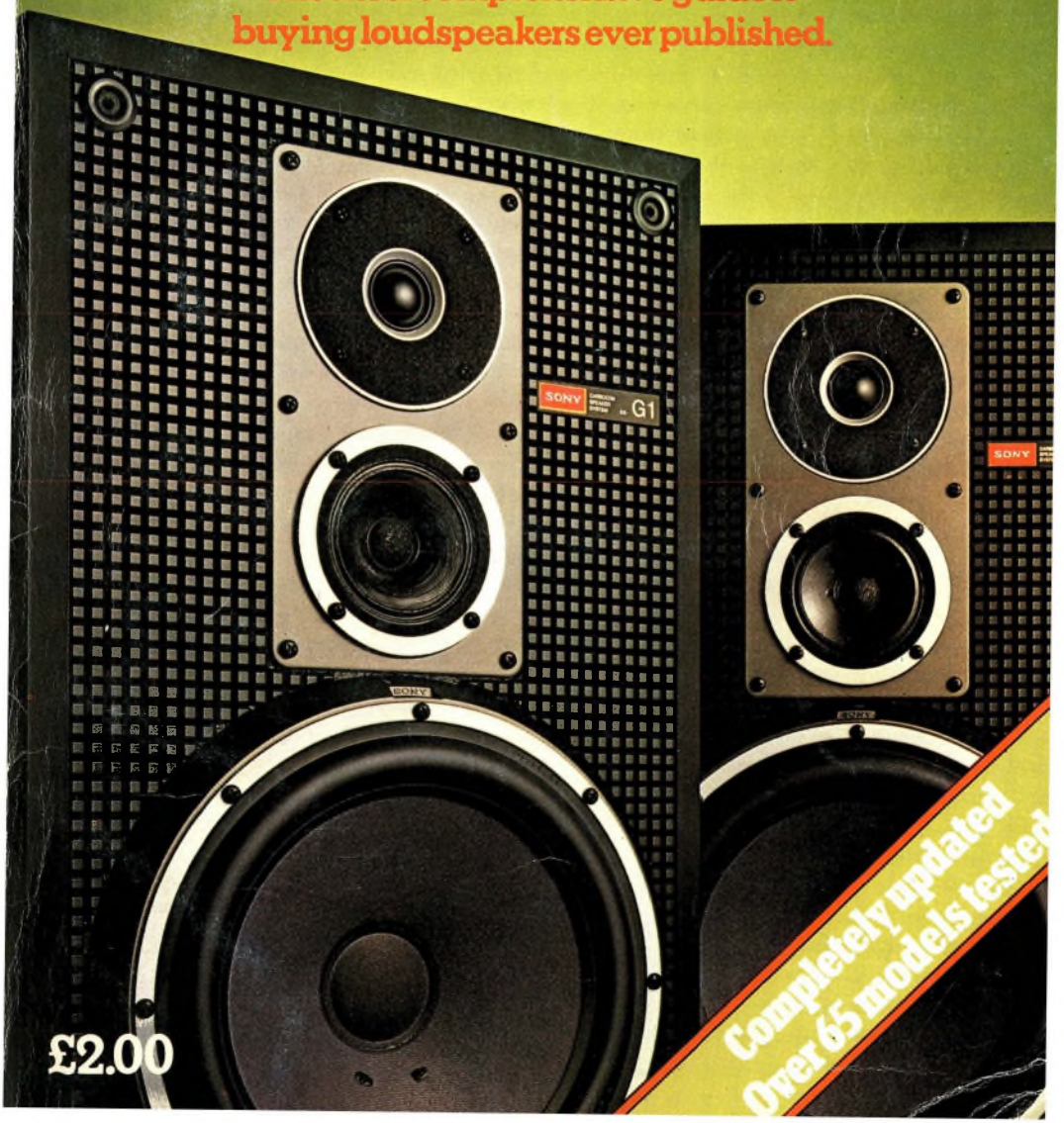
HI-FI CHOICE

LOUDSPEAKERS

The most comprehensive guide to buying loudspeakers ever published.



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Hi-Fi Choice No 15 Loudspeakers 3 by Martin Colloms

Contents

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

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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 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 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 *Glossary* summarises the conditions of measurements used in the individual reviews more concisely, providing a useful reference point when reading them.

The *Loudspeaker Review* section, some 120 pages in all, gives all the basic data on the 60 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.

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-simplified 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, accetable, 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 *H-Fi Choice*'s scale of reviewing is that all the items are assessed under the same conditions, so direct compairsons are valid. We should point out, however, that standards and conditions vary so much within 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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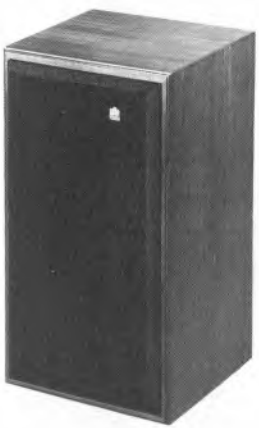

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Experience at exhibitions has shown that one of the main beefs of *Hi-Fi Choice* readers is our high price. And to make matters worse, for this issue we have not only increased the price but included a higher than usual proportion of repeats, so a bit of fancy excusework is called for. Perfectly good reasons exist for both (though their conjunction is perhaps a little unfortunate), and the causes lie in the economics of publishing and the particularities of the speaker market.

The magazine purchaser does not perhaps always appreciate that the cover price he pays is usually significantly less than the actual production costs of publication (primarily printing and paper). The magazine makes its profit and covers this subsidy by means of a healthy advertising content, so that an issue of a monthly hi-fi magazine might contain 40 editorial pages and 160 advertising. In contrast *Choice* is more likely to offset 160 editorial pages with 40 of advertising, for a variety of reasons which presumably include of our critical editorial stance. The fact remains that if the advertisers don't pay for increasingly expensive Finnish trees, then the purchaser has to do so; we estimate that paper costs have risen by more than 50% since our last price rise two and a half years ago, and it is inescapable that these costs represent the single most important factor determining the price of the publication.

The reason why the book contains a significant number of repeats/revisions from the previous volume is that the lifespan of a loudspeaker is usually considerably longer than for other hi-fi components (perhaps on average twice as long, with some models remaining in the catalogues five years or more.) To drop out these well established models wholesale merely to include a greater number of new models would have meant omitting many important designs. And because the cover price is derived more from the total pages than the amount of review work undertaken, we were unfortunately unable to accommodate both. Instead we exercised some editorial discretion in selection of the reprint reviews, omitting some of the speakers which did not perform too well under our criteria last time around in addition to obsolete models. Likewise competition for inclusion amongst the new reviews was quite intense, and some selection had to take place on the basis of informal listening tests. It remains an unfortunate fact of life that there are far too many designs on the market for the number of pages that we can produce at an acceptable cost.

The net effect has been to produce a volume that is effectively a distillate of a larger (unpublished) work. We have calculated in fact that the entire project summarises some 40,000 individual characterisations and value judgements from the listening tests, some 900 pen chart curves and other technical measurements, plus some 500 other measurements and observations, so maybe it isn't such a bad deal after all! This selectivity has in fact meant that the overall standard (of the review speakers) in this volume is rather higher than in its predecessor, with a corresponding increase in the proportion of models which we consider merit recommendation; this is certainly partly caused by our own 'distillation' process, though it is also due to steady, if slow, improvements in standards of speaker design.

The last speaker book project was dogged by a certain amount of pre-publication politicking, with a number of manufacturers declining to submit models. Where we felt it was necessary to preserve the balance of that issue we purchased samples independently, though the consequent lack of liaison between manufacturer and reviewer usually does more harm than good in our experience. Happily the volume was generally well-received on publication and nearly all manufacturers were pleased to be invited to take part in this second stage. In fact the only major 'name' that declined to participate and which we would have liked to include was Tannoy, and if only because we had to leave out other potentially worthy designs for space reasons anyway, we decided not to purchase in this case; readers may be interested to note that Martin Colloms recently reviewed the Tannoy Oxford and Chester under broadly similar conditions. Just before embarking on this Choice project, Mr. Colloms undertook two large group tests of loudspeakers for monthly magazines; to enable those who might wish to chase up the comments on any particular models, a listing is include at the end of the Conclusions section. Some models have been repeated here, but by and large we tried to avoid this, and those manufacturers whose models do appear in both were at least

persuaded to submit different samples. (In point of fact these 'common' models provide a fascinating basis for comparative assessment of the groups, and for checking the consistency of the review methods we have adopted.)

We have in fact gone to considerable trouble to check our own consistency between the two issues, by including a number of models reviewed in the last volume in the listening tests (usually as a new sample but in one or two cases the originals were available.) More often than not the judgements showed impressive consistency, and it was unnecessary to modify the original reviews, though we have included comments where necessary. By this technique we have been able to scale the results from the previous work against the latest tests and ensure overall consistency in judgement. We have also done our best to ensure that the information on all the speakers is correct and up to date, and in several cases have done a completely new review on a loudspeaker that has undergone significant design changes.

One of the thornier decisions to make was whether to change the overall review format and explore new avenues of technical evaluation. Although the facilities were available to carry out such things as phase measurements and delayed resonance examinations, interpretation is hazardous for even the experienced engineer, let alone the lay reader, and such techniques are probably primarily useful to the designer who is researching these comparatively subtle aspects of performance. In the present state of understanding in the 'art' of loudspeakers, we believe that careful measurement applied to the prime performance parameters, coupled with exhaustive listening tests, gives the most reliable total result.

At the risk of boring our regular readers (!), there are a number of points that I have made before editorially, but which bear repetition. First and foremost all loudspeaker reviews can be justifiably criticised on a number of grounds, and the reader is well advised to bear in mind the inherent limitations of any approach. Some critics would argue that the only way to assess a speaker accurately is to live with it for a period of time at home; the corollary unfortunately is that this probably restricts one to about a dozen models a year, and while the judgements may become more refined, it is clearly impossible to carry out serious comparisons of the large number of competitive models available by this means. Indeed the wide comparative yardstick of the *Choice* project does provide a unique perspective on the market as a whole.

One danger of this perspective remains that the group itself tends to define the performance norm by which individual speakers are assessed, and it is probably true that the more unorthodox and idiosyncratic designs will tend to suffer as a result (whether they deserve to or not perhaps remains a moot point.) This is one reason why we have tended to avoid including exotic designs, concentrating on models in the popular price ranges. (The other reason is that we firmly believe that *Choice* should provide sensible sound advice for the typical buyer, rather than pandering to the vicarious tastes of the confirmed audiophage.)

Perhaps the biggest problem facing loudspeaker reviewing is that of sample variations. There is no way of guaranteeing that the loudspeaker we heard and described is going to be the same as the one purchased from a shop. Some manufacturers treat product consistency more seriously than others, and this is usually reflected in the price; however it is clearly difficult to assess such intangibles in a review of a single pair, although the conscientious and competant retailer may be of some assistance. This in itself remains sufficient justification for strongly recommending that speakers are not purchased without prior audition, and there are plenty of other good reasons besides (notably personal taste, listening room effects, ancillary component interactions etc.)

Some of the political unrest that preceded the previous volume related to Martin Collom's occasional work as a design consultant in the loudspeaker field. To avoid criticism we have ensured that none of the models reviewed were designed by him (which rather restricted the available choice of Monitor Audio models.)

Clearly a reviewer's taste will to some extent be reflected in his project, but Mr. Colloms was only one of six in a 'blind' listening panel, so his personal prejudices can have little effect on these important results (his room is likely to have a much more significant effect, and rooms don't have prejudices!) Furthermore to use a reviewer with less experience of loudspeakers would undoubtedly have been to court disaster in a field where misunderstanding is rife.

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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 of size at a stroke, and the increasing popularity of hi-fi in the consumer rather than enthusiast market created demand for a more 'domestic' speaker. Meanwhile increasing technical sophistication amongst designers and manufacturers bred an awareness of the undesirability of this *ad hoc* mixing of components without consideration of the interactions that made up the total system. Consequently more modestly sized complete speaker systems rapidly became the norm.

Around a decade or so ago a number of developments took place: the introduction of transistor amplifiers boosted the power 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 total 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 amp and 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

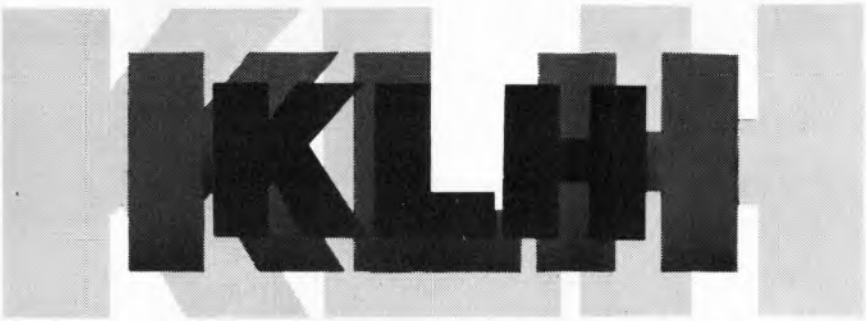
room. Improving and controlling the distribution has been one of the more recent advances in speaker design; defining the optimum distribution pattern is a rather harder task.

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 age, make 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 amp 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 amps and is still widely used in high-power public address systems; it 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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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 this 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 unpredicatably 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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x 255mm

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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 which models the audio signal at its loudspeaker terminals. The loudspeaker is a motor of sorts, which requires energy to give movement and hence sound, so its draws current from the amp, 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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party-type conditions, so if a system is used in the village hall disco one weekend, it will be no surprise to find burned out voice-coils and/or amps the next day.

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

Stereo performance

The word stereo comes from a Greek root meaning 'solid', the concept being that it is possible to create recreate a solid image of the recorded sound field by using two loudspeakers instead of one (mono). To do this it is first necessary to ensure that the original sound field has been captured in the recording, a state of affairs that is unfortunately rarely the case. To capture the sound field coherently, it is necessary to use a simple two-microphone technique that is similar to the '3D' pictures found in children's slide viewers. In the latter example, the two similar but slightly different images enable the viewer to perceive a sense of depth or 'solidity' in the picture, and this is very similar to the way in which true stero 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 deliverately 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 will be fairly straightforward to ask and answer, such as setting a budget, while getting some idea of the loudness required when taking account of trade-offs between size, bass extension and sensitivity become 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 service 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.

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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Some of the points concerning the review methods adopted have already been outlined in the *Consumer Introduction*, but the following is a more detailed and technical description of all the stages involved. These fall into three distinct sections, the first two concerned with listening tests and the third with laboratory testing.

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 for the tape used, and was left free of any additional processing encumbrances.

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 make use of an anechoic chamber to make the recordings, in this case, that at the GEC Research Centre, Wembley.

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.

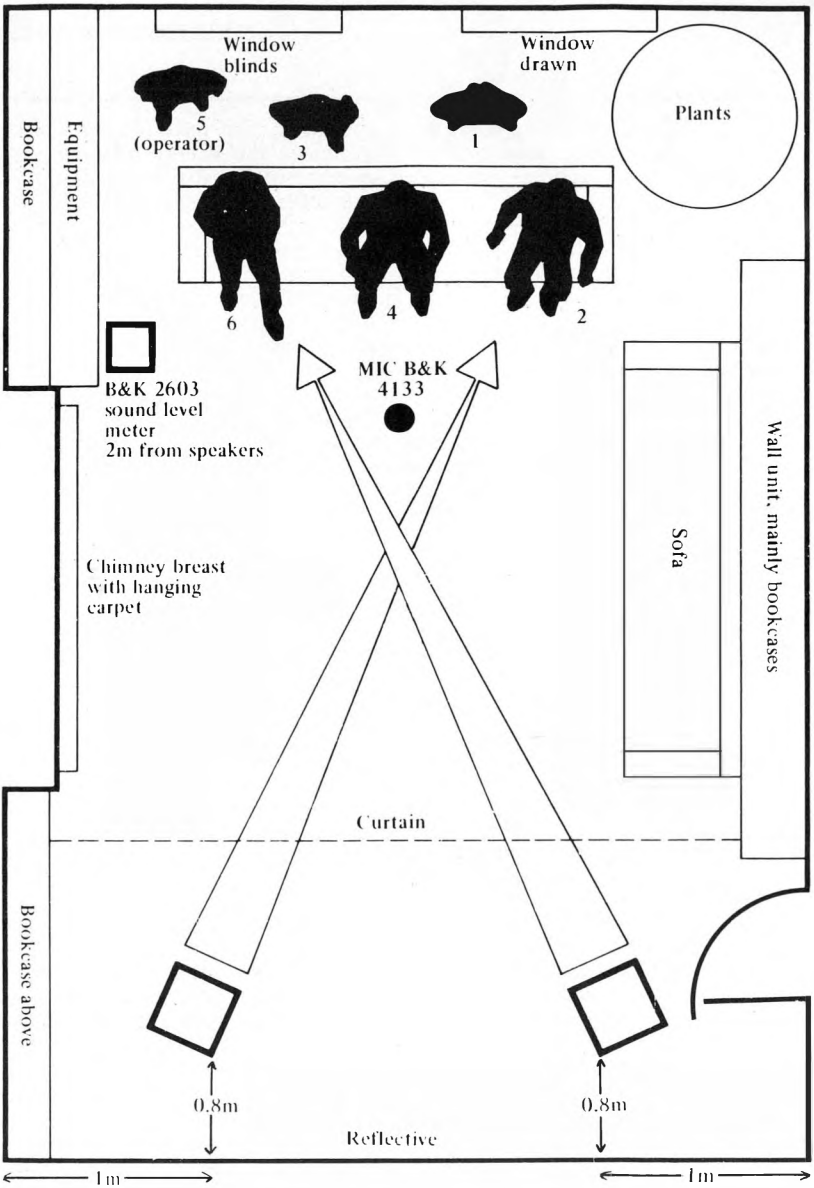
Replay environment

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 uncolored 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 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 constantly 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



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.

