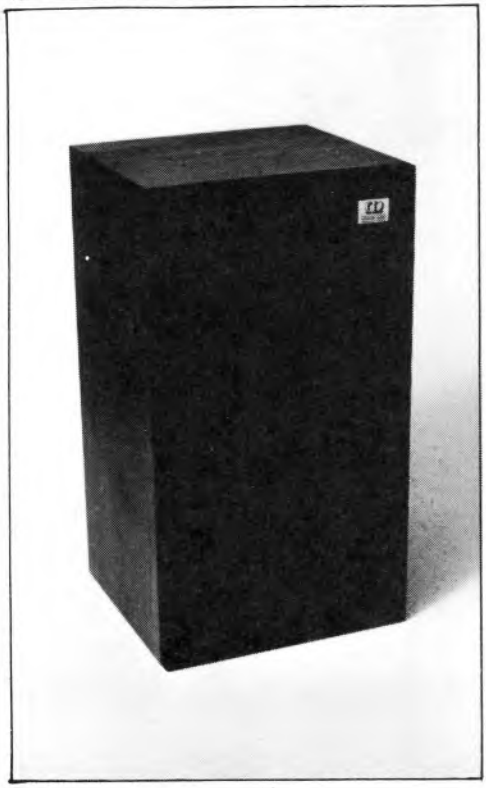
This lively stand-mounted system demonstrated a wide dynamic range with outstanding power handling capacity. Coloration levels were moderate, stereo good and distortion very good; Overall the ratings were impressive and generally justified the price. With a more advanced and necessarily more expensive model such as this, personal audition is advisable to assess the particular frequency balance and character, but the Mission *770 II* nonetheless continues to be a recommended *Choice* model.

| | |
|---|---|
| Size (H, W, D) | 59, 30, 28.5 (23, 12, 12) cm(inches) |
| Weight | 12.7 (28) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20–200W |
| Recommended placement | stands |
| Frequency response within ±3dB (2m) | 65Hz–17kHz |
| Low frequency rolloff (−6dB) at 1m | 55Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 87dB |
| Approximate maximum sound level (pair at 2m) | 105dBA |
| Distortion (96dB at 1m) | excellent |
| Distortion (100W peak) | good |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £370 inc stands |



# Monitor Audio MA9

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



In some respects the *MA9* may be regarded as having evolved from the earlier *MA7*. A compact 12 litre enclosure, the excellently finished and veneered cabinet is well constructed, being reflex tuned at 43Hz by a rather small 35mm diameter port. Double veneered chipboard 17mm thick is used for the panels, with a foam lining for internal absorption; attention to detail is also shown by the rebated grille. The complex 10-element crossover uses high quality components with the crossover point at approximately 2.7kHz. Two drivers are used in vertical array, namely a plastiflex doped pulp cone bass/midrange cone built on a steel frame chassis, and a 25mm SEAS plastic dome tweeter.

**Lab results**

This modestly priced loudspeaker showed quite reasonable pair matching – generally to within ±1dB. The calculated sensitivity was 89dB/W, which is usefully above average; this allows decent sound levels of up to 102dBA to be obtained in typical rooms with amplifiers of up to 100W per channel, while as little as 15W/channel would give good results. The 55Hz −6dB low frequency rolloff was also better than average for the size and sensitivity.

Measured on the median mid/high frequency axis at 1m, the *MA9* recorded a smooth but gently rising response from 50Hz to 2kHz (a sort of compromise between shelf and open-stand mounting). However it also demonstrated a 5dB trough through the presence range, with a depressed treble range thereafter. The 2m set of characteristic forward responses shed some light on this trough, as the 15° vertical above curves showed much better integration than the median axis. Consequently the *MA9* should be positioned a little below ear level to give the best results. Aside from this, the lateral dispersion was clearly very good, but with a consistent mid prominence centred on 1kHz.

While clearly aiming at an 8 ohm impedance, a problem at the crossover point resulted in a drop to 4.4 ohms, resulting in a just 'acceptable' rating for amplifier loading. It was measured for distortion using the full 96dB sound level, as this was considered safe in the case of a fairly efficient model such as this. In view of its size the results were quite satisfactory, with third harmonic at innocuous levels at low frequencies, rising to just 1.8% at 2kHz. Second harmonic distortion was however a little high, with a worst case of 8%. 120Hz, and on 100W pulsed input the speaker was fine at 5kHz, but compressed a significant 0.5dB at 500Hz.

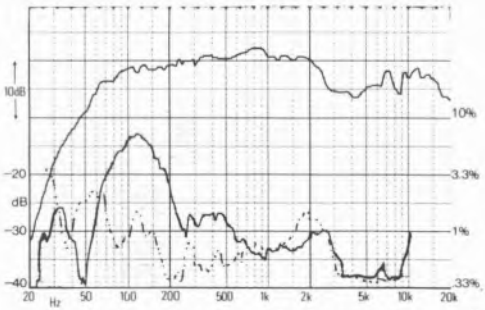
**Sound quality**

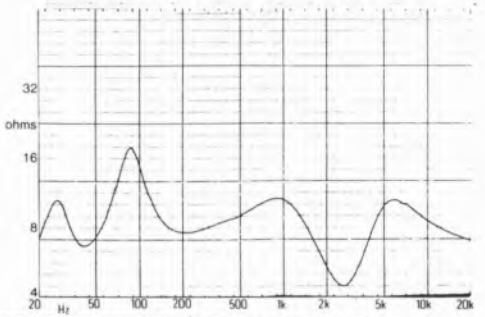
Auditioned on lowish stands, the *MA9* sounded poor when compared with live sounds. It was considered over-rich with a 'middy' 'boxy' effect and relatively poor intelligibility. It withstood a modest 15W average or 50W peak of electric bass guitar before gross overload.

Judged 'acceptable' on commercial stereo programme, it sounded rather dull and lifeless with descriptions of boxy and cardboard colorations; one panelist suggested that it would match overbright cartridges. However one listener rated it quite highly, and so it would appear to depend on personal taste rather more than most. The stereo showed little real depth and scored just 'average'.

**Summary**
The sound quality rating may seem uninspiring, but it takes no account of price; in fact, at £110 a pair, the *MA9* is worth considering. It was well built and finished, offered above average sensitivity as well as adequate bass, and could suit some systems, particularly those with a bright cartridge used in a sparsely finished room.

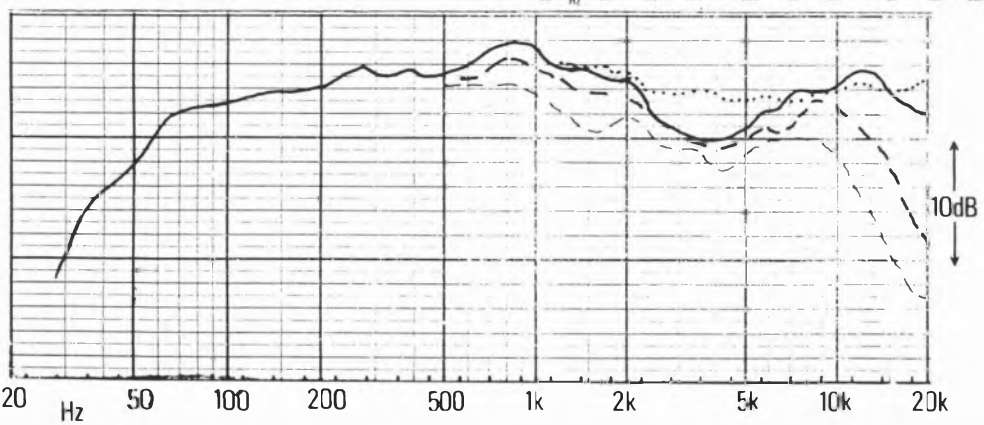
*Top: Frequency response, 1 m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2 m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*




| | |
|---|---|
| Size (H, W, D) | 41, 23, 22 (16, 9, 8.5) cm(inches) |
| Weight | 5.5 (12) 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) | 65Hz–20kHz* |
| Low frequency rolloff (−6dB) at 1m | 55Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m | 89dB |
| Approximate maximum sound level (pair at 2m) | 102dBA |
| Distortion (96dB at 1m) | good |
| Distortion (100W peak) | good |
| Impedance characteristic (ease of drive) | acceptable |
| Forward response uniformity | average |
| Typical price per pair inc VAT | £110 |

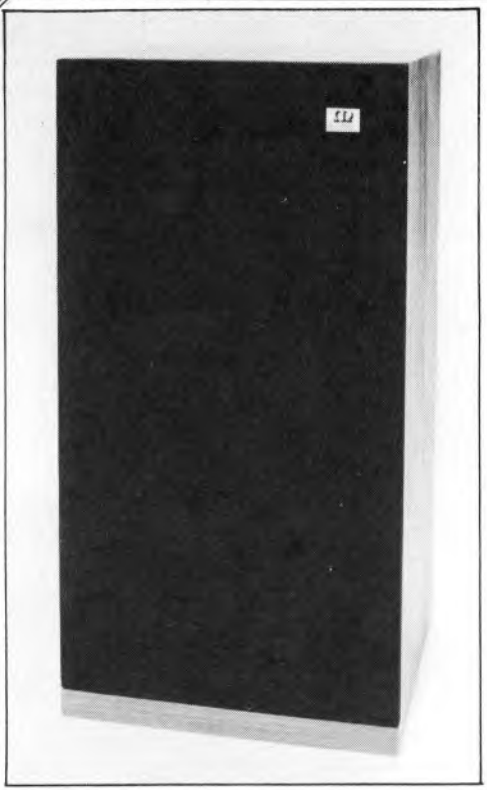
*depends on vertical axis



BEST BUY

# Monitor Audio MA6 Improved

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



Paralleling the more expensive bextrene-coned *MA4 Mk II,* the *MA6* is described in the manufacturer's brochure as a budget model, designed to be cost effective while still offering much of the performance of its more advanced relative. To this end, a special doped 200mm pulp cone driver is employed for the bass-midrange, together with a grille protected version of the Audax 25mm soft dome tweeter. A vertical-in-line format is adopted for the drivers, with the crossover point at approximately 3kHz, this achieved *via* a good quality, nine-element crossover.

The finely veneered 32 litre enclosure is reflex loaded at low frequencies by a tunnel port, and the interior of the chipboard cabinet is damped by Celotex fibreboard, then acoustic foam-lined and filled with polyester wadding.

**Lab results**

Pair matching was pretty good, to within ±0.5dB overall, while the sensitivity of 87.5dB is usefully above average. A typical −6dB point of 48Hz was recorded. Rated as good on third harmonic distortion, values were typically 0.3% although a rise to 0.8% was present at 2kHz. At lower frequencies the results were good for example, 3%, 52Hz. The maximum sound level attained was a substantial 103dBA and is therefore more than adequate for most domestic applications. Some port chuffing was audible on bass guitar above 30W, although rattles did not occur until 50W was reached, and while 200W of peak programme could be applied, some compression was apparent. The impedance curve described a nominally 8 ohm model, never falling below 6.4 and hence by definition representing a 'good' amplifier load.

Measured on-axis 1m, the curve showed a moderate bass lift from 70 to 150Hz, with a slightly uneven presence band and a degree of treble lift, a peak some 3-4dB high occuring at 14kHz. Out at 2m, the range up to 6kHz was clearly quite even and well integrated, although the treble did show a 1-2dB shelf lift from 5-16kHz. The use of fairly high stands would be to this model's advantage, in view of the mild bass lift and the improved upper range response on or slightly below axis. Above 10kHz the 30° lateral response decayed a little more quickly than usual, but not unduly so.

**Sound quality**

Scoring an encouraging 'good' on the live sound comparisons, the bass register appeared to sound 'soft', lacking power and definition although possessing reasonable 'weight'. Somewhat chesty and mellow on voice, moderate boxiness was also apparent, with an emphasis in the upper treble.

Maintaining this ranking on the stereo tests with a comparatively good mark for stereo imaging, the latter showed reasonable depth, albeit with some lateral imprecision, and the overall clarity was much improved over the original version. Some 'boxy' coloration was present, but the balance was to a good standard and the midband also seemed quite unstrained and neutral.

**Summary**

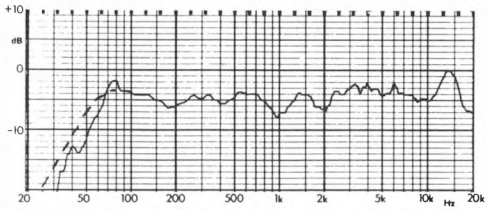
A well finished speaker of clean appearance, the *MA6 Imp* was sufficiently accurate in the absolute sense to do well on the live sound comparisons, and

# Monitor Audio MA6 Improved

(partly re-assessed)

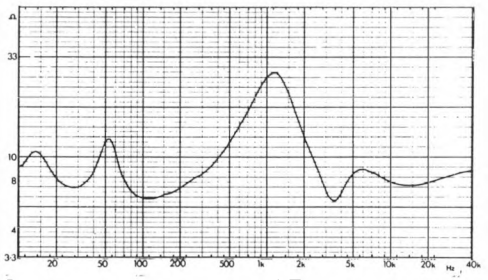
BEST BUY

also provided a sufficiently musical mix of detail, stereo, balance and low coloration to return quite a high score on the vital wide-band stereo sessions. High sound levels were possible, and the speaker proved easy to drive, showing quite good response uniformity and off-axis integration as well as low distortion. It has been sufficiently upgraded to merit its title 'Improved', and 'best buy' status is now appropriate.

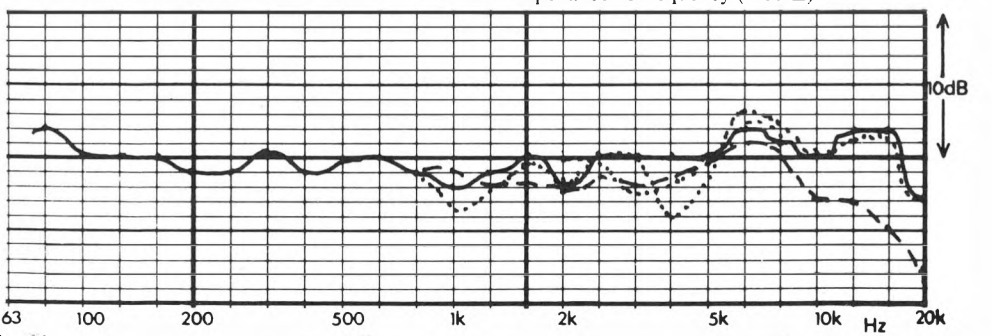



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)

| | |
|---|---|
| Size | 58(23) H; 30(12) W; 28.5(11) D: cm(inches) |
| Weight | 13(28) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20-150W |
| Recommended placement | on stands clear of walls |
| Frequency response within ±3dB (2m) | 63Hz to 18kHz |
| Low frequency rolloff (−6dB) at (1m) | 48Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) | 87.5dB/W at 1m |
| Approximate maximum sound level (pair at 2 metres) | 103dBA |
| Third harmonic distortion (96dB at 1 metre) | good 52Hz–3%, 100Hz–1%, 150Hz–0.3%, 2kHz–0.8%, typically better than 0.3% |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | v. good |
| Typical price per pair inc. VAT | £160 |



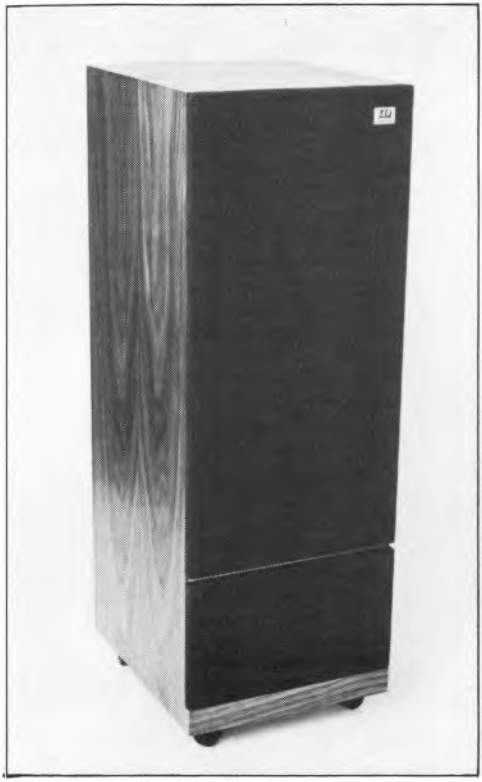

Impedance vs frequency (mod Z)




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

# Monitor Audio MA84

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



Following the precedent set by the *MA2*, the *84* incorporates an integral stand, comprising a hollow, open damped chamber in the base of the enclosure which gives the appearance of a completely veneered floor-standing model. Of rigid construction, internal circumferential bracing, bituminous panel damping pads, and an acoustic foam lining are all used. The internal volume of approximately 45 litres is tuned by a fair sized tunnel port to 38Hz.

A two-way system with the crossover at the usual 3kHz, the bass driver is a heavy duty, high sensitivity version of KEF's bextrene coned 200mm series, while the high frequency unit is a popular 25mm soft dome. The drivers are mounted vertically in line for good lateral response symmetry, and the substantial grille is internally chamfered to reduce diffraction effects. Both inside and out the construction and finish are to a high standard.

**Lab results**

The sensitivity reading was based on the fundamental range between 200 and 400Hz, and worked out marginally above average at 87dB/W. With a peak power input of up to 250W programme, satisfying sound levels as high as 103dB should be possible in typical rooms (taking into account the depressed treble). It proved to be an easy amplifier load, with a typical value of 8 ohms and phase angles held to below 30°. Pair matching was fine at ±0.5dB over the whole range, and the grille had little deleterious effect on the response bar a 1.5dB increase in the dip at 2.5kHz.

On axis at 1m the low frequency response fell off slowly, illustrating good extension, and while the numerical −6dB point was charted at 50Hz, in practice worthwhile output will be available down to 35Hz in most rooms. The 500Hz region was prominent and the presence range smoothly depressed, while above 6kHz the treble made some recovery; overall however ±4.5dB limits were required for the range between 50 and 18kHz. The trends were smoothed by the ⅓-octave analysis at 2m, but still showed the depressed presence region whose character was largely unaffected by measuring axis. The crossover integration and driver control was evidently very good, judged from the consistency and uniformity of the off-axis curves, and the system clearly possessed good dispersion properties.

Driven to 96dB the distortion was commendable, with third harmonic at sensible levels even at low frequencies, and particularly good in the midrange. On 100W pulsed input the high power crossover showed its true mettle by perfectly transducing pulses at 500Hz and 5kHz.

**Sound quality**

Scoring a plain 'average' on comparison with live sounds, the panel felt that the sound quality was 'dulled', with a 'chesty' 'boxy' effect and a 'thickened' balance, but conversely some excess sibilance was also apparent on speech. The low frequencies were deep and powerful, accepting up to 250W peak input, which is good for a 200mm driver.

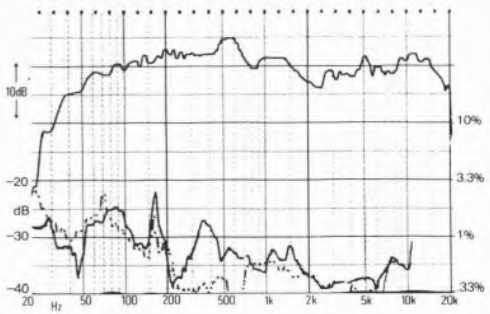
On stereo programme the ratings improved, as the panel had more time to adjust to the particular frequency balance. The *84* was pleasantly smooth and at the same time coloration was comparatively low. It was felt to have good potential, and in view of the dulled balance the stereo image results were

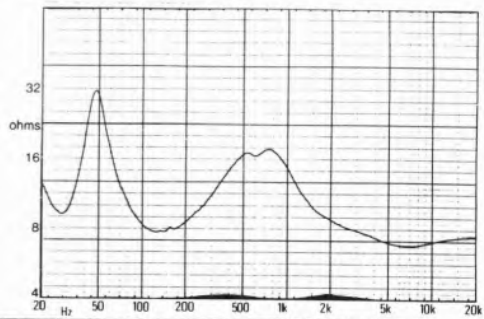
surprisingly good, with precision and depth well above average.

**Summary**

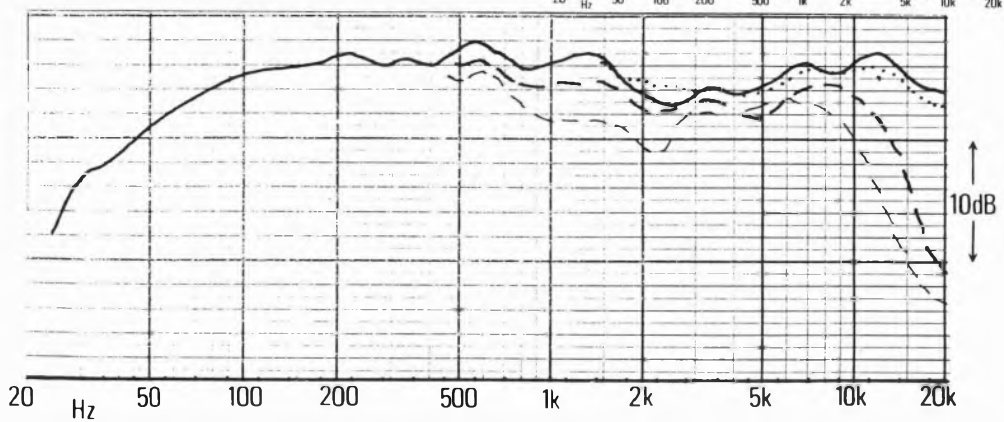
In engineering and constructional terms this speaker represents good value for money. Many aspects of its performance are promising – for example the good power handling and the low distortion – but the subjective frequency balance was sufficiently dull to constrain the sound quality and prevent recommendation. Notwithstanding this it may suit some systems, and is worth considering, with the integral stand providing a further plus point.

*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).*



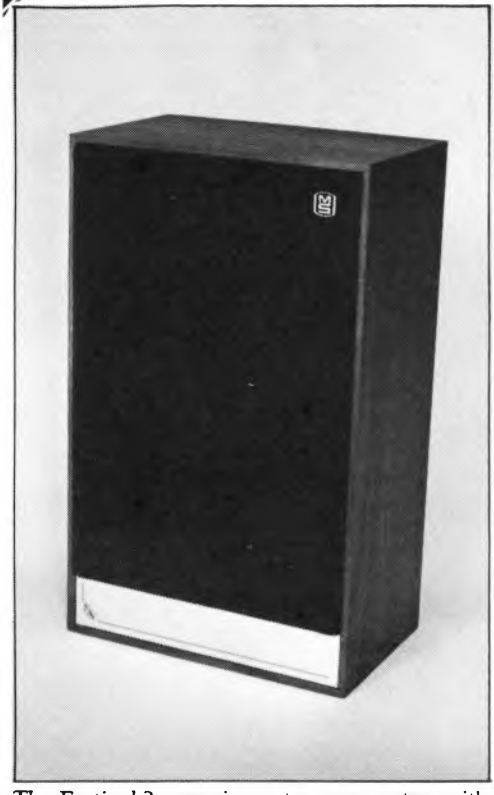

| | |
|---|---|
| Size (H, W, D) | 76, 28, 33 (30, 11, 13) cm(inches) |
| Weight | 20.5 (45) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20–250W |
| Recommended placement | floor (integral stand) |
| Frequency response within ±3dB (2m) | 60Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 50Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 87dB |
| Approximate maximum sound level (pair at 2m) | 103dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | very good |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | good |
| Typical price per pair inc VAT | £240 |



BEST BUY

# Mordaunt-Short Festival 2

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



The *Festival 2* comprises a two-way system with sealed 15 litre box loading, and is the middle sized model from an established range of related and compact systems, the others being the *Carnival 2* and *Pageant 2* (see *Summaries*). All share the same doped pulp cone 200mm bass/mid unit, made by Mordaunt-Short, but use different cabinet volumes, loading techniques and HF units. In the case of the *Festival* a 25mm plastic dome tweeter front loaded by a short horn phase correcting assembly completes the vertical driver array.

The chipboard cabinet finish was very good, but it is undamped and simply provided with a light filling of polyester wadding for internal energy absorption. A good quality five-element plus one resistor crossover was fitted, forming part of an integral assembly with the rear terminal panel, the latter provided with both DIN and spring clip connections. The unrebated grille was covered in a fairly thick 'furnishing' type material.

## Lab results

The grille was found to produce a strong effect on the response output, attenuating it by one or two dB throughout the range above 2kHz. However the system is designed to be used with the grille on, and balances well as such. Good pair matching was demonstrated with a terminal sensitivity a little above average at 87dB/W, and as a fine typical impedance modulus of 8 ohms with low phase angles was measured, the *Festival* rated as a good amplifier load. The system resonance was fairly high at 70Hz, with the −6dB low frequency rolloff at 60Hz, but some augmentation will occur with shelf-mounting, which is quite permissible with this design.

Distortion levels at 96dB were reasonable, with third harmonic peaking at just under 2% and 2nd at 2.5% around 1.5kHz. At low frequencies the performance was above average, and the design also coped well with the 100W pulsed input, returning moderate values of compression: 0.3dB at 500Hz and 0.2dB, 5kHz.

The axial sinewave frequency response needed ±4dB limits, but the general trend was quite well balanced and uniform, with a notably well integrated presence and treble range. Averaged over ⅓-octave bands, the forward response was more uniform and well integrated, with the system scoring high marks for dispersion. A listening axis slightly above the tweeter is probably optimum, although this is not particularly critical.

## Sound quality

Scoring 'good' throughout the listening tests, the *Festival*'s performance was remarkable for its price. While the low bass notes were deficient with a consequent 'fullness' in the 80–100Hz range, the power handling was fine, the speaker accepting 45W average or 150W peak of electric bass guitar before it 'cracked'. The sound was somewhat 'boxy' and 'wooden' with a mid emphasis, but it proved sufficiently open and clear to give a good score.

On stereo imaging the overall standard was maintained, with good effective lateral localisation but some loss of depth. Criticisms were made of a lightened frequency balance and some 'hard', 'thin' and 'boxy' midrange effects, but these were not too severe.