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 diapole, 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. We decided to emulate a test first used successfully by Acoustic Research some twenty years ago, which relied on a simulated test source. In this case, pink noise is fed into a wide band single unit dome loudspeaker, possessing particularly low coloration. A recording of this was made in the anechoic chamber, and as with the musical instruments, the quality of 'test' reproduction as compared with the original sopurce, could be readily assessed. 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 recognisable tonal balance. 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 greater detail in the stereo sets.

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 incorportaed, 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 93-95bBA 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.

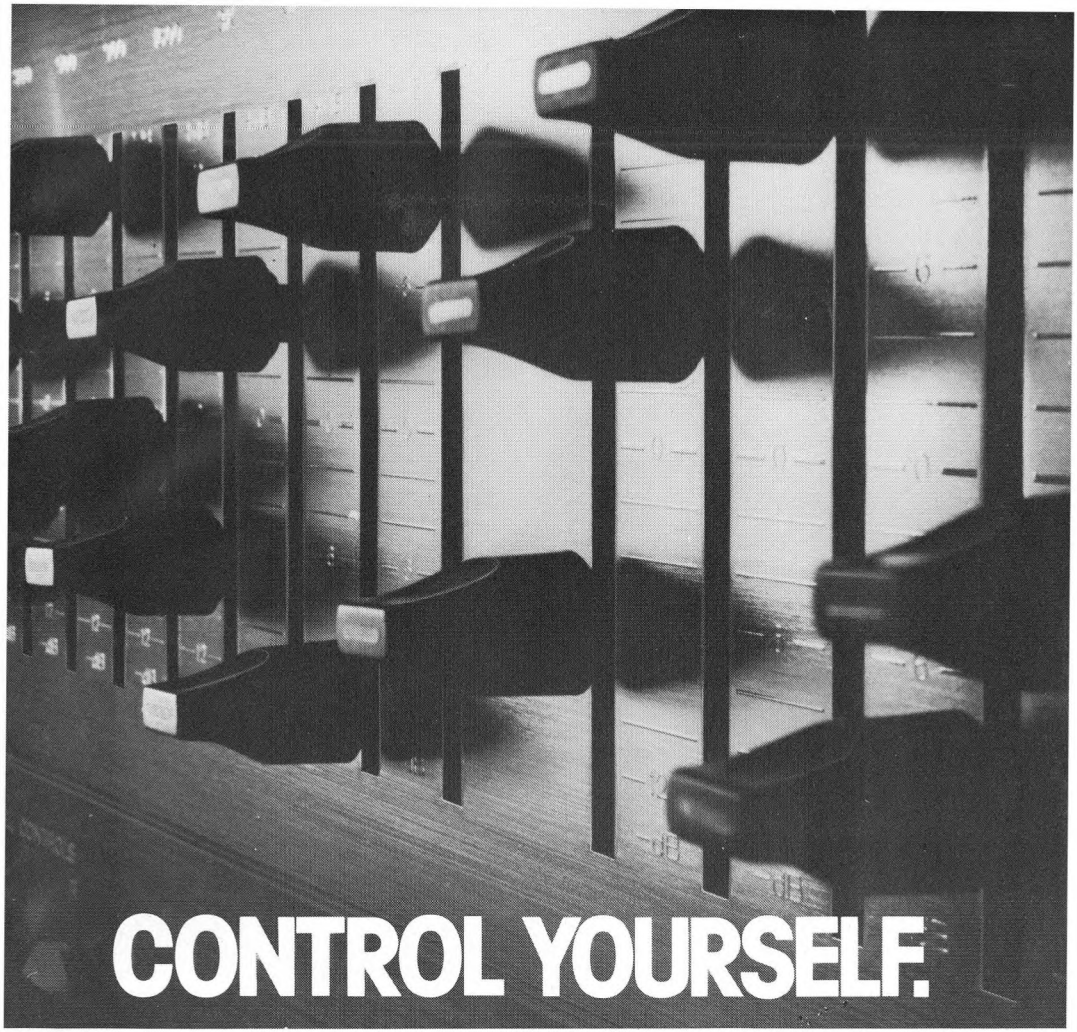
LAB TEST PROGRAMME

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 AR facility was used instead. Every attempt was made to undertake measurements generally held to be of the greatest relevance to sound quality.

The Characteristic Forward Response

This primary measurement concerned what is termed 'the integrated, averaged, forward frequency response; using 1/3 octave filtered measurement of a broad band 'pink' noise (constant energy per 1/3 octave) output from the speaker. The axial, 10° vertical and 30° horizontal (lateral) responses were recorded, and for comparative purposes, all three are reproduced on the same graph. Where a speaker showed significant lateral asymmetry, curves in both left– and right+ directions were taken. In addition the vertical response was set 10° above a small enclosure, but 10° below a tall one.

Traditionally, such measurements have been undertaken at a mike-to-speaker distance of



CONTROL YOURSELF.

Alone among stereo equalisers, the new ADC Sound Shaper Two Mark II incorporates a Light Emitting Diode (LED) metering system.

Unlike conventional meters, the 14 LEDs – seven for each channel – monitor signal levels instantly and with unerring accuracy.

But wait until you hear what it can do for your system. Those tempting slider controls give up to 12 dB lift or cut at any of 12 audio frequencies on each channel.

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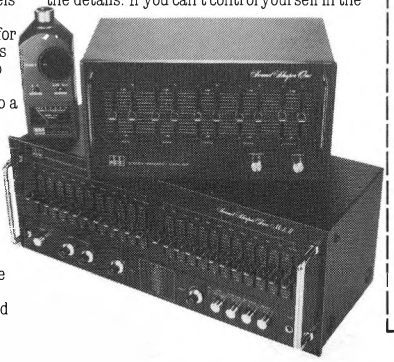
And to the tape enthusiast, they offer almost unlimited creative scope.

ADC also make the Sound Shaper One, a similar equaliser but with control over five stereo frequency bands instead of twelve.

Then there's the new ADC SLM-2 Sound Level Meter, a valuable but inexpensive addition that helps get the best from any system – especially one including an ADC Sound Shaper.

Send us the coupon, and we'll send you the details. If you can't control yourself in the meantime however, ask your ADC dealer for a demonstration.



To: Audio Dynamics Corporation,
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Audio Dynamics Corporation. A division of BSR Limited.

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FOR MORE I

Lurking within the walls of every record groove is a wealth of extraordinarily detailed information. This is contained in groove modulations of a thousandth of an inch at most, reducing in places to an amazing one millionth of an inch.

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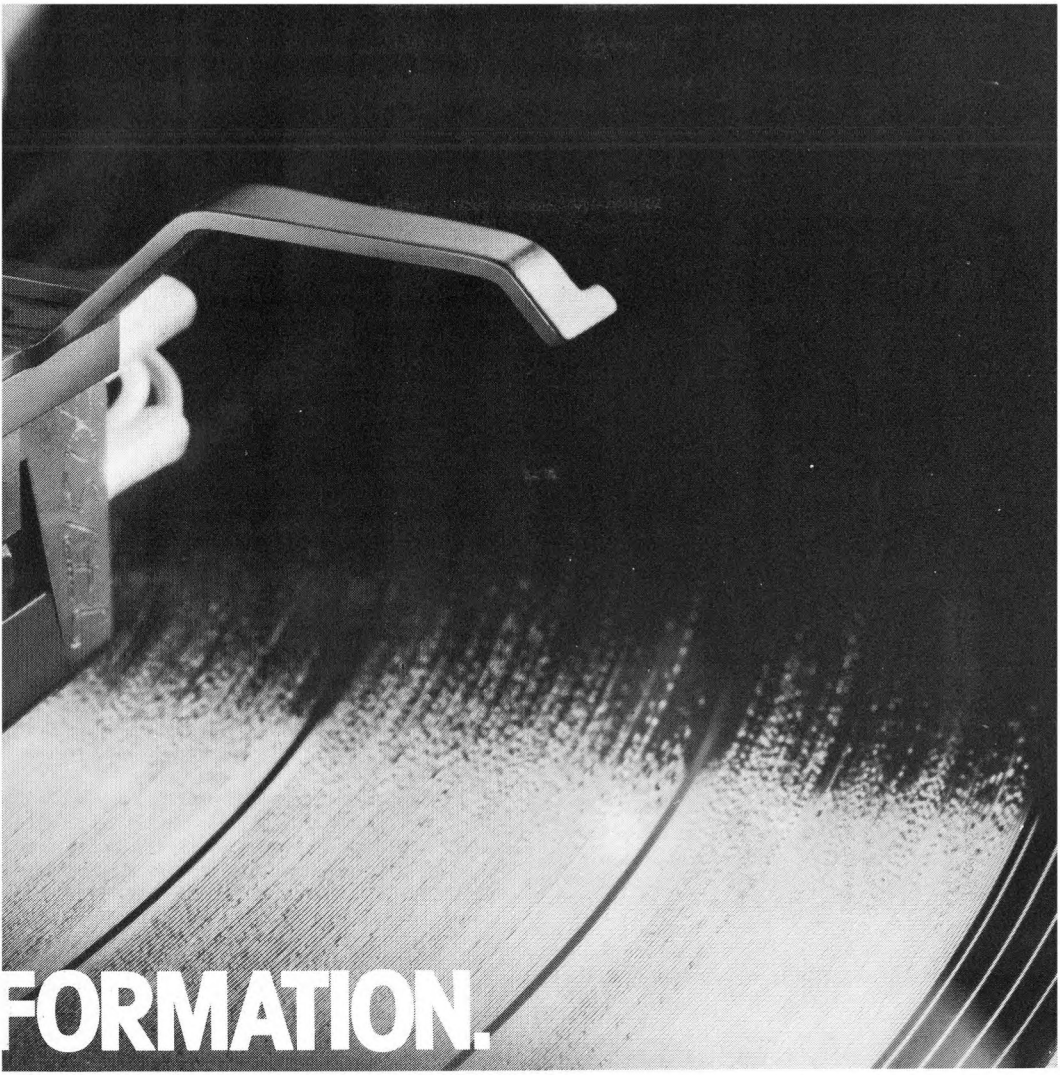

acknowledged contenders in the 'best cartridge currently available' stakes. (Remember the ADC 10E, and the legendary ADC 25 and 26?)

Today there's the remarkable ADC ZLM with its unique Aliptic stylus, a cartridge which prompted The Gramophone to write: "To say that the results were staggering would be an understatement."

Our LMF carbon fibre tonearms have been attracting similar comments. "Firm, extended low frequency range... neutral mid-band ...precise stereo imaging... the LMF-1 gains a recommendation..." (Hi-Fi Choice).

But even if you can't afford these admittedly esoteric items, we still have good news for you. The famous LMG-1 headshell, renowned for its rigidity and freedom from resonance, can make a surprising improvement to many systems for just a few pounds

Neither are all our cartridges wildly expensive. The QLM 36 Mk III, for example, costs only around £28.* Yet Hi-Fi Answers reckon that it "...extracts a lot of information from one's records in a most delightful way."

Need we say more? Except that if you send us the coupon, we'll send you further information.

*Suggested retail price QLM 36 Mk III £27.80 plus VAT.

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1m, but for this project it was decided that the characteristic forward response should be measured at a 2m microphone distance, which correponds more closely to a normal listening distance in a domestic environment. Due to limitations of the pink noise averaging technique at this range, the extreme low frequency portion of the graphs should not be interpreted too strictly. For a more accurate indication of performance at LF, the reference sine wave curve (taken at 1m) should be inspected; the quoted LF cutoff values in the data relate to this curve. 1m and 2m curves will differ somewhat, since at 2m cabinet diffraction effects are reduced, and the outputs of several drivers will begin to integrate more effectively.

A good performance in terms of the characteristic forward frequency response can be outlined as follows:

1 An even, wide and balanced *axial* response, well within the major ±3dB.
2 A 10° vertical curve deviating by no more than 2-3dB from the axial response, up to 15kHz or so.
3 A 30° lateral curve deviating from the axial response by no more than 3-4dB up to 15kHz.
4 Close symmetry of response in the left and right hand directions.

A loudspeaker meeting these requirements would be classed as one with a smooth and uniform output over the 20° vertical by 60° horizontal listening 'window' and, potentially, it should be capable of a natural sound with good stereo imaging, if its coloration, and to a lesser extent distortion, is sufficiently low.

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 Garston Chamber is accurate to 30Hz), 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.

The more limited size of the AR chamber for the new reviews required some correction for bass anomalies which are included (dashed) on the graphs.

Distortion (3rd harmonic)

Working on the basis that 2nd harmonic is relatively harmless due to its subjectively innocuous character, it was decided to measure the 3rd harmonic content, at a 96dB pressure level and 1m. Two points are however worth mentioning: first, the mechanisms in loudspeakers which produce odd harmonics such as the 3rd are also those which relate to intermodulation, so indirectly, IM aspects are also included. Secondly, it will be seen that the harmonic measurement is continued to the microphone response limit at 36kHz, (ie the 3rd harmonic of 12kHz) even though this is beyond audibility. This was done simply because if significant 3rd harmonic is generated, it is also likely to produce difference intermodulation products which could be audible.

Ideally 3rd harmonic distortion levels of well below 1% are desirable at mid frequencies, and while some rise is inevitable at low frequencies below 100Hz, even here a target maximum of 2% is worthwhile, rising perhaps to 5% below 50Hz.

The stated 96dB sound pressure level at 1 metre is a fairly high one, and whilst the larger medium efficiency models only required a few watts to attain it, the smallest lower efficiency designs found it rather a strain. In such cases the test level was reduced to 90dB, and the change noted. A percentage scale has been printed for convenience sake, but note that correction must be made for significant changes in level on the reference trace; this is particularly relevant at the lowest frequencies where the axial power falls away.

While the original reviews show a swept plot of the 3rd harmonic distortion, in the latest examples a Hewlett Packard HP3582A spectrum analyser was employed and typical 3rd harmonic distortion levels have been tabulated.

Impedance

Using constant-curve drive from the B&K sweep oscillator, the modulus of impedance of the loudspeakers was plotted, the 25dB logarithmic potentiometer range conveniently encompassing the great majority of variations. The 0dB or baseline is set at 3.3 ohms which gives 10 ohms at +10dB, and 33 ohms at +20dB. This curve represents the electrical combination

of resistive and reactive parts (whether capacitive or inductive), and to assess the magnitude of the reative component, measurements were also taken of the phase angle of the impedance over the nominal 20Hz-20kHz range. When a loudspeaker shows low impedance and or high reactive components in combination, it is regarded as difficult to drive and could well cause matching problems with amplifiers designed primarily for an 8 ohm nominal loading.

Constructional quality

All 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 96dB (2 metres) from a stereo pair of speakers in an average room of volume 80 cubic metres.

It is almost impossible to specify a maximum power rating, as a complex relationship exists between the type of program, the maximum power input (peak and average) and how long this maximum level is maintained. In this test we found most of even the smallest speakers could sustain a 500W peak, 250W mean power input on solo instruments in the mid band, 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.

Acknowledgements

Bruel & Kjaer, for the loan of the gating unit and for advice on measurement techniques.
Mrs M. Barker.
Roy Brooker, of GEC Hirst Research Centre.
Calrec, for the loan of microphone and pre-amp used for live recodings.
Catherine Colloms, for loan of musical instrument.
Marianne Colloms, for panel service, typing and text cheching.
Paul Crook, for invaluable assistance throughout the project.
Enigma Records Ltd, for the loan of Dolby 'A' unit.
Tony Faulkner, of Enigma Records, for considerable advice on recording techniques, and loan of material for the stereo test sessions;

BEHIND THIS BADGE KEEP US

Just over a year ago we launched the Wharfedale XP2s.

The new, improved successors to Britain's best selling speakers.

The newcomers have proved even more popular than their

distinguished predecessors.

The Shelton XP2, for example, was described by 'What Hi-Fi' (April 1979) as "outstanding value." The Shelton's dome tweeter, they continued, gives it a "smooth, open and spacious sound," and the overall performance was described as "well integrated and detailed."

'Practical Hi-Fi' tested the Denton-smallest of the XP2 range -in their April 1979 issue. The verdict: "Initial listening impressions excellent, considering its diminutive size."

At the other end of the XP2 scale, in September 1978 'Hi-Fi for Pleasure' compared the Glendale with two speakers each costing nearly twice as much. They found the "overall standard of construction and finish excellent... Detail at the bass end was very good with no feeling that any information was missing... the midrange area seemed to be neutral with no obvious colourations."

The writer concluded that "as far as the Glendale is concerned I think that... it sets a standard in £100 loudspeakers which must be very hard to beat."

WHARFEDALE DENTON XP2.
Frequency response (–3dB) 65Hz–18kHz. Suitable for amplifiers of 10–30 watts r.m.

Please send me the Wharfedale XP2 brochure.

Name_____

Address_____

HCA 9/79

To: Rank Hi Fi, Highfield Road, Idle, Bradford, Yorks., BD10 8SF.

Distributed in Ireland by: Kilroy Brothers Ltd., Shanowen Road, Whitehall, Dublin 9. Tel: 379961

THERE'S ENOUGH TO
IN FRONT.

The final word goes to Paul
Messenger, writing in the March
1979 issue of 'Hi-Fi News and
Record Review.' He summed-up the
Shelton XP2 as "a very well-
balanced system that comfortably
out-performs its immediate
competition, and which I would
refer to a lot of designs costing twice
the price."

But then we've always maintained
that one aspect of the XP2s will
keep us well behind the competition.

The price.

WHARFEDALE

WHARFEDALE. BRITAIN'S MOST FAMOUS SPEAKERS.

WHARFEDALE SHELTON XP2.
Frequency response (–3dB) 63Hz – 20kHz. Suitable for amplifiers of 10 – 35 watts r.m.s.

WHARFEDALE LINTON XP2.
Frequency response (–3dB) 60Hz – 20kHz. Suitable for amplifiers of 10 – 40 watts r.m.s.

WHARFEDALE GLENDALE XP2.
Frequency response (–3dB) 50Hz – 20kHz. Suitable for amplifiers of 15 – 50 watts r.m.s.

also for his role as a panelist and independant critic.
Fender Sound House, Soho Square, for the loan of musical instruments (snare & side drum, cymbals, electric bass guitar).
Steve Jacques, for considerable assistance in live-v-recorded sessions.
Lentek, for loan of moving-coil pre-amp and Entre cartridge.
Paul Messenger, for loan of Naim NAP250 amplifier.
Monitor Audio for loan of Sound Cable.
Pioneer, for loan of tape deck, RTU11/TAU11.
Rank Audio Visual, for loan of Rotel RTB5000 amplifier (500W per channel).
Sansui, for loan of amplifiers BA/CA2000.
S.M.E., for loan of SME 3009 111 pickup arm.
David Stebbings for reverberation measurements in my listening room.
Technics (National Panasonic), for loan of tape deck, 1500.
Yamaha (Fallowfields), for loan of amplifiers B2/C2 and ILV speaker cable.
Celestion Ltd., for loan of mastertape.
Sony U.K. Ltd., for loan of videorecorder and PCM1 units.
Court Acoustics, for loan of BGW amplifiers.

Listening panel
Marianne Colloms
Martin Colloms
Tony Faulkner
Simon Fleetwood
John Atkinson
Alan Harris
Adrian Hope
Paul Messenger
Peter Maltby
Mike Deadman
David Prakel
Paul Benson
Additional data provided by Paul Crook, who was the main test sequence assistant.

Location
Laboratory tests: Building Research Establishment, Garston, Watford; Acoustic Research Facility, Houghton Regis; test equipment supplied by author. Subjective testing: author's listening room (for details see earlier.)

Equipment used

1 **Domestic stereo listening tests**
Dolby 'A', 361 x 2
Lucas ILV speaker cable
Naim NAP 250 amplifier
Pioneer TAU11/RT11 tape deck
Realistic Sound Level meter (referenced to B&K S.L.M.)
Sansui BA2000 amplifier and CA2000 pre-amp
Technics 1500 tape deck
Modified Thorens TD160 turntable with SME 3009 111 pickup arm and Entre cartridge
Dolby A301
Sansui speaker cable
BGW 410 power amplifier
Technics SH9020 power monitor
Technics SU9070 pre amp
Revox B77 tape deck
Dynavector Karat (prototype) cartridge
Mission 774 arm.

2 **Live-v-recorded tests**
B&K 4133 12.5mm precision microphone
B&K 2603 microphone measuring amplifier
Calrec microphone and phantom power unit
ITT LPK M130 simulated noise source on baffle
Pioneer TAU11/RTU11 tape deck (pre-aligned)
Rogers pink noise generator
Rotel RB5000 power amplifier
Sansui CA2000 pre amplifier
Sound Cable and Lucas ILV cable
Technics 1500 tape deck
Ivie 30A 1/3 octave analyser and B&K 4133 12.5mm mike
BGW 250B power amp (bridged mono mode.)

Instruments
Ludwig snare drum, courtesy Fender Sound House.
Paiste hi-hat cymbal and stand, courtesy Fender Sound House.
Fender precision electric bass guitar, courtesy Fender Sound House.
Epiphone acoustic guitar, courtesy Steve Jacques.
Wooden xylophone.
Noise source.
Male voice (Steve Jacques).

Lab testing
B&K piston phone callibrator, courtesy Building Research Establishment.
B&K 4133 precision 12.5mm microphone.

We want you to hear all of the music.

The ear knows how to deal with gross distortion. It simply stops listening. But what happens when the distortion is so subtle that it is barely perceived? Usually this kind of distortion is accepted by the ear as part of the musical information. It's not until you've listened for a while that you start to sense something isn't quite right, that there's something between you and the music. To some, it's like listening through closed curtains; for others, it's an uneasy, fatigued feeling. What happens, in effect, is that your ears and brain try to listen through the distortion and end up working too hard to hear all of the music.

Harman Kardon's new generation of stereo components are designed, built and tested with new understandings about distortion and what makes one component sound better than another. All Harman Kardon receivers, separates and tape decks are of ultrawideband design for excellent phase linearity and superb transient response (transients are crisp, textures remain clear, open and transparent). The electronics are engineered for low distortion with minimum feedback. Negative feedback is in universal use to reduce conventional forms of distortion. But too much feedback cause TIM (transient intermodulation distortion). At Harman Kardon, we use an 'open loop' design and engineer conventional forms of distortion down to the lowest possible levels without the use of feedback. Then, we add just the slightest bit of feedback to reduce those levels even further while keeping TIM at almost a nonexistent level. You hear all of the music, free from dynamic, as well as static, forms of distortion.

Harman Kardon engineers also use new dynamic list procedures for their cassette decks including critical listening to every sub-component to eliminate or reduce distortion that can be heard but not as yet quantified. Tape drives are designed to eliminate all audible speed variations. Even when they fall outside the scope of conventional measurements. Each of the decks feature ultrawideband response, phase linearity, rugged and precise tape transports, permalloy heads, low noise electronics, Dolby ", and an array of other outstanding features. Whether you use a Harman Kardon stereo cassette deck in combination with Harman Kardon separates or a Harman Kardon receiver, we think you will agree the combination is subtly different and immeasurably better-designed, engineered and tested to let you hear all the music.

Pictured here:

hk670 Twin Powered 60/60 Watts
DC Coupled Ultrawideband AM/FM Stereo Receiver

hk3500 Front Loading Dual Motor
Three Head Stereo Cassette Deck with Dolby "

For complete technical information, write to the following address:

harman/kardon

St. Johns Road, Tylers Green,
High Wycombe, Bucks. HP10 8HR
Telephone: Penn (049 481) 5331

B&K 2603 microphone amplifier and recorder drive
B&K 1614 1/3-octave analyser
B&K 10m microphone remote cable
B&K 22305B high speed level recorder
B&K 1014 BF sweep oscillator
B&K 4440 delayed measuring gate specially modified for trailing pulse trigger
B&K 25dB, 50dB and linear 110 mV potentiometers
Digital phase meter, courtesy Bob Stuart, Meridian
Calibrated reference resistors for impedance scaling
ITT LPK M130 phase reference
Lucas ILV cable
Levell TM11 electronic multimeter
Rogers pink noise generator, (specially aligned)
Sansui BA2000 power amplifier
Telequipment D83 oscilloscope
HP 3582A computing spectrum analyser
HP 339A distortion unit
Ivie 30A 1/3 octave spectrum analyser
Technics 8077K amplifier
Baxandall sweep oscillator

Programme used for stereo listening tests
The extracts comprised a selection of 10 tracks, recorded in Dolby 'A' mode and on the Sony PCM system.
1) Jennifer Bate, Liszt, **organ recital**, Royal Albert Hall, crossed-pair technique, Enigma VAR1051A.
2) Maurice Hasson and Ian Brown, **Violin and Piano duet**, crossed-pair technique, Enigma VAR1025A.
3) Elton John, Yellow Brick Road, **pop from disc recording**, DJLPD 1001.
4) John Lill, **solo piano**, crossed-pair technique, Enigma VAR 1006B.
5) George Malcolm, Northern Sinfonia, Handel Concerti Grossi, **classical orchestra**, Enigma VAR 1045A.
6) Prokofiev, Peter & The Wolf (Angela Rippon, Owain Arwel Hughes, RPO), **classical orchestra**, Enigma VAR 1041A.
7) Leo Sayer, Endless Flight, **high level pop**.
8) Sibelius 5th Symphony (Von Karajan, BPO) **(distorted disc**, end of side track on moderately worn record) DGG SLDM 138973.
9) Steeleye Span, Rocket Cottage, **electric folk band**.
10) Westminster Cathedral **Choir**, Enigma VAR 1016A.
11) Little Feat, **Time loves a hero**, Dolby A master.
12) Stravinsky **Orpheus,** ballet excerpts, Orch St Johns Smith Square, PCM master.
13) Berlioz, **Symphonie Fantastique,** rehearsal session, PCM master.
14) **The Fox Touch, Vol I.** Virgil Fox on cathedral organ, Crystal Clear direct cut disc.

Tony Faulkner's Introduction
Listening through an extended programme of domestic stereo and of live versus reproduced speaker audition tests is a very taxing activity, particularly with such a large number of different units. What made this particularly interesting was that at no time was I told the identity of any system I had heard, right up until after completing the write-up. This is indeed a cruel test, but nonetheless important to preserve lack of preconceptions and bias.

As with any individual, my feelings are strictly personal and will undoubtedly be disagreed with by some, but I can assure the reader that they are the sincere opinions of one particular pair of 'professional ears'. What I look for in a speaker is clarity throughout the audible range, without fatiguing characteristics such as excessive mid-band coloration, boomy bass, ragged extreme top, and wandering, unstable stereo images - these particular problems tend to become very wearing during the course of a day's work. My job is concerned solely with classical music, and I am quite prepared to monitor at less than ear-splitting levels in order to avoid the compromises in speaker performance usually necessary to achieve high sensitivity and power-output.

I have to listen to quite a variety of loudspeakers in my trade, and I can say in all honesty that my only reference as such is what I hear (or think I hear!) in the concert-hall. To rely too much on one monitor loudspeaker design is, I believe, a mistake since familiarity breeds contempt, and one can end up tailoring one's recordings to minimize the design problems of the monitors one chooses (with equalization, etc.). To refresh my 'acoustic memory', I attend a large number of concerts and I would suggest to many readers, and also speaker designers, audio critics and recording

engineers, that that is the only way I have yet discovered of managing to keep one's 'feet on the ground'. In my world of classical music, reference to live sound is of great importance, however the world of rock and middle-of-the-road music has no similar reference, and I have very limited experience in this field of recording. Nonetheless, design difficulties apparent in classical music and live-versus-recorded speaker tests will very often be just as noticeable in rock music, although the high-levels sought by many enthusiasts will generally have to be achieved through extra compromises in speaker design to gain efficiency, unless one has a very deep pocket for high-power amplifiers.

In summary, my comments have been included separately in each review in order to give one particular person's findings rather than just an amalgam of the whole panel's comments. The adage 'one man's meat is another man's poison' will not be inappropriate for some readers (and doubtless manufacturers!) when they read what has been said by the *Hi-Fi Choice* team throughout the book. But this book is intended as a stimulant for readers and enthusiasts to go out and judge for themselves, as well as noting our findings. After all the final purchaser of a pair of loudspeakers has to listen through his own ears, not those of a listening panel or a B&K test microphone.


NAD 3020 Amplifier
NAD
Series 20
Stereo Amplifier 3020
Power
Balance
Aux
Tuner
Phono
Tape
Audio Muting
Loudness
Volume
FM
MHz
Stereo
Tuning
NAD 4020 Tuner
FM Stereo Tuner 4020
Mono
Muting
NAD

NAD 3020 AMPLIFIER

Specification

Continuous average power output at 8 ohms (min. RMS power per channel, 20-20kHz both channels driven with no more than the rated distortion)	20W
Dynamic headroom at 8 ohms	+3dB
Dynamic power output (maximum short-term power output per channel)	8 ohms 40W 4 ohms 60W 2 ohms 80W
THD (Total Harmonic Distortion, 20-20kHz), from 250mW to rated power output	<0.02%
SMPTE IM (Intermodulation Distortion 60Hz + 7kHz 4:1) from 250mW to rated power output	<0.02%
IHF IM (CCIF IM Distortion, 19k + 20kHz) at rated power output	<0.02%

Preamplifier Section

Phone Inputs	
Input sensitivity re rated output	2.5mV
re 1 watt output	0.6mV
Signal-to-noise ratio, A-weighted ref. 5mV with cartridge connected	>75dB
Channel separation	>50dB
High Level Inputs	
Signal-to-noise ratio, A-weighted ref. 1W	>90dB
Channel separation	>60dB
Frequency response	±0.5dB, 20-20kHz
Infrasonic filter (24dB/octave slope)	—3dB at 15Hz
Ultrasonic filter (12dB/octave)	—3dB at 35kHz

PRICE AT TIME OF GOING TO PRESS £71·00

NAD 4020 TUNER

This new tuner from NAD takes advantage of the current dramatic advances in FM tuner circuitry to give extremely high performance for just £69.

The front end of the NAD 4020 provides for the connection of either a 75-ohm or 300-ohm antenna cable, and employs a dual-gate MOSFET RF amplifier, producing a good combination of sensitivity, resistance to cross modulation from strong signals, and rejection of interfering signals.

Stereo multiplex decoding is performed by a new phase-locked-loop (PLL) IC for low noise and superb stereo separation. The PLL decoder also yields minimum distortion in stereo reception.

The NAD 4020 tuner has LED indicators for tuning and signal strength, the latter having the dual function of correct tuning within +25kHz guaranteeing lowest stereo distortion, and indicating signal strength by proportional brightness.

NAD 4020 Specification

Input sensitivity IHF, 50dB S/N mono	<3.5μV (16dBf)
S/N stereo	<35μV (36dBf)
Signal-to-noise ratio, A-weighted mono/stereo	74dB/68dB
Selectivity, alternate channel	70dB
THD and IM Distortion at 100% modulation, stereo	<0.3%

PRICE AT TIME OF GOING TO PRESS £71·00

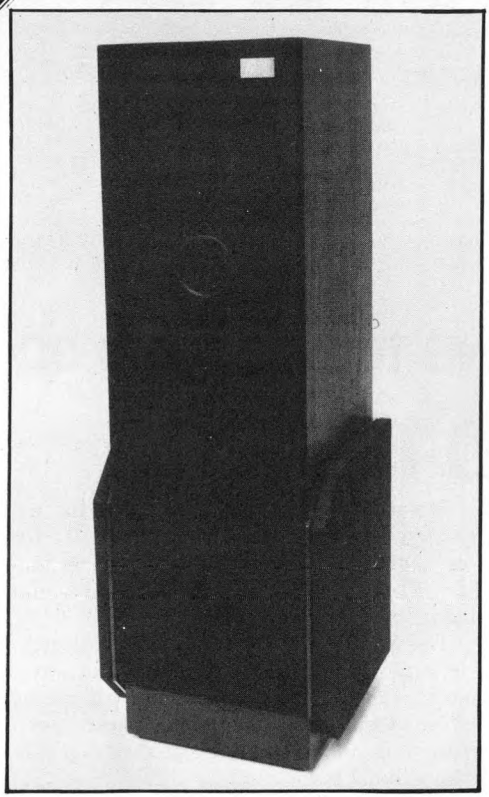
NAD

NAD Sales Ltd., 60 Farringdon Road,
London E C1. Tel: 01-251 4631.