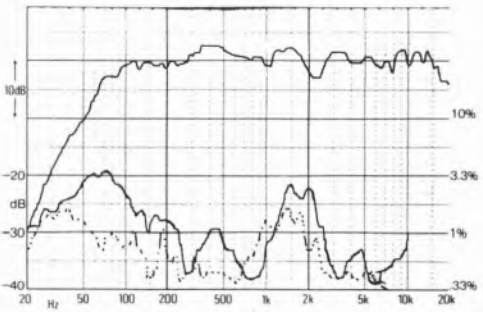
## Summary

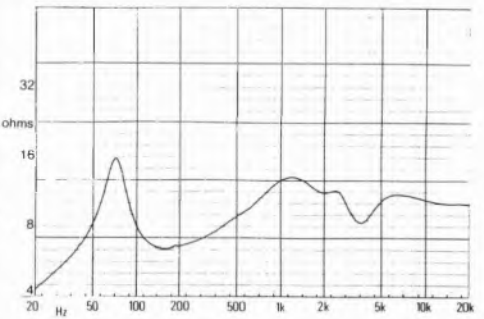
The sound quality was possibly not quite as good as the tabulated results and characterisations sug-

BEST BUY

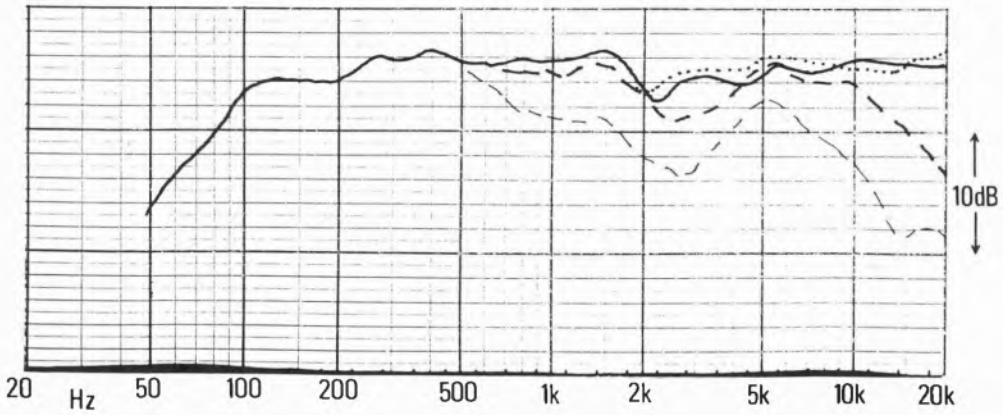
gest, but nonetheless the *Festival* has done very well for its price. It offered quite high maximum sound levels, good amplifier matching and high quality finish (if a trifle old-fashioned looking). While the sound may have been slightly 'thin', it was well integrated and detailed. Taking into account its overall performance the *Festival* has achieved 'Best Buy' status and ranks as fine value for money.

*Top: Frequency response, 1m sinewave, plus 2nd (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).*



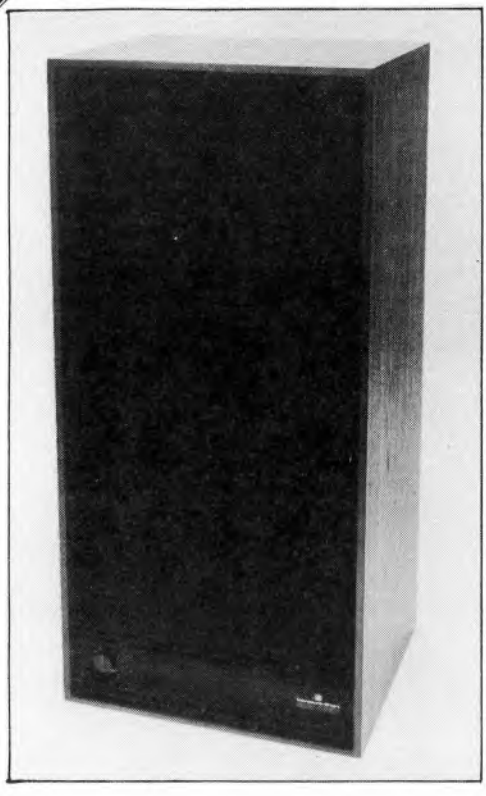

| | |
|---|---|
| Size (H, W, D) | 45.5, 28, 18.5 (18, 11, 7.3) cm(inches) |
| Weight | 6.4 (14) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20–100W |
| Recommended placement | open shelf or stand |
| Frequency response within ±3dB (2m) | 80Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 60Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m | 87dB |
| Approximate maximum sound level (pair at 2m) | 102dBA |
| Distortion (96dB at 1m) | good |
| Distortion (100W peak) | good |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £135 |



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,

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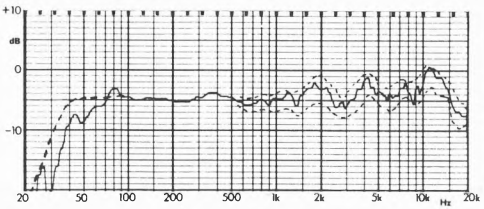
above average imaging and a good depth presentation. Musical clarity was also to a high standard, and the bass, if slightly boomy, was satisfactorily deep and powerful. Colorations were also well controlled, and mainly confined to a trace of treble peakiness.

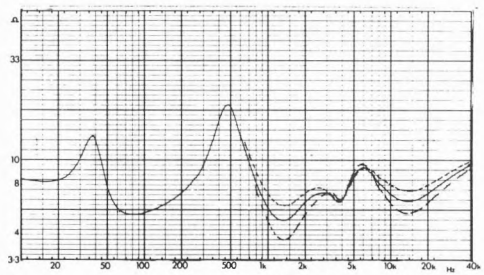
**Summary**

With one or two minor criticisms — notably amplifier loading and upper treble balance — this speaker offered a fine performance particularly on bass, power handling, loudness, coloration, distortion and maximum sound levels. Well constructed, with an attractive appearance and producing satisfying stereo, the *Signifer* justified its high price, and thus merits recommendation.

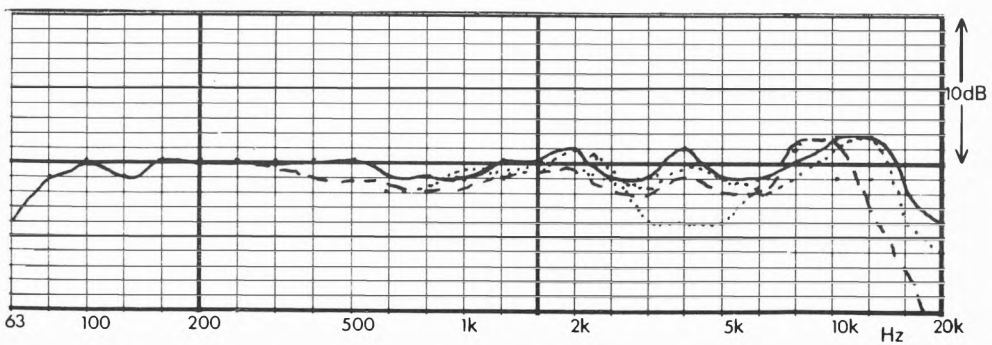



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)

| | |
|---|---|
| Size | 81(38) H; 38.5(15) W; 33(13) D; cm(inches) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 20–250W |
| Recommended placement | on M/S stand well clear of walls |
| Frequency response within ±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 inc VAT | £600 |




Impedance vs frequency (mod Z)




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

# Nightingale Point Five

Nightingale Acoustics, School Road, Brecon Ash, Norwich, Norfolk NR14 8HG
Tel (0508) 70829

This unusual loudspeaker appears suited to floor mounting but in fact gives better results if put on a low stand as recommended, some 20–25 cm high. A full vertically orientated system, three drivers are employed and are staggered in depth to provide time delay compensation. The low frequency range is handled by a KEF 200 mm bextrene cone, the mid by a Peerless 100 mm doped pulp cone, and the high frequencies by a 25 mm soft plastic dome. The 25 litre bass enclosure is reflex tuned to 30 Hz by a substantial port, with the good quality nine-element crossover operating at 500 Hz and 3 kHz.

The well-finished cabinet is veneered in tough mahogany coloured laminate with the front grille and top 'box' sections in acoustic foam. This 'box' is a special design feature and contains the HF unit mounted on a small asymmetric open baffle.

**Lab results**

With a marginally above average efficiency of 87 dB/W the *NM point 5* demonstrated a better than usual −6 dB rolloff at 44 Hz. An excellent pair match was held over the bass register but ±1.5 dB errors were noted at both 3 and 9 kHz. The top grille cover smoothly attenuated the treble range by 1.5–2.0 dB, and there were indications that the speaker was in fact better balanced with the cover off.

With a 100 W suggested maximum power input per channel, the *NM point 5* can achieve up to 102 dBA in a typical room. The distortion was uneven on second harmonic analysis but low enough to avoid censure, and third harmonic was particularly good at the 96 dB test level. The 100 W pulsed input produced an interesting result, whereby catastrophic 3.5 dB expansion at 500 Hz generated 15% third harmonic distortion, and yet at 5 kHz the result was fine. Nightingale have since upgraded the offending inductor in the crossover to solve this problem.

On axis at 1 m the *NM point 5* demonstrated a well balanced and uniform response with good extension at the frequency extremes, but at 2 m with ⅓-octave averaging a gentle upper mid and treble range prominence was apparent, some 2.5 dB above the general trend. The benefits of time alignment and good crossover design were evident in the excellent off-axis responses which exhibited fine uniformity in both vertical and lateral planes.

**Sound quality**

The open and wide dispersion character proved an advantage on the live sound comparisons where it rated as 'very good'. Panelists felt the sound was a trifle 'hard' and 'presence-bright' with transients presented forward of the main body of the reproduced sound. Above 15 W average (50 W) peak of electric bass guitar some distortion was audible, but otherwise the bass register was pretty clean and firm.

On the stereo programme tests the results were less favourable, and strongly differing opinions were encountered. Weak on piano, the mid showed a mildly 'abrasive' quality with some 'tube' like coloration, and the frequency response did not sound particularly well balanced. This appeared to detract from the stereo imaging, but despite some problems the results were still quite good.

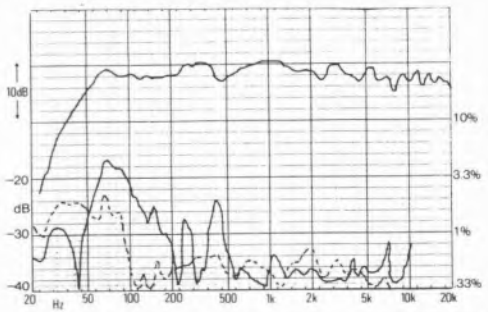
**Summary**

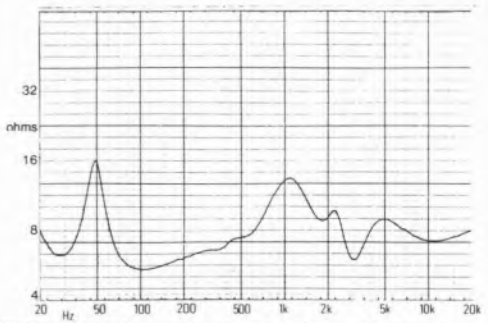
Power handling was somewhat restricted for the

size but the bass extension was not, and as the subjective character found favour with some panelists and not with others, a personal audition is advisable. Overall the performance suggests admission to the 'worth considering' category at a price just a little above the group average.

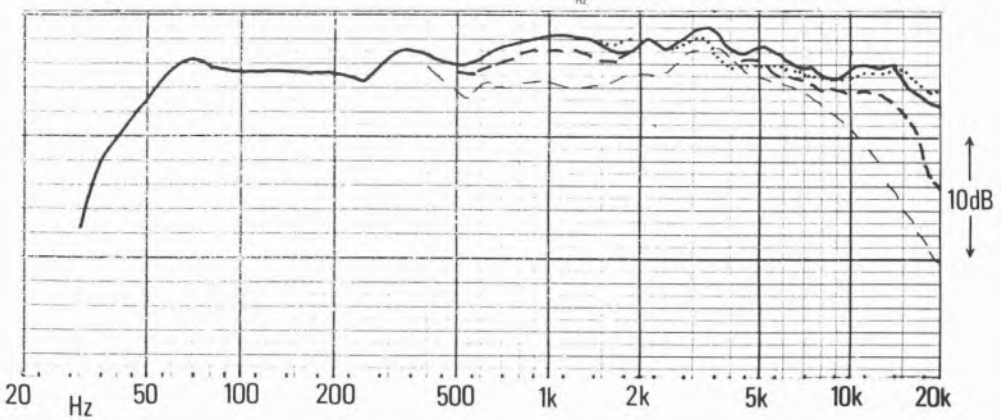
*Note:* The top cover will apparently soon be revised to improve acoustic transparency in the treble.

*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) | 80. 26.7, 36.8 (31.5, 10.5, 14.5) cm(inches) |
| Weight | 15.5 (34) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–100W |
| Recommended placement | low stands |
| Frequency response within ±3dB (2m) | 48Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 44Hz |
| Voltage sensitivity (ref 2.83V. *ie:* 1 watt in 8 ohms) at 1m | 87dB |
| Approximate maximum sound level (pair at 2m) | 102dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | good |
| Impedance characteristic (ease of drive) | average |
| Forward response uniformity | good |
| Typical price per pair inc VAT | £350 |



# Philips AH489

Philips Electrical Ltd., City House, 420/430 London Road, Croydon CR9 3QR
Tel 01-689 2166

Philips loudspeakers have had rather a mixed reception in *Choice* in the past, with some doing very well and others proving rather disappointing. The *AH489* is a relatively inexpensive three-way system of passive design, using a thirty litre reflex tuned enclosure (30Hz). The vertical in line driver placement provides good lateral radiation symmetry. The three units comprise a 200mm pulp cone bass-midrange; a 55mm fabric dome upper mid and a 25mm fabric dome tweeter.

Finished in Philips style with a silver trim and a vinyl 'veneer' covering, the *'489* is relatively shallow in its proportions, suggesting shelf mounting. The 20mm chipboard cabinet is quite rigid, but lacks any damping bar a small quantity of felt for internal acoustic absorption. The grille assembly is well designed. with a reinforced moulded frame and cloth of high acoustic transparency.

**Lab results**

In the Philips tradition this model possessed an above average sensitivity of 90dB/W, and this is in no way compromised by the high measured impedance and accompanying low phase angles which serve to rate the speaker as a good amplifier load. In view of the sensitivity, the low frequency −6dB cutoff was satisfactory at 58Hz; if shelf mounted, some extension below this would be audible in most rooms. Pair matching was very good until 8kHz, beyond which mild ±1.5dB errors were present.

As with most higher sensitivity models, the distortion at 96dB was really quite low. The worst value of 2% second harmonic at 90Hz was insignificant and third harmonic performance was particularly good. The 100W peak input was in fact rather cruel for such a system, since 110dB is not a likely intentional maximum level at 1m. In fact it rated as acceptable due to 5% levels of third and fifth harmonic at 500Hz; obviously crossover saturation was beginning. Compression was a satisfactory 0.3dB at 5kHz with no extra distortion.

On axis at 1m the Philips demonstrated a fairly average response – a little curtailed in bandwidth and with indications of mid dominance. This was confirmed at 2m where the mid region was some 3dB above the reference low frequency range (80–300Hz), the frequency balance clearly suggesting wall mounting. The mid-treble was smooth on axis but poorly integrated in the 15° vertical plane, with a severe notch developing at 8kHz near the upper crossover point. In the lateral plane the dispersion was good so our recommendation is to keep the speaker mid/tweeter axis at ear level.

**Sound quality**

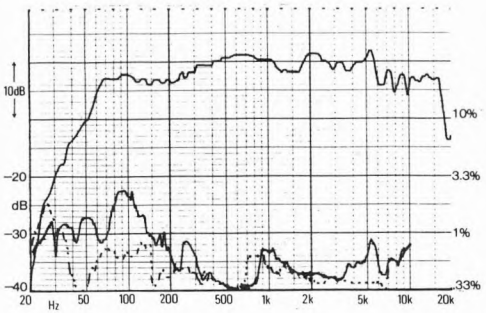
Rated average for its reproduction of live sounds, the *489* sounded 'middy' and 'boxy' and lacked an open and airy character. It could sound hard and somewhat strident on occasion, but the bass register was satisfactory, 20W average of electric guitar being accepted without distress (100W peak before gross overload).

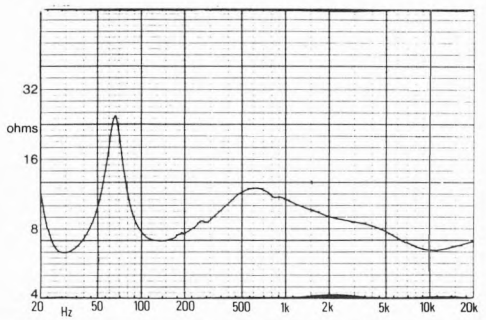
While the stereo image quality was judged about average, the overall sound quality on commercial programme fell below this to just 'acceptable'. On organ the *'489* was rather 'reedy' and 'nasal', with a hard 'loud' coloration, and most panelists felt that it was none too pleasant overall.

**Summary**

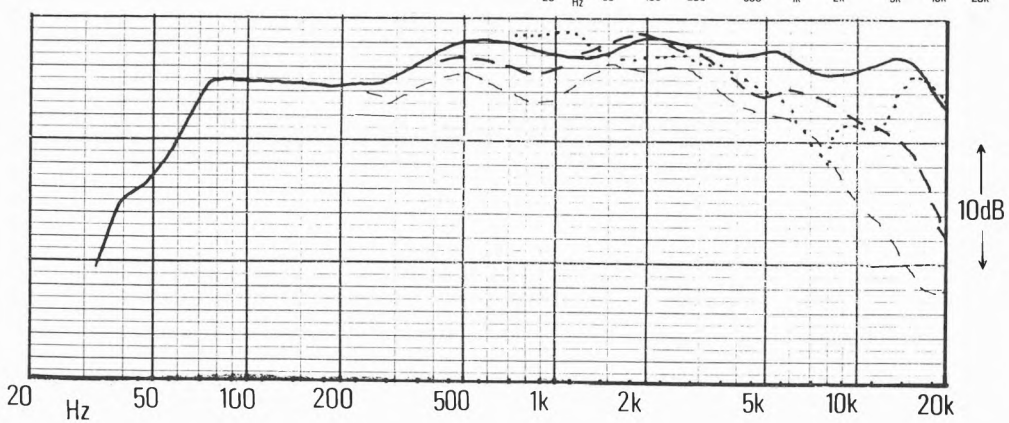
While it did offer a useful sensitivity and an easy amplifier load, as well as low distortion and promisingly smooth response, this speaker simply did not sound pleasing or accurate enough for recommendation. If the system were rebalanced in frequency terms with better vertical dispersion and integration, the story might be very different.

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




| | |
|---|---|
| Size (H, W, D) | 56, 33.5, 22.5 (22, 13, 9) cm (inches) |
| Weight | 11 (24) kg (lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 10–100W |
| Recommended placement | open shelf |
| Frequency response within ±3dB (2m) | 65Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 58Hz |
| 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) | excellent |
| Distortion (100W peak) | acceptable |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | average |
| Typical price per pair inc VAT | £140 |



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 upmarket 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

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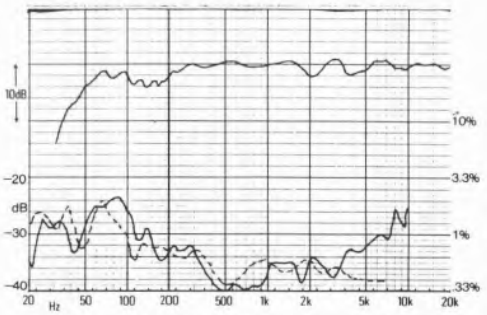
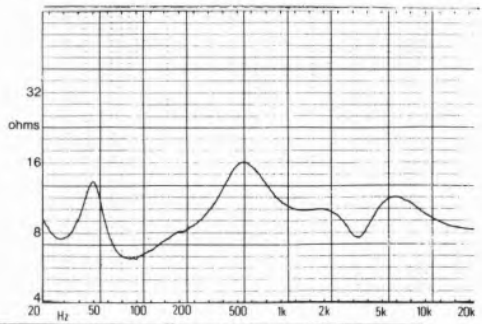
lumpy but was nonetheless favoured for its power and depth. Imaging was very good, and proved stable with a pleasing perspective and well developed depth, while the whole sound was 'atmospheric' and not concentrated on the enclosures. An 'airy' if slightly 'thin' effect was produced but without any hardness and with very little 'fizz', while coloration was very low by conventional standards. Clarity and detail rendition were also both very good.

**Summary**

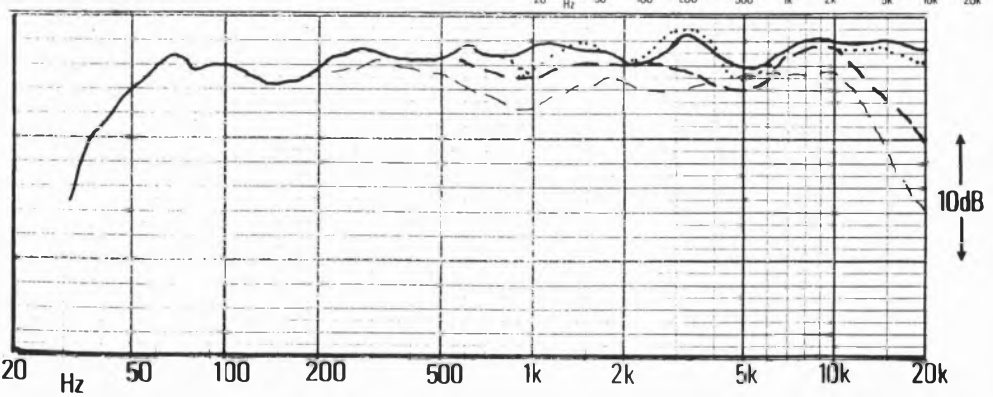
A compact, high quality speaker with extended bass and exceptional power handling, the Proac *3* offers a smooth and wide frequency response together with low levels of coloration and very good sound quality. The price is undoubtedly very high, but the performance is exceptional, and justifies recommendation.

*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).*



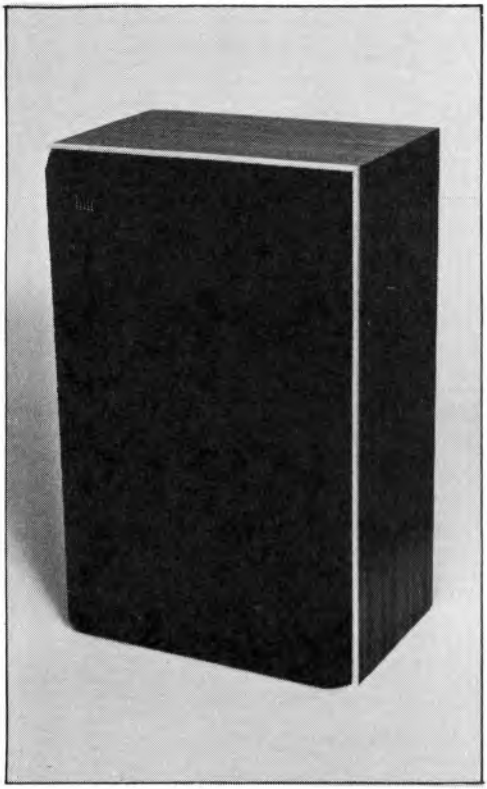




| | |
|---|---|
| Size (H, W, D) | 68.5, 30.5, 33 (27, 12, 13) cm(inches) |
| Weight | 30 (66) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–500W |
| Recommended placement | stands |
| Frequency response within ±3dB (2m) | 47Hz–20kHz |
| Low frequency 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 | £1,200 |



# Pye 6484

Pye Ltd., 137 Ditton Walk, Cambridge CB8 8QD
Tel (02205) 2781



Pye's association with its parent company Philips is clearly revealed by this inexpensive three-way design, for in terms of its style and component parts, it undoubtedly originates from Eindhoven. A 23 litre bass reflex system, the bass/midrange is covered by a 200mm light pulp cone driver, with the lower treble (specified as 4–9kHz) allocated to a 100mm pulp cone and described as a 'midrange' driver in the literature. The last octave of treble is handled by a 25mm dome tweeter.

In resonance terms the plastic-veneered cabinet is rather 'live', with no damping and just a small amount of internal absorption. The crossover was extraordinarily primitive for a three-way model, comprising only two capacitors of value 3.3 and 6.8uF; this did not augur well so far as driver or crossover band integration was concerned.

**Lab results**

Even taking price into account, the overall results were not particularly inspiring. Pair matching was disappointing with a ±2dB imbalance common throughout the range and of a random rather than a controlled nature. The ragged response made assessment of the sensitivity difficult, but 91dB/W would seem to be a fair estimate, which means the system is fairly sensitive. The −6dB bass rolloff was also high at 67Hz, but with a maximum 50W power handling the speakers will nevertheless generate a quite substantial 104dBA sound level in most rooms. The impedance was a genuine 8 ohms and will be easy to drive, but the low phase angles are as much a product of crossover simplicity as anything else.

Driven to 96dB, 1m, the distortion levels were low for the price and rated 'very good' on our scale. It also did well on the 100W pulsed peak test – perhaps predictably, as there are no inductors to saturate in the crossover.

On axis at 1m the sinewave response was characterised by a lumpy low frequency range with inadequate bass damping. Two severe phase cancellations were present at 3 and 8kHz respectively, though the regions in between were promising. ⅓-octave averaging at 2m provided some amelioration, but the 8kHz problem remained. The response was notably variable with axis particularly in the vertical plane – a clear indication of poor crossover control. Overall the design exhibited a mid to presence range prominence, with an isolated treble peak centred on 15kHz.

**Sound quality**

Compared with live sounds, the Pye was just not convincing, and only rated as 'acceptable'. It sounded uneven, with a boxy and prominent midrange which possessed a 'thin' and 'hard' balance. 20W average of bass guitar was accepted with quite good subjective power, albeit rather unevenly and with poor differentiation of bass notes.

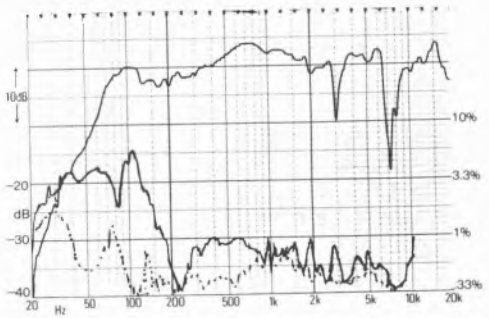
On the stereo programme, the panel was confused by the obvious changes in frequency balance with head movement, as well as by a 'phasey', 'disjointed' quality. The stereo was flat and lacked 'focus', and the sound 'hard', 'boxy' and noticeably coloured in the treble.

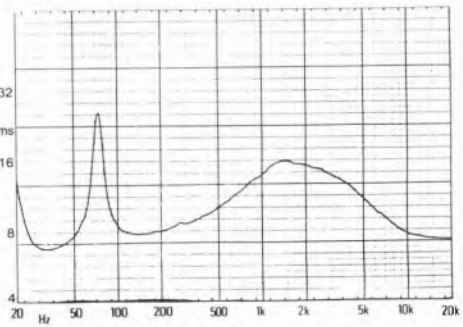
**Summary**

Despite its hi-fi appearance and three driver reflexed cabinet, the Pye *6484* is not a true contender in the context of *Hi-Fi Choice*. The

drivers do have hi-fi potential, but the system design and particularly the crossover (or lack of it) is the main limitation.