RECOMMENDED

Acoustic Research AR90

Teledyne Acoustic Research, High Street, Houghton Regis, Beds 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.

Acoustic Research AR90

RECOMMENDED

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.

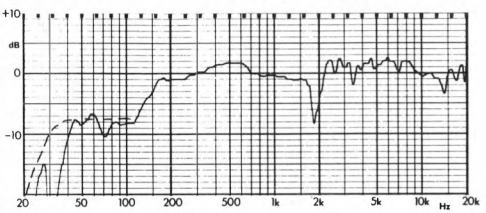
T. F. Comments

I found this model to be easy on the ears, with good stereo and a generally good sound despite the some boxy effects. However, its performance seemed to vary more with different program than most.

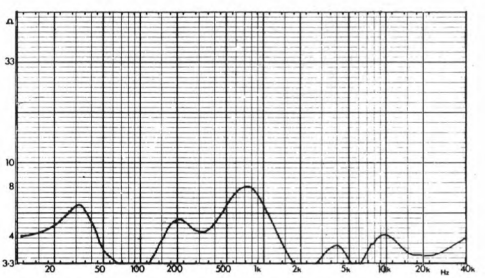
Summary

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. Thus while in strict value for money terms it is not exceptional, the performance level attained nevertheless indicates recommendation.

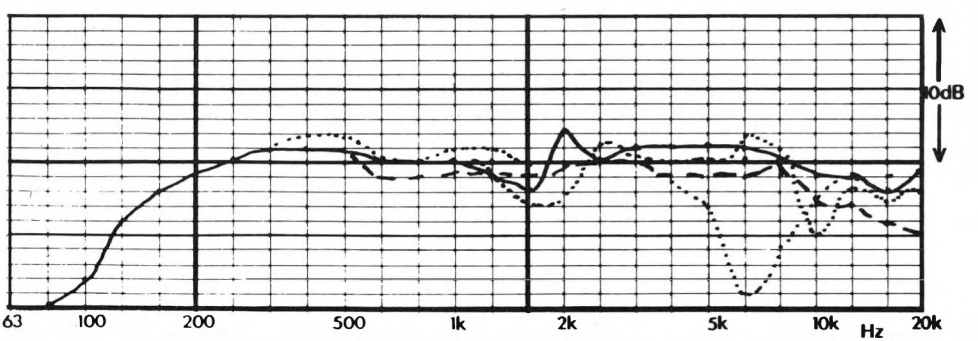
Size	108(42.5) H; 37(14.5) W; 38(15) D; cm(inches)
Weight	37(82) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15–300W
Recommended placement	on floor back to wall or greater than .6m from wall
Frequency response within ±3dB (2m)	125*Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	30Hz*
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	90dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	v. good 30Hz–1.5%, 100Hz–.3%, 400Hz–0.5%, 6kHz–1%, typically 0.2 to 0.1% over range
Impedance characteristic (ease of drive)	poor
Forward response uniformity	good
Typical price per pair inc. VAT	£725



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

Audiomaster MLS1

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

In common with many other speakers, this small UK enclosure uses drivers made by the French company, Son Audax. A low efficiency design, ideally the matching amplifier should be relatively large, in the 30-50 watt region, and while the speaker favours free space mounting, an open shelf should also work quite well. In both locations the speaker should be positioned vertically.

Technical details

The sealed box cabinet is fitted with a low resonance bextrene-coned driver of 160mm nominal diameter. Above approximately 3kHz the high frequencies are handled by a 25mm fabric-dome driver, and a complex crossover totalling 9 elements equalises and integrates the driver sound outputs.

Lab results

The pair matching was pretty good, with 0.5dB typical L-R difference, and a mid band region 500-2kHz where an increase to 1.5dB was recorded. These results were however a little inferior to a pair of *MLS 1*s recently reviewed in *Hi-Fi for Pleasure* (Jan 78). The sensitivity was undoubtedly low at 84dB, although no worse than other similar systems in the report. The low frequency cut off was established at 57Hz which is fair for this size of enclosure, with the impedance curve indicating that the low frequency resonance occurs at 63Hz. Nowhere does the impedance value fall below 7.5ohms, and this result, together with the lack of severe reactive impedance components,suggests that the *MLS1* is easy to drive.

The characteristic frequency responses were well above average, indicating an even, well-balanced design with no obvious irregularities, and the close alignment of the off-axis curves with those taken on the main axis can be seen. The drivers are thus well integrated, making listener position relatively uncritical, as well as benefiting stereo imagery.

At 90dB, the third harmonic distortion was considered to be very good, particularly above 100Hz, while the rise below this level is not unexpected in a speaker of this size and is quite reasonable. Some buzzes were heard on bass signals during listening, but these did not show on the graphs.

Sound quality

On balance, and without making any allowance for price and size, the *MLS1* was rated as well above average.

It was however undoubtedly strongest on the stereo programme, where it attracted precious little criticism. Slight 'lack of low bass', 'tizz', 'fizz', and 'boxy' effects were noted, but as such, the coloration rating is 'good'. Stereo imaging was found to be precise with a good depth impression, and the speaker had an airy open balance which was liked by the majority of the panellists.

On the live sound comparisons, however, those coloration effects that were present seemed to be more obvious. The speaker sometimes sounded 'small' with a dulled impression on transients, while on pure bass sounds a buzzing, possibly caused by the rear panel, could be heard at relatively low volumes. While it could be driven to quite high

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sound levels (101dBA), the output was found to harden noticeably and was less pleasant in consequence. Some panellists felt that there was a slight emphasis in the high treble, while the extreme treble was deficient; the former can be in fact observed on the response traces. Nevertheless, the rating on this test remained at 'average', which is no disgrace.

T.F. Comments

I liked this speaker a great deal in the stereo tests, considerable clarity exposing program faults and great musical detail. In mono it was marginally below average due to some 'boxiness' and rattles.

Summary

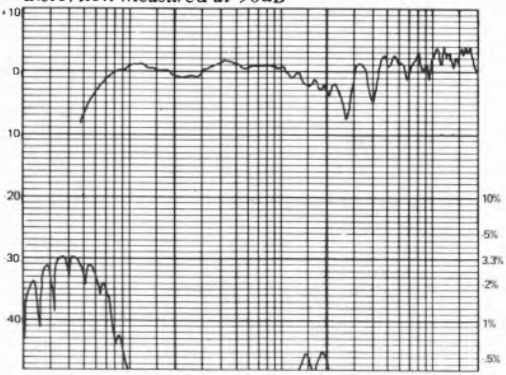
Bar a slight reservation concerning the pair matching of these particular samples, the *MLS1* is considered to be a fine example of a compact low coloration speaker, possessing good distortion and frequency response characteristics and a natural sound balance.

Reassessment of samples for the latest tests unfortunately gave rise to slightly increased criticism of treble over brightness. This was not severe enough to affect our recommendation at this price, and we understand the manufacturers are investigating, but pre-purchase auditioning is clearly desirable.

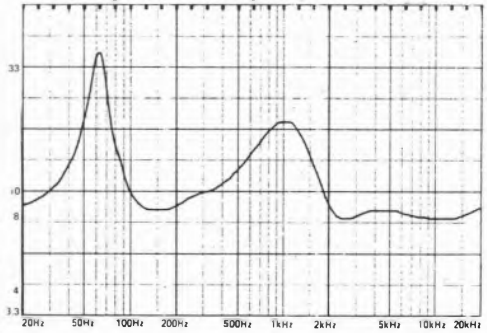
Size	37.2(14.5) H; 23(9) W; 19.2(7.5) D: cm(inches)
Weight	5.3(11.7) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	57Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	84dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£105

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

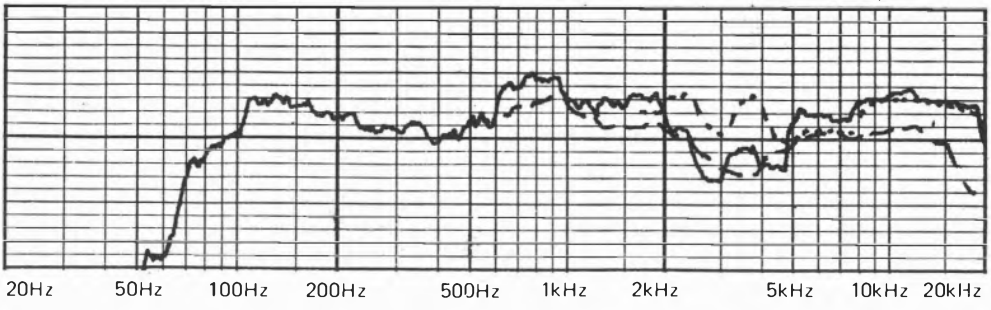
distortion measured at 90dB



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



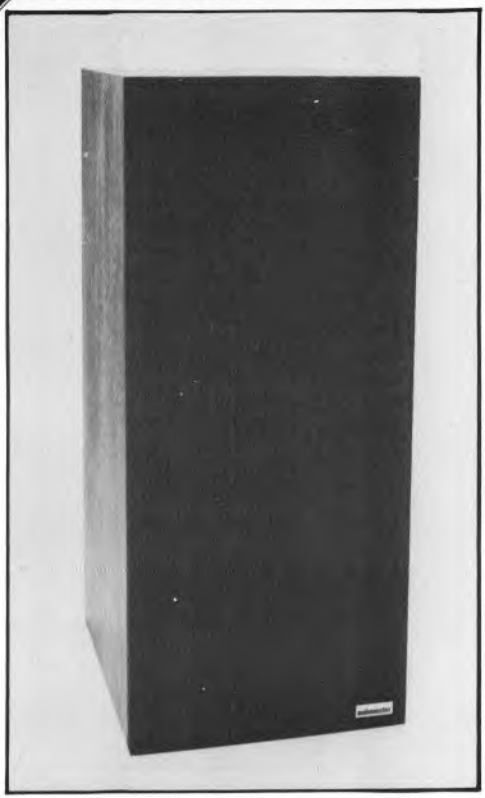
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Audiomaster MLS4

Audiomaster Ltd., 33 Bridle Path, Watford, Herts WD2 4BZ. Tel: 0923 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 $^1/_3$-ocatve 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.

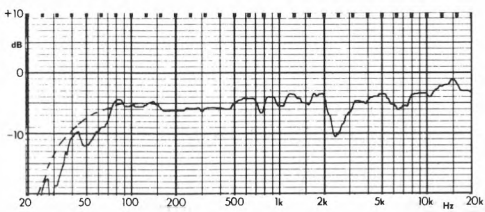
T. F. Comments

I found this model fine in most respects bar a tendency to stridency on strings, with a touch of fizziness.

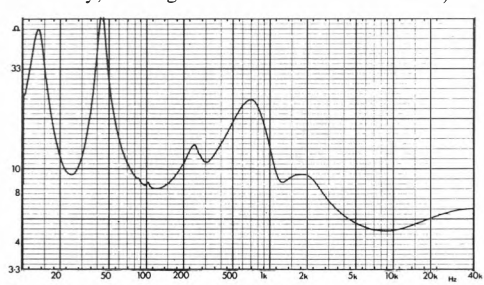
Summary

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.£190 per pair inclusive.

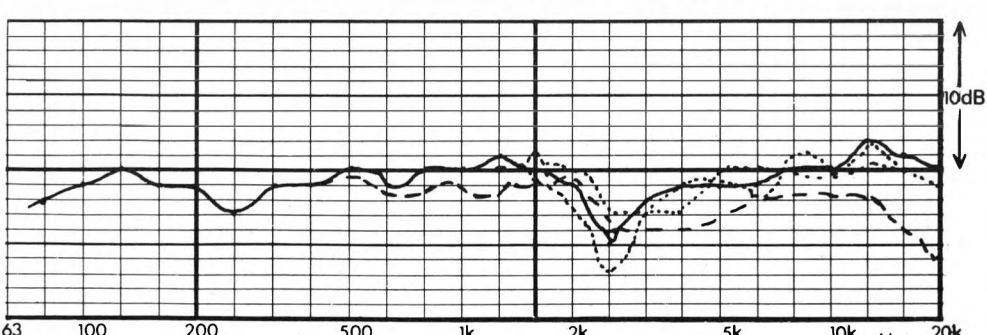
Size	62.5(24) H; 27.5(11) W; 31 (12) D; cm(inches)
Weight	14(30) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15–150W
Recommended placement	25cm stand, clear of walls
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	37Hz
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	£200



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

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Audio Pro B2-50 (subwoofer)

Audio Pro (Hi-Fi) Ltd., Sandy Lanc, Moston Road, Sandbach, Cheshire. Tel: 09367 7520

One of two subwoofers or bass extension systems evaluated in this issue, the *B2-50* undoubtedly offers a high standard of performance, with a bandwidth down to 20Hz (-3dB), and a sound level of up to 100dB in half space condition. Intelligently designed, this relatively compact 50 litre enclosure incorporates electronic crossovers for the satellite loudspeakers, the woofer power amplifier and electronics include standby and automatic switch on facilities, and controls for crossover points and sensitivity are provided.

While the unit may be married to the main system *via* existing speakers leads, ideally the supplied single DIN cable of generous length should be used, inserted between pre- and power amp sections, or alternatively in a tape monitor loop. Crossover frequencies may be varied from 40Hz to 200Hz, with the overlap adjustable to provide a degree of equalisation for the region between the satellites and the subwoofer.

The drivers comprise two 170mm units with massive magnets in an unusual form of '6th order Butterworth' reflex enclosure, where the driver characteristics are largely synthesised in the power amplifier feedback. Mounted on castors, the cube-shaped cabinet is dressed in black ash veneer with a black qulle.

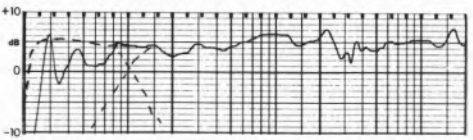
Using a near field microphone technique, it was possible to largely substantiate the manufacturer's specification of -3dB at 20Hz, and +/- 1.5dB to 200Hz, with the nominal -6dB point at a remarkably low 18Hz! The crossover slopes are shown and also agree with the specification, at 6dB per octave for the satellites and 12dB/ octave for the sub woofer. At higher frequencies third harmonic distortion was low at the 96dB sound level, proving more than satisfactory at the lower limits. Maximum levels approached 99dB, 1m before overload.

The better the satellite system, the better the results obtained. We found a 70Hz crossover point best for stereo, with the woofer located near to or between the stereo pair. The bass extension was in the main unobtrusive until genuine low bass appeared — then the floor shook and pedal organ pipes and orchestral bass drums were accorded their full acoustic dimensions. Despite the prohibitive cost, a purchaser might well be tempted to have two subwoofers, each with a good quality speaker on top! Overall, the sound was well integrated and sufficiently clean not to compromise the low bass coloration of any good system.

Albeit rather expensive, this is undoubtedly a well designed and engineered subwoofer of compact dimensions, which delivered the goods.

Size	37.2(15) H; 46.2(18) W; 44.4(17) D; cm(inches)
Weight	28(62) kg(lbs)
Recommended placement	floor, close to ancillary speakers
Frequency response within ±3dB (2m)	20Hz to 200Hz*
Low frequency rolloff (—6dB) at (1m)	18Hz
Approximate maximum sound level (pair at 2 metres)	with satellites ≅100dBA
Third harmonic distortion (96dB at 1 metre)	v. good 24Hz–5%, 50Hz–0.8%, 100Hz–0.4%, low considering extension
Typical price each inc. VAT	£480

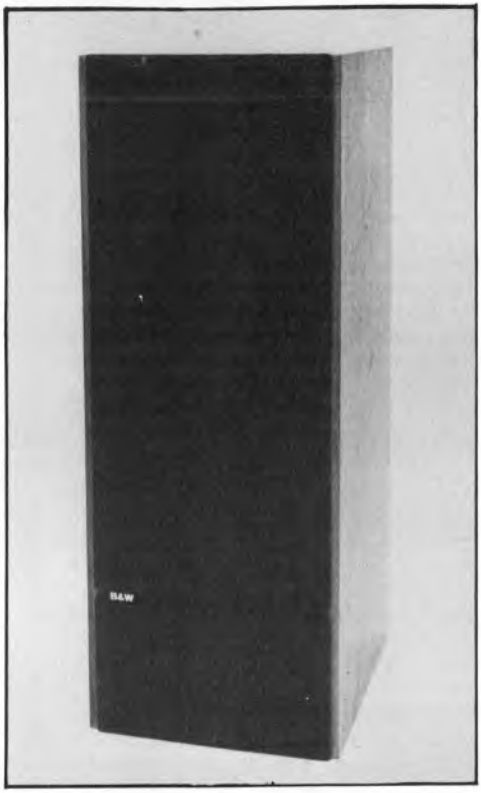
* Subject to errors due to anechoic chamber



Solid: axial sine wave reference response with satellite; dashing shows chamber correction and crossover slopes.

B&W DM2A

B & W Loudspeakers Ltd., Meadow Road, Worthing BN11 2RX. Tel: 0903 205611



This tall, slim enclosure was accompanied by a steel pillar stand with a veneered base, and the whole may be bolted together for improved rigidity and stability. Carrying the legend of an earlier and long lived B&W system, this Mark II version in fact bears little resemblance to its predecessor.

The main bass enclosure volume is fairly small at c.35 litres, and carries a 200mm bextrene-coned high excursion unit with a fine die cast frame, reflex loaded via a 62mm dia tunnel port. Uppermost in the vertical-in-line driver format is the 110mm bextrene midrange driver, also possessing a fine, open die cast frame and located in its own wool filled enclosure. The treble is handled by a 25mm soft dome unit, all drivers being of B&W's own manufacture.

A good quality 19-element crossover divides the range at 400Hz and 3kHz, while the rear panel fuse did not blow until some 250W of program was applied. The enclosure construction was quite elaborate, employing internal radial bracing, thick bituminous damping pads and a well veneered walnut exterior with finished semi-matt.

Lab results

Up to 5kHz and at 1m, the pair matching was considered to be a good standard, but the treble ranges were somewhat different, with regions of 2dB imbalance. The sensitivity at 86dB/w was almost indentical to that measured on another pair recently tested for Hi Fi News (June '79 issue), and is fairly low. Referred to this sensitivity, the –6dB low frequency point was nominally at 45Hz.

Third harmonic distortion was moderate throughout the range at around 0.58%, although two isolated regions were poorer, registering 1%, 280Hz and 1.5%, 6kHz. At lower frequencies however distortion performance was well above average, giving 0.78% at 50Hz for example.

The speaker also demonstrated fine power handling, sustaining high levels of electric bass guitar (50W average), and showing no acoustic problems prior to blowing the fuse protection (1.6 amp quick blow). The impedance curve serves to classify the model as an 'average' amplifier load, mainly due to the dip to 5.5 ohms near 140Hz, an area where program power is high. Elsewhere the mean value was 12ohms or so, and thus should present no problems.

At 1m the axial reference frequency response was pretty good, holding to within +/–3dB limits from 50Hz to 17kHz, although some lumpiness was evident, together with a recession of 2-3dB over several octaves from 2.5kHz to 8kHz. This trend was also illustrated at 2m, where the relative prominence of the treble range from 8-10kHz is apparent. Off-axis curves above and below in the vertical plane and in the lateral plane were good, confirming the good crossover control. (Interestingly, both power handling and dispersion seemed improved when compared with the Hi Fi News samples.)

Sound quality

When compared with live sounds, the *DM2 II* scored a disappointing 'acceptable' rating — not particularly good in view of its price. Voice

reproduction was considered mildly dulled and boxy with exaggerated sibilants, while the snare drum lacked attack and the bass register, although quite well extended, lacked some precision and clarity.

Fed with a wider range of stereo program material, the speaker fared a little better, achieving an 'average' rating which is broadly commensurate with its price. Stereo imaging was classed as good, particularly in terms of ambience and lateral positioning; however the full depth on several recordings was not felt to have been transmitted. Organ bass was well extended though with some upper emphasis, and the midrange seemed a trifle forward and boxy. The presence band was veiled with a suggestion of fizziness in the upper treble, while several panelists noted that the speaker seemed a trifle 'light' overall.

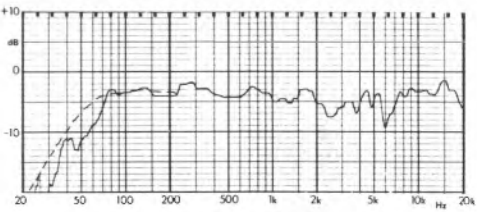
T.F. comments

With some midrange coloration and a subjectively uneven and fizzy treble, this model rated as just average for me.

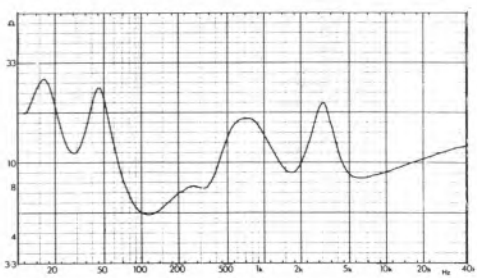
Summary

In engineering terms the *DM2 II* represents good value, comprising as it does a well made and well finished three-way system, with little or no apparent compromise involved. The special stands were effective, the dispersion very good, and while a number of parameters were clearly average a little or above in quality, unfortunately certain vital areas of its subjective sound did not rate highly enough for the *DM2 II* to gain a recommendation. However a personal audition is nonetheless advised to assess the speaker with specific ancillary equipment and program type.

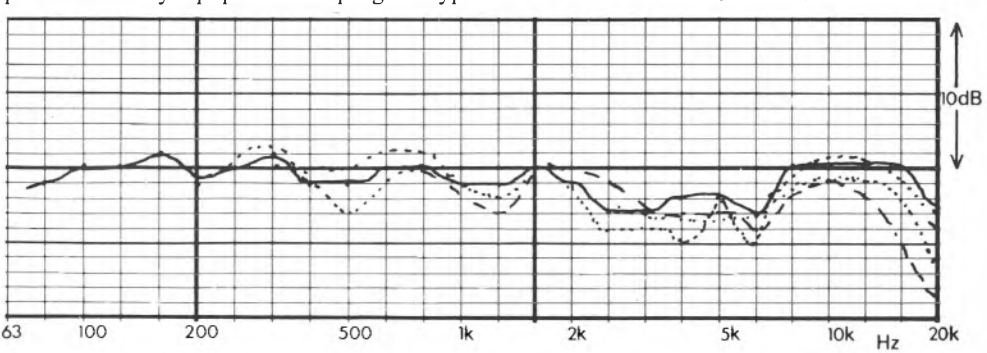
Size	71(28) H; 27(11) W; 34(13) D; cm(inches)
Weight	22(48) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–200W
Recommended placement	on B & W stand clear of walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	99dBA
Third harmonic distortion (96dB at 1 metre)	good 50Hz–0.7%, 100Hz–0.6%, 280Hz–1%, 6kHz–1.5%, typically 0.5%
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£300



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



Impedance vs frequency (mod Z)



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

RECOMMENDED

B&W DM5

B & W Loudspeakers Ltd., Meadow Road, Worthing BN11 2RX. Worthing 205611.

I first tested this model some eighteen months ago during a group test for another magazine, at which time it came out well above many of its competitors. A compact design, the *DM5* is intended for bookshelf mounting, and accordingly the frequency response has been partially tailored to suit this application.

Technical details

A two way sealed box enclosure, the *DM5* uses drive units of B&W's own manufacture. A 150mm bextrene cone unit covers the range up to 4kHz, crossing over *via* a high quality third-order network to a 18mm fabric dome unit. The cabinet has been treated with resonance damping panels — a feature uncommon in this relatively cheap price bracket.

Lab results

Pair matching was pretty good, and typically held within 1dB, with a limited area around 2kHz where a 1.5dB difference was apparent. The sensitivity at 87dB was fairly high for a small box, but offset against this result were some fairly low impedance values. During the previous review I criticised the speaker for its poor impedance at high frequencies, and was informed by the manufacturer that this would be corrected on future production. With these new samples, however, I measured a minimum of 3 ohms at 15kHz, and so apparently no change has occurred. This is despite B&W's specified nominal impedance of 8 ohms.

The power handling was good for a small speaker, allowing the full 96dB spl to be used for distortion analysis. The important mid-band (200Hz-2kHz) gave low values not exceeding 0.5% third harmonic until below resonance, when a rise to 15% at 40Hz was observed.

The sine wave 1 metre response showed a strong rising trend, totalling 8dB from 60Hz to 400Hz. The midrange was prominent, exposed by the falling presence suckout from 1.5-3.0kHz, while the treble range was dominated by the +5dB emphasis from 10-20kHz.

The 2 metre averaged response showed good integration of the off-axis curves but some loss (—5dB) in the crossover region around 5kHz. The dispersion at very high frequencies was outstanding; for example, only 2dB down at 20kHz, 30° off axis. The characteristic upper treble prominence, 'middy' balance and presence loss were all still apparent. Shelf mounting will in practice help to augment the upper bass and provide some compensation.

Sound quality

The *DM5* actually fared better than the more expensive *DM7* on the listening tests, attaining an overall rating of 'average', which is no mean achievement at the price.

Its particular strength lay in the live sound comparisons, where it attained an 'above average' rating (which is largely in agreement with the findings of the previous review). A usefully high (102dBA) maximum sound level could be reached, and the low frequency range was well controlled, accepting up to 40watts of bass guitar without distress and with surprisingly good definition. Some coloration was apparent, evident in the form of moderate

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'boxy', 'tunnel' and 'tizzy' effects. The presence band dulling was fairly obvious to the panel, as was the mid prominent balance and the treble emphasis. On cymbal, for example, there was too much 'fizz' and too little 'ring'. Voice sounded a trifle tubby and sibilant.

On the stereo tests the light balance and lack of deep bass became more obvious, the speaker exaggerating disc distortion, thereby suggesting that amplifier treble cut might be useful. The stereo image quality however was highly rated.

T.F. Comments

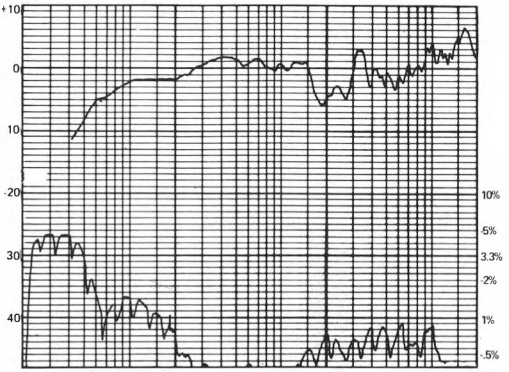
Satisfactory at the price, this model achieved average marks throughout, with above average imaging. There was some lack of bass and a slightly 'horny' treble.

Summary

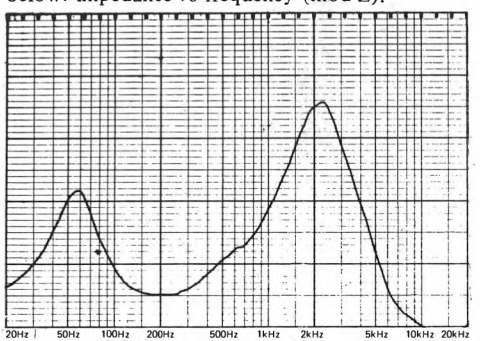
At its price level this speaker has a number of attributes, including low distortion, good power handling, especially at low frequencies, and a high maximum loudness. It is marred by noticeable treble emphasis and coloration, and to a lesser extent, by its poor impedance characteristic.

Size	45.5(18) H; 27(10.6) W; 36.7(14.5) D; cm(inches)
Weight	30(66) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20 to 100W
Recommended placement	shelf/stand
Frequency response within ±3dB (2m)	70Hz to 11kHz
Low frequency rolloff (—6dB) at (1m)	54Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	87dB at 1m
Approximate maximum sound level (pair at 2 metres)	102dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	poor
Forward response uniformity	good
Typical price per pair inc. VAT	£120

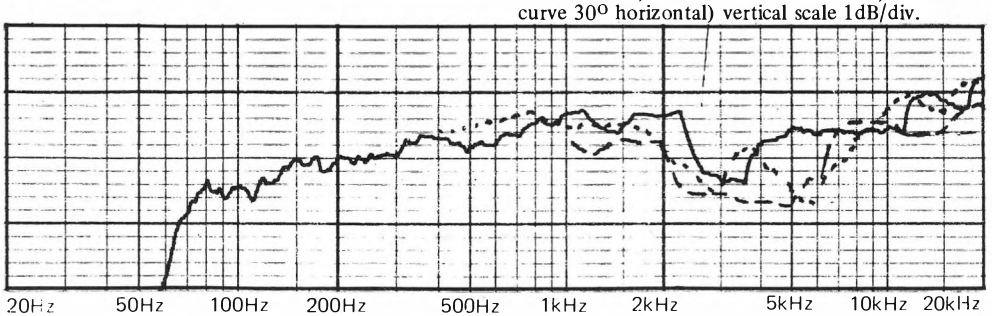
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



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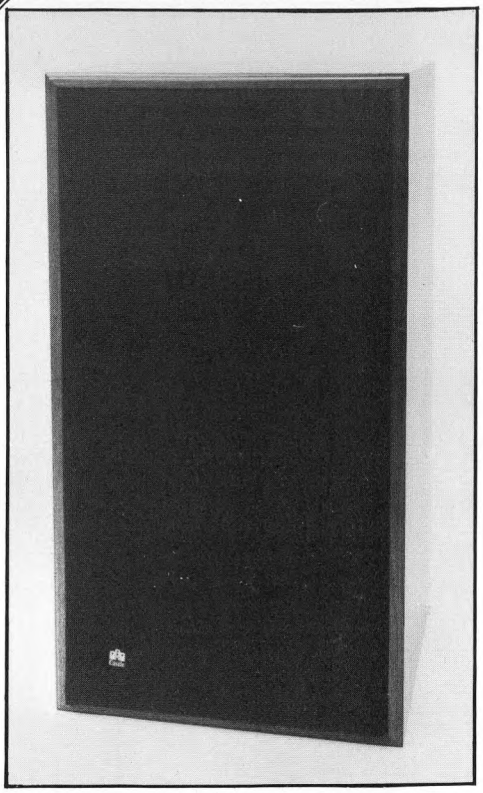
Castle Conway II

Castle Acoustics Ltd., Shortbank Road, Skipton, N. Yorks. Tel: 0756 5333/4



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

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

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

Lab results

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

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

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

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

Sound quality

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

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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.

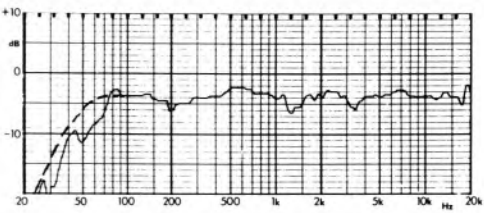
T.F. comments

Despite a slight edginess in the treble, I liked this model for its generally clean sound, plus good stereo imaging and clarity.

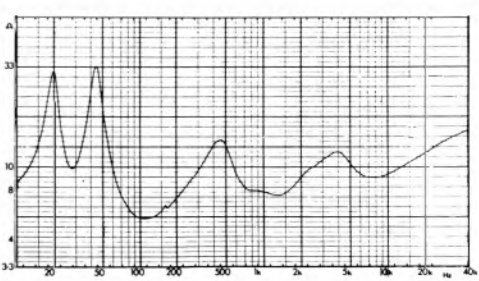
Summary

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 £200 the *Conway* can be strongly recommended as fine value. (Incidentally another Castle model, the *Kendal II* also performed well in similar tests conducted for Hi Fi For Pleasure and published in their May .79 issue.)

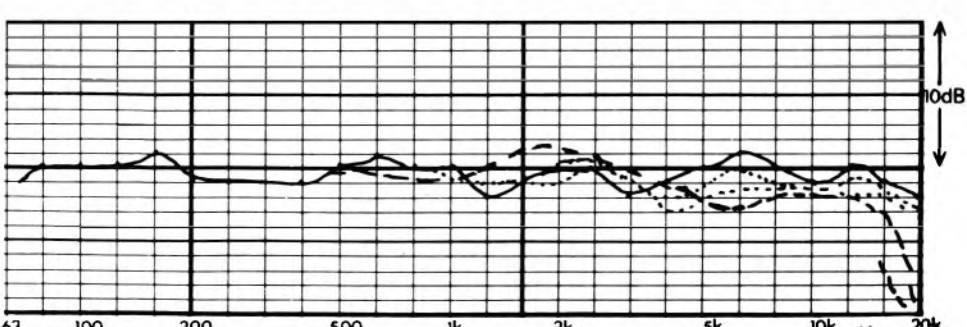
Size	63.4(25) H; 27.5(11) W; 31(12) D; cm(inches)
Weight	18.5(41) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–200W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	38Hz
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	£210



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 Richmond II

Castle Acoustics Ltd., Shortbank Road, Skipton, N. Yorks. (0756) 5333/4.

Produced by a relatively young British company, the Castle range is designed using the manufacturer's own range of enclosures and drivers. The *Richmond II* is said to employ the latest reflex design techniques, and as such should offer an attractive combination of a compact package possessing a good low frequency response plus high sensitivity. The instructions state that either shelf or stand mounting is permissible.