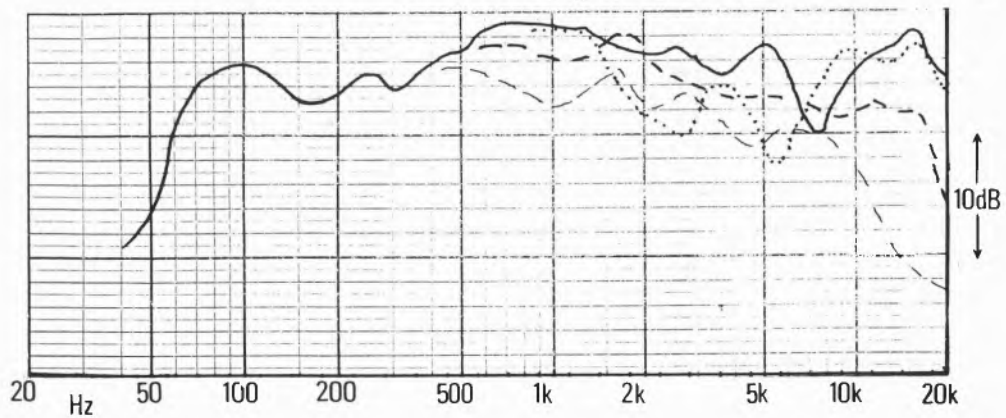
*Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*




| | |
|---|---|
| Size (H, W, D) | 52, 33, 20 (20.5, 13, 9) cm(inches) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 10–50W |
| Recommended placement | open shelf |
| Frequency response within ±3dB (2m) | not applicable* |
| Low frequency rolloff (−6dB) at 1m | 67Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 91dB |
| Approximate maximum sound level (pair at 2m) | 104dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | good |
| Impedance characteristic (ease of drive) | very good |
| Forward response uniformity | poor |
| Typical price per pair inc VAT | £70 |

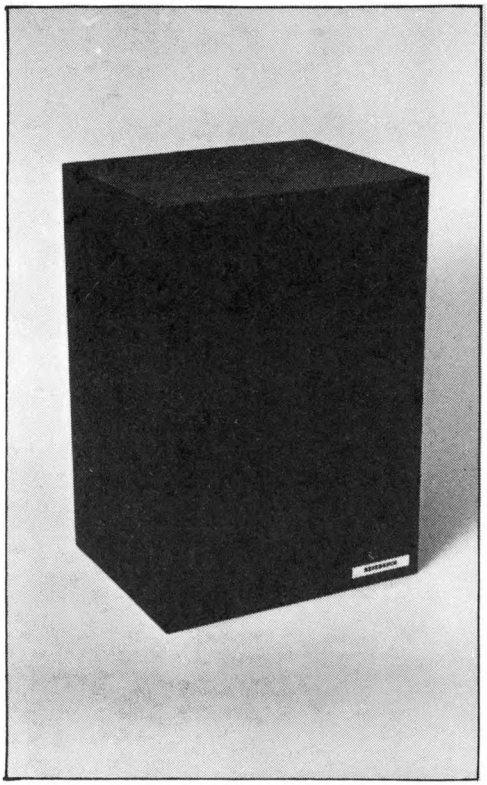
*see curves



RECOMMENDED

# RCL Reference

Radio Components Ltd., Unit E2, Bridge Works Industrial Estate, Bridge Road, Hunton Bridge, Near Watford, Hertfordshire. Tel (0923) 768399



With an abundance of 'References' turning up on speaker labels these days the Radio Components model is the least expensive to date, retailing typically at a modest £75 a pair. The company is responsible for supplying SEAS units in the UK and has taken the opportunity to produce several speaker systems incorporating these drivers. In this case two are used, namely a 170mm diameter pulp cone unit and a 25mm soft dome ferro-fluid-damped tweeter. A three-element crossover is fitted, which also includes three resistors for driver level matching.

A sealed box enclosure, the *Reference* is a diminutive 10 litres in volume, and is made of plain but well veneered chipboard, with a dense wool filling. The grille baffle was also of plain board 12mm thick with no rebate, and this omission is likely to worsen the cabinet diffraction effects.

**Lab results**

The system resonance was 66Hz which gave a reasonably extended bass in view of its size at −6dB, 60Hz. The sensitivity averaged 85dB which is a little below average, and we feel that the manufacturer's claim of suitability for amplifiers down to 6 watts is somewhat optimistic; we would regard 25W as a more practical starting point. Modest sound levels of 95dBA should be possible from a pair in a typical room, the speaker possessing a 50W power handling capacity.

Pair matching was undoubtedly good for such an inexpensive model, and held to within ±0.5dB over the entire range; the 8 ohm impedance rating means that it is easy to drive. However the grille did disturb the response: the dip at 6.6kHz was traced to its influence, as was a 2dB loss above 16kHz.

The speaker gamely withstood a sustained input level sufficient to produce 96dB at 1m for the swept measurement of second and third harmonic distortion. Both results were in fact very good, except at the lowest frequencies where the bass driver was running out of steam, and although 1% third harmonic was recorded at 70Hz this is not too serious. With the 100W peak input, 3% second harmonic occurred at 500Hz, but the third harmonic content remained low and negligible compression appeared at either test frequency.

On axis at 1m the low frequency range was well controlled to 300Hz, above which the output rose to a prominence at 800Hz. If the response had remained flat thereafter then shelf mounting would have been ideal; unfortunately the output then dropped to a presence trough several dB deep before the treble range made a delayed recovery. At 2m this situation was little improved, but the off-axis responses did show a very good uniformity, suggesting that the crossover was successfully integrating the drivers and controlling the usual phase anomalies.

**Sound quality**

Judged 'acceptable' on the live sound comparisons, the *Reference* could be 'cracked' on electric bass guitar at inputs above 50W peak but was happy below this level, with the bass sounding reasonably clean. The overall sound was rather dull and thick with noticeable but not unpleasant boxy coloration.

The design also sounded acceptable albeit rather lifeless on stereo programme. The isolated treble

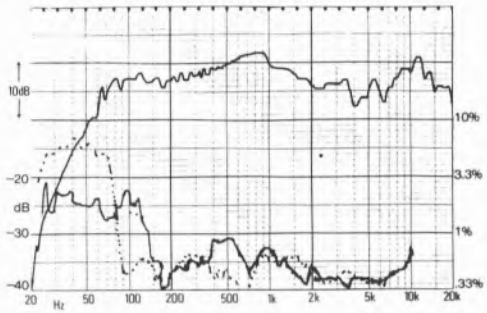
RECOMMENDED

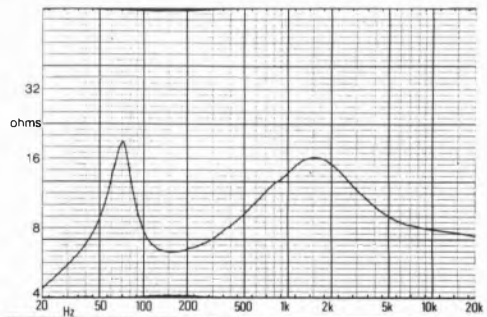
appeared a little 'zingy' at times, and detail was withdrawn, defocusing an otherwise promising stereo image.

**Summary**

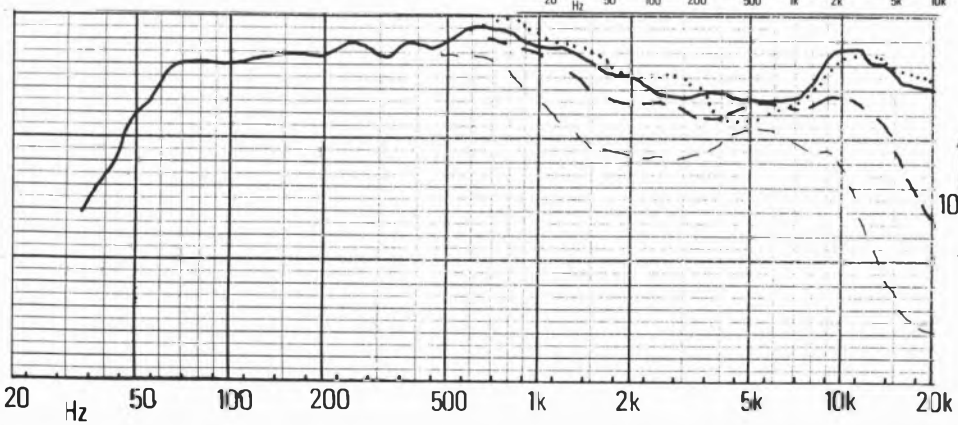
As one of the cheapest models in the report, this speaker has done quite well. It is comparatively musical and this fact, together with its combined ratings, are sufficient to merit a recommendation on value for money grounds. An audition is nonetheless advised prior to purchase.

*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) | 34.5, 24, 20 (13.6, 9.4, 8) cm(inches) |
| Weight | 5.5 (12) kg(lbs) |
| 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) | 60Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 60Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m | 85dB |
| Approximate maximum sound level (pair at 2m) | 95dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | acceptable |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | above average |
| Typical price per pair inc VAT | £75 |



RECOMMENDED

# RAM CD20

RAM Electronics Ltd., The Granary, Trowse, Norwich
Tel (0603) 614479

The RAM *CD20* is one of this company's new range of speakers and uses two vertically aligned SEAS drive units, namely a 19mm plastic dome tweeter and a 150mm pulp cone bass/midrange. The six-element plus two resistor crossover was unsecured – simply left floating in the acoustic filling – which is a practice I do not condone.

The enclosure is tuned to 35Hz *via* a foam damped port, which is rather a low frequency for the small 16 litre volume. The chipboard cabinet carries internal bituminous pad damping plus a foam lining. The foam damped port has been turned into a styling feature in the black lower section at the front of the enclosure, but the grille baffle itself did not include any rebate to help reduce diffraction effects.

**Lab results**

The grille baffle and covering were not found to notably affect the frequency response, and a fine stereo pair match was demonstrated. Sensitivity was about average at 86dB/W, and with a 100W power input ceiling on programme, this corresponds to a quite respectable maximum level of 101dB from a pair in a normal room. The −6dB at 55Hz low frequency rolloff was typical for the size, and with a well controlled nominally 8 ohms impedance the *CD20* is a good amplifier load.

Rated at 'very good' for swept distortion at 96dB, 1m, only a minor 1.5% peak of third harmonic at 1.5kHz was worthy of note. Low frequency distortion was also well controlled to the 70Hz limit. At the rather high 100W peak pulse input a significant compression of 0.5dB was measured at 5kHz, and while the 500Hz result was less at 0.2dB, 3% of second harmonic appeared here, which is three times the measured level at 96dB. On axis at 1m the frequency response looked quite even and balanced, bar a peaky tendency at 14kHz. At 2m with ⅓-octave averaging, this should prove harmless in subjective terms, judging by the look of the curve. An upper mid prominence was however shown, and less than perfect driver integration is revealed by the vertical 15° off-axis response (dotted) which is somewhat different from axial response in the 3kHz crossover range. The lateral dispersion was however very good.

**Sound quality**

The *CD20* was quite promising judged from the results of comparisons with live sounds. While the usual mid colorations were evident to a moderate degree, the sound was reasonably well integrated with fair precision of transients, although it could sound a little 'lispy' on speech. At above 8W average of electric bass guitar some port chuffing and blowing was audible, but gross bass overload was not reached until 35W average or about 100W peak on plucked transients.

With 'average' scores on the stereo programme listening tests, this model has done well for its price. Imaging had good potential, but was marred by a 'loud' 'forwardness' in the midband which detracted from the impression of depth. The overall tonal character was rather 'thin' and 'clinical', with a touch of 'brashness' in the treble register.

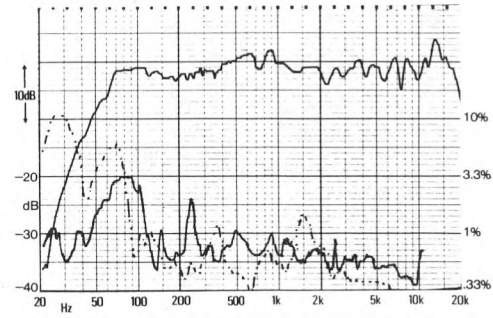
**Summary**

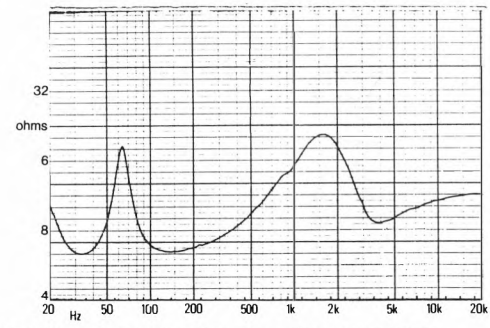
The *CD20* was a well finished and quite well made loudspeaker, with a performance that in almost all respects was close to the group average. Its price is

RECOMMENDED

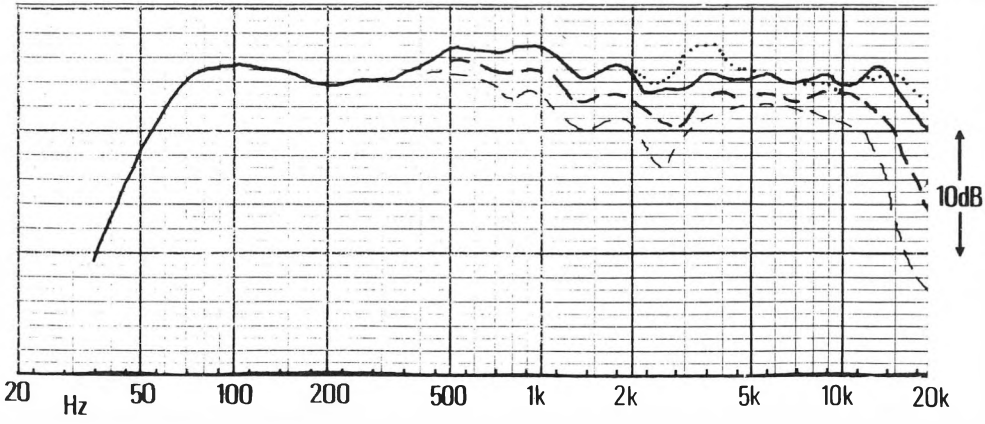
now very competitive, so recommendation is merited, though prior audition in the context of a chosen system is to be preferred.

*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).*



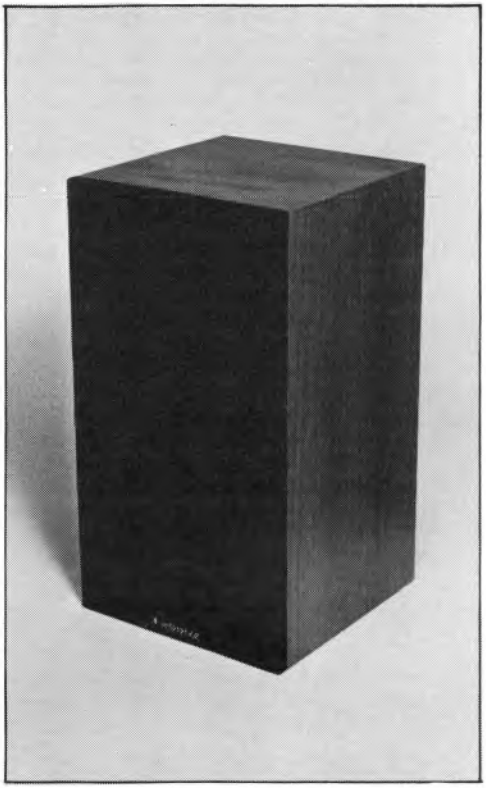




| | |
|---|---|
| Size (H, W, D) | 42, 25, 23 (16.5, 10, 9) cm(inches) |
| Weight | 6.5 (14.3) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–100W |
| Recommended placement | open shelf or stand |
| Frequency response within ±3dB (2m) | 60Hz–18kHz |
| Low frequency rolloff (−6dB) at 1m | 55Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m. | 86dB |
| Approximate maximum sound level (pair at 2m) | 101dBA |
| 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 | £120 |



# Reference Standard

Reference Audio Products Ltd., PO Box 86, Headington, Oxfordshire OX3 9SZ
Tel (0865) 60844



Another UK-made and designed loudspeaker, this model comes from a company which calls itself 'Reference'. The 20 litres sealed box loads a 200mm Peerless coated straight-sided pulp cone, which covers the bass/midrange up to the nominal 4kHz crossover point. The treble range is allotted to a SEAS fabric dome unit of 25mm radiating diameter, with the four-element 12dB/octave crossover also incorporating two resistors for damping and attenuation.

The well veneered cabinet is built from 13mm thick chipboard, with a double laminate of bituminous panel damping. The sensible grille baffle was internally rebated to reduce diffraction effects, and unusually thick cable was employed for the internal wiring, despite the moderate power rating of the crossover components.

**Lab results**

The characteristic sensitivity was quite high for this system and is estimated at 89dB/W, although the unevenness of the output with frequency makes this figure prone to error. In case the 2kHz trough was phase induced we reversed the tweeter connections, but as this produced an almost identical result, and as both systems also exhibited very good pair matching, they were assumed correct. The grille did not induce any further significant aberrations in response.

In view of its 100W power rating on programme, a genuine 104dBA should be available in most rooms; the 60Hz rolloff point for −6dB output is typical for the size and sensitivity. Since the system is described as suitable for stand and shelf mounting, the latter would provide a bass enhancement to 50Hz or so. The impedance was easy to drive at a genuine 8 ohms, showing low phase angles of less than 30°.

Rating well on swept distortion at a high 96dB sound level, third harmonic measured 1.5% at 130Hz and 1kHz, but otherwise the results were good, particularly at low frequencies. It also coped quite well with the 100W pulsed power input, producing no extra distortion but exhibiting 0.4dB compression at both test frequencies. This was however at a pretty loud 109dBA peak, 1m.

On axis at 1m the frequency response was not promising, showing a rising midband curtailed by a 10dB trough centred on 2kHz, and with the output recovering erratically above 3kHz. From the 2m ⅓-octave responses this trough may be seen to be somewhat vertical axis dependent, and a position with the tweeter a little below ear level would provide some improvement. Laterally the dispersion was good.

**Sound quality**

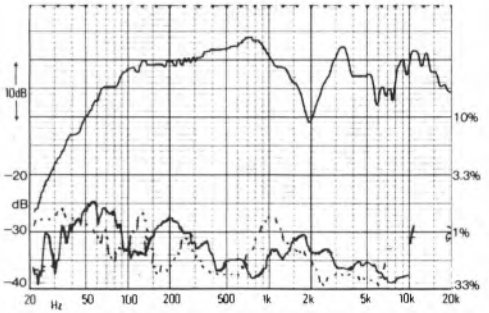
The *Standard* showed a consistently 'average' performance throughout the listening tests, which is reasonable in view of its below average price. On bass guitar a slight buzz developed due to inadequate driver fixing, but otherwise the bass was quite clean with good tonal differentiation, and it accepted up to 40W average power input. The sound on live comparisons appeared a trifle uneven with some mid prominence and 'boxiness', plus isolated sibilance exaggeration on speech.

On the commercial programme its reception was mixed, with good reactions from some panelists and bad from others. The performance did vary considerably with the type of programme played, and while the imaging showed restricted real depth, it demonstrated a strange psycho-acoustic

'spaciousness', possibly related to the presence suckout.

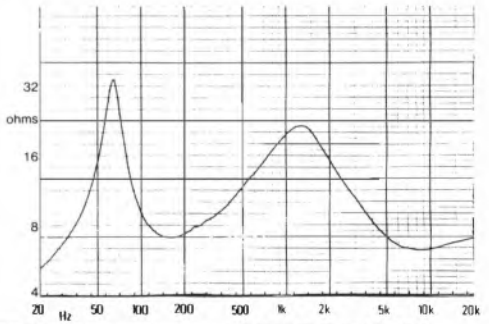
**Summary**

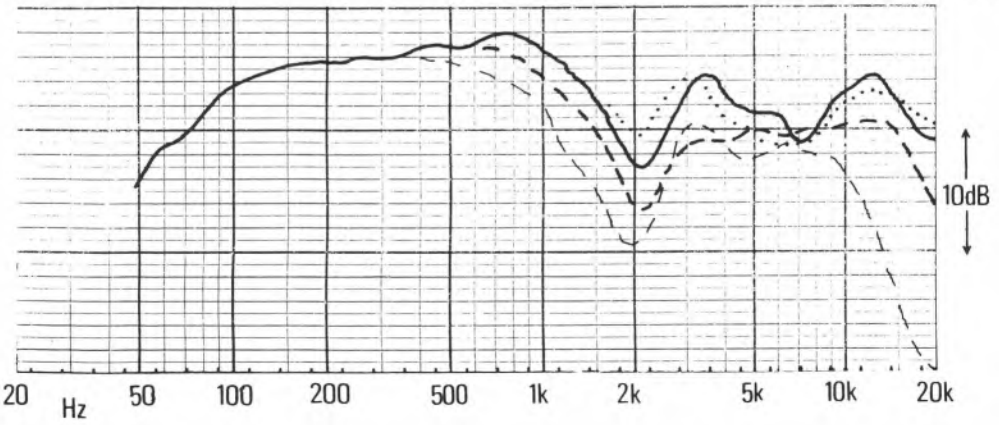
This modest loudspeaker has a most individual character and attracts widely divergent opinions concerning its merits. High standards in terms of accuracy were not achieved, but it has done well enough at its price level to be worth considering, although a personal audition is strongly advised.




| | |
|---|---|
| Size (H, W, D) | 46, 25.5, 27 (18, 10, 10.5) cm(inches) |
| Weight | 8.5 (18.7) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 10–100W |
| Recommended placement | stands |
| Frequency response within ±3dB (2m) | not applicable* |
| Low frequency rolloff (−6dB) at 1m | 60Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 89dB |
| Approximate maximum sound level (pair at 2m) | 104dBA |
| Distortion (96dB at 1m) | good |
| Distortion (100W peak) | good |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | average |
| Typical price per pair inc VAT | £170 |

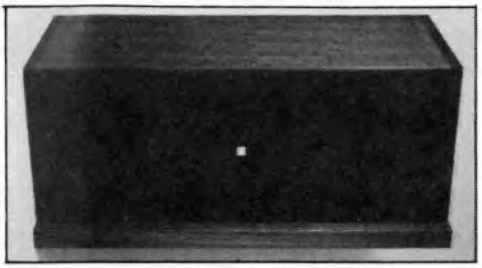
*depends on axis, see curves



# 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.

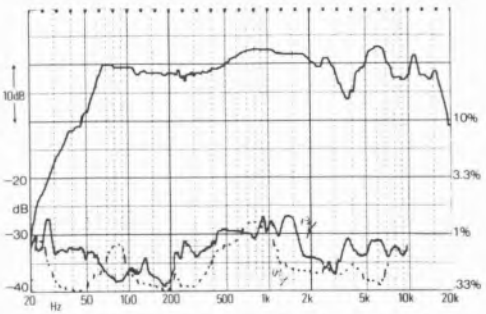
The performance improved on stereo programme, where the listeners felt that the imaging was well above average, with a promising rendition of detail

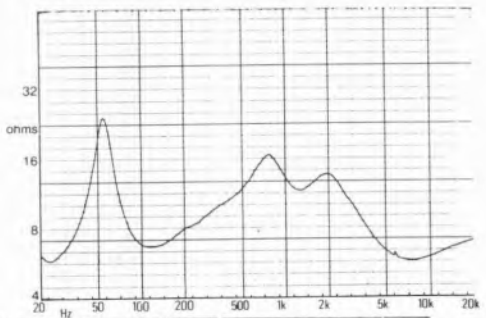
and good clarity. Colorations were well controlled with slight 'boxiness' and 'peakiness' in the treble register.

**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.

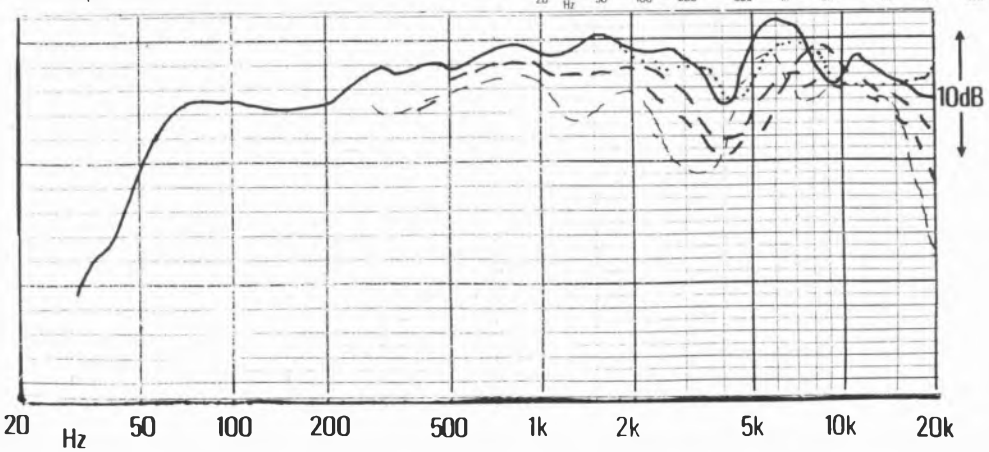
*Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*




| | |
|---|---|
| Size (H. W. D) | 90. 106. 46 (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.

RECOMMENDED

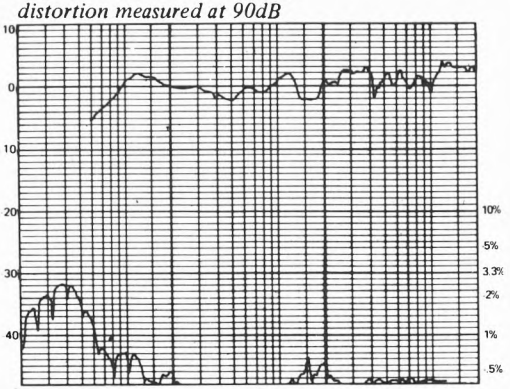
Little bass depth was perceived, although detail and clarity were both of a high order.

A further pair assessed in the last tests have allayed our fears with a better overall balance and fewer criticisms from listeners.

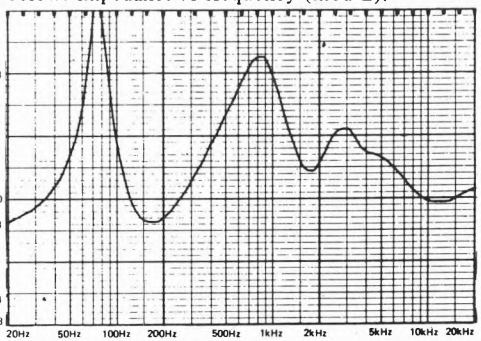
**Summary**

The intrinsic quality of this design has well enabled it to maintain its competitive market position, and its reputation as a miniature of monitor quality is undoubtedly justified. Sounding more natural on high stands clear of walls or corners, quite good results can also be obtained in open shelf location. Bearing in mind the limited bass power handling and loudness, the *3/5a* may nevertheless be recommended on the basis of its high sound quality for the price.