Technical details

A 130mm treated pulp-cone bass-midrange driver is employed, together with a 30mm plastic cone treble unit. The high quality crossover comes in at 3.5kHz, with a ducted port of adequate diameter completing the driver panel array.

Lab results

The pair matching was very good, with the responses aligning within 1dB throughout. The sensitivity was high at 90dB and was unaffected by the impedance characteristic, the latter recording an average of 8 ohms, with no area below 5 ohms. As such the Castle acquired an 'average' ranking for amplifier loading. At 48Hz, the —6dB low frequency point was good for the speaker's size and efficiency.

In general, distortion results were likewise commendable, and allowing for a moderate 0.8% third harmonic area from 1.5kHz to 3kHz, very low figures were demonstrated from 100Hz right up to the measurement limit at 12kHz. Apart from an isolated bump of 1.5% at 90Hz, distortion levels also remained good at low frequencies, and did not exceed 3% until below 50Hz.

At 1 metre the sine wave response illustrated a near perfect low frequency range, together with a slightly (+1.5dB) prominent upper mid, 500Hz-1.5kHz. A rise at high frequencies to +4dB at 15kHz-20KHz was also apparent, but nonetheless, ±2.5dB limits were sufficient to encompass the entire range.

At 2 metres the curve was essentially the same, although the mid prominence had increased somewhat to +4dB. The off-axis curves also demonstrated very good integration and uniformity; clearly this is a carefully designed system. Shelf mounting would help to restore the low frequency range relative to the mid, and would also probably give the best subjective results.

Sound quality

The *Richmond* gained 'average' and 'above average' ratings respectively, for the live and the stereo tests, both results commendable for the price level.

It could be driven to high sound levels, namely 104dBA, and did not require much power to do this, as the minimum recommended amplifier rating of 10W per channel bears out. The low frequency power handling showed some restriction at 8W average of electric bass guitar, but the speaker's high efficiency meant that even with this input there was sufficient accoustic power

Stereo imaging was considered to be above average, but the panel consistently felt the speaker to be a trifle on the thin and bright

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side of an ideal balance. In fact the majority of criticisms related to this effect, and serve to reinforce the shelf mounting recommendation, which should provide some compensation. In addition, some 'boxy' and 'hard' effects were noted although moderate in degree. The low frequency range was free of boom, but the extreme treble emphasis did not pass unnoticed, and at least one panellist felt it could prove a little fatiguing.

T.F. Comments

At its price, this speaker performed well and with good efficiency. I found the treble rather hard and 'spikey' and a rather thin overall balance, however.

Summary

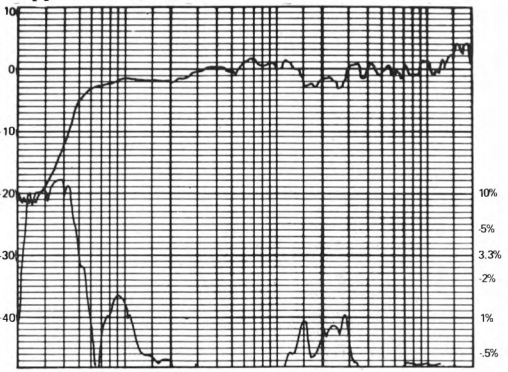
This compact loudspeaker offers an essentially smooth and well integrated response with low distortion and above average sound quality. Its efficiency is a further bonus, and it can also attain high sound levels. Taking into consideration its price, the *Richmond* certainly deserves recommendation.

Note

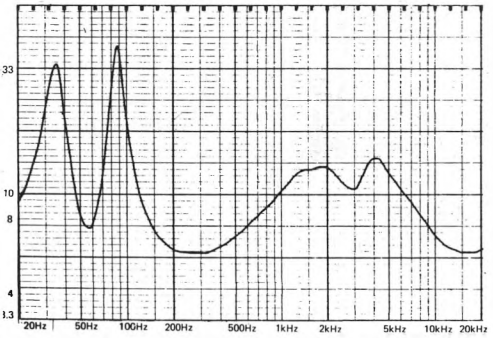
Castle have informed us of a minor production change to the bass-mid unit which slightly improves the upper midrange quality. However specifications and curves will remain substantially unaltered.

Size	41.5(16.5) H; 23(9) W; 25(10) D; cm(inches)
Weight	8.5(18.8) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 50W
Recommended placement	stand or open shelf
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	48Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	90dBat 1m
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£110

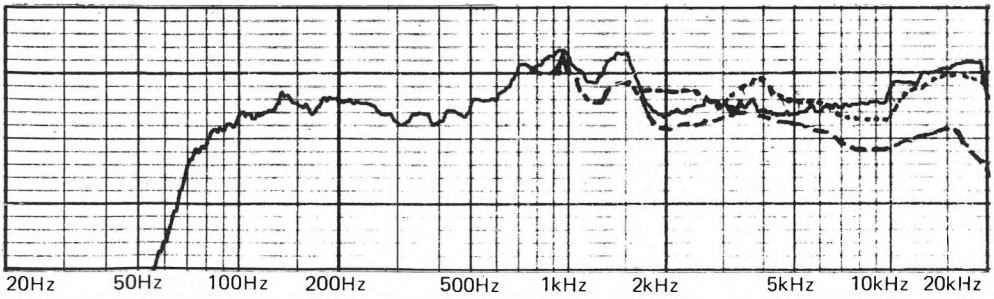
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



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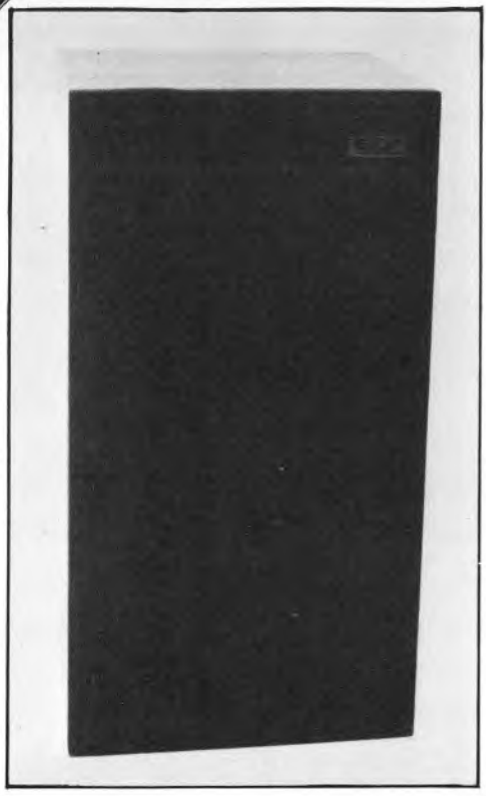
Celef Monitor Improved

Celef Audio Ltd., 130 Thirsk Road, Boreham Wood, Herts. Tel: 01-953 8933



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 88dB/W was above average* for a bextrene coned system, and the –6dB bass roll off point was at 50Hz, which is quite low considering the size. Third harmonic distortion was very good at 96dB, 1 meter, and with typical values in the 0.4% region, it was still only 0.6% 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 a 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 6.6ohms 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. The response can also be seen to be slightly elevated above 300Hz.

At 2m the axial trend was similar, although the third octave integration of the bumps suggests the trough to be more serious than the 1m response had indicated. The off-axis curves, while favourable in their close agreement with the main response, clearly show a suckout in the forward plane, averaging some 3-4dB over at least an octave, 2-4kHz. In consequence the characteristic response appeared double humped at 300Hz-1kHz and 5kHz-10kHz, with some treble range uneveness also apparent.

Subjective results

A just 'acceptable' 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 improved on the stereo tests, to reach 'average'. Imaging on occasion

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showed promise, but inexplicably it lacked depth and frequently disappointed the panelists. Moderate coloration, hardness and boxiness, plus treble uneveness 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.

T.F. Comment

I found piano reproduction disappointing, the balance being somewhat mid-biased with some coloration. The stereo lacked the quality of the better examples in the report. Auditioning the second samples, I noted significantly improved balance and clarity with reduced coloration.

Summary

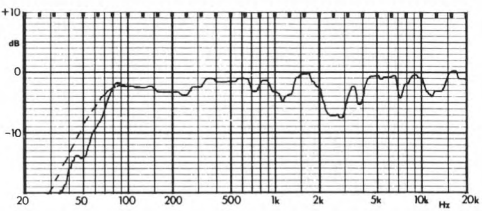
It is difficult to single out any one factor as responsible for the rather average overall performance. However, in the context of this report, the Monitor is not really good enough to merit recommendation on the basis of our test sample.

*Note

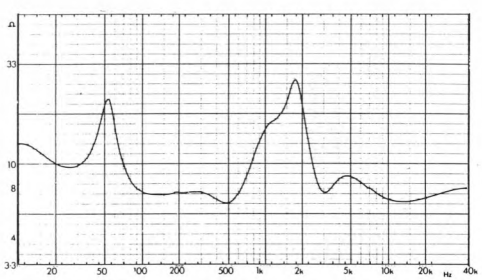
As we went to press we were informed of an unintentional alteration in performance in our samples, which had come about due to the use of a new version of the bass/mid unit. A further standard production pair were briefly auditioned, being submitted at a very late stage in the proceedings. Sensitivity was fractionally lower, estimated at 87dB/W, with significantly improved mid balance. Boxiness was slightly reduced, presence restored, and the result smoother and more 'open'. On the assumption that this standard will be maintained, we can offer a cautious recommendation.

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)	15–200W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	80Hz to 2kHz*
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB/W at 1m*
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	v. good 60Hz–2%, 100Hz–0.6%, 200Hz–0.1%, typically 0.4% overall
Impedance characteristic (ease of drive)	good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£190

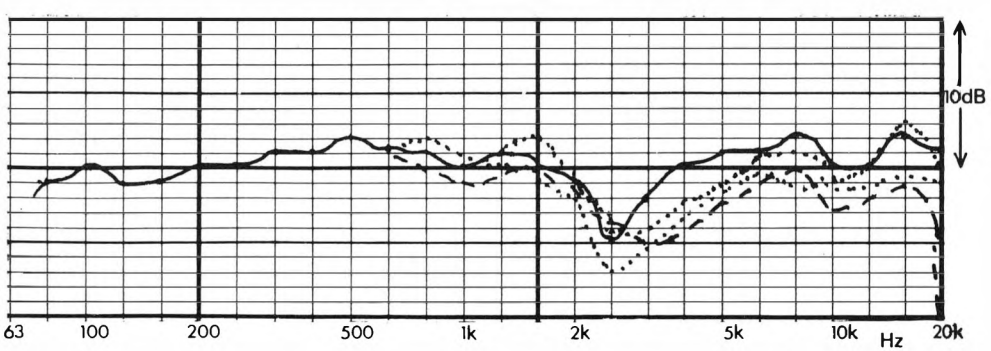
* See text



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

Celestion Ditton 15XR

Rola Celestion Ltd., Ditton Works, Foxhall Road, Ipswich IP3 8JP. (0473) 73131.

The *15XR* is a new version of a famous and long established design, the *Ditton 15,* the latter having enjoyed a 10 year production run. A slim and compact enclosure, the *15XR* can be described as a reflex two-way, as in addition to bass-mid & treble drivers, it uses a 200mm passive low frequency radiator.

Technical details

Bass and midrange coverage is supplied by a new Celestion 200mm pulp cone driver with applied surface damping, while above 2.5kHz a 25mm fabric dome tweeter (again manufactured by Celestion) takes over. A simple 3-element crossover provides the power division between the three units and, in common with its predecessor, the speaker is loaded by an ABR.

Lab results

A level difference of 1.5dB was measured between the two enclosures, but having taken this into account, the remaining irregularities held within 1dB throughout. In practice, a minor adjustment of the amplifier balance control would provide compensation. An average 88 dB sensitivity was recorded, together with a —6dB point at 48Hz. In contrast to the Ditton 22, the 15XR is easy to drive with an impedance of no less than 7 ohms and with a typical value of 10 ohms, containing low reactive effects.

A 'very good' classification applies to the distortion results at 96dBA, which is loud for a small box, and it was only the spike at 1.5kHz and the 0.8% rise at 100Hz which precluded a rating of 'excellent'. Predictably, the distortion rose rapidly below 50Hz, reaching 30% at 30Hz, so a low filter at 40Hz may be an advantage if this model is to be driven hard.

While an encouragingly even frequency response was recorded up to 1.4kHz, this was followed by a 3dB suckout and a +4dB peak at 3kHz, together with a generally uneven response thereafter. At 2 metres the characteristic response suggested a mild mid-prominence, a dulling in the low presence band, and a forward 3-4kHz area followed by another suckout. The off-axis curves do not exhibit close uniformity with the axial trend, and the integration was thus considered to be less than satisfactory. This means that not only will certain changes in sound quality be apparent with different listener positions, but the stereo precision is also likely to be impaired. As with the *22,* the grille is suspected of inciting certain of the upper range irregularities, something from which the older *Ditton 15* did not suffer.

Sound quality

The *15XR* scored 'below average' on the live sound comparisons and 'average' on the stereo programme sessions. Despite the frequency response anomalies, however, the benefits of the narrow cabinet when vertically positioned could be perceived in terms of good stereo imaging properties despite the noted integration problem.

The *15XR* could be driven as hard as the larger *22,* resulting in a loud 105dBA maximum level. The low frequency range could produce satisfying power on electric

bass, and withstood 15W average without rattles or buzzes.

On the live tests coloration was however fairly noticeable, with frequent comments of 'boxy', 'chesty' and 'hard' effects, and a distant 'shut-in' quality. These were less obvious on the stereo programme, but moderate degrees of hardness, nasality, hollowness and a forward midrange were described.

T.F. Comments

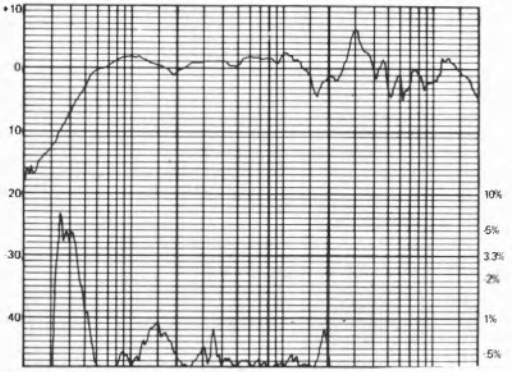
I found the sound quality marginally below average throughout, with a rather chesty bass and hard prominent top; this model is capable nevertheless of quite high volumes for the price.

Summary

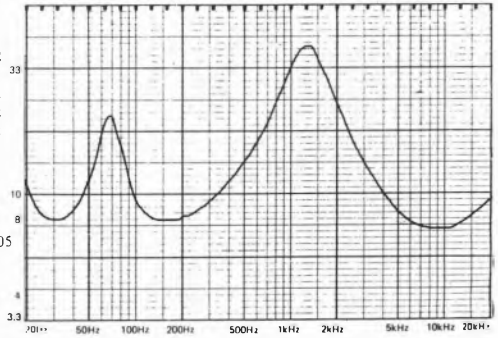
This loudspeaker possesses no serious faults, can be driven hard and is inexpensive. It does not however compare too well on sound quality grounds with those price range competitors that have received recommendations in this report.

Size	56(22) H; 25(9.8) W; 24(9.5) D; cm(inches)
Weight	8.2(18) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	48Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc. VAT	£105

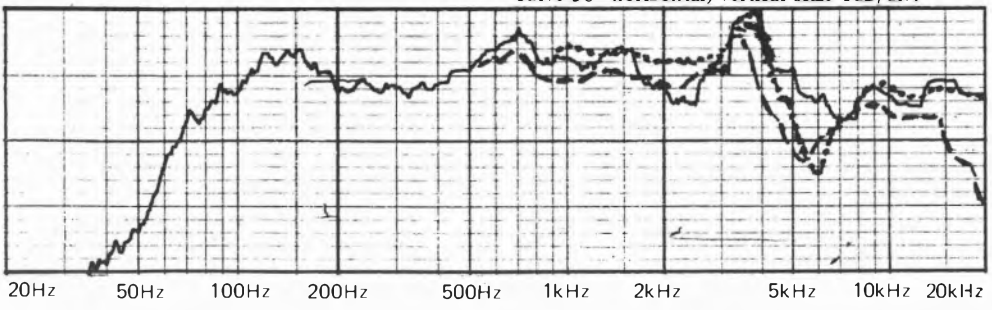
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



RECOMMENDED

Celestion Ditton 22

Rola Celestion Ltd., Ditton Works, Foxhall Road, Ipswich IP3 8JP. (0473) 73131.

A compact and inexpensive three way loudspeaker, the *Celestion 22* belongs to the Ditton range, and as such, offers a higher sensitivity than the plastic coned 'UL' series manufactured by the same company. Shelf or stand mounting is permissible, and even sideways positioning is suggested, although this must impair the stereo quality owing to the speaker's vertical-in-line configuration of drive units.

Technical details

A sealed box enclosure, the low and mid frequencies are handled by two pulp-cone units, the former 200mm and the latter 100mm in diameter. The treble is handled by a 25mm fabric dome. All the drive units are Celestion's own manufacture, with the relatively simple crossover operating at 500Hz and 3.0kHz.

Lab results

With less than 1dB of L/R imbalance up to 15kHz, and only a small 2dB error above this, the pair matching was undoubtedly very good. The —6dB low frequency point was recorded at 50Hz, with a usefully high sensitivity of 89dB. This however was offset to some extent by the relatively 'difficult to drive' impedance characteristic; the latter measured as low as 3.5 ohms at 3.2kHz, and was typically of the order of 4-5 ohms. The distortion levels were generally very low, but were slightly let down by 0.9% third harmonic readings from 1.3-3kHz, and an early rise in the lower frequencies at 180Hz, where 1% was recorded; the 3rd harmonic of this 180Hz fundamental appears at 540Hz, which is an aurally sensitive range. However considering the high 96dB test level, distortion values at the lower frequencies were really very good.

On the 1 metre sine reference curve, the response was almost ruler flat from 80Hz to 1.5kHz, above which the output was a little erratic, with a suckout in the 4-8kHz range. Measured at 2 metres, with $\frac{1}{3}$ octave signal averaging, the same trends remained, and a reasonably well integrated group of responses was obtained. The 30° off-axis curve possessed some problems in the 7-12kHz range, which I suspect are caused by interference effects due to the grille baffle producing a cavity around the treble driver. The 10° vertical response revealed a 5dB suckout at 5kHz, which indicates that the listener should be close to the main axis for the best results.

Sound quality

While the live sound results suggested an 'average' rating, the speaker did produce a well above average maximum sound level at 105dBA, and withstood the full output of the 500W amplifier on short term peaks. 8-10 watts of electric bass guitar did excite some buzzes, but the low frequencies were judged to be quite even and uncoloured. Some coloration was however apparent in the mid and treble ranges, this including hollowness, some hardness and nasality, and an uneven treble which emphasised sibilants and gave a trace of 'fizz' high up. The balance sounded dulled and lacking a degree of presence.

The *22* faired quite well on the stereo tests,

RECOMMENDED

possessing fair image depth and precision. The uneven treble range was noted by the panel, and on occasion they felt it gave an edgy quality to the sound.

T.F. Comments

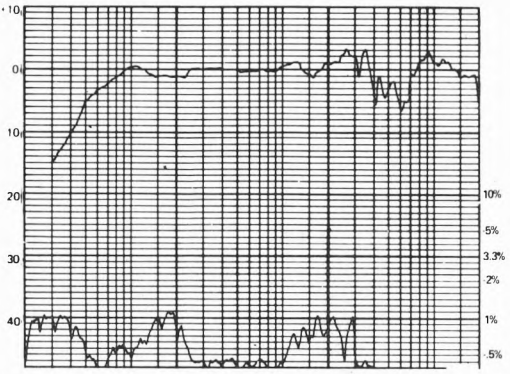
I found this speaker on or above average in all respects, and it was also capable of producing high volumes comfortably. The HF had a 'nasal' quality which made percussion sound a little 'wiry'.

Summary

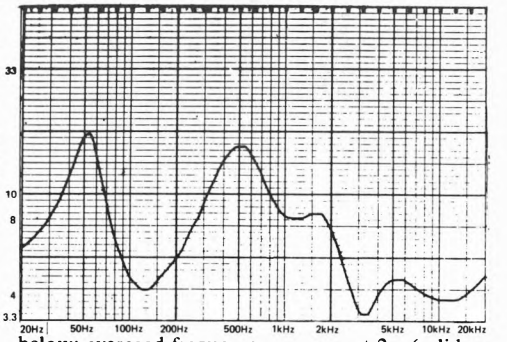
Taking into account its moderate price, the *Ditton 22* has some strong points, notably a high maximum level, fairly good low frequency range, good sensitivity and a pretty fair sound quality. On the minus side, the amp loading could be a problem, implying that an amp suitable for 4 ohm drive should be used. While it clearly does not break any performance standards, the *22* is still well worth considering.

Size	51(20) H; 33(13) W; 27(10.5) D; cm(inches)
Weight	12.4(27.3) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	to W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	poor
Forward response uniformity	good
Typical price perpair inc. VAT	£150

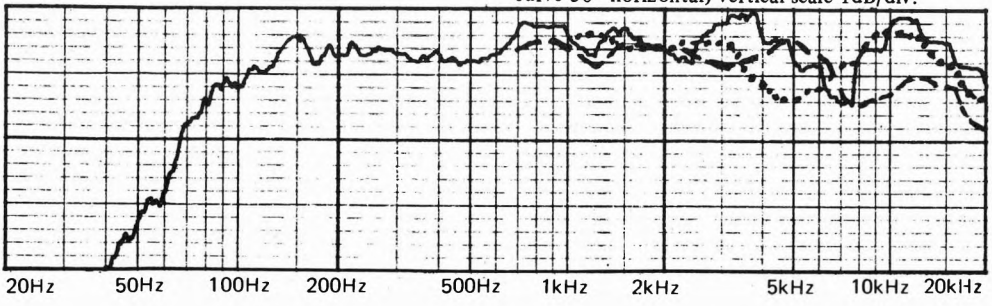
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



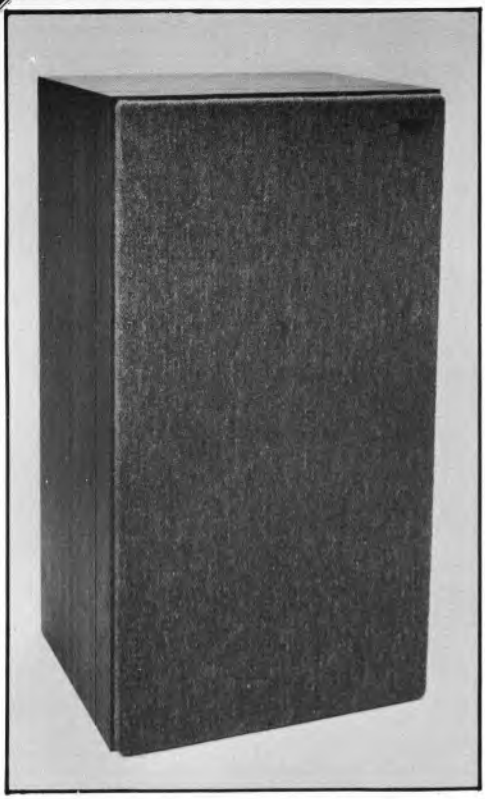
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Celestion 551

Celestion Ltd., Ditton Works, Foxhall Road, Ipswich 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, asymetric 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 of 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

RECOMMENDED

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 dulling 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.

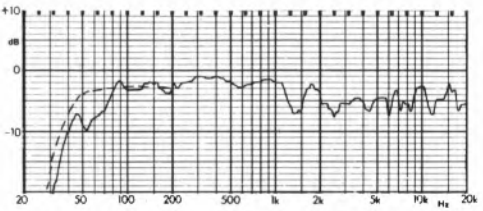
T.F. Comment

Exhibiting an above average imaging and a generally competant sound with satisfactorily low coloration this seemed to be one of the better models auditioned, particularly on piano.

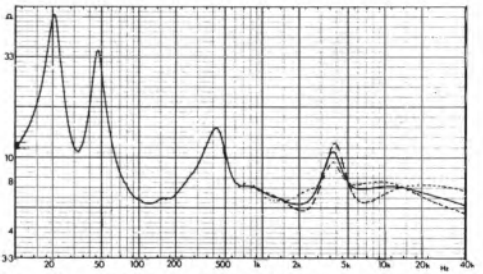
Summary

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.

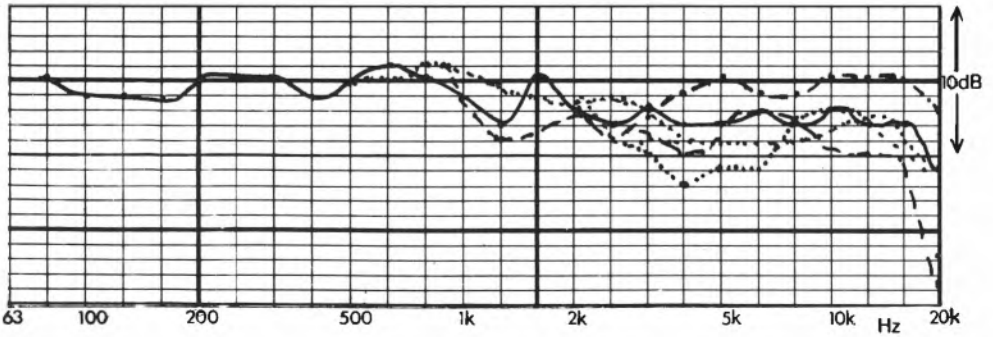
Size	72(28) H; 40(15.5) W; 32(12.5) D; cm(inches)
Weight	25(55) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–200W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	63Hz to 16kHz
Low frequency rolloff (—6dB) at (1m)	38Hz
Voltage 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	£350



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



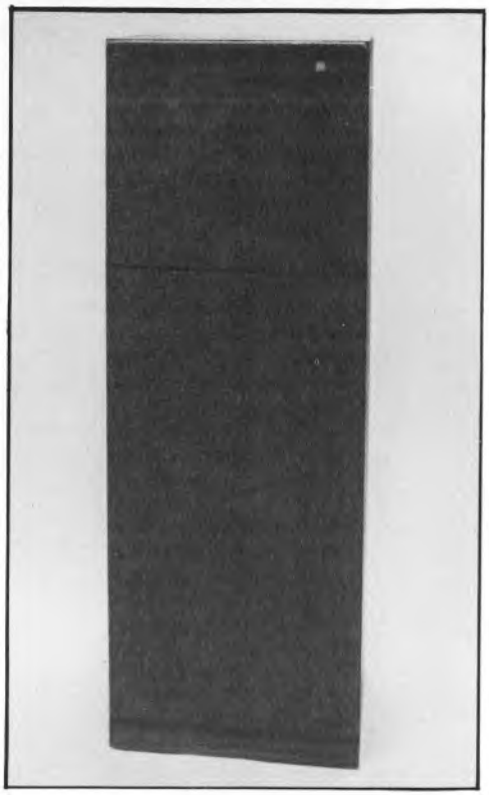
Impedance vs frequency (mod Z)



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

Celestion 662

Celestion Ltd., Ditton Works, Foxhall Road, Ipswich IP3 8JP. Tel: 0473 73131



As anyone familiar with Celestion's nomenclature will know, the *662* represents a development of a long established Celestion model, the *66*. Essentially similar in form and driver lineup to its predecessor, its appearance has been brought up to date with a 'furnished' look, a split grille assembly and a small plinth. A stand may be used, although I feel that the enclosure is tall and slim enough without it, as it already stands over 1m high. Our tests also showed that the addition was undesirable on acoustic grounds.

The drivers are much improved over those used for the old model, the vertical-in-line arrangement consisting of a 300mm doped pulp passive radiator or ABR, and a 300mm doped pulp cone bass unit on a diecast frame, crossing over to a 50mm polypropylene dome mid unit, the latter fitted with a tangentially pleated surround and a massive magnet. The same new 19mm dome that is fitted to the *551* also operates here above 4.5kHz, with the high power cross-over employing five components. Large wedges of anechoic foam inside the enclosure damp standing waves, but no bituminous panel damping was present, the internal volume being approximately 95 litres.

Lab results

As with the *551* the 25mm thick unchamfered grille panel was found to affect the response by up to 2dB, particularly in the treble range, all printed curves being taken with the grilles on. Pair matching was fairly good although a 1.5dB mismatch occurred over the 1.5-3.0kHz octave. The sensitivity rated as average at 88dB/W, and despite this a low 35Hz frequency was recorded for the –6dB rolloff point.

With an excellent rating for third harmonic distortion at 96dB, levels were typically at 0.15%, with worst values at 1%, 70Hz and 1%, 35Hz. On powerhandling the *662* was in the top class with a high maximum sound level at 104dBA. Bass guitar reproduction was exceptional, exhibiting real power and an ability to accept all our 300W amplifier could provide. The impedance characteristic was also very good at typically 10 ohms and never falling below 6.

The axial 1m sine wave response just met +/– 2.5dB limits from 40Hz to 20kHz, although the trace was still distinctly lumpy with uneveness in the 600-1500Hz region, while the presence band was also somewhat depressed. The response appeared smoother on the 2m averaged characteristic, but it nonetheless revealed a 3dB shelf cut over the treble range as well as confirming the depressed presence region. My aversion to stand mounting was confirmed by the poor response in the vertical plane at 10° below, and the listener must ensure that the mid/HF axis is directed at ear level. Above axis however no problems were evident, and in spite of the grille diffraction, distribution was good in the lateral plane.

Sound quality

Interestingly enough, the *662* and smaller *551* were ranked equal overall on these tests. On the live sound comparisons however the *662* did show an improvement over the *551* on the bass guitar, and while it was felt to sound slightly

boxy, hollow and nasal, with a noticeably rich sound due to a treble deficient balance, the end result was nevertheless acceptably smooth.

Fed with wide range stereo program a similarly satisfactory rating was obtained. An excellent ability to reproduce high volumes was demonstrated, which served to balance certain colorations which the panel felt to be slightly more obtrusive than with the *551*. Most felt this speaker lacked some presence and 'sparkle', and commented on reduced clarity, and while the imaging was quite well defined, some loss of depth was also apparent.

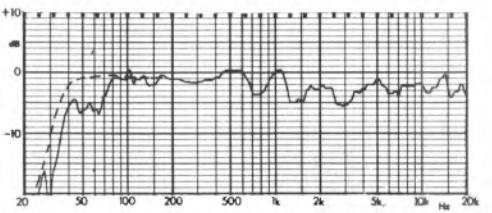
T.F. Comment

I quite liked this model despite some hollowness and an audible suckout. I found it above average with fairly good stereo.

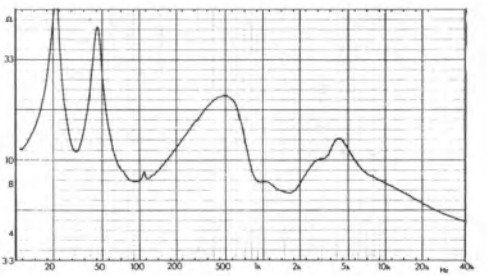
Summary

In one word this speaker is pleasant. While superfically it may seem to offer no real benefits by comparison with the *551*, in fact the powerful, well-extended bass and low distortion represent plus points, while it also proved easy to drive and took tremendous power without distress. Overall, its performance was well balanced, and recommendation is only withheld because of the highish price; if liked on audition, and price is no deterrent, then there is little in this review to dissuade a purchaser.