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).
*distortion measured at 90dB*

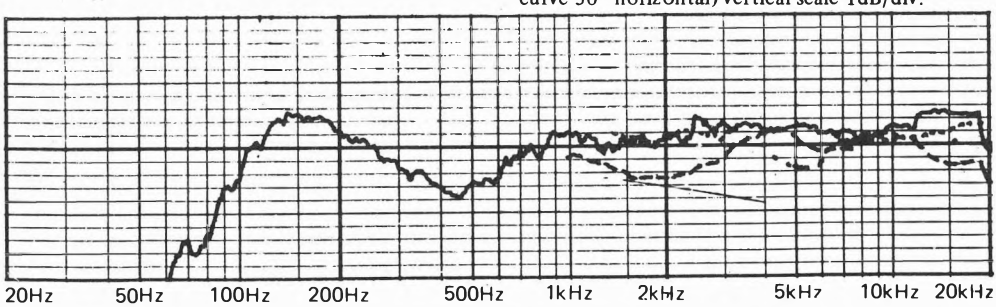



below: impedance *vs* frequency (mod Z).




| | |
|---|---|
| Size | 30(12) H; 18.5(7.5) W; 16(6.5) D; cm(inches) |
| Weight | 5.5(11.5) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 30 to 50W |
| Recommended placement | high stand (or shelf) |
| Frequency response within ±3dB (2m) | 90Hz to 20kHz |
| Low frequency rolloff (—6dB) at (1m) | 59Hz |
| Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) | 82.5dB at 1m |
| Approximate maximum sound level (pair at 2 metres) | 93dBA |
| Third harmonic distortion (90dB at 1 metre) | very good |
| Impedance characteristic (ease of drive) | very good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £185 |

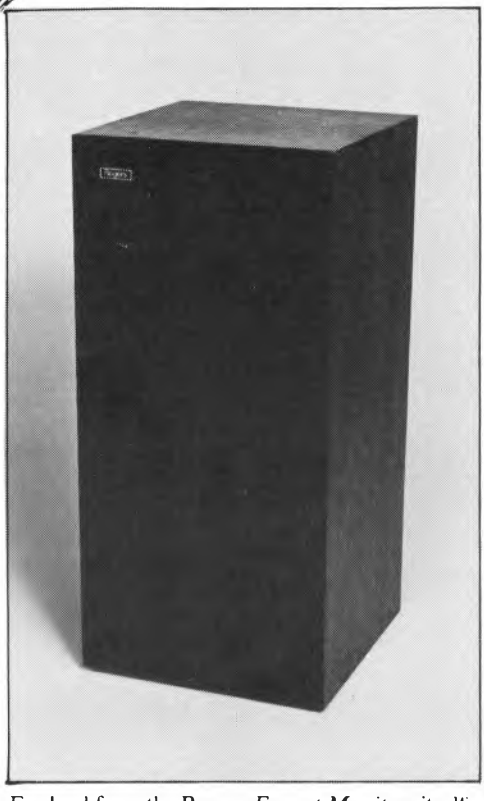
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



BEST BUY

# Rogers Studio

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



Evolved from the Rogers *Export Monitor,* itself a close relative of the original *LS 3/6* BBC design, the *Studio* is designed to meet new targets set by Rogers for this classic and essentially two-way system. As before the main driver is a 200mm bextrene cone unit, the latest version corresponding very closely to the original BBC profile. Built on a cast alloy frame, a high power motor coil and improvements in excursion control and linearity endow it with fine power handling. The 3–13kHz range is allocated to the Celestion *HF1300,* with a KEF *T27* 19mm extending the range through the final octave. A complex high quality crossover integrates the three drivers, and the 43 litre enclosure is reflex tuned by a substantial short tunnel port to approximately 45Hz. The excellently veneered panels are made from a resin fibre instead of the original plywood, and are damped by bituminous pads.

**Lab results**

Sensitivity was an average 86dB/W, which is a little higher than for other similar systems. With an allowable 250W programme maximum, quite high sound levels of 104dBA are possible, while the low frequency rolloff is a respectable 46Hz for −6dB. Pair matching was very good with a slight imbalance above 15kHz, and as a true 8 ohm system the *Studio* should be easy to drive.

Distortion levels were well controlled, exhibiting particularly good results in the midband. Although high values were recorded at low frequencies, they were more than satisfactory at the test 96dB sound level. The good crossover power handling was evidenced by the peak distortion result at 500Hz, with just 0.5dB of compression and 1% of second harmonic; 0.2dB of compression was recorded at 5kHz, but no additional distortion was generated.

On axis at 1m the low frequency range was clearly well tuned and balanced, with an almost textbook response from 55Hz up into the midband. Mild irregularities were present thereafter, but the essential evenness of the frequency balance was preserved. At 2m with ⅓-octave averaging, the phase notch at 14kHz was shown up for the minor subjective feature it was, with the well balanced and integrated response well charted. Such flatness and dispersion uniformity potentially offers fine stereo.

**Sound quality**

Rated in the top class on comparisons with live sounds, the *Studio* was relatively uncoloured, exhibiting a slightly 'light' character well suited to voice and solo instrument reproduction. It was considered to possess good accuracy, while the bass power handling was highly satisfactory, with good fundamental power and quite even tonal differentiation up to an average of 60W (250W peak) on electric guitar.

On the stereo sessions the speaker sounded smooth and transparent, exhibiting a wide, even response and quite low coloration. A slightly 'light' and 'airy' impression was given, not perfectly 'rounded' in balance, and the bass was marginally 'boomy' in our listening room, but the mid and treble were exceptional. Stereo imaging was precise and stable, with good depth.

**Summary**

Rogers have succeeded here in refining an established design concept to a level where new

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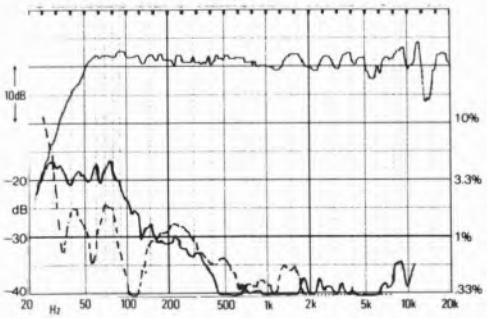
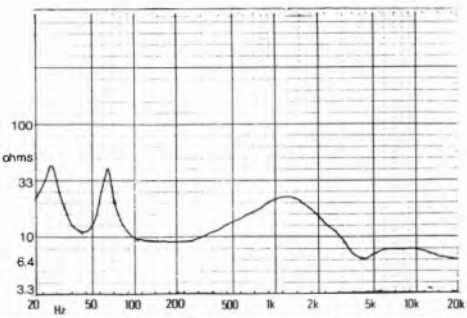
standards of sensitivity, coloration, balance, distortion and power handling are attained using a relatively compact enclosure. Moreover the price has been kept competitive so it is an undoubted 'best buy' and has been shown to merit its 'studio' label.

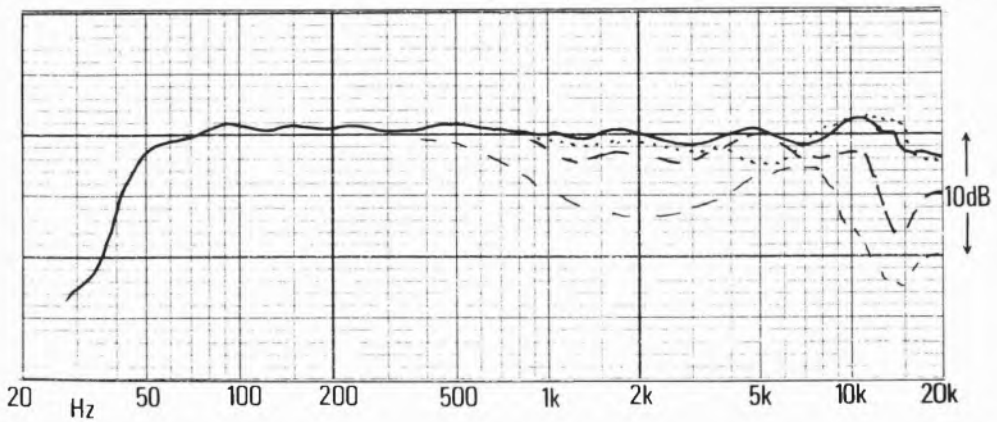
*Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*




| | |
|---|---|
| Size (H, W, D) | 63.5, 30.5, 30.5 (25, 12, 12) cm(inches) |
| Weight | 14 (31) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–250W |
| Recommended placement | stands |
| Frequency response within ±3dB (2m) | 50Hz–20kHz* |
| Low frequency rolloff (−6dB) at 1m | 46Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 86dB |
| Approximate maximum sound level (pair at 2m) | 104dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | very good |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £345 |

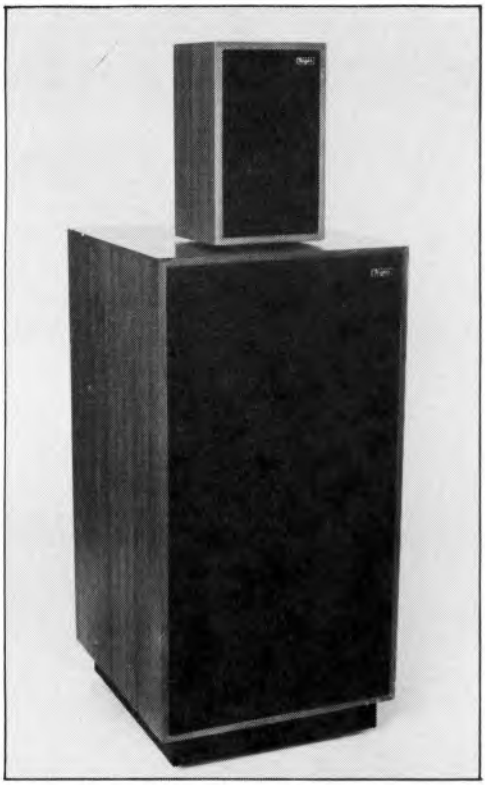
*depends on exact HF axis



# Rogers Reference System

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



A rather complicated and specialised system, the *Reference* was designed to provide an answer to the demand for bass power and extension, while still retaining *LS3/5a* speakers for the rest of the range. This is particularly relevant to those enthusiasts who already appreciate the virtues of the *3/5a* and may wish to upgrade their systems. As such, the *Reference* comprises a massive pair of 91 litre subwoofer cabinets, fitted with 350mm die-cast frame bass units. The latter possess a third order sealed box low frequency alignment *via* an additional capacitor, and are fed directly from an accompanying power amplifier/electronic crossover which offers adjustment for bass response shape and filtering. A separate stereo amplifier (typically a Rogers but others can be substituted) is used for satellite drive and normal system operation, carrying the filtered signals directed back from the crossover unit. As the *3/5a*s are relieved of the bass register, they can be driven somewhat louder than usual (see separate review) and conveniently stand on top of the bass cabinets. This system is undoubtedly comprehensive and does all that is required of it, but setting up is awkward – more so, for example, than the Audio Pro ensemble.

**Lab results**

The *Reference* was evaluated as a complete system, and as it contains amplification, a number of parameters could not be measured, such as impedance and sensitivity (for the *LS3/5a* alone, see the separate review). What is perhaps more important is the maximum sound level attainable, given the power handling limitation of the *3/5a*. This worked out at 96dBA for a pair under normal conditions, which is a satisfactory but by no means overpowering peak dynamic margin, the electronics endowing the *3/5a* with a 3dB increase (on its own a modest 93dBA represents the limit). The woofer system returned a well extended bass, in our estimation reaching 25Hz for −6dB, one of the lowest in the issue.

The distortion results are in two parts, with a 96dB level for the subwoofer up to 300Hz and a more modest 90dB for the *3/5* 'miniature'. The critical third harmonic component was held to low levels – under 3% even at 50Hz, 96dB. Second harmonic was higher than expected at low frequencies, but the 3.7% result at 100Hz should prove pretty innocuous in subjective terms; 2% of second was recorded at 1.8kHz, but this was also judged of little consequence. The peak power test could not be tried due to the particular electronics system fitted.

On axis at 1m the response was very wide with fine balance and uniformity, and showed good integration of the bass system with the *3/5a*. For a 30Hz to 20kHz range, ±2.5dB limits sufficed, while at 2m the output was smoothed further, and demonstrated the slightly forward balance of the *3/5a* with its remarkable dispersion properties. The proximity of the top cabinet surface to the *3/5a* did however produce some mild aberrations in the response, which fortunately appeared to have little effect upon the sound quality, and could be reduced by elevating the *3/5a* a few inches and placing a thick foam or felt mat (6 x 3 x 1 ins) on the front of the bass cabinet top.

**Sound quality**

Considered very good on live sound comparisons, the full potential of the *3/5a* was realised and the

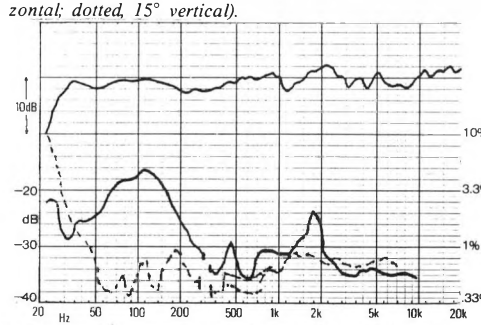
bass sounded deep, powerful and generally uniform. Overall the sound quality was placed in the top class, with good stereo imaging demonstrated on commercial programme, as well as a high level of musical detail and an open spacious sound up to the peak level tolerated by the *LS3/5a*s. Some of the latter's particular slight boxiness and nasality was of course still apparent, and occasionally the bass could sound somewhat overpowering on its normal setting in our listening room.

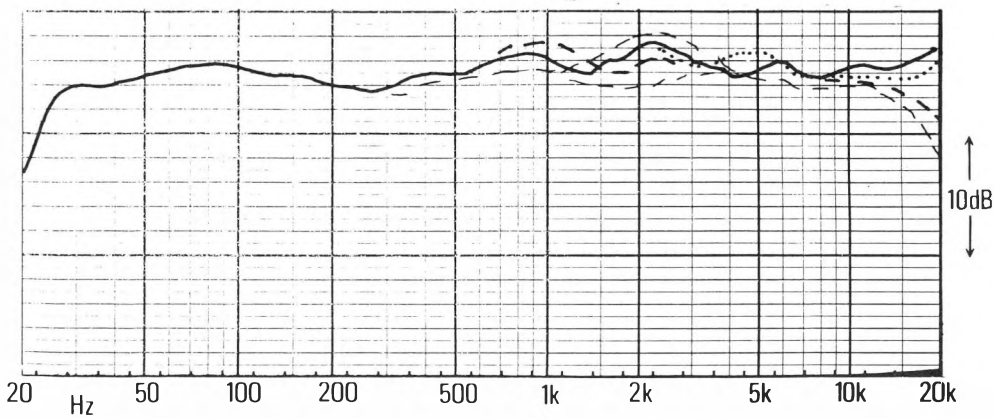
**Summary**

Despite its limited dynamic range, the *Reference* system is clearly a high-class performer of exceptional bandwidth, and enhances the established *LS3/5a* sound quality. If you enjoy living with *3/5a*s, the addition of this elaborate and well designed subwoofer system will provide the bass you have been missing, the performance of the whole deserving commendation.

| | |
|---|---|
| Size (H, W, D) | 112.5, 42, 46 (44.4, 16.5, 18) cm (inches) |
| Weight | 36.5 (89.5) kg (lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | built-in amplifiers provided |
| Recommended placement | floor |
| Frequency response within ±3dB (2m) | 27Hz–20kHz |
| Low frequency rolloff (−6dB) at 1m | 25Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | variable |
| Approximate maximum sound level (pair at 2m) | 96dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | not available |
| Impedance characteristic (ease of drive) | active |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £860 (inc 3/5a and amplifier) |

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

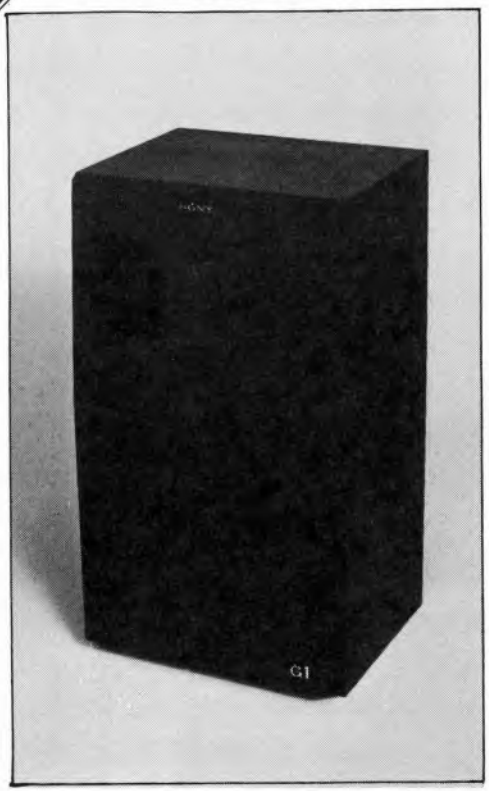


BEST BUY

# 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 ⅓-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

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

**Summary**

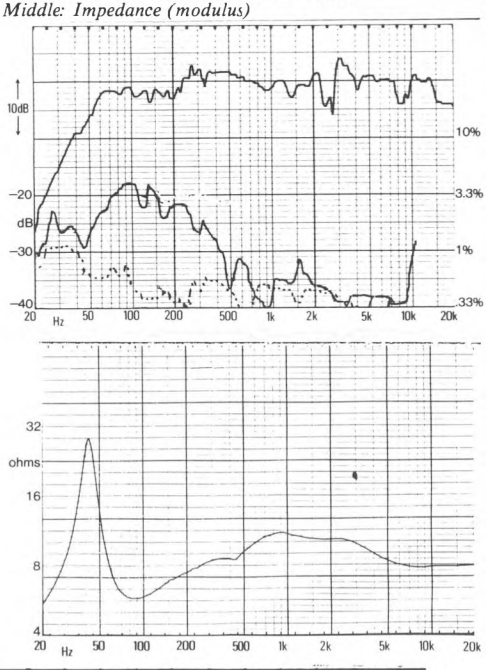
This good looking and well engineered system offered a fine all round subjective performance with firm bass amenable to lift if desired. A very high maximum sound level was attained with high sensitivity, excellently low distortion and an 'average' amplifier rating. Recommendation is clearly in order, but as the *GI* was on occasion a touch aggressive, personal audition would be worthwhile.

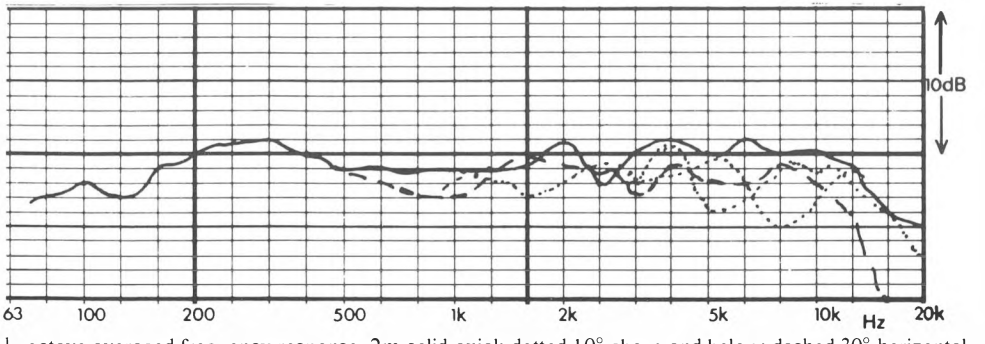
**Note:**

The *Mk II* version which was fully retested for this edition offers minor modifications to improve the high power durability, but was otherwise very similar to the *Mk I.* It did well on the pulsed power test with a minimal increase in distortion, but performance was better with the grille off, the latter responsible in part for the 3kHz response irregularity.

| | |
|---|---|
| Size | 59.5(23) H; 33.4(13) W; 30(12) D; cm(inches) |
| Weight | 13(29) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 10–100W |
| Recommended placement | stand or open shelf |
| Frequency response within ±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

# Sony SSG4

Sony UK Ltd., 134 Regent Street, London W1
Tel 01-439 3874


This loudspeaker was built in West Germany at Sony's European speaker production plant, and is heavily engineered. A three-way system, the 250mm fibre cone bass unit is built on a massive die-cast frame with a high power ventilated voice coil. A special pulp-fibre material is used for the 75mm dome/cone midrange unit, with a 25mm plastic dome SEAS to cover the treble. A good quality eight-element crossover is fitted, with an additional four resistors to provide damping and attenuation.

The rigid but undamped chipboard enclosure is well finished in a synthetic dark walnut veneer. The sizeable 50 litre volume is reflex loaded at a rather low 24Hz by a 60mm diameter tunnel port some 140mm long. The interior is fibreglass filled for volume absorption, and the grille is a moulded structure with lateral slots to reduce diffraction, the success of which is borne out on test.

## Lab results

Based on the lower frequency reference range the sensitivity was rated at a high 90dB/W, and with a 100W power handling substantial 106dBA sound levels may be attained under normal conditions. The *G4* showed a good stereo pair match – some ±0.5dB, 50Hz to 18kHz – with a bass rolloff −6dB point at a fairly high 55Hz. The rolloff was in fact more gradual than usual, and useful output would normally be available down to 40Hz.

Apart from a rise in third harmonic distortion to nearly 2%, 700Hz, both second and third harmonic content was very low for all other frequencies at 96dB. Using a 100W pulsed input the crossover was beginning to overload, producing a 0.1dB expansion at 500Hz with 3% second and 2.5% third harmonic, but no problems were evident at 5kHz bar a slight 0.2dB compression.

The impedance rating was 'average', in this case signifying that the standard 8 ohms tolerance was exceeded, but this was not particularly serious and was due to an impedance minimum of approximately 5.6 ohms at 7kHz. In its favour phase angles were low at typically 20°, with a 25° maximum.

On axis at 1m the response showed a fairly even balance, but with an upper midrange depression 2.5dB deep from 800Hz to 3kHz. At 2m with ⅓-octave averaging of a pink noise source, the response trends were clearer. Prominences centred on 400Hz and 5kHz appeared, giving a 'double humped' effect, and more variation than usual was present in the 15° vertical response, particularly as regards the 0.6–2.0kHz range. However the dispersion did rate quite well.

## Sound quality

A just 'acceptable' rating was denoted for accuracy when compared with live sounds, and one critical listener even drew a good sketch of the double humped response based on aural judgment alone. The system sounded 'boxy' and 'thickened', with a 'cupped' mid coloration and a 'dull' extreme treble, although conversely the lower treble was too 'hard' and 'forward'. Bass power handling was however good to a 100W peak input, though a trifle uneven in presentation.

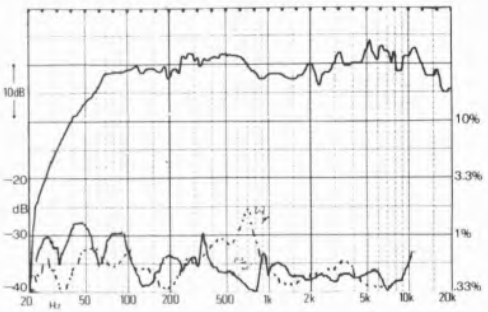
The panelists were less critical on stereo programme, and the system scored 'good' for both stereo imaging and overall sound quality. In 'normal' use it in fact sounded rather better than the live comparisons had led us to believe, and most

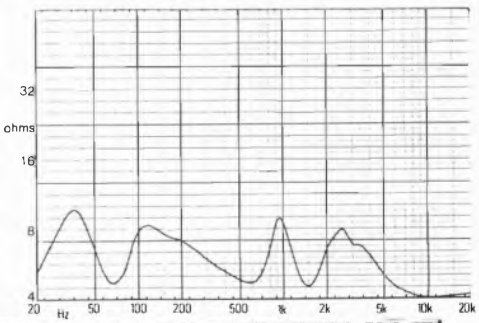
panelists commented on good clarity, and a pleasing subjective balance.

**Summary**

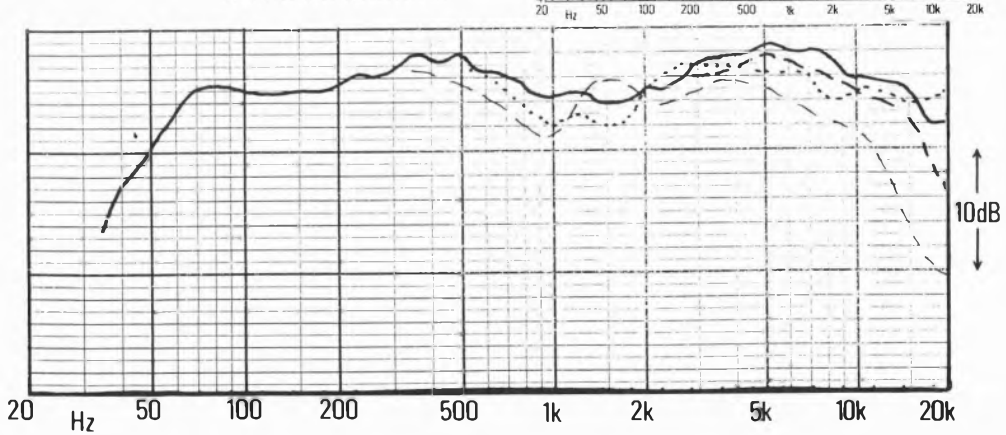
This model is not in the same value category as its smaller brother the *G1*, and yet it is sufficiently pleasing in terms of its sound quality and well enough engineered to merit consideration and audition.

*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).*



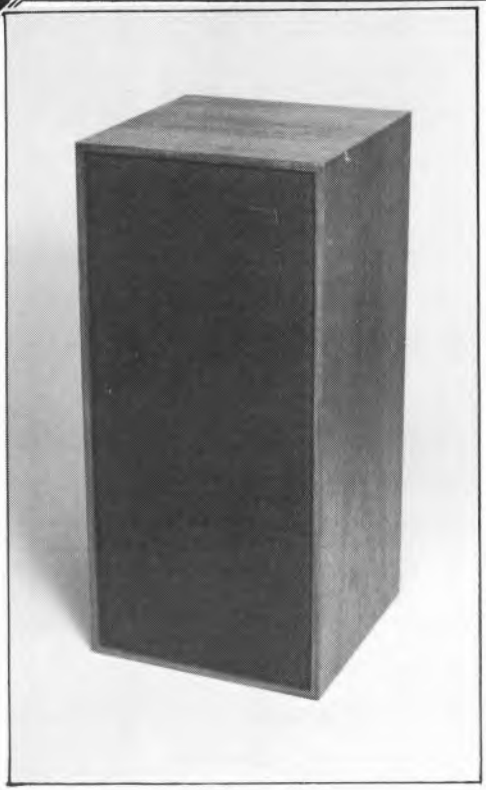

| | |
|---|---|
| Size (H, W, D) | 63.4, 36.7, 29.2 (25, 14.4, 11.5) cm(inches) |
| Weight | 19 (42) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 10–100W |
| Recommended placement | stand |
| Frequency response within ±3dB (2m) | 59Hz–16kHz |
| Low frequency rolloff (−6dB) at 1m | 55Hz |
| 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) | average |
| Forward response uniformity | above average |
| Typical price per pair inc VAT | £300 |



BEST BUY

# Spendor BC1

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



First produced in the late 1960s the *BC1* has long been used as a reference by *Choice*, and as such its review is periodically updated by reassessing new production samples. In fact, the overall sound quality and perceived balance has changed comparatively little over the years, but significant improvements have been made in power handling.

Basically a two-way system comprising a high quality bituminous damped plywood cabinet of some 44 litres volume, the main driver is Spendor's own highly refined 200mm bextrene cone built on a die-cast frame. The treble is covered by a selected Celestion *HF1300*, whose design origins are in fact twice as old as those of the *BC1*, while the final octave above 14kHz is allocated to a 19mm dome unit from Coles (the latter originally marketed by STC). The complex high power crossover filters and equalises the input power with provision for precise treble level matching. A simple 50mm port reflex tunes the bass, the opening being foam-lined to reduce turbulence noises from heavy bass outputs.

**Lab results**

Excellent pair matching was recorded, with minor differences at 10 and 15kHz, but the sensitivity was fairly low at 84dB/W with the −6dB cutoff at 48Hz. Suited to amplifiers in the 30 to 125W range, the *BC1* was capable of a sufficient 98dBA maximum sound level in a typical room without distress. Rated as 'good' on amplifier loading, the minimum impedance was a harmless 6 ohms, 18kHz, and the system was thus easy to drive.