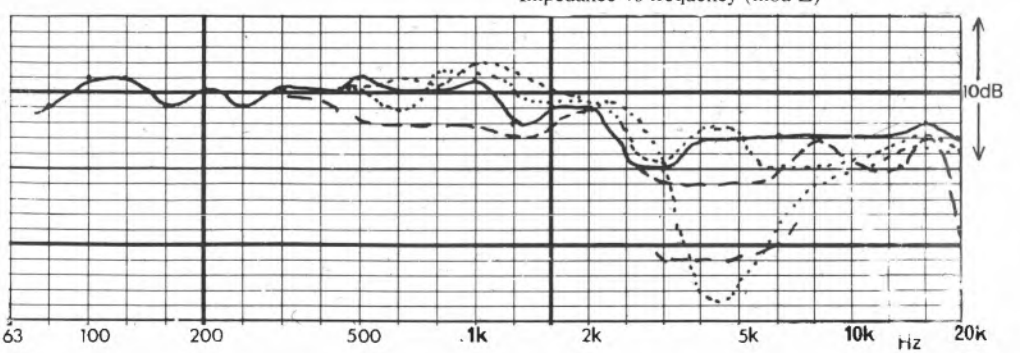
Size	111.5(44) H; 40(16) W; 32(12.5) D; cm(inches)
Weight	34(75) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	12–300W
Recommended placement	floor, away from walls
Frequency response within ±3dB (2m)	63Hz to 20Hz
Low frequency rolloff (—6dB) at (1m)	35Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	excellent 35Hz–1%, 70Hz–1%, 7kHz–0.15%, typically 0.15%
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	good
Typical price per pair inc. VAT	£490



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



Impedance vs frequency (mod Z)

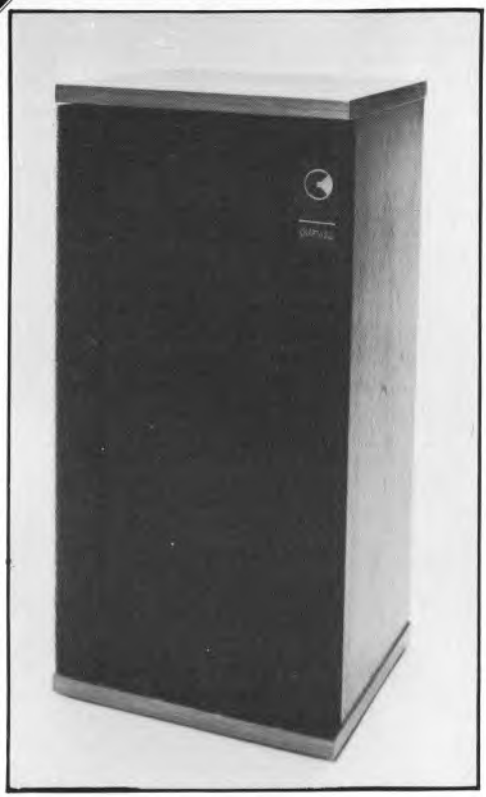


1/3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

Chartwell 110

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 co-polymer cone covers the bass midrange to 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 55Hz, which is fine for this enclosure volume. Third harmonic distortion rated 'good' on the tests with typical values of 0.4%. Several areas of higher distortion were present namely 1.6%, 700Hz; 3.0%, 100Hz; 1.0%, 66Hz and 3.0%, 58Hz. However it could be conceded that 96dB represents a not inconsiderable level for this size of box.

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 103dBA 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 1 metre the response showed some exceptionally flat regions, notably up to 1kHz. The mid driver however clearly had a problem or two in reaching the crossover point at 2.5kHz, above which point stability was restored.

This characteristic was confirmed at 2 metres, the anomalies resolving themselves into a moderate trough in the presence band 2-3kHz, although some improvement was apparent in the 10° above vertical axis. This suggests that for optimum results, the listner's ear should be marginally above the tweeter axis, which will in fact be the case if using the normal 25cm high stands recommended. With the exception of the trough, the integration and off-axis uniformity were of a high standard.

Sound quality

Achieving an 'average' 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, but the frequency balance was quite neutral and not criticised overmuch

Results improved somewhat in the stero sessions with a 'good' rating overall, promising

RECOMMENDED

at the price. Stereo imagery was well favoured with good lateral precision and fair depth, this helped to some degree by the good clarity commented upon by several of the listeners. Extreme bass was understandably absent, but the overall character was a fairly neutral and the colorations moderate.

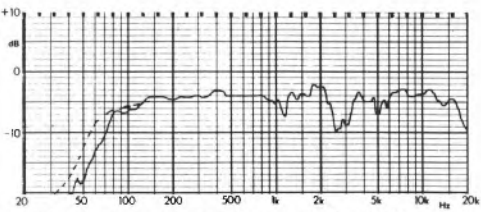
T.F. Comment

Despite a slightly 'tinkly' top which might obtrude on more distorted programme, I quite liked this design, particularly for its clarity.

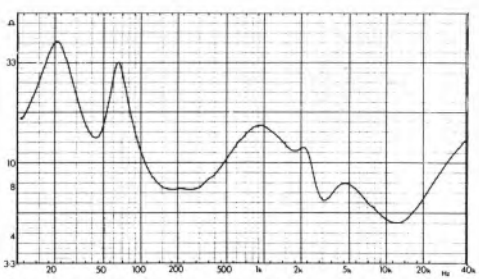
Summary

Chartwell have succeeded in a difficult task, namely that of producing a reasonably priced small system possessed by lowish coloration and good clarity. The maximum sound level was exceptional for its size, stereo imaging was well above average, distortion good and constructional quality excellent. It also proved an easy load to drive, and was more sensitive than other similar plastic-coned designs; clearly such a performance merits recommendation.

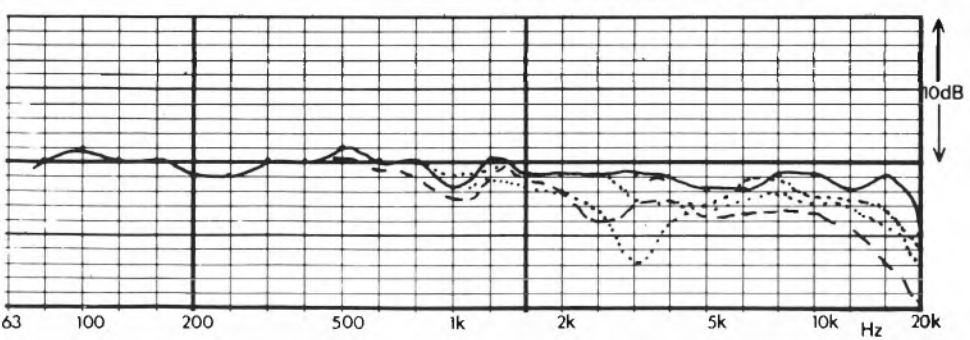
Size	46(18) H; 23(9) W; 21(8) D; cm(inches)
Weight	7.5(16.5) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–150W
Recommended placement	open stand clear of walls
Frequency response within ±3dB (2m)	80Hz to 16kHz
Low frequency rolloff (—6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W
Approximate maximum sound level (pair at 2 metres)	102dBA
Third harmonic distortion (96dB at 1 metre)	good 58Hz–3%, 66Hz–1%, 100Hz–3%, 200Hz–0.4% 700Hz–1.6%, typically 0.4%
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£170



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



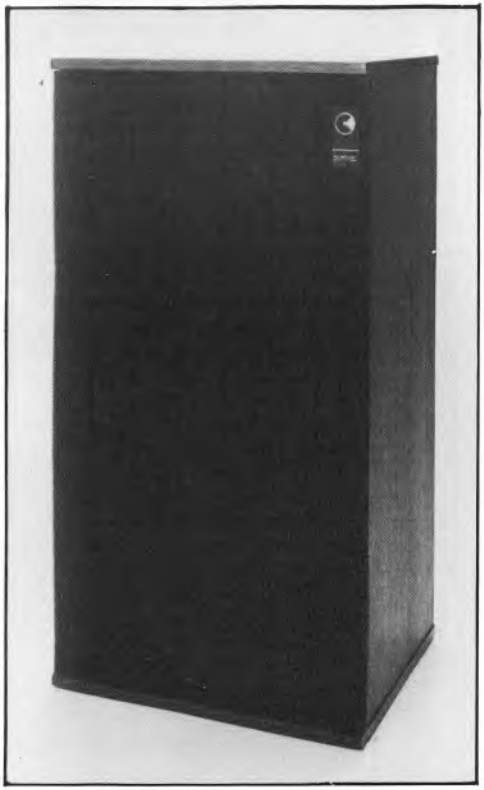
Impedance vs frequency (mod Z)



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

Chartwell 210

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



Although a design bearing the same name and appearance was included in the previous issue, this is in fact an entirely new model, with a revised 200mm polypropylene co-polymer cone and a grille-protected Audax 25mm dome tweeter (as opposed to the 34mm open dome used for the earlier version.)

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 87dB/W was about average although higher than usual for plastics-coned systems, and the low frequency rolloff was quite well extended at 40Hz.

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 102dBA maximum level. The impedance curve gave some cause for concern however, due to a dip to about 4 ohms in the lower treble region, where significant program power will be present. 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 +/–1.5dB 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 disappointing, with the 'average' rating showing no real advantage over its half-size and -price brother, the *PM110.* The listening panel described several significant colorations, including boxy, nasal and slightly muffled effects and the bass register was not felt to be either very natural or detailed, particularly for

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 an 'average' rating — slightly below that for the *PM110*. Stereo imaging did not appear very strong with a noticeable lack of depth and a blurring of positional information. 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.

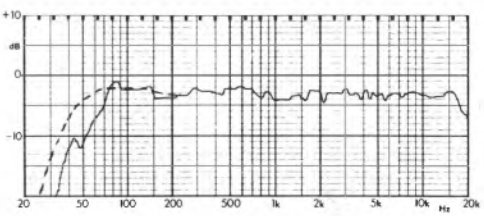
T.F Comments

I found an almost boomy quality about this speaker together with some mid coloration and a disappointing stereo effect. While it is by no means poor, I just did not favour it.

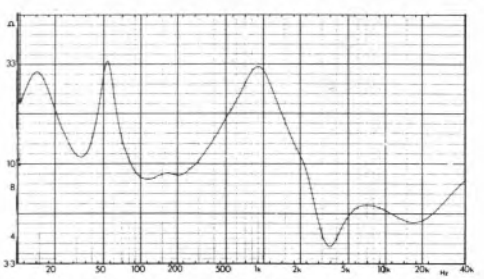
Summary

The results were intriguing, since on track record — technology lab curves and engineering quality — one would have expected a better outcome. However the extensive listening tests clearly showed that all is not right with this design, and while it is pretty decent in a world market context, it does not justify recommendation at the price within the framework of this report.

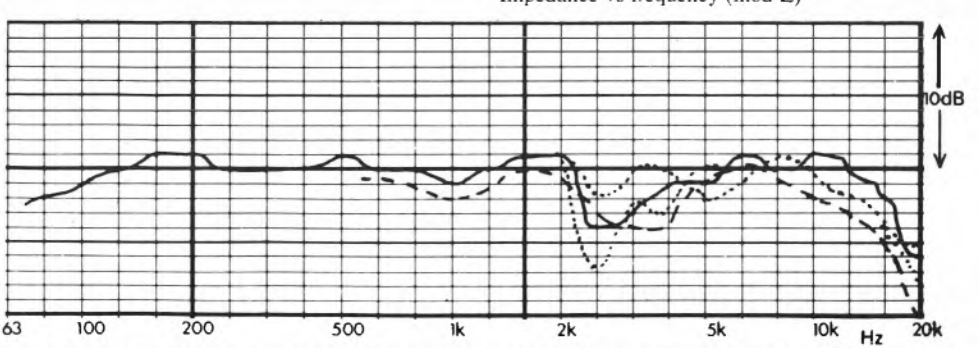
Size	66(26) H; 34.3(13.5) W; 28.6(11.3) D; cm(inches)
Weight	15(33) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	12-200W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
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)	good 50Hz–3%, 100Hz–0.9%, 700Hz–0.5%, 1kHz–1%, then typically 0.3% in the treble range
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	v. good
Typical price per pair inc. VAT	£300



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



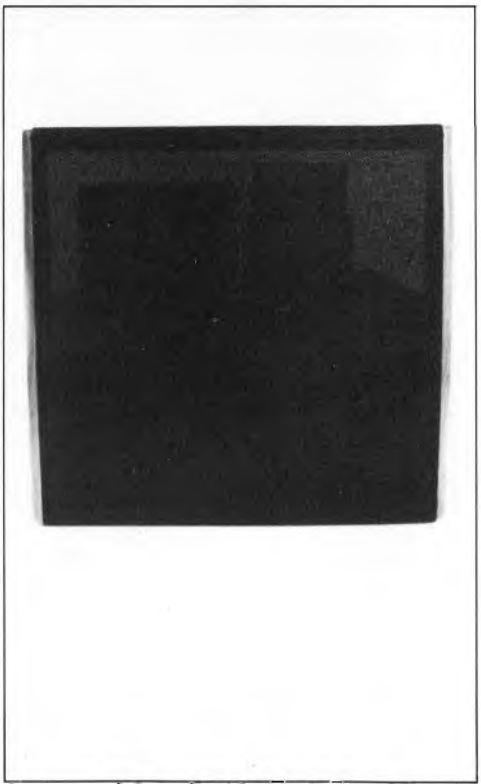
Impedance vs frequency (mod Z)



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

Dahlquist DQ10

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



An unusual American loudspeaker with more than a passing external resemblance to a black Quad Electrostatic, the *DQ10* in fact employs an array of five drivers, four moving-coil and one piezo-electric. As requested, the review samples were supplied as mirror-image pairs, and rather than using the stubby feet supplied by the manufacturers we found the best results were obtained with the speaker positioned on a pillar stand, taking the care to establish optimum angling.

Technical details

The lower section of the enclosure comprises a sealed box LF assembly powered by a 250mm pulp-cone driver. On the top deck (so to speak) is arranged a group of staggered open-baffle drivers, comprising a pulp-cone mid unit (Philips), a fabric-dome upper mid (Isophon), a plastic-dome treble driver (again Isophon), and a horn-loaded piezo unit

Lab results

Up to 10kHz a very good pair match was measured, but irregularities set in at the higher frequencies, no doubt in some degree attributable to the irregular polar pattern in this range. One enclosure peaked up to +5dB at 15kHz, then fell quickly to —10dB at 20kHz, while the other peaked at 17kHz. This suggests that perhaps the horn tweeters are poorly matched. The sensitivity was fairly low at 85dB, and this is not helped by the just 'acceptable' impedance characteristic, which dipped to 4.5 ohms at 100Hz. The low frequency range was quite extended with a —6dB point at 40Hz, and excellent distortion results were obtained at 96dB spl.

One metre is too close for an accurate measurement of this speaker's overall response but it provides representative information about low and mid frequencies. A small narrow resonance notch can be seen at 150Hz while the 200Hz-2kHz range is mildly elevated against the remaining level.

While the overall trends are acceptable, even at 2 metres the midrange is clearly prominent and the presence band depressed, while both the 10 above and 30 lateral responses show comparatively poor uniformity and integration. The marked asymmetry between the right and left off axis directed responses shows the importance of the mirror-imaged driver arrangement, and the correct left/right room orientation.

Sound quality

Apart from the extreme HF, which many considered to be too directional with an accompanying 'edgy' effect, the overall impression was that of muted airiness and smoothness, which rarely sounded 'loud' in the unpleasant sense. A high 103dBA could be produced, at which point 500W peak and close to 250W average was feeding each loudspeaker (accordingly the fuses had to be uprated to achieve this). The low frequencies were reproduced with fair power and clarity.

Compared with live sound, the *DQ10* scored 'average' which is not too good for a speaker in its price range. While certain areas of the frequency range found favour, for example, voice was surprisingly good, a general 'thick', 'rich' and 'dull' impression was given, with clear presence loss and an occasional 'fizz' in

the high treble.

A 'below average' score was analysed from the stereo test sheets with relatively weak imaging, considering that the mirror arrangement was in operation. Multi-miked recordings sounded pleasantly spacious, but locations were hazy on coherent cross-pair program. The high treble was found to emphasise distortion, and several colorations were described, including 'boomy' 'sibilant' and 'dull', these often recorded by panellists who were sitting somewhat off-axis.

T.F. Comments

Sitting in the best possible listening position, I was apparently the only panel member to appreciate a good stereo image; in this optimum position I found the extreme HF rather uncomfortable. In the mono tests my previously favourable position was less pleasant, and there were indications of uneven response and cancellations.

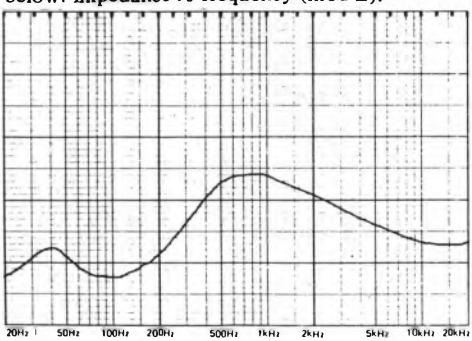
Summary

While areas of this loudspeaker can sound very promising, and could well find favour with some, taken on balance the overall results do not appear to justify the price. It is critical of listener position and it is thus essential to set them up carefully. A large amplifier is also necessary to drive them adequately.

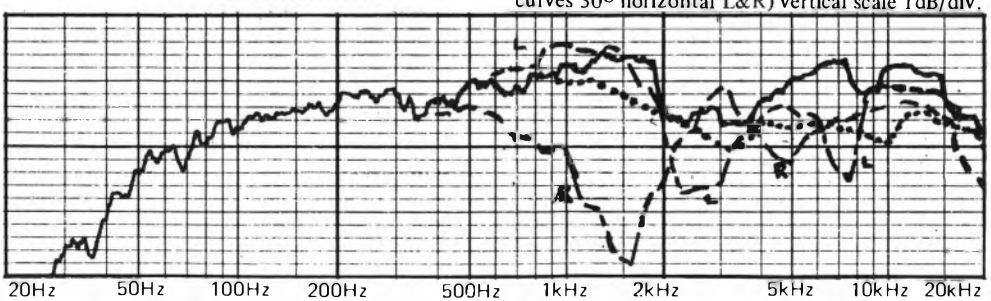
Size