The third harmonic results at 96dB, 1m were very good, particularly in the midband, and although they did increase rapidly at low frequencies, 3% at 50Hz is still fine in subjective terms. Rather more second harmonic was however recorded, with an isolated peak of 2% at 3kHz – very close to the crossover. It proved happy on the 100W pulsed input showing a moderate 0.3dB compression at 500Hz and just 0.1dB at 5kHz, with no additional distortion.

On axis at 1m a phase notch effect was present at 13kHz – the upper crossover – and some minor irregularity was also evident at the lower crossover point of 3.5kHz. A mild upper bass suckout was evident tending to isolate the bass as a prominence around 100Hz. At 2m with ⅓-octave averaging, the output showed excellent integration, smoothness and balance, with the off-axis curves demonstrating a close correspondence with those on axis, thereby confirming the good dispersion.

**Sound quality**

Rated 'good' on live sound comparisons some 'boxiness' was apparent in the lower midrange with a 'thickened' and 'nasal' effect higher up, but neither was judged very serious. The vocal balance was very good with accurate sibilants, and acoustic guitar was also well handled. By current competitive standards the bass power handling was judged just moderate, with up to 40W average or 125W peak input allowed before 'cracking'. Bass notes were well differentiated in timbre, but the output was a trifle lumpy.

Overall the stereo programme performance was judged 'very good'. Imaging was laterally stable and precise, with fine depth resolution, while detail was well defined and without the exaggerations in frequency balance so often encountered. Its scoring was one of the best regardless of price,

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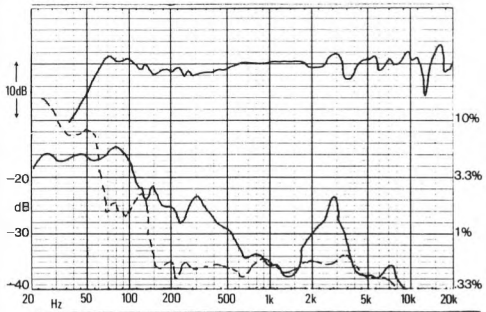
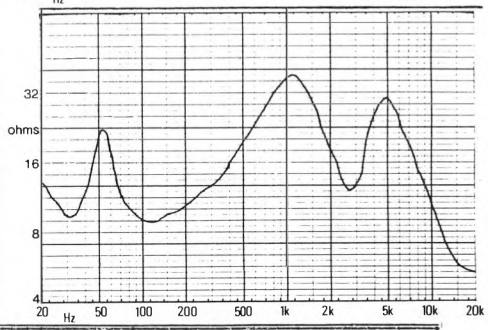
particularly when heavy rock programme is excluded.

**Summary**

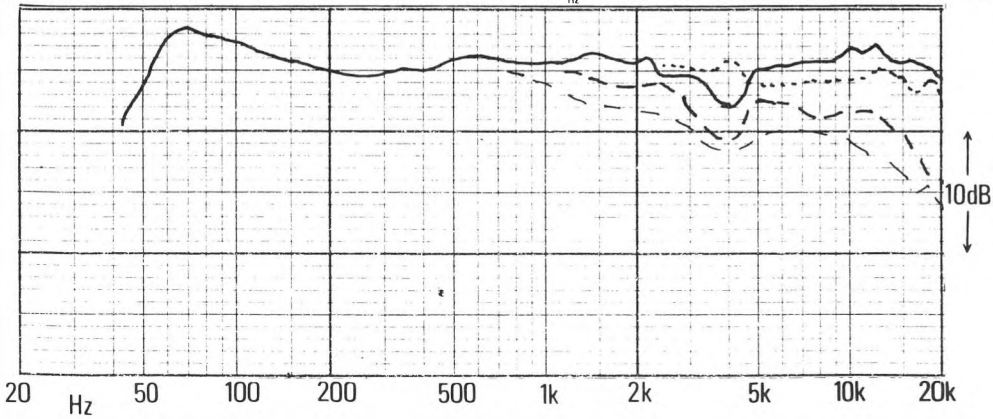
The *BC1* continues to be a well engineered, fine sounding and accurate loudspeaker, offering very good value for money. Few models come close to it even now as regards its midrange performance, and a 'best buy' rating is applicable. However, the high level rock enthusiast should note that the design is somewhat limited as regards bass power handling and consequently in terms of the maximum sound level it can attain, and in general terms the bass does seem subjectively somewhat poorly controlled.

*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).*



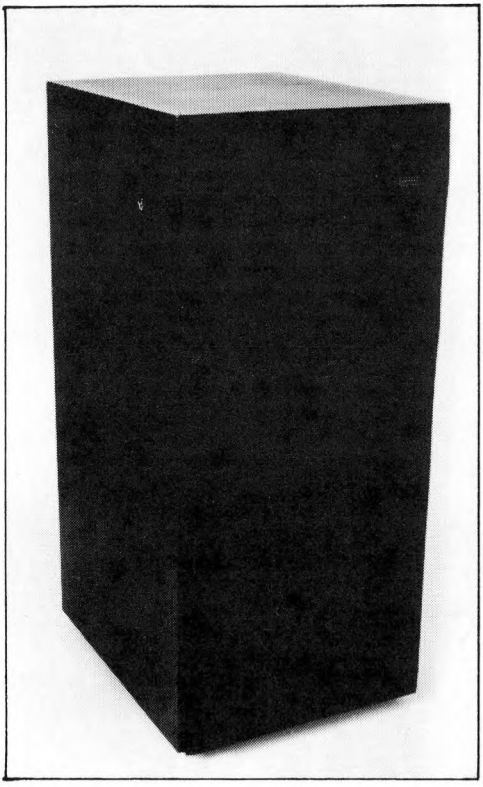

| | |
|---|---|
| Size | 63.5(25) H; 29.8(11.7) W; 30.5(12) D; cm(inches) |
| Weight | 14(30.8) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 30 to 125W |
| Recommended placement | stand |
| Frequency response within ±3dB (2m) | 70Hz to 20kHz |
| Low frequency rolloff (−6dB) at (1m) | 48Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) | 84dB at 1m |
| Approximate maximum sound level (pair at 2 metres) | 98dBA |
| Third harmonic distortion (96dB at 1 metre) | very good |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | £325 |



RECOMMENDED

# Spendor SA3

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



First seen in prototype form early this year, the *SA3* was designed in response to a requirement for a high sound level alternative to the *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 will also be available at around £750 a pair. Possessing a nominal 88–89dB/W sensitivity, it can be updated to active drive at a later date.

**Lab results**

A low −6dB point of 33Hz was charted showing the bass extension expected of such a large loudspeaker. The power headroom settings showed that a high maximum level of 110dBA should be available from a pair under normal conditions (and working on an estimated 200W programme handling capacity for the passive version, this should be capable of 108dBA but without the sizeable subjective overload headroom of the active model).

The distortion at 96dB 1m was judged excellent, with admirably low levels of third harmonic. While not strictly applicable, the pulsed distortion test was tried at two sound levels, namely 108dB and 98dB. At the former no distortion was detected, although a significant 0.6dB compression was measured at 5kHz and a negligible 0.1dB 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

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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.

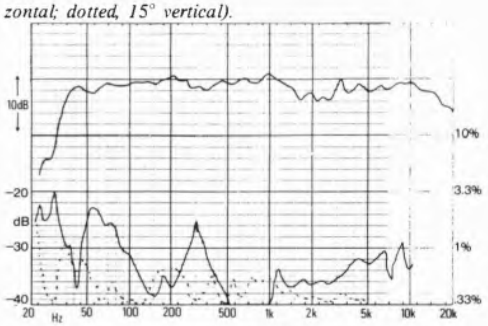
**Summary**

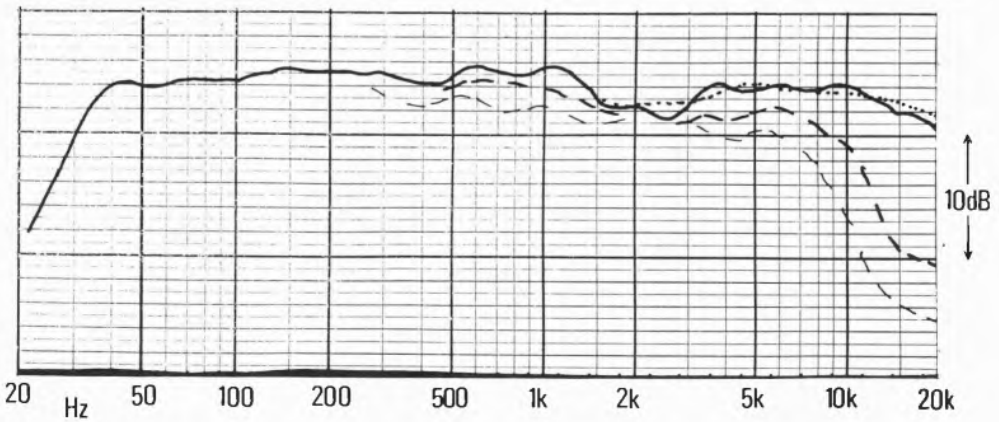
Joining that select group of accurate high performance systems, this fine and powerful loudspeaker intended for professional duties will, I am sure, find great favour on the domestic market as well. While in objective terms it does not quite possess the same midrange subtlety as the *BC1*, the system 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 | variable |
| Approximate maximum sound level (pair at 2m) | 110dBA |
| Distortion (96dB at 1m) | excellent |
| Distortion (100W peak) | very good |
| Impedance characteristic (ease of drive) | active |
| Forward response uniformity | very good |
| Typical price per pair inc VAT | anticipated *c* £1,400 'active', *c* £750 passive (not tested) |

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



# Tangent Excelsior

Tangent Acoustics Ltd., 4 Viking Way, Bar Hill, Cambridge CB3 8EL
Tel (0954) 81377

An inexpensive and unusually styled loudspeaker, the *Excelsior*'s rounded edge cabinet is in a matt black 'crackle' finish, with the grille successfully disguising the form and location of the drivers. However, the grille baffle itself was rather thick and close to the drivers and not rebated, so as a result adverse diffraction effects are likely – a supposition subsequently borne out on test.

A two-way sealed box system of 23 litres capacity, a 200mm doped pulp cone driver partners a 25mm plastic dome tweeter, both units manufactured by Audax. Three elements are used in the crossover, but a wiring fault was present in one system, whereby a loose capacitor had fallen across the input terminals due to inadequate fixing. A foam lining is used in the box to provide some absorption of internal sound energy, and although no panel damping was present, this is hardly surprising considering the price level involved.

**Lab results**

A high 91 dB/W sensitivity was recorded, and with a 100W programme power ceiling, generous 106dBA maximum sound levels are possible – good for the price. One penalty was the highish bass cutoff frequency at 75 Hz for −6dB, although in practice shelf mounting would augment this by 10Hz or so. Pair matching was more than satisfactory and typically ±0.75dB over the major part of the range. However, the grille was found to attenuate the upper treble by an average of 2dB, and to worsen the anomalies at 6.6 kHz, 10kHz and 14kHz.

Rated 'acceptable' for distortion, third harmonic values were more than reasonable, but a rise in 2nd to 4.5% was charted at 6kHz. Fed 100W pulses at 500Hz, 0.5dB of compression occurred with 4% second and 2% third harmonic distortion. and although compression was less at 5kHz (0.3dB), 4% of second and 1% of third harmonic distortion was still apparent. Rated 'average' for amplifier loading, the speaker impedance fell to nearly 5 ohms at 12kHz, but this is not considered serious, and phase angles were genuinely low, the worst case being 35°, 5.5kHz at a harmless impedance level.

On axis at 1 m the *Excelsior* response was rather lumpy in the mid and presence range, but showing indications of a promising overall balance with ±4dB limits from 80Hz to 19kHz. At 2m with ⅓-octave averaging, the picture was better resolved in terms of subjective balance. The bass showed a prominence at 100Hz with a rising midrange, and the speaker was clearly presence 'forward' around 5kHz; this quickly reduced laterally off-axis where the dispersion was not too good. A strong notch appeared at 6kHz 15° above axis, indicating poor driver integration and suggesting that the speaker should be mounted fairly high on stands or a shelf for the best results.

**Sound quality**

On comparison with live sounds the *Excelsior* rated 'poor'. Some bass distortion could be heard on 1W average of electric bass guitar, though it went on to accept 35W before the onset of severe distortion. It was considered to be quite 'hard' and 'nasal' in coloration, with poor sibilants and a 'wooden' and 'boxy' lower midrange. Low bass notes were in fact missing.

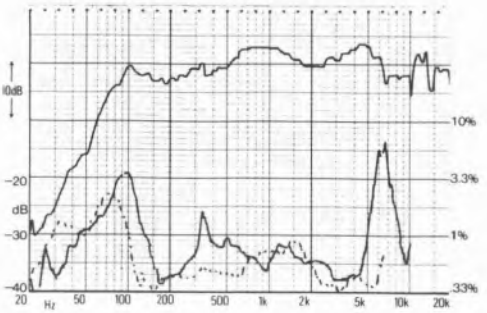
Similar results were obtained on the stereo programme. Piano was reproduced with a 'clangy'

quality and detail was withheld, the impression being of a rather 'close' and coloured sound with an 'abrasive' and uneven treble. Stereo imaging showed lateral instability and a flat presentation with little depth.

**Summary**

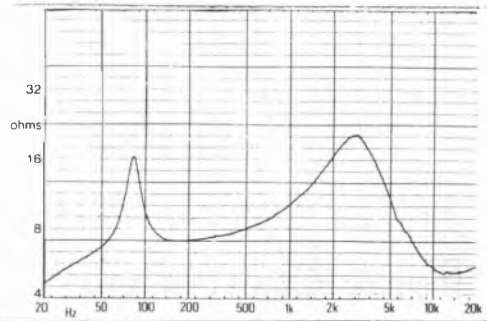
This speaker's strong points were its size, styling and loudness capability, plus the modest price level. The construction could have been better in regard to the crossover and its fixing, while the overall sound quality did not meet with the panel's approval.

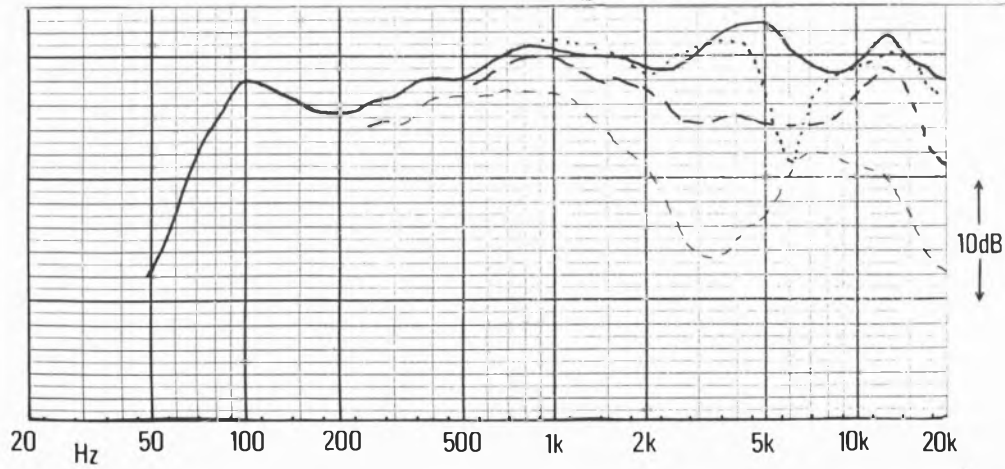
*Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*




| | |
|---|---|
| Size (H, W, D) | 50, 27, 25 (19.7, 10.6, 9.8) cm(inches) |
| Weight | 8 (17.6) 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) | 300Hz–20kHz* |
| Low frequency rolloff (−6dB) at 1m | 75Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) at 1m | 91dB |
| Approximate maximum sound level (pair at 2m) | 106dBA |
| Distortion (96dB at 1m) | acceptable |
| Distortion (100W peak) | acceptable |
| Impedance characteristic (ease of drive) | average |
| Forward response uniformity | acceptable |
| Typical price per pair inc VAT | £90 |

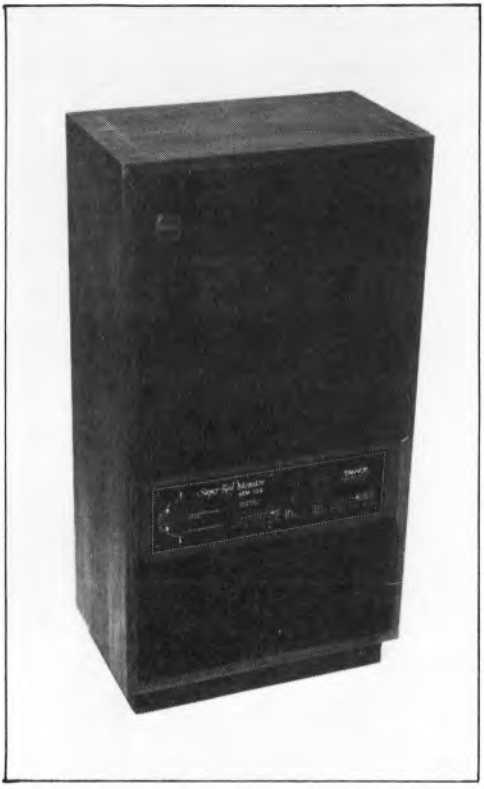
*dependent on axis



# 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.

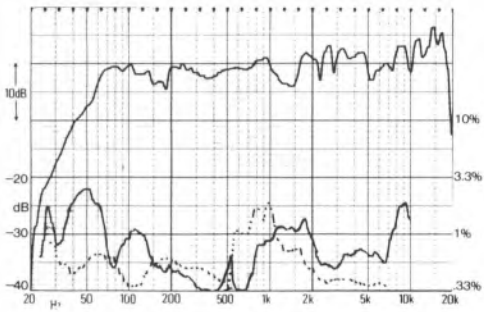
On the stereo programme tests some midrange coloration was present which restricted the stereo depth, while lateral positional focus was none too precise. Piano reproduction was a trifle 'wooden' and the treble register tended to show up noise and clicks more than usual.

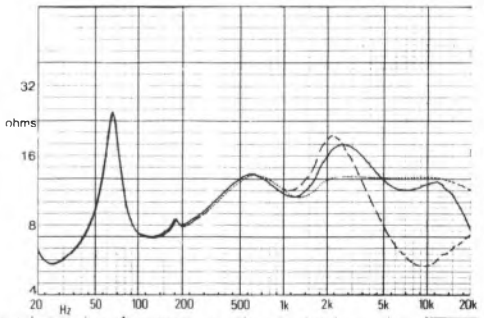
### Summary

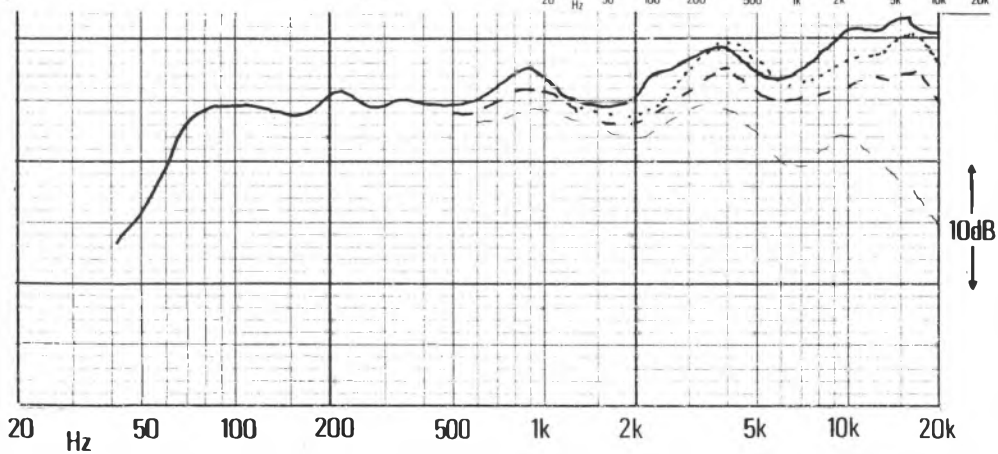
This design was rather out of place in the context of the project as a whole, since its virtues of easy drive, very high sensitivity and high acoustic level capabilities are not the factors uppermost in the minds of a panel accustomed to the more subtle and refined reproduction afforded by domestic hi-fi 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.

| | |
|---|---|
| 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 |

*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).*



# Technics SB10

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

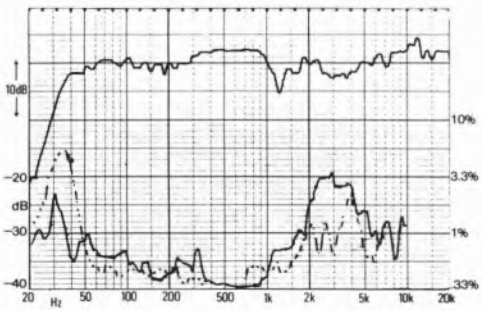
This design was considered fairly good on the comparisons with live sounds including speech. The output appeared somewhat 'flat' and 'withdrawn', with a loss of transient attack and some excess midrange 'fullness', while the bass was not quite firm enough, although it showed fine even extension and withstood 200W peak of electric bass guitar.

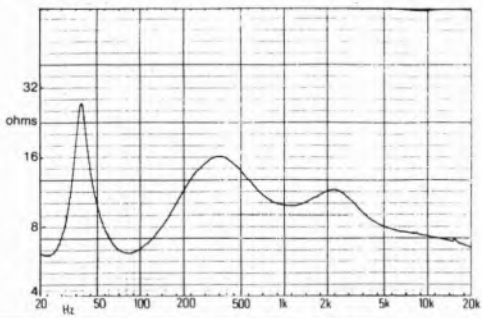
On stereo programme the results were close to the group average, which was disappointing considering the price. The stereo image performance was surprisingly weak, with lateral positioning anomalies and restricted depth, while the treble range was not particularly liked, some panelists specifically noting audible distortion.

**Summary**

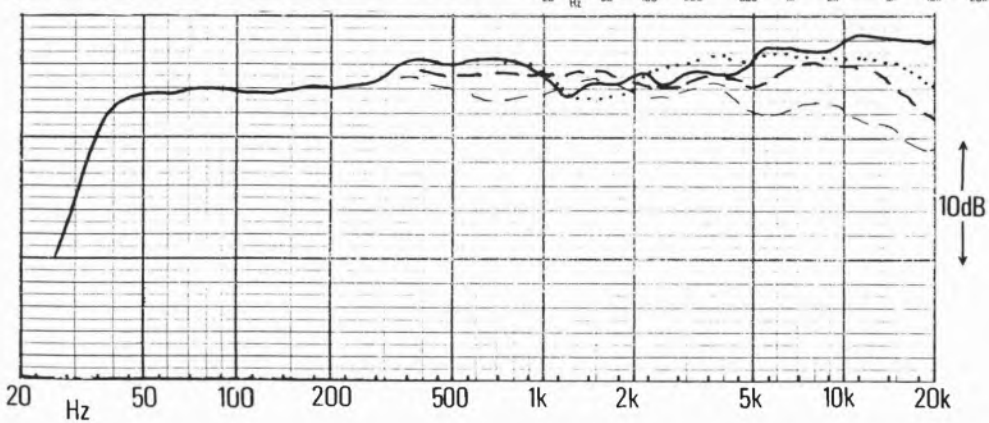
This speaker is a classic example of the ends not justifying the means; specifically, the subjective results do not justify the application of costly and externally impressive engineering and modern technology. The problems noted in the lower treble are not the only cause for concern, and despite the 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 (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).*



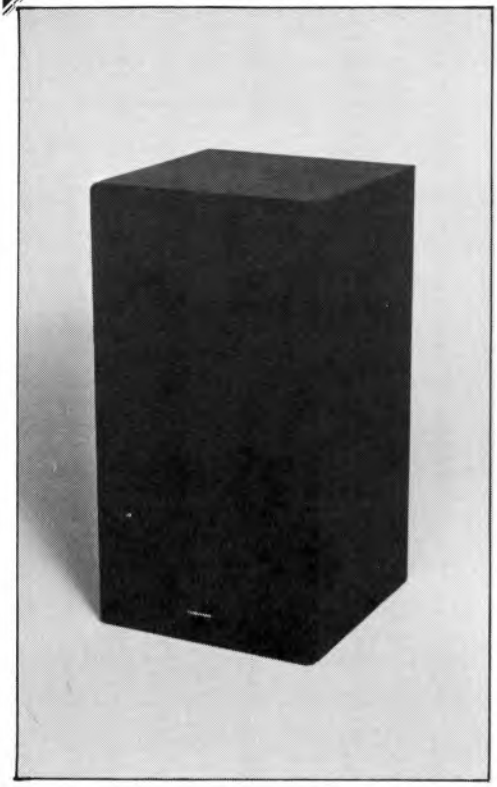

| | |
|---|---|
| Size (H, W, D) | 71.1, 40.2, 32 (28, 16, 12.6) cm(inches) |
| Weight | 32 (70) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 25–100W |
| Recommended placement | stand |
| Frequency response within ±3dB (2m) | 40Hz–210kHz |
| Low frequency 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) | 99dBA |
| 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 |



BEST BUY

# 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

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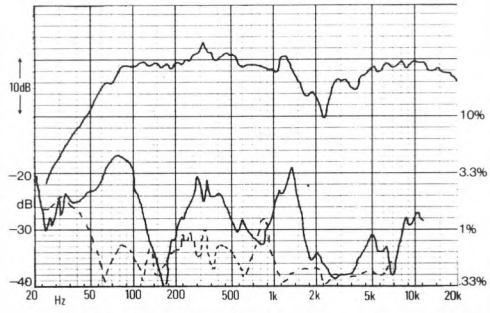
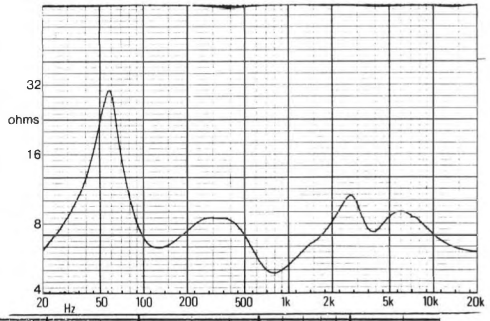
frequency band notch. But if this was atypical as the designer promises, then normal production with a shade better presence band should be even better.

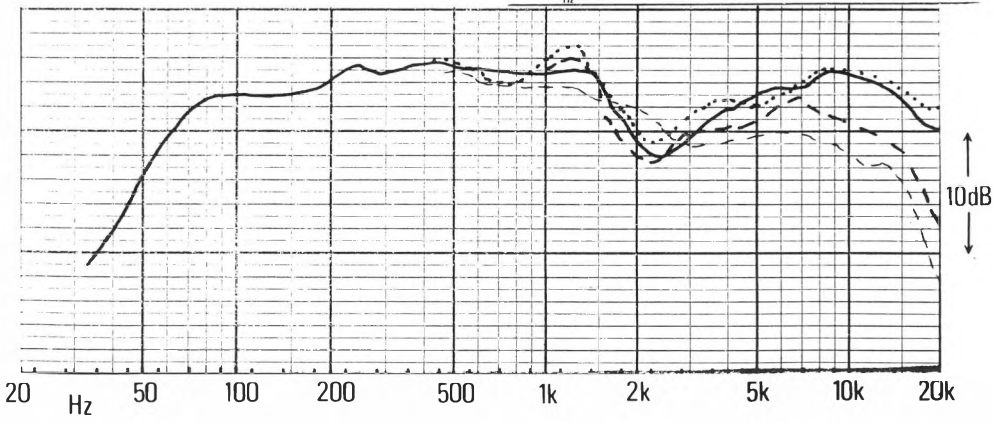
*Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*




| | |
|---|---|
| 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 inc VAT | £130 |

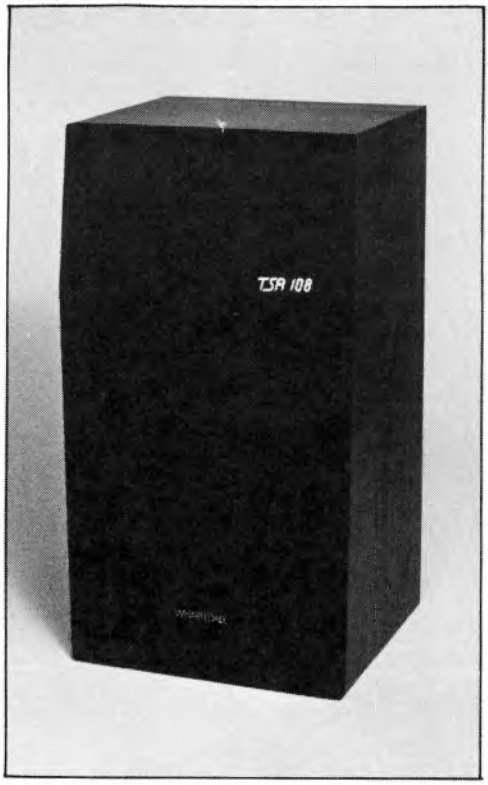
*on best axis



# Wharfedale TSR108

Rank Hi-Fi, Highfield Road, Idle, Bradford, BD10 8SF
Tel (0274) 611131




Wharfedale are now producing three ranges of speakers comprising the *'E'* series (high efficiency), the *Laser* series (high value for money models), and the *TSR* range (an upmarket mix of technology and performance). The *TSR108* is the smallest of its group and comprises a 30 litre enclosure, reflex loaded by a substantial 80mm diameter tunnel port. The nicely engineered 200mm bass/mid unit is fitted with a generous magnet and Wharfedale's own polypropylene diaphragm, which uses a special mineral filled mix. The tweeter is sunk in the cabinet for time delay compensation, and comprises a 25mm damped plastic dome in an absorbent cavity to reduce edge diffraction.

**Lab results**

Investigation showed the grille assembly to be responsible for only minor changes in response, and pair matching was more than satisfactory at ±0.6dB. At 88dB/W the sensitivity was usefully above average, and the speaker's ability to sustain short-term undistorted peaks of up to 200W permits a high 106dBA maximum sound level from a pair. The 50Hz −6dB bass rolloff was quite good for the size and sensitivity. Classed as an average amplifier load, the *'108* was essentially 6 ohms, although phase angles were generally low and should present no problems for most modern amplifiers.

A good distortion performance was obtained at 96dB/1m. Second and third harmonics hovered around a moderate 1% in the midband, while a sharp rise in second harmonic to 2.5%, 9kHz, suggested a resonance problem. With 100W pulsed toneburst input the speaker showed no additional distortion, though a significant 0.6dB loss occurred at 100W, 500Hz; however compression was negligible at 500Hz, 25W, and at 5kHz, 100W.

Two frequency responses are shown at the 1m reference position. One corresponds to the first samples which were fully tested, while the second dotted line refers to a second pair which arrived very late in the project. Differences are significant, and include improved control of the 400–500Hz prominence with the second samples, plus a more open and brighter treble balance. Taken from the original samples, the ⅓-octave characteristic at 2m illustrated a mid prominence plus a drooping presence and treble register. However, within this characteristic the off-axis curves were quite uniform, showing fine driver dispersion and integration.

**Sound quality**

The following discussion on sound quality does take into account the characteristics of the latest samples supplied (as does the chart and table), the second samples showing a more natural and open balance with reduced mid coloration. Rated 'acceptable' on live sound comparisons, panelists noted a 'wooden' and 'boxy' quality with some 'hollowness'. The midrange appeared to affect the differentiation of bass guitar notes in terms of pitch and timbre adversely, but good power handling was demonstrated, with up to 80W average input accepted gracefully.

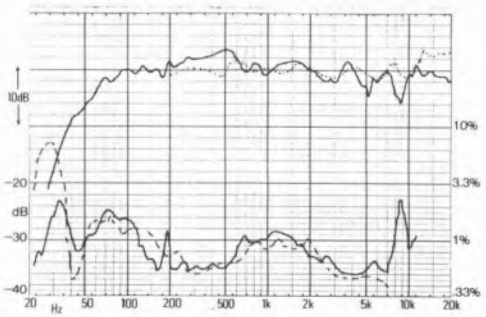
Similar colorations were noted on stereo programme auditioning, but to a lesser degree. The first pair were undoubtedly rather dull, but the second were much 'livelier', though with some 'edginess' in the extreme treble.

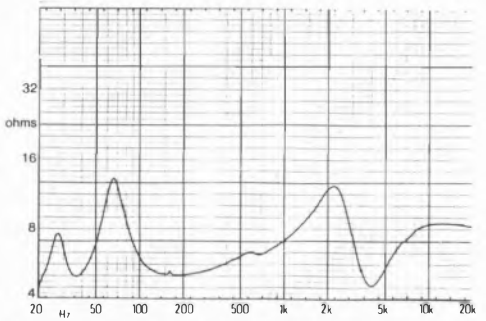
**Summary**

Due to the change in quality between the first and

second samples, and as well as the fact that the second models could not be fully tested, the *TSR 108* is placed in the 'worth considering' category, with personal audition recommended. It does offer promising sound quality, moderate distortion and good power handling, plus a maximum sound level and sensitivity a little above average. Furthermore, the construction and finish were most satisfactory.

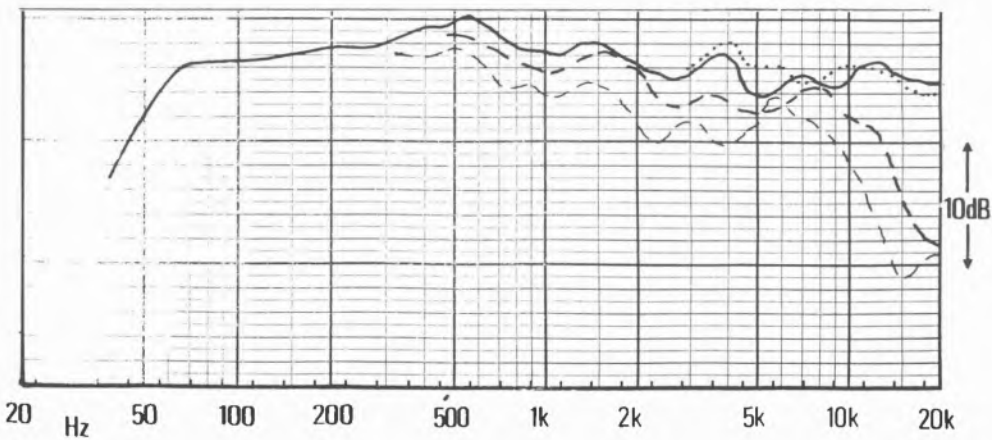
*Top: Frequency response, 1m sinewave, plus 2nd (solia) and 3rd (dashea) harmonic distortion @ 96dB*
*Middle: Impedance (modulus)*
*Bottom: Frequency response, 2m ⅓-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*




| | |
|---|---|
| Size (H, W, D) | 57.7, 31, 28.8 (23, 12, 11.3) cm(inches) |
| Weight | 14 (31) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 15–200W |
| Recommended placement | stand |
| Frequency response within ±3dB (2m) | 67Hz–20kHz* |
| Low frequency rolloff (−6dB) at 1m | 50Hz |
| Voltage sensitivity (ref 2.83V, *ie:* 1 watt in 8 ohms) | 88dB |
| Approximate maximum sound level (pair at 2m) | 106dBA |
| Distortion (96dB at 1m) | good |
| Distortion (100W peak) | good |
| Impedance characteristic (ease of drive) | average |
| Forward response uniformity | good |
| Typical price per pair inc VAT | £245 |

*second sample



# Wharfedale E20

Rank Hi-Fi, Highfield Road, Idle, Bradford, BD10 8SF
Tel (0274) 611131

The smallest and newest model from their famous 'efficiency' range of speaker systems, the *E20* comprises a compact 30 litre enclosure suitable for upper shelf mounting or placement on stands backed close to a wall.

Reflex tuned to 50Hz, the enclosure is fitted with a sizeable 56mm diameter short tunnel port, and unlike the other *E* models the *'20* has a vertical in-line driver formation – a 200mm bass/mid and a 25mm plastic dome tweeter. The steel frame of the former is disguised by a massive detachable alloy front trim, and the unit uses a very light flared pulp cone. A good quality four-element crossover divides the frequency range at 4kHz, with a variable control to give treble adjustment from −4 to +2dB; a very high 95dB/W sensitivity is claimed. The chipboard cabinet is undamped but finely veneered. The transparent 'fishnet' grille is superior to conventional types in terms of its acoustic properties, and also lends an interesting modern look to the styling.

**Lab results**

The amazing sensitivity was confirmed on test thus allowing decent volume levels from as little at 3W! With a maximum capacity of 50W, very high 108dBA sound levels are possible under normal conditions. Understandably the low frequency response was compromised as a result, with a 70Hz −6dB cutoff, although this would be augmented by positioning near a rear wall.

Pair matching was not particularly good, recording ±1.3dB up to 3kHz and with a broad 2dB level mismatch above, but the variation in tweeter sensitivity could in fact be accommodated by adjustment of the front panel control.

Rated very good on swept harmonic distortion at 96dB (this requiring only a 1.2W input), the third harmonic content was kept to a low level, while the higher charted levels of second harmonic were quite acceptable insofar as subjective effects are concerned. The pulsed 100W input was evidently rather cruel, since the speaker was delivering 500Hz tone bursts at a level close on 115dB at 1m. A 1.5dB compression occurred with some additional distortion; a significant 0.8dB of compression was still apparent at a 110dB *s.p.l.* The speaker was not particularly happy at 5kHz either, with a 0.4dB compression, 10% of second plus 5% of third harmonic distortions recorded; this explains our suggested 50W power handling limit.

The axial response rose with frequency – a characteristic suited to shelf mounting. After a fairly mild hiccough at 900Hz it recovered to a pretty smooth and well integrated treble band. Dispersion was good to 20° or so, above which the directionality of the treble range horn became apparent. Overall the frequency balance was a bit 'toppy'.

**Sound quality**

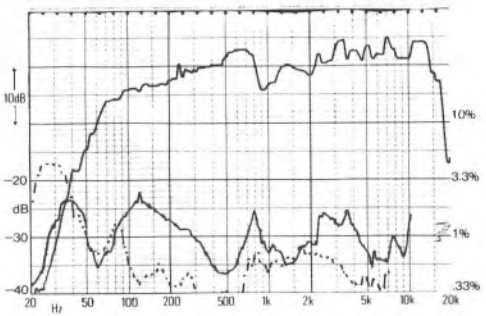
At first glance the ratings of 'acceptable' throughout the listening tests do not appear very promising, but in fact the *E20* fell only a little short of attaining an 'average' grade, at a below average price. The treble possessed a slightly 'sssy' and 'whistly' coloration, while the mid was a trifle 'hard' and 'boxy', but nonetheless the sound was clear, 'lively' and open. Fundamental bass notes may have been deficient, but the speaker gave a good impression elsewhere in the bass range, with surprising acoustic power. Stereo imaging was not however

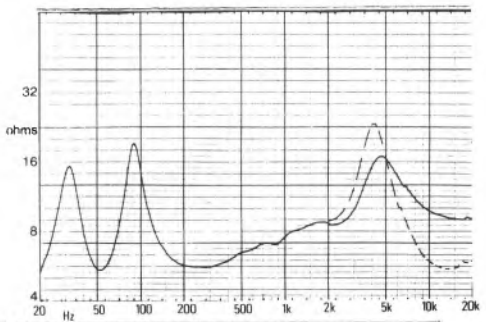
very impressive, exhibiting some positional defocusing and a lack of depth, though with better stability than the much larger *E70* previously reviewed.

**Summary**

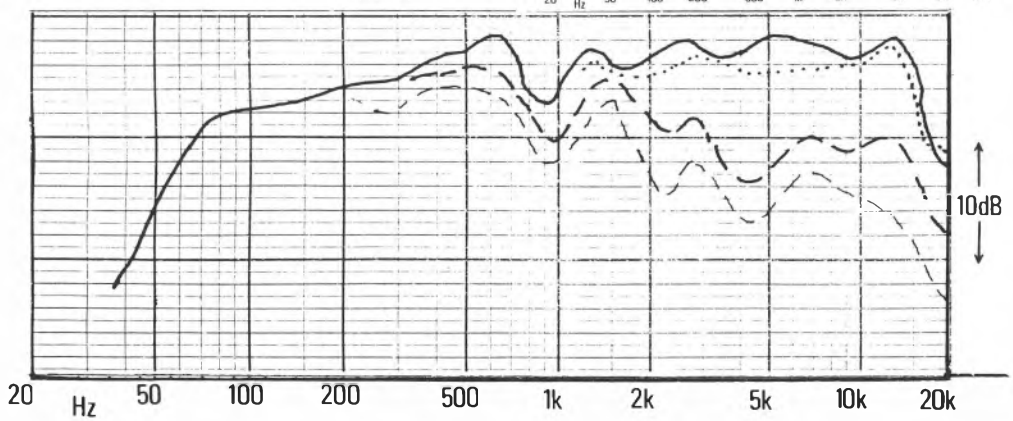
On grounds of its sound quality alone, the *E20* would probably not make a rating, but its unique combination of quality finish, exceptional sensitivity, good clarity and lively nature, as well as its reasonably easy-to-drive impedance, means that it is well worth considering. If high sound levels using modest amplifier powers with reasonable fidelity are required from a shelf or wall-mounted location, then the *E20* could well provide the answer at a relatively low cost.

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



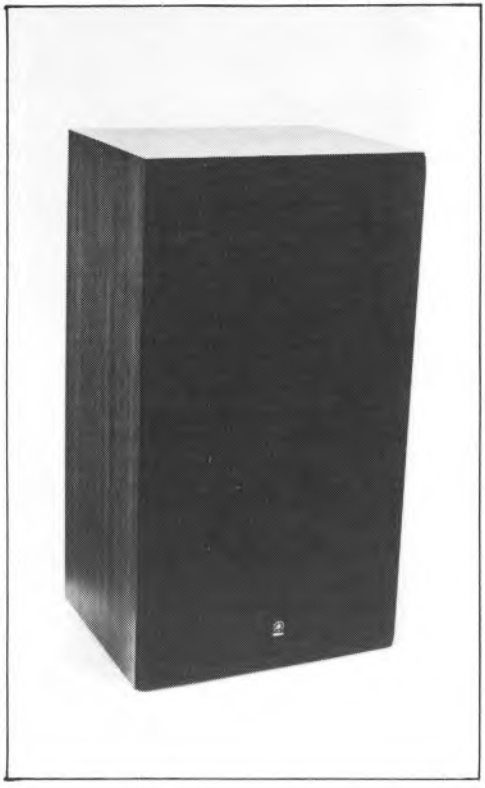




| | |
|---|---|
| Size (H, W, D) | 56.6, 30.5, 24 (22.3, 12, 9.5) cm(inches) |
| Weight | 11.3 (25) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 3–50W |
| Recommended placement | open shelf or stand |
| Frequency response within ±3dB (2m) | 150Hz–16kHz |
| Low frequency rolloff (−6dB) at 1m | 70Hz |
| Voltage sensitivity (ref 2.83V, *ie*: 1 watt in 8 ohms) at 1m | 95dB |
| Approximate maximum sound level (pair at 2m) | 108dBA |
| Distortion (96dB at 1m) | very good |
| Distortion (100W peak) | acceptable |
| Impedance characteristic (ease of drive) | average |
| Forward response uniformity | acceptable |
| Typical price per pair inc VAT | £170 |



# Yamaha NS590

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



In some respects the *NS590* might be regarded as an economy version of the famous *NS1000*. Of very similar size and 55 litre volume, the sealed box loads the 305mm pulp cone bass unit, providing a system resonance at 50Hz, which is a little higher than for the *'1000*. The first crossover point is at 700Hz, the range above being handled by a 100mm cone type midrange unit while the well-known 20mm beryllium dome tweeter used in the *1000* is employed above 6kHz. Controls are provided for mid and treble attenuation only, and the components used for the 12dB/octave electrical crossover network are of high power handling and accuracy. The rigid chipboard enclosure is covered by a good quality grained vinyl laminate, but no panel damping is provided.

**Lab results**

Good pair matching was exhibited, generally within ±0.7dB, but the non-rebated grille was found to be partially responsible for the response aberrations at 2.5, 4.2 and 12kHz, which improved with its removal. At 90dB/W the sensitivity was high and close to the manufacturer's target. The low frequency rolloff was placed at 53Hz with the −6dB point slightly worse than for the *'1000*. Accepting a maximum of 200W peak programme the *'590* was judged capable of high sound levels of up to 107dBA in a typical room, while amplifier inputs as low as 10W will still give a respectable volume.

Rated 'good' for amplifier loading, the speaker dipped a little below 6.4 ohms at a harmless 12kHz, and was typically around the 9 ohms level with low phase angles. Rated excellent on swept distortion at 96dB, the results were little inferior to those for the *'1000*, itself an excellent performer in this respect. Fed 100W pulses it proved exemplary, passing both test frequencies with under 0.1dB compression, despite the high 110dB sound level being generated.

At 1m the response showed a gently humped mid prominence centred on 500Hz, while above this the output decayed slowly to 5kHz where the tweeter took over with a 6dB jump. From this point on the treble also showed a decaying characteristic, giving the effect of a prominence at 7kHz. This interpretation was confirmed by the ⅓-octave results, which also showed a 'double-humped' tendency (a similar effect was noted with the Sony *G4*). Off-axis vertical variations in the 4–8kHz range showed that the design was not particularly well integrated, lateral dispersion being weak in that region as well.

**Sound quality**

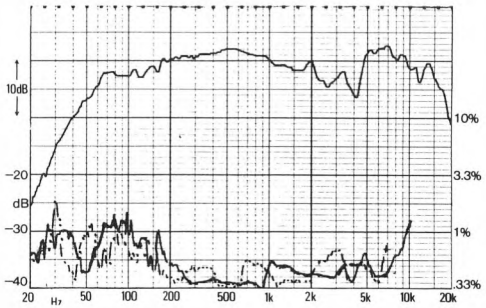
Placed in the 'acceptable' category for live sound comparisons, the bass register was nonetheless liked for its remendous power handling and control (accepting up to 500W peak of electric bass guitar). The midrange sounded rather dull, 'hollow' and 'shut in', with some sibilance in the treble.

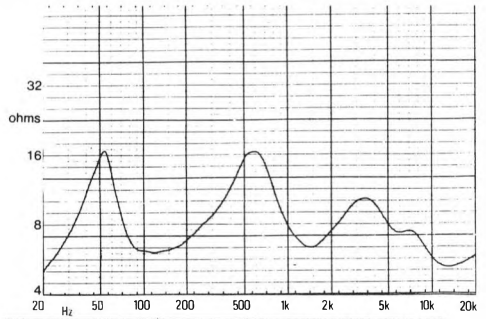
On the stereo tests the results were much improved, and the *590* was felt to have considerable but as yet unrealised potential. While sounding fairly detailed, the spectral balance gave an odd isolated effect in the treble, while the rendition of some sounds was changed as regards their stereo perspective: for example, woodwind was projected too far forward. More 'presence' was definitely needed.

**Summary**

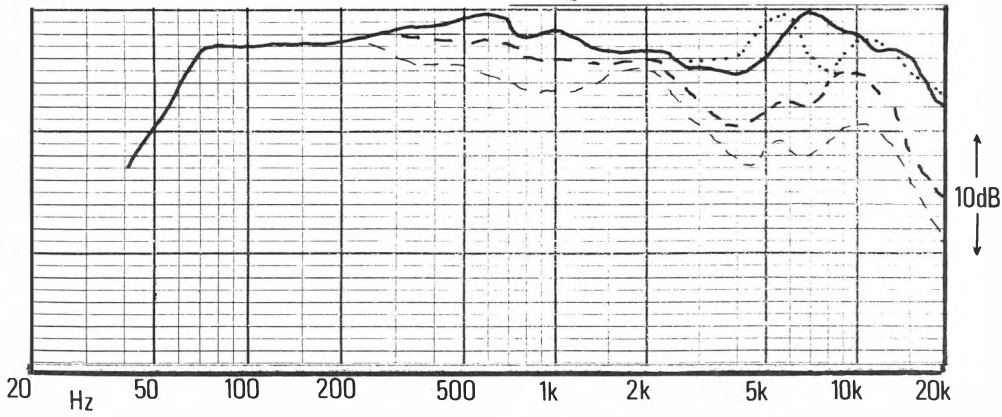
In engineering terms the *NS590* does offer quite good value for money and almost fulfils its promise as a budget *NS1000*. It is worth considering in view of its pleasant character, high sensitivity and exceptionally low distortion, plus high power and sound level capabilities. But there are indications that an even better speaker is lurking inside this box, hoping to escape through improved system and crossover design!

*Top: Frequency response, 1 m 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) | 66.5, 37, 32 (26.2, 14.5, 12.5) cm(inches) |
| Weight | 23.5 (52) kg(lbs) |
| Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) | 10–200W |
| Recommended placement | stand |
| Frequency response within ±3dB (2m) | 60Hz–18kHz |
| 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) | 107dBA |
| Distortion (96dB at 1m) | excellent |
| Distortion (100W peak) | very good |
| Impedance characteristic (ease of drive) | good |
| Forward response uniformity | average |
| Typical price per pair inc VAT | £300 |



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

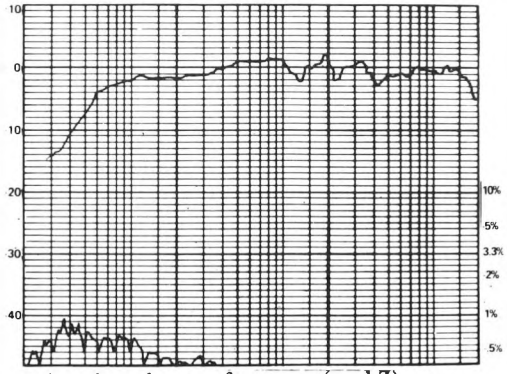
RECOMMENDED

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.

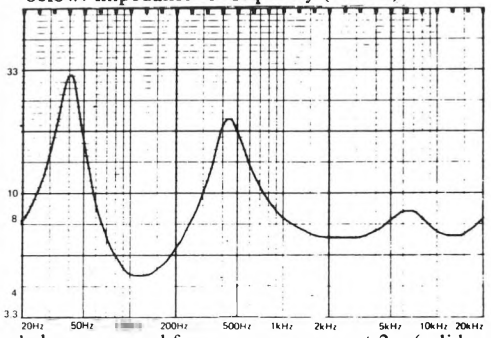
**Summary**

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.

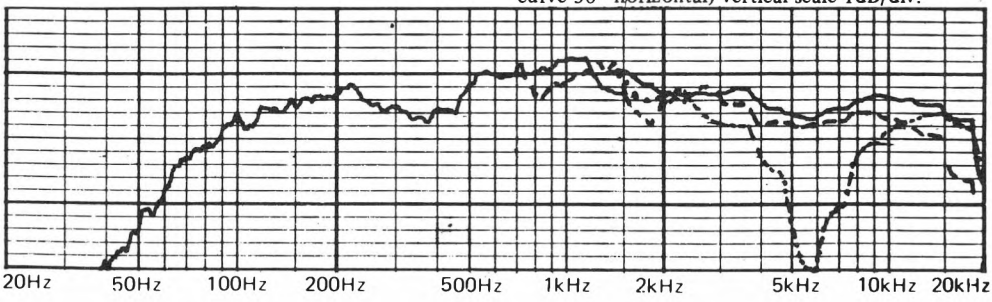



below: impedance *vs* frequency (mod Z).




| | |
|---|---|
| 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 inc VAT | £550 'M' (£800) |

below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



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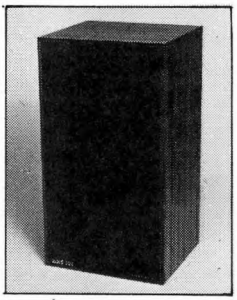

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**Audiomaster MLS1** (£125)
Probably the most neutral of the 'baby/budget' loudspeakers, this model was highly rated two editions ago and slightly downrated on re-audition for our last edition; we understand that the speaker has now reverted to its 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 DM2A** (£310)
This tall slim loudspeaker showed generally good engineering and gave a fine technical performance, but was rated only average on sound quality, with comments concerning a recessed presence band, a 'fizzy' upper treble, and some 'boxiness'. Sensitivity was about average, and the design was reasonably easy to drive.

**Castle Richmond II** (£105)
A firm recommendation from two 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.

**Celestion 662** (£500)
This very large loudspeaker gave a similar performance in many respects to the *551*, whose review is reprinted, 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.

**Goodmans Kappa** (£190)
This unusually styled model has a 'leatherette' finish with hardwood trim, and lived up to its 'Achromat' name with low coloration levels. However the sound quality was dominated by unevenness in the depressed midrange region, and was rated only average overall. The ease of drive was considered only acceptable, and the sensitivity at 85dB was slightly below average.

**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 in the last volume.

**ITT 8072** (£170)
With a somewhat uneven frequency balance, caused in part by an unusual cabinet design with the recessed tweeter and midrange laterally disposed, this design scored below average on sound quality, and was particularly criticised from a stereo standpoint. Sensitivity was about average, and the speaker proved easy to drive.

**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 *149*, whose review has

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been reprinted, 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.

**KEF Corelli** (£140)

Offering more traditional appearance and a higher standard of finish than the similarly-sized 'budget' *Celeste,* the *Corelli* has been around for some years now, but in no way shows its age. Colorations are mild, frequency balance essentially even, and the low frequency performance noteworthy. The design gave slightly below average sensitivity and proved reasonably easy to drive. In terms of the KEF range, it might be considered an earlier 'no frills' version of the new *103.2;* it is still good value and continues to be recommended.

**Monitor Audio 'Mini Monitor'** (£95)

Distinct response unevenness in the presence and treble areas was the main source of criticism in this compact and notably insensitive design (81.5dB). Stereo imaging was above average and the model proved easy to drive, but 'boxy', 'hollow' and 'fizzy' colorations were all noted, the overall 'average' sound quality rating being nevertheless quite respectable for the price.

**Mordaunt-Short Pageant 2** (£200)

Above average in sensitivity and easy to drive, the *Pageant* is a well-balanced design, if not quite the price class leader then it was when it first appeared. Coloration is now somewhat more obtrusive than in some of its immediate competition, though detail rendition is excellent and imaging precise, so it still merits consideration.

**Philips AH587** (£480)

This active-drive system employs Philips' *MFB* technique, allowing extended bass (−6dB, 43Hz) from a compact enclosure, and enabling the response to be accurately tailored to suit different typical room sites. The response was generally even, but with two notable suckouts, and the sound quality rating was only 'acceptable', with criticism of colorations and a rather 'thin' character, though the stereo was good.

**Pye 5777** (£185)

Difficult to drive, due perhaps to an error in the crossover design, this model had average sensitivity and showed uneven frequency responses. Sound quality was rated well below average, with strong criticism of colorations and of poor stereo.

**Revox BX350** (£380)

An unusual linear phase type design, any benefits of this technique were not reflected in our listening findings, as stereo imagery was rated only average. Above average sensitivity was marred by a difficult-to-drive impedance characteristic, while the measured responses were rather unimpressive. Sound quality overall was only average, so the price is difficult to justify.

**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.

**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 naturally 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

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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.

**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 *Davids* 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 Teesdale SP2** (£135)

Recently made obsolete, some stocks of this highly cost-effective recommended design may still remain at the time of publication, so a mention is worthwhile. The sound quality rating was good overall, though a fair degree of coloration was noted. Stereo imaging and bass performance were well liked, and an above average 88dB sensitivity was recorded at the expense of an only acceptable amplifier drive characteristic.

**Wharfedale Shelton XP2** (£65)

Another obsolete Wharfedale model that may still be available, the *Shelton* gave an acceptable 'minimum hi-fi standard' at a very low price, rating average on sound quality and good on stereo performance. Sensitivity was average and amplifier loading only acceptable, while the main subjective criticisms were some 'boom', 'tizz' and 'boxiness'.

**Wharfedale E70** (£385)

Despite the very high 94dB 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 rather at the expense of limited bass extension and output. Nevertheless some critical listeners continue to find significant merit in the overall result.

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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 rules, 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.

One can perhaps speculate that if compression effects exist, dynamic changes in channel balance may also occur with a stereo speaker pair, if one nears the peak level and the other does not. Conservative crossover design will almost invariably solve these problems, and in fact one designer has improved the power handling of his system as a direct result of our test findings.

**Low frequency power handling**

It was necessary to get some idea of the full power bass performance on peaks, as the pulse test 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.

**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. For example, take a high performance miniature such as the *LS3/5a;* here an artificial flattening of its measured mild response anomalies generally results in a degraded subjective neutrality.

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. In fact, some speakers are deliberately balanced in the reverse manner, to add artificial subjective depth, but if this is done to excess, all program tends to sound dull and lacking in detail, sparkle and immediacy.

Coloration is a sort of unwanted, unmusical hangover remaining after the real sound has passed on. There are many characterisations such as '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 cannot 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

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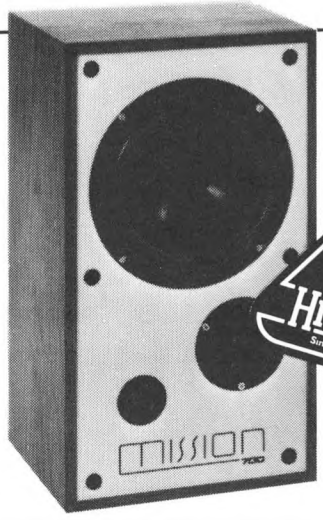


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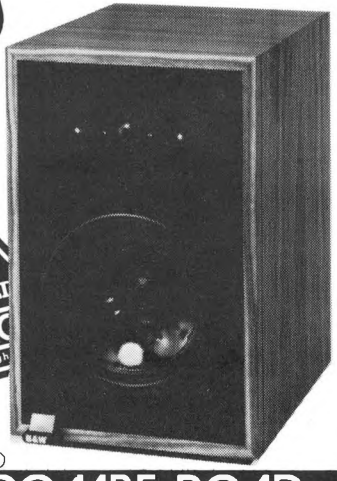
• **ARC** (101) • **KEF** (Celeste & R103 mk2) •

• **MISSION** (700 illustrated left)


• **SPENDOR** (SA1 & SA3) •

**MISSION** (770) • **KEF** (105 mk2 & Corelli)

• **HARBETH** (HL1 mk 3) •

• **ROGERS** (LS35A) • **B&W** (DM12 illustrated right) •

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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 $\pm 10°$ vertical and $\pm 30°$ lateral.

While many of the modern rules and guidelines for optimum speaker design are employed by the majority of the successful performers in this report — for example, resonance damped thin wall enclosures, laminated plastic diaphragms and complex crossover networks — at the same time it was interesting to find examples of more traditional, even old-fashioned, technology still succeeding. If the Mission *770* and Spendor *BC1* could be regarded as successful examples of applying modern design theory, then consider the case of the KLH *317* and

# Conclusions

Castle Acoustics *Conway II*. Neither of these latter systems has a damped cabinet or plastic-coned main drivers, while their crossovers are relatively simple, and yet both have done well in this report.

In fact following the rules may allow a designer to succeed more frequently than otherwise, but the present state of imperfection concerning what combination of factors actually makes a good speaker means that it is still possible, by skill or good fortune, to brew a unlikely design mix and come up with a winner. More often than not, one never knows quite why, and hence a repeat performance can be highly unlikely!

In general the recommended loudspeakers were ones with low distortion, although the *R105* was an exception in that marginally above average values (although still relatively low) were recorded in the mid band, but did not appear to prejudice sound quality unduly. Low coloration speakers generally sounded least coloured when stand mounted, off the floor, and clear of both room corners and walls; in this respect the report contains an acknowledged bias in favour of those systems which audition well under these conditions.

Sensitivity did not seem to be a dominant factor in influencing sound quality, though undeniably it is of importance to a purchaser in other respects. In general it would appear that the lower sensitivity models were more frequently recommended, usually because of their lower levels of coloration.

Significant differences in power handling were established; related systems of very similar price and performance but from different manufacturers could show a maximum sound level difference of as much as 6-8dB. No definite link was established between sensitivity and maximum loudness; some higher sensitivity systems could not be driven very hard, and yet some of the smaller low sensitivity enclosures withstood staggering peak power inputs and achieved respectably high sound levels in the process. Within the group, the measured sensitivity range was from 82dB/W to 94dB/W, with an average value of around 88dB/W. In real terms this means that 150 watts of amplifier input with an 82dB/W model will sound more like 10 watts into a 94dB/W example! This result is clearly important; if no sacrifice of quality is involved, it means that a given budget will allow a better high sensitivity speaker to be purchased and used with a smaller, less expensive amplifier.

**Subwoofers**

The most interesting contradiction concerned the discovery that subwoofers worked best with the larger 'satellite' systems, which strictly speaking were rather less in need of them! Despite their obvious careful design, the subwoofers can and do produce a small proportion of lower midband coloration which is worsened at the higher crossover setting, for here the bandwidth of the woofer is at its widest. Thus when the promised performance of a subwoofer is required to meet critical conditions — for example, a colourless, seamless extension of the range to very low frequencies — then preferably the crossover point must be at or below 70Hz. This in turn implies that the main stereo pair should have a reasonable response to at least half an octave below this, ie 50Hz or so, which rules out many tiny 'satellite' systems which would appear to be ideal for use with a subwoofer. (The Rogers *Reference* system succeeds through skilful system matching, and is not a universal subwoofer system like the Audio Pro in any case.)

By the standards established for *Hi-Fi Choice*, the general claim that subwoofers may be located anywhere in the room was not verified. Even with the crossover points as low as 50Hz it was found all too easy to become aware of the location of the subwoofer system, and in the end we were driven to place them virtually in-between the main stereo pair, if distortion of the stereo image at upper bass frequencies was to be avoided.

It was also discovered that bass generated from a single box (in this case the subwoofer system fed with a mono signal) showed a less even room distribution than the stereo bass produced by a spaced pair of comparably extended speakers systems, and that in the long run the latter arrangement was more satisfying.

Furthermore it should not be thought that a subwoofer can add 'weight and richness' to an otherwise anaemic sounding speaker. Such a balance fault is not the province of the subwoofer to correct, and will simply result in a coloured 'boom' to the sound. At its best the subwoofer is

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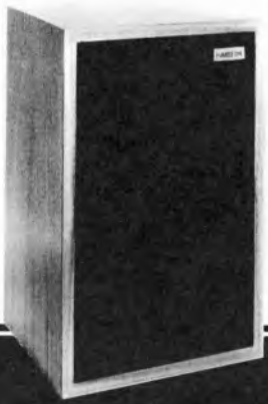

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rarely audible, as only a few per cent of available recordings have much bass information below 40Hz, but it must be conceded that the power handling of the satellite speakers is improved a few dB with the addition of such a system, while the subjective effect of clean 20Hz bass is rather stimulating when it does occur. I nonetheless find it impossible to give a value judgement for the systems reviewed in this issue; while in no way seeking to imply that they represent bad value, I personally am not wholly convinced of their merits and believe that with the present 'state of play', better results can be obtained by careful selection of a main speaker pair. For example, consider a pair of high quality medium sized enclosures costing perhaps £350.00 a pair, and add a good subwoofer such as the Audio Pro at £500, thus giving a total outlay of around £850.00. A pair of KEF *R105s* would not only be less expensive, but also probably more convenient, and the subjective results more predictable. About the only situation in which I can envisage a subwoofer conferring real benefits is that proposed by the Editor, Paul Messenger, namely to satisfy the requirements of a bass enthusiast who is unable to accommodate normally anything larger than small stereo speakers.

The trends emerging from the latest batch of speakers tested include a continuing rise in both sensitivity and efficiency, allowing moderately priced and sized systems to produce high sound levels, albeit with some mild impairment in bass extension. A reaction against the established low efficiency, low coloration and often underdamped 'boomy' bass is discernible, with companies stressing 'dynamic range' – often unfortunately without a good understanding of the term.

At the same time absolute thermal or 'watts' power handling has been greatly improved, while the permissible driver cone bass excursion has also increased; together these permit the reproduction of heavy rock programme at ever growing levels. Many manufacturers are looking to advanced electronic protection systems, with KEF and B&W key exponents in this field, while others are relying on fuses and/or special treatment of the delicate tweeter unit; for example, by ferro-fluid coolant in the coil/gap. Even the most inexpensive model sported this feature!

An almost 100% acceptance of stand-mounting for medium-sized enclosures is now apparent, and hardly any came without that recommendation. The interest in active speakers has increased, but in real terms this is still in its infancy and represents a very small share of the market, while even those products currently available are not without their own problems. 'Activation' is certainly not the *panacea* for all the ills attributed to passive crossover systems.

The logic of the vertical in-line driver formation has now been accepted by nearly all serious manufacturers, and very few are making new models without this feature, with the result that the stereo performance of the group as a whole continues to improve.

Thanks are due to the many manufacturers who have taken our criticisms with forbearance and who have endeavoured to correct problems as they occurred during the project rather than accusing us of incompetence or, worse still, inaccuracy.

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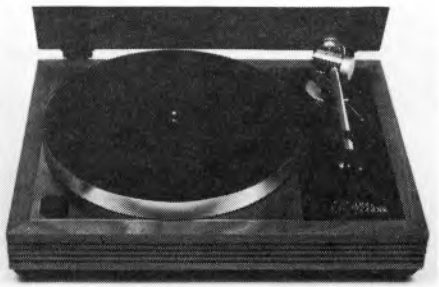

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It must be obvious to dedicated *Choice* readers that there has been some inconsistency on our part regarding the legends attached to the various 'recommended' categories in the past few editions of *Loudspeakers.* The term 'Best Buy' was actually omitted from the last issue, and replaced with 'Exceptional Performance', but as a category this proved rather confusing as it was less well defined. The 'Best Buy' classification is one which the industry does not particularly favour, and we ourselves are conscious of the dangers of oversimplification, but as it has proved popular with our readers we decided to restore it in this issue, thus falling back in line with the other titles in the series.

To avoid misunderstanding this time round, we have attempted to outline more precisely what is meant by each category. The 'Best Buy' classification indicates very good value for money, but the law of diminishing returns imposes a price ceiling beyond which improved sound quality does not keep pace with price increases. For this issue, we have judged the limit to be a typical price of £350 per pair, inclusive of VAT. Thus only models below this price are eligible for inclusion, and in our view those speakers listed represent the best overall value for money in their respective price range.

Speakers in the 'Recommended' category are clearly very good performers but do not represent such fine value for money as the 'Best Buys'. They often offer a special combination of features which could suit particular locations or personal tastes: for example, styling, speaker placement, or matching system options. As such they can be seen as realistic alternatives to the 'Best Buy' models. Recommended models costing in excess of £350 include some of the best speakers currently available in terms of reproduced sound quality, irrespective of price.

The third category is described as 'Worth Considering', and includes those speakers which despite a slightly flawed performance or a poorer than average value-for-money rating still have sufficient merit to deserve a mention. An exclusion from this listing is a rather damning indictment of the competitive performance of a model in the *Choice* context. It is vital to appreciate that value-for-money judgements are made in relation to the stated typical price, and may need re-interpretation in the light of marketplace changes.

## BEST BUYS (£70 to £150)

**Castle Richmond II** (£100)
An established compact design intended for shelf mounting, the *Richmond* continues to offer good sensitivity plus high maximum sound levels and power handling, as well as a well balanced subjective performance.

**Celestion 130** (£110)
A pleasant sounding and easy-to-drive system, the *130* offers fine value for money, and above average sensitivity.

**KEF Celeste III/IV** (£120)
This is a low cost stand or shelf mounted system of reasonable sensitivity and good all-round performance. It is unusual in being available in various colour finishes.

**KLH 317** (£150)
While the engineering is unsophisticated, the end result is not. The sound is good and the system is sensitive as well as capable of high sound levels.

**Mission 700** (£110)
The panel was very impressed with the sound quality of this compact and well finished system. All characteristics are remarkably good for the price.

**Mordaunt-Short Festival II** (£135)
More successful in our tests than was the companion *Pageant* system, the *Festival* is a finely-made and good sounding speaker, offering excellent value for money.

**Toshiba SS50GB** (£130)
An inexpensive three-way system, this pleasant sounding all-rounder is very competitively priced.

## RECOMMENDED (£70–£150)

**Audiomaster MLS1** (£125)
Not recently tested, but previously highly recommended for an inexpensive miniature, the *MLS1* is reliably reported to be continuing its fine low coloration performance.

**J.R. Metro** (£110)
This is one of the best of the miniatures intended for bookshelf mounting, and gave a very good account of itself. Its inevitably restricted bass extension and power handling unfortunately precludes 'best buy' status.

**JR 149** (£145)
Unusually styled, this is a low sensitivity miniature system of limited maximum sound levels and power handling, but it offers a fine balance, very

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sitting at home, listening to your Hi-Fi, ever get the chance to compare it with the real, live sound? The professional engineers originating the program you listen to are making this comparison continually. Well over 1000 Spendor loudspeakers are currently in use with these organisations:

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good stereo and low levels of coloration.
**KEF Corelli** (£140)
A well engineered all-rounder with powerful, clean bass, its lowish sensitivity suggests a decently large amplifier to produce the best results.
**Marantz SP445** (£100)
Best used on an open shelf, this pleasant sounding model did well for the price. It is sensitive and offers high sound levels, particularly for the rock enthusiast.
**RCL Reference** (£75)
Considering the low price this model was pleasantly civilised, and is well worth listening to.
**RAM CD20** (£120)
Offering good overall engineering and design, the *CD20* is well finished and provides a sufficiently good acoustic performance to merit recommendation at the recently reduced price.

**WORTH CONSIDERING** (£70–£150)

**Monitor Audio MA9** (£110)
This is a flawed but pleasant design which is worth trying.

**BEST BUYS** (£150–£250)

**Audiomaster MLS4** (£215)
Modestly priced for the type, this offers moderate coloration, plus a neutral balance and an extended bass for its size.
**Castle Kendal II** (£155)
A surprisingly refined, sensitive and well-balanced system, this two-way compact is preferred on stands and delivers high sound levels with very good sound quality for the price, particularly on rock programme.
**Monitor Audio MA6 Improved** (£160)
Rated good value in its earlier form, this stand-mounted speaker has been sufficiently refined to qualify for a 'best buy' rating at its competitive price.
**Sony SSG1 II** (£210)
Another top value model, the Sony is a 'punchy' clear sounding system with firm bass, and both sound level and sensitivity are high. The sound was much admired on audition.

**RECOMMENDED** (£150–£250)

**Audiomaster LS3/5a** (£185)
See *Rogers LS3/5a*.
**B&W DM12** (£190)
A real compact of fine finish and engineering complete with full protection, the sound is not completely neutral but the overall performance is good.
**Celestion 200** (£185)
This system is well worth hearing and offers a well balanced sound with above average sensitivity.
**Heybrook HB2** (£170)
This diminutive model is carefully made and offers unusually high quality sound for the size and price.
**Lentek** (£290)
A compact stand-mounted system of high constructional quality and finish, the low sensitivity offers a subtle blend of neutrality and low coloration plus good stereo image quality. (See note on *Mk II* version in review.)
**RAM LS3/5a**
See below.
**Rogers LS3/5a** (£185)
The *3/5a* is still probably the finest of all the miniature systems, its low sensitivity and limited power handling counteracted by its low levels of coloration, good stereo properties, great musical transparency and accurate balance.
**Spendor SA1** (£200)
A miniature system possessing surprising bass extension and power handling, moderate distortion levels, plus a neutral balance, low coloration sound and fine imaging. A good-sized amplifier is worthwhile.

**WORTH CONSIDERING** (£150–£250)

**Acoustic Research AR94** (£235)
**Celef Monitor Improved** (£210)
**Chartwell PM110 II** (£185)
**Coles Nimbus** (£170)
**Grundig M1500** (£210)
**IMF Super Compact II** (£205)
**KEF R101** (£185)
**Monitor Audio MA84** (£240)
**Mordaunt-Short Pageant 2** (£200)
**Reference Standard** (£170)
**Wharfedale TSR108** (£245)
**Wharfedale E20** (£170)

**BEST BUYS** (£250–£350)

**ARC 101A/P** (£275)
This usefully sensitive and compact model is one of a very few designed to work well when stand-

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mounted close to a wall. It has a lively character and offers good detail and power handling.

**Castle Conway II** (£275)
A well balanced top performing all-rounder, the Castle Conway is strongly recommended at the price. The slightly more expensive *IIA* offers alternative cabinetwork with integral stand, and should be acoustically identical.

**KEF R103.2** (£255)
Although this speaker does not give an exciting first impression, listener satisfaction and appreciation increases with continued listening. Its stereo performance and power handling are both excellent for the size.

**Rogers Studio** (£345)
A genuine enhancement of the original *Export Monitor* design, this accurate loudspeaker offers fine bass and power handling, together with a reasonable sensitivity. It is also very well made and finished.

**Spendor BC1** (£325)
Its midband quality and neutral balance continue to set very high standards ensuring recommendation, but some listeners might find the bass quality and limited power handling a slight weakness.

## RECOMMENDED (£250–£350)

**Celef Mini Pro HE** (£265)
This speaker achieved slightly inconsistent ratings from one panelist to another, but many listeners will like its lively and generally well balanced performance. It also offers a high standard of construction and finish for the price.

**Chartwell PM210 II** (£310)
The earlier model just missed the recommended listings by a small margin, and this *Mk II* version is sufficiently improved to merit inclusion. A well finished all-rounder of neutral and consistent performance, it also demonstrated good power handling.

**Harbeth HL1 III** (£330)
Exhibiting fairly good power handling plus low levels of coloration and above average sensitivity, the *HL1 III* belongs to that select group of high quality compact monitors, and is well worth trying.

## WORTH CONSIDERING (£250–£350)

**Nightingale NM5** (£350)
**Sony SSG4** (£300)
**Yamaha NS590** (£300)

## RECOMMENDED (£350–£600)
(above the Best Buy limit)

**Castle Howard II** (£475 inc stands)
While we are not completely happy with the rather 'full' sound of this system, the bass is well extended and the overall sound quality very good. A consistent balance plus good power handling are also demonstrated.

**Celestion 551** (£360 inc stands)
This is a well engineered design with a good all-round performance, particularly as regards its stereo presentation, bass power handling and extension.

**Mission 770** (£370 inc stands)
For its modest size this stand-mounted system offers remarkable power handling with a high maximum sound level and low distortion. Still a touch on the 'bright' side of neutrality, it nonetheless performs well.

**Mordaunt-Short Signifer** (£600)
This speaker is undoubtedly the company's finest model to date, showing itself to be a well designed system of good all-round performance.

**Yamaha NS1000M** (£550)
A relatively compact system designed for open shelf or stand mounting, the *NS1000M* is superbly engineered and finished, and offers very low distortion, a high maximum sound level and good sensitivity. Unusually, the price is now rather lower than at the time of our last edition.

## WORTH CONSIDERING (£350–£600)

**Gales GS401A** (£500)
The Gale is a well made model with an unusual appearance in its most familiar black and chrome form. It performs better on rock material than the comparative ratings in this issue might otherwise suggest.

## RECOMMENDED (£600 plus)

**JBL L150** (£1,000)
A large floor-standing model of extended bass and very wide dynamic range, the *L150* also sounds good and possesses fine stereo imaging properties.

**KEF R105.2** (£850 inc full top cover)
A very fine design, the *R105* is preferred subjectively without the full grille in position, as this makes the balance a trifle dull. It offers exceptionally stable and deep stereo imaging, with extended bass, good power handling, and low levels of coloration.

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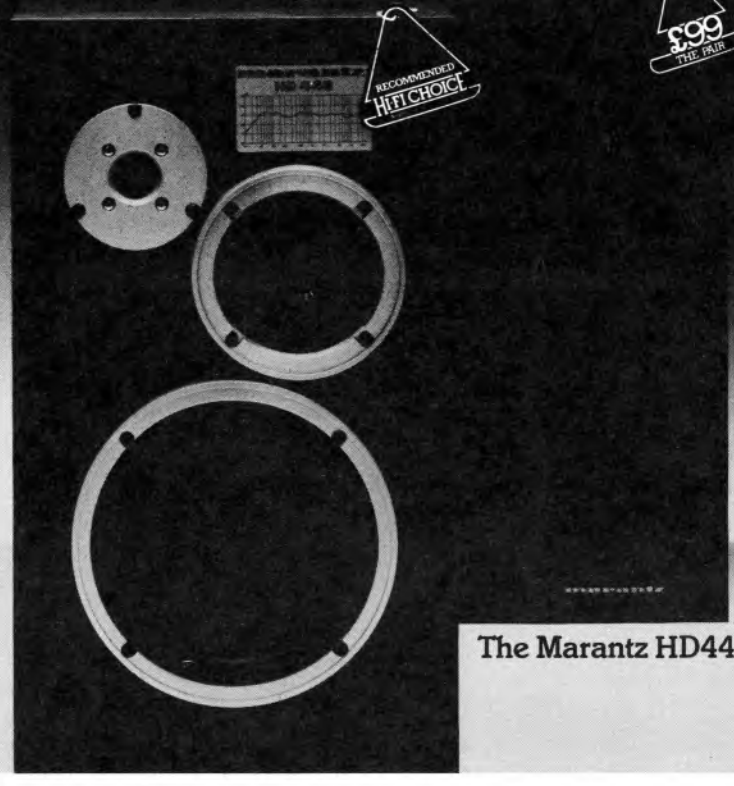
**Proac Studio 3** (£1,200)
By dint of sheer perseverance, the designer of this model has produced a very costly but highly satisfactory system, exhibiting very good stereo, fine bass and excellent power handling. Very low levels of coloration and a slightly 'open' frequency balance are also in evidence, and a big amplifier is needed for the best results.
**Spendor SA3** (£750 passive; £1,400 inc power amps and electronic crossover as tested)
The *SA3* has the makings of a top-class high level monitor, exhibiting a neutral balance, high power handling capabilities and extended bass, with great musical clarity.

## WORTH CONSIDERING

Other more specialised products worth considering include:
**Audio Pro Subwoofer** (£400)
This did its job most effectively.
**Rogers Reference System** (£860)
This adds dual subwoofers to the established *LS3/5a* miniature monitors, to produce a substantial system exhibiting excellent bass extension and fine stereo properties.
**Acoustic Research AR90** (£725)
A large speaker tailored for floor standing, this model has extended bass and a generally good sound quality.
**Revox Triton** (£840)
This is a specialised design intended for Revox owners who desire complete brand continuity. Nonetheless, the sound quality was good.

# Look before you listen.

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**Quadraphenia,** 10 Nursery Street, Sheffield, Yorks.
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**R.E.W.,** 230 Tottenham Court Road, London WC1.
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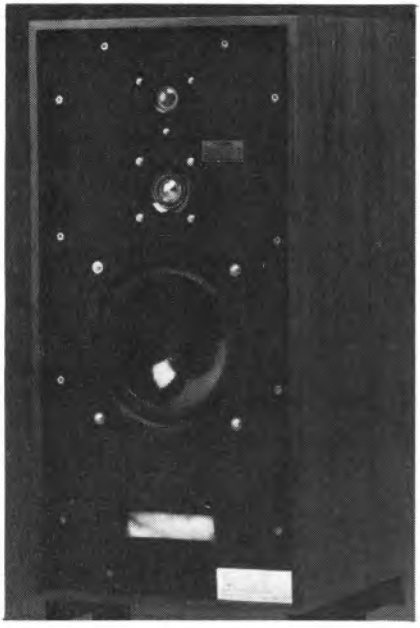

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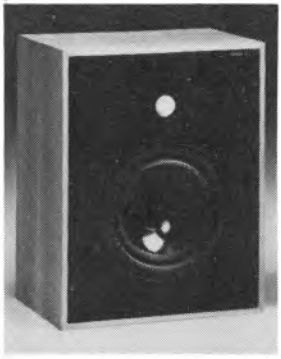

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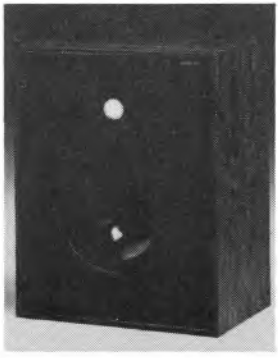

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# RUBBISH RUBBISH and still more RUBBISH

Frankly, we were not impressed by the "Best Buys" and "Recommendations" as shown in this issue. The same predictable conclusions come up again and again — not surprising when you consider that despite the scope of the book, many excellent speakers could still not be included. Where were the Meridian Active, the Linn Isobarics, the Swallow Actives, etc etc?? They were with us — Subjective Audio; just waiting to show you how good they are!!

So where do you go when you're thoroughly sick of reading about KEF 105's, Mission 770's and ARC 101's??

You come to us — because we have been very selective in our choice of speakers, choosing only those which satisfy our very demanding critera. "Adequate" is not a word we approve of here, to be with us, they have to excel and believe us or not, those below do.

Furthermore, we offer a service second to none when you are considering purchasing speakers from us:

a) If any speaker (excepting special orders) proves unsatisfactory for any reason, we will refund the full purchase price within 7 days. Basically, if you are not happy, then neither are we!!

b) If within 12 months of purchase, you decide to obtain a more expensive pair of speakers, we will allow the full ex-vat purchase price towards the new pair we supply. Obviously reductions will be made for cabinet damage.

OUR CHOICE:

**PASSIVE TYPE**
Isobaric "DMS"
Gale 401/A
Swallow RM/200
Harbeth HL1/Mk3
JBL L/150
SKS Intaglio
Infinity RS/a;RS/b

**ACTIVE TYPE:**
Meridian M1
Meridian M2
Isobaric PMS
Gale Active "A" (soon)
Swallow ALS/1

**Subjective Audio Ltd**
59 Grovelands Road
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**Subjective Audio (North) Ltd**
The Old School, St Anns Lane,
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# Overall Comparison Chart:

| MODEL | METRIC Dimensions (cm/kg) H | W | D | Wt | IMPERIAL Dimensions (in/lt) H | W | D | Wt | Bass encl int vol litres | Max sound level in 100m at 2m dBA/pair | Lab sensitivity at 1m dBlin at 2.83V input | Low frequency roll-off −6dB point Hz | Recc min; max amp power w/ch (ref 8 ohms) | Overall frequency response |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Acoustic Research AR90 | 108 | 37 | 38 | 37 | 43 | 14.5 | 15 | 81.4 | 90 | 103 | 90dB | 30* | 30–300 | good* |
| Acoustic Research AR92 | 80 | 35.5 | 29 | 21 | 31.4 | 14 | 11.5 | 46 | 47 | 102 | 90dB | 50* | 20–100 | good |
| Acoustic Research AR94 | 77.8 | 35.6 | 27.3 | 20 | 30.5 | 14 | 10.8 | 43 | 50 | 101 | 89dB | 40 | 15–100 | average |
| ARC 101 A/P | 56.5 | 31 | 28 | 12 | 22 | 12 | 11 | 26 | 28 | 106 | 88dB | 60* | 15–150 | average |
| Audiomaster MLS4 | 63 | 28 | 31 | 14 | 24 | 11 | 12 | 30 | 40 | 101 | 85dB | 37 | 25–150 | good |
| B&W DM12 | 35.5 | 22 | 27 | 9.6 | 14 | 8.75 | 10.5 | 21 | 12 | 102 | 86dB | 60 | 25–150 | good |
| B&W DM7 II | 90 | 27 | 28 | 29 | 35 | 11 | 15 | 64 | 35 | 105 | 87.5dB | 36 | 20–150 | good |
| Castle Kendal II | 52.5 | 29 | 28 | 10 | 20.5 | 11.5 | 11 | 22 | 30 | 105 | 89dB | 52 | 10–100 | very good |
| Castle Conway II | 63.5 | 34.5 | 35 | 18.5 | 25 | 13.6 | 14 | 41 | 55 | 105 | 87dB | 38 | 15–200 | very good |
| Castle Howard II | 80 | 40 | 42 | 28 | 31.5 | 16 | 16.5 | 62 | 90 | 105 | 86.5dB | 29 | 25–200 | very good |
| Celef Monitor II | 52 | 24.5 | 28 | 10 | 20 | 9.6 | 10 | 22 | 22 | 102 | 86dB | 50 | 25–100 | good |
| Celef Mini Pro HE | 58.5 | 30.5 | 28 | 15 | 23 | 12 | 11 | 33 | 33 | 105 | 87dB | 48 | 25–200 | good |
| Celestion 130 | 48.5 | 25 | 24 | 7.7 | 19 | 10 | 9.5 | 17 | 20 | 102 | 88dB | 60 | 15– 75 | good |
| Celestion 200 | 60 | 33 | 26.5 | 12.7 | 23.5 | 13 | 10.5 | 28 | 37 | 104 | 88.5dB | 58 | 15–150 | average |
| Celestion 551 | 72 | 40 | 32 | 25 | 28 | 15.5 | 12.5 | 55 | 63 | 103 | 86.5dB | 38 | 25–200 | good |
| Chartwell PM110 II | 46 | 23 | 21 | 7.5 | 18 | 9 | 8 | 16.5 | 13 | 102 | 86dB | 63 | 25–150 | good |
| Chartwell PM210 II | 66 | 34.3 | 28.6 | 17.5 | 26 | 13.5 | 11.3 | 38 | 45 | 103 | 85.5dB | 43 | 25–200 | very good |
| Coles Nimbus | 42 | 32 | 25.4 | | 16.5 | 12.5 | 10 | | 25 | 98 | 85dB | 48 | 25–100 | average |
| Gale GS401A | 33 | 60.5 | 27 | 20 | 13 | 24 | 10.6 | 44 | 40 | 105 | 88dB | 50 | 25–150 | good |
| Grundig M1500 | 55 | 29 | 22 | 10 | 22 | 11.5 | 8.7 | 22 | 26 | 103 | 89dB | 50 | 15–100 | good |
| Harbeth HL1 III | 63.5 | 32.5 | 30.5 | 13.5 | 25 | 13 | 12 | 30 | 50 | 102 | 87.5dB | 46 | 15–100 | good |
| Heybrook HB2 | 41 | 23 | 23 | 8 | 16 | 9 | 9 | 18 | 12 | 96 | 84dB | 60 | 30–100 | good |
| IMF TLS50 IIA | 88 | 35 | 39 | 27 | 35 | 14 | 15 | 60 | 82 | 103 | 86dB | 34 | 25–200 | good |
| IMF Super Compact II | 46 | 28 | 30 | 10.5 | 18 | 11 | 12 | 23 | 25 | 98 | 86dB | 50 | 25–100 | good |
| JBL L150 | 105.4 | 43 | 33 | 36 | 41.5 | 17 | 13 | 79 | 110 | 111 | 89dB | 33 | 10–500 | very good |
| JR 149 | 37 | 23 | 23 | 5.5 | 14.5 | 9 | 9 | 12 | 8 | 95 | 83dB | 45 | 30– 50 | good |
| JR Metro | 28 | 16 | 19 | 4.5 | 11 | 6.3 | 7.5 | 10 | 5 | 97 | 83.5dB | 85* | 30– 75 | good |
| JVC Zero 5 | 65.5 | 37 | 35.5 | | 26 | 15 | 13 | | 50 | 107 | 94dB | 63 | 5–200 | average |
| KEF Celeste III (IV) | 52.4 | 26.5 | 23 | 8.1 | 20.6 | 10.4 | 9 | 18 | 17 | 100 | 87dB | 55 | 25–200 | very good |
| KEF R101 | 34 | 18 | 19 | 5.6 | 13.5 | 7 | 7.5 | 12 | 6.7 | 96 | 81dB | 60 | 40–100 | good |
| KEF R103.2 | 50.6 | 26.5 | 25 | 8.6 | 20 | 10.4 | 10 | 19 | 19 | 103 | 86.5dB | 48 | 25–200 | very good |
| KEF R105.2 | 96.5 | 41.5 | 45.5 | 36 | 38 | 16.3 | 18 | 80 | 70 | 103 | 85dB | 33 | 25–300 | very good |
| KLH 317 | 58 | 30 | 25 | 13.2 | 23 | 12 | 10 | 29 | 20 | 104 | 89dB | 55 | 10–100 | average |
| KLH 3 | 32 | 22 | 15 | 8 | 12.5 | 8.5 | 6 | 17.6 | 6 | 101 | 86dB | 38 | 25–100 | good |
| Lentek S4 | 49.5 | 25 | 25.5 | 11.5 | 19.5 | 9.7 | 10 | 25.7 | 18 | 99 | 84.5dB | 47 | 30–100 | very good |
| Lentek Monitor X | 110 | 40.6 | 39.3 | 38.2 | 42.3 | 16 | 15.5 | 84 | 115 | 97 | 85dB | 35 | 25– 70 | good |
| Marantz SP445 | 49 | 29 | 22 | 8.8 | 19.3 | 11.4 | 8.7 | 18 | 20 | 105 | 90dB | 72 | 10–100 | acceptable |
| Mission 700 | 46 | 26 | 25 | 6.5 | 18 | 10.2 | 9.8 | 14 | 22 | 103 | 88.5dB | 66 | 15–100 | good |
| Mission 770 | 59 | 30 | 28.5 | 12.7 | 23 | 12 | 12 | 28 | 38 | 105 | 87dB | 55 | 20–200 | very good |
| Monitor Audio MA6 Imp | 58 | 30 | 28.5 | 13 | 23 | 12 | 11 | 28 | 32 | 103 | 87.5dB | 48 | 20–150 | good |
| Monitor Audio MA9 | 41 | 23 | 22 | 5.5 | 16 | 9 | 8.5 | 12 | 12 | 102 | 89dB | 55 | 15–100 | average |
| Monitor Audio MA84 | 76 | 28 | 33 | 20.5 | 30 | 11 | 13 | 45 | 45 | 103 | 87dB | 50 | 20–250 | average |
| Mordaunt-Short Festival 2 | 45.5 | 28 | 18.5 | 6.4 | 18 | 11 | 7.3 | 14 | 15 | 102 | 87dB | 60 | 20–100 | good |
| Mordaunt-Short Signifer | 81 | 38.5 | 33 | | 32 | 15 | 13 | | 70 | 105 | 86dB | 33 | 25–250 | very good |
| Nightingale NM Point Five | 80 | 26.7 | 36.8 | 15.5 | 31.5 | 10.5 | 14.5 | 34 | 25 | 102 | 87dB | 44 | 25–100 | good |
| Philips AH489 | 56 | 33.5 | 22.5 | 11 | 22 | 13 | 9 | 24 | 30 | 105 | 90dB | 58 | 10–100 | average |
| ProAc Studio 3 | 68.5 | 30.5 | 33 | 30 | 27 | 12 | 13 | 66 | 51 | 109 | 86dB | 42 | 25–500 | very good |
| Pye 6484 | 52 | 33 | 20 | | 20.5 | 13 | 8 | | 23 | 104 | 91dB | 67 | 10– 50 | acceptable |
| RCL Reference | 34.5 | 24 | 20 | 5.5 | 13.6 | 9.4 | 8 | 12 | 10 | 95 | 85dB | 60 | 25– 50 | average |
| RAM CD20 | 42 | 25 | 23 | 6.5 | 16.5 | 10 | 9 | 14.3 | 16 | 101 | 86dB | 55 | 25–100 | good |
| Reference Standard | 46 | 25.5 | 27 | 8.5 | 18 | 10 | 10.5 | 18.7 | 22 | 104 | 89dB | 60 | 10–100 | acceptable |
| Revox Triton | 94 | 106 | 46 | 98 | 31 | 41.5 | 18.8 | 216 | 45 | 103 | 90dB | 53* | 15– 60 | average |
| Rogers LS3/5A | 30 | 18.5 | 16 | 5.5 | 12 | 7.5 | 6.5 | 11.5 | 5.5 | 93 | 82dB | 59 | 30– 50 | good |
| Rogers Studio | 63.5 | 30.5 | 30.5 | 14 | 25 | 12 | 12 | 31 | 43 | 104 | 86dB | 46 | 25–250 | very good |
| Rogers Reference System | 112.5 | 42 | 46 | 36.5 | 44.4 | 16.5 | 18 | 89.5 | 91 | 96 | variable | 25 | — | very good |
| Sony SSG1 II | 60 | 33.5 | 30 | 13 | 23 | 13 | 12 | 29 | 37 | 105 | 89dB | 50 | 10–100 | good |
| Sony SSG4 | 63.4 | 36.7 | 29.2 | 19 | 25 | 14.4 | 11.5 | 42 | 50 | 105 | 90dB | 55 | 10–100 | average |
| Spendor BC1 | 63.5 | 29.8 | 30.5 | 14 | 25 | 11.7 | 12 | 31 | 44 | 98 | 84dB | 48 | 30–125 | very good |
| Spendor SA3 (Active) | 85 | 38 | 46 | 41 | 33.5 | 15 | 18 | 90 | 120 | 110 | variable | 33 | — | good |
| Tangent Excelsior | 50 | 27 | 25 | 8 | 19.7 | 10.6 | 9.8 | 17.6 | 23 | 106 | 91dB | 75 | 10–100 | acceptable |
| Tannoy SRM12X | 85 | 44.5 | 27 | 30 | 33.3 | 17.6 | 10.7 | 66 | 80 | 113 | 93dB | 50 | 5–500 | average |
| Technics SB10 | 71.1 | 40.2 | 32 | 32 | 28 | 16 | 12.6 | 70 | 64 | 99 | 86dB | 33 | 25–100 | good |
| Toshiba SS50GB | 53.6 | 28.6 | 28.7 | 1.3 | 21 | 11.3 | 11.3 | 25 | 28 | 100 | 88dB | 55 | 15– 50 | average |
| Wharfedale TSR108 | 57.7 | 31 | 28.5 | 14 | 23 | 12 | 11.25 | 31 | 30 | 106 | 88dB | 50 | 15–200 | good |
| Wharfedale E20 | 56.5 | 30.5 | 24 | 11.3 | 22.3 | 12 | 9.5 | 25 | 31 | 108 | 95dB | 70 | 3– 50 | acceptable |
| Yamaha NS590 | 66.5 | 37 | 32 | 23.5 | 26.2 | 14.5 | 12.5 | 52 | 55 | 107 | 90dB | 53 | 10–200 | average |
| Yamaha NS1000M | 67.5 | 37.5 | 32.6 | 31 | 26.5 | 14.7 | 12.8 | 68.2 | 55 | 107 | 90dB | 50 | 10–200 | good |

*improved by wall mounting

| *Dispersion/ distribution* | *Coloration* | *Amp loading impedance* | *Peak distortion 100W* | *Swept distortion 96dB* | *Overall subjective quality* | *Stereo image quality* | *Truth to life* | *Typical price per pair inc VAT £* | *MODEL* |
|---|---|---|---|---|---|---|---|---|---|
| good | good | poor | N/A | very good | good | very good | average | 780 | Acoustic Research AR90 |
| average | average | poor | acceptable | good | acceptable | acceptable | average | 390 | Acoustic Research AR92 |
| average | average | average | acceptable | very good | average | average | acceptable | 235 | Acoustic Research AR94 |
| good | good | good | good | good | good+ | good+ | average | 275 | ARC 101 A/P |
| very good | good | average | N/A | very good | good+ | good | good | 215 | Audiomaster MLS4 |
| good | good | good | very good | good | good | good | acceptable | 190 | B&W DM12 |
| excellent | average | very good | good | very good | average | good | average | 380 | B&W DM7 II |
| excellent | very good | very good | acceptable | good | good | average | very good | 155 | Castle Kendal II |
| excellent | very good | average | N/A | very good | very good | very good | very good | 275 | Castle Conway II |
| very good | good | good | very good | excellent | good+ | good | acceptable | 475 | Castle Howard II |
| very good | average | very good | acceptable | good | average | average | average | 210 | Celef Monitor II |
| very good | good | average | very good | good | good+ | good | acceptable | 255 | Celef Mini Pro HE |
| good | average | average | good | good | average | average | average | 110 | Celestion 130 |
| average | good | good | very good | very good | average | average | good | 185 | Celestion 200 |
| good | good | good | N/A | very good | good | good | good | 360 | Celestion 551 |
| excellent | average | average | good | good | average | average | good | 185 | Chartwell PM110 II |
| very good | good | good | N/A | good | good+ | good | good | 310 | Chartwell PM210 II |
| very good | average | good | acceptable | acceptable | acceptable | average | average | 170 | Coles Nimbus |
| average | good | poor | good | excellent | good | average | very good | 500 | Gale GS401A |
| average | good | poor | good | good | good | average | average | 210 | Grundig M1500 |
| very good | very good | good | acceptable | very good | good+ | good | very good | 330 | Harbeth HL1 III |
| excellent | good | good | acceptable | good | good | good | good | 170 | Heybrook HB2 |
| acceptable | average | poor | very good | excellent | average | average | average | 520 | IMF TLS50 IIA |
| average | average | good | acceptable | very good | average | average | average | 205 | IMF Super Compact II |
| very good | good | good | good | excellent | good+ | good | good | 1000 | JBL 150 |
| very good | good | good | N/A | very good | good | very good | average | 145 | JR 149 |
| excellent | average | very good | very good | good | average | good | average | 110 | JR Metro |
| average | average | average | good | excellent | average | good | average | 400 | JVC Zero 5 |
| very good | average | good | N/A | very good | average | good | average | 120 | KEF Celeste III (IV) |
| excellent | average | very good | N/A | very good | average | good | average | 185 | KEF R101 |
| very good | good | good | very good | good | good+ | good+ | average | 255 | KEF R103.2 |
| very good | very good | very good | good | good | very good | excellent | good | 860 | KEF R105.2 |
| good | good | very good | N/A | very good | good | good | good | 150 | KLH 317 |
| acceptable | average | good | very good | acceptable | average | average | average | 270 | KLH 3 |
| very good | good | good | N/A | very good | good+ | very good | average | 295* | Lentek S4 |
| very good | good | average | good | very good | average | average | average | 490 | Lentek Monitor X |
| poor | average | good | acceptable | good | average | average | average | 100 | Marantz SP445 |
| average | good | good | good | good | good | good+ | average | 110 | Mission 700 |
| excellent | good | good | good | excellent | good+ | good+ | good | 370 | Mission 770 |
| very good | good | good | N/A | good | good | good | good | 160 | Monitor Audio MA6 Imp |
| good | average | acceptable | good | good | acceptable | average | poor | 110 | Monitor Audio MA9 |
| very good | average | good | very good | very good | good | good | average | 240 | Monitor Audio MA84 |
| very good | good | good | good | good | good | good | good | 135 | Mordaunt-Short Festival 2 |
| very good | very good | average | N/A | very good | very good | very good | very good | 600 | Mordaunt-Short Signifer |
| excellent | good | average | good | very good | good | good | very good | 350 | Nightingale Point Five |
| average | average | good | acceptable | excellent | acceptable | average | average | 140 | Philips AH489 |
| excellent | very good | good | good | excellent | very good | very good | very good | 1200 | ProAc Studio 3 |
| poor | acceptable | very good | good | very good | poor | acceptable | acceptable | 70 | Pye 6484 |
| very good | average | good | acceptable | very good | acceptable | average | acceptable | 75 | RCL Reference |
| very good | good | good | acceptable | good | average | average | very good | 125 | RAM CD20 |
| good | average | good | good | good | average | average | average | 170 | Reference Standard |
| good | good | acceptable | acceptable | good | good | good | average | 840 | Revox Triton |
| very good | good | very good | N/A | very good | good | very good | good | 185 | Rogers LS3/5A |
| excellent | very good | good | very good | very good | very good | very good | very good | 345 | Rogers Studio |
| excellent | good | active | N/A | very good | good+ | good | very good | 860 | Rogers Reference System |
| good | good | good | good | excellent | good+ | good | good | 210 | Sony SSG1 II |
| average* | average | average | acceptable | good | good | good | acceptable | 300 | Sony SSG4 |
| very good | very good | good | very good | very good | very good | very good | good | 325 | Spendor BC1 |
| very good | very good | active | very good | excellent | very good | very good | very good | 1400* | Spendor SA3 |
| poor | acceptable | average | acceptable | acceptable | poor | acceptable | poor | 90 | Tangent Excelsior |
| very good | average | good | good | good | acceptable | average | acceptable | 560 | Tannoy SRM12X |
| very good | average | good | acceptable | acceptable | average | acceptable | good | 600 | Technics SB10 |
| very good | average | average | very good | good | good | good | average | 130 | Toshiba SS50GB |
| very good | average | average | good | good | good | average | acceptable | 245 | Wharfedale TSR108 |
| average | acceptable | average | acceptable | very good | acceptable | acceptable | acceptable | 170 | Wharfedale E20 |
| acceptable | average | good | very good | excellent | good | good | acceptable | 300 | Yamaha NS590 |
| very good | good | average | very good | excellent | good+ | good | good | 550 | Yamaha NS1000M |

# Superfi

## So now you know what Martin Colloms likes

But unless you're thinking of buying him a pair of speakers for Christmas, you still don't know enough to make any decisions! Let alone part with your hard earnt post tax pre-VAT income.

Because speakers are as individual as people — some you like, and some, despite all their good points, you just can't bear to listen to.

At Superfi, we don't talk to you about loudspeakers, or even tell you what you should be listening to. We allow you to compare them in the two best demonstration rooms in the country, so in that way you can make up your own mind.

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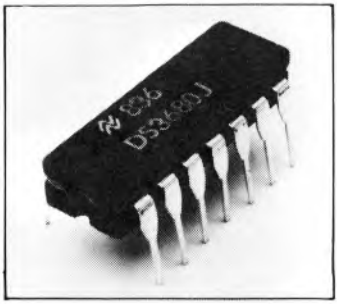

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# FROM THE BOTTOM TO THE TOP...
# We demonstrate the lot!

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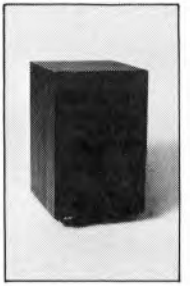
MISSION ELECTRONICS

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)

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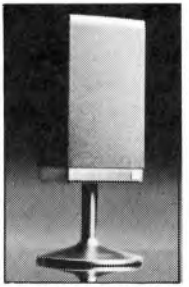
HEBYROOK HB2

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)

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# 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, dBlin.)

**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 higherthe 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.

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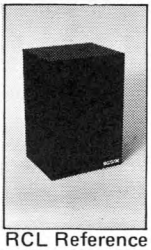

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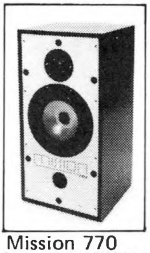

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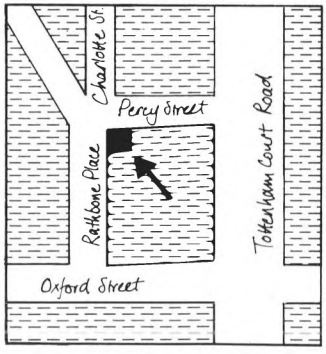

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Harvey Turnbull is directing the Ethnomusicological Audio Visual Archive at Cambridge University Music Faculty.

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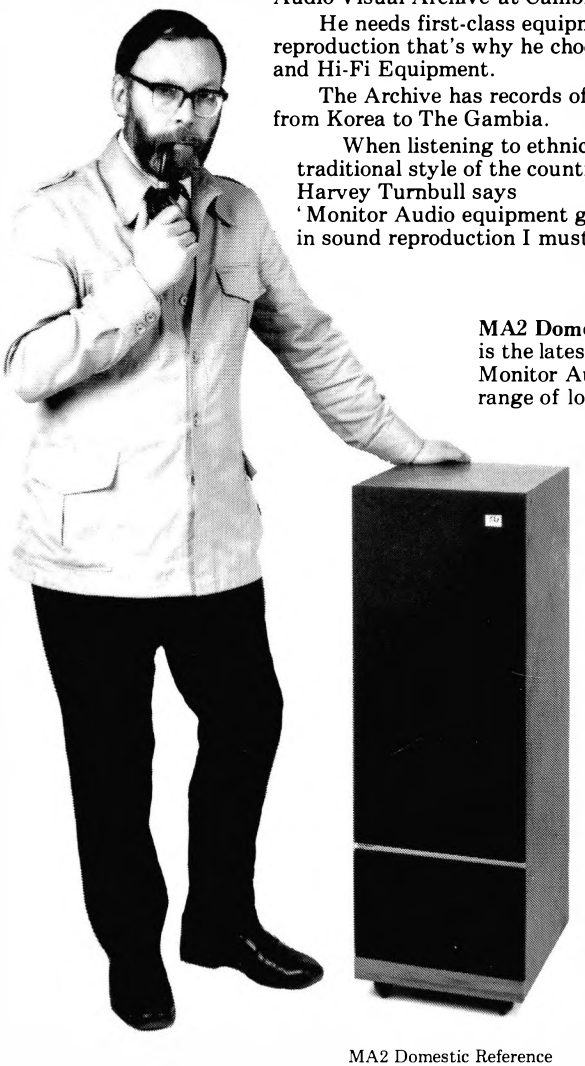

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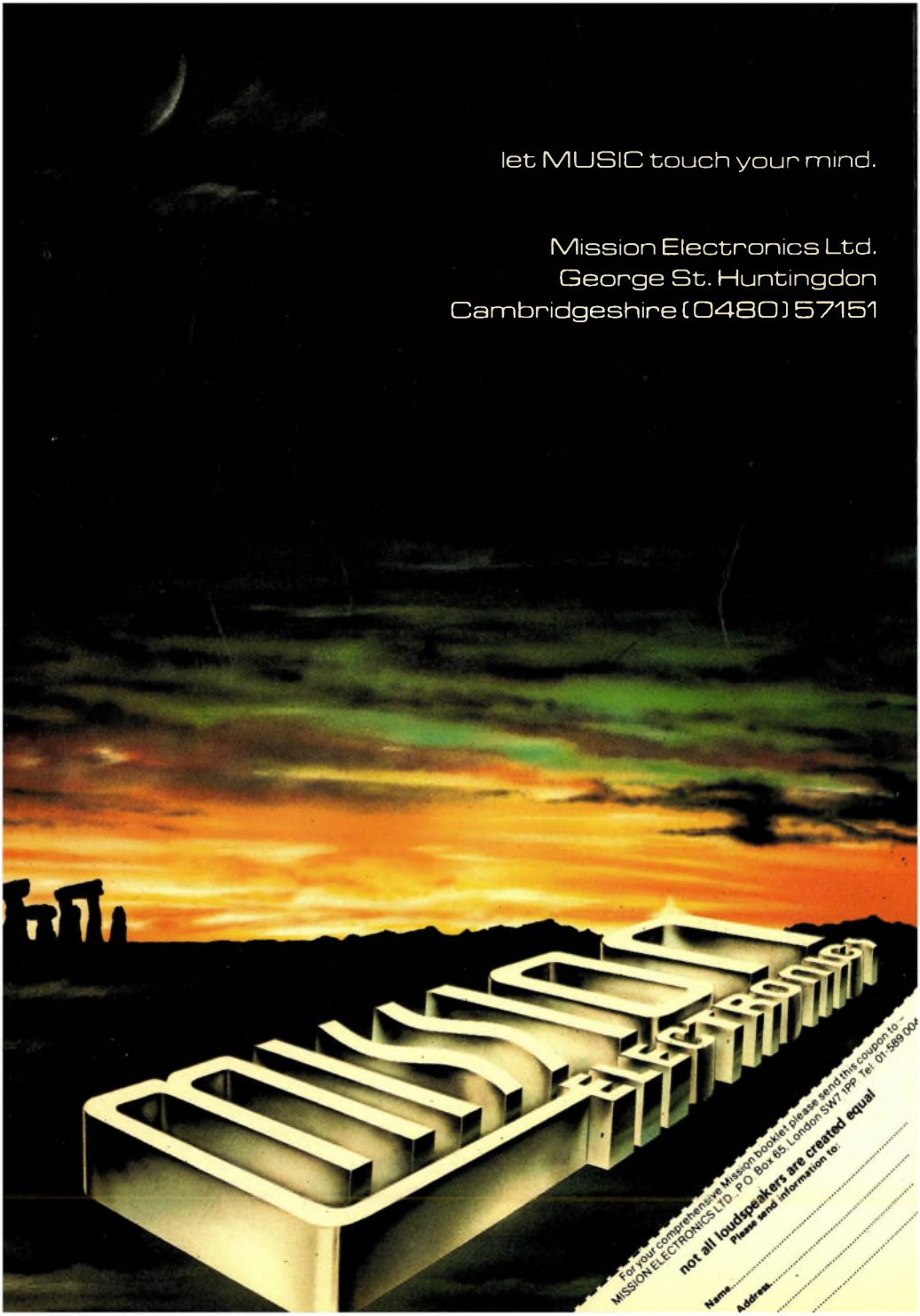
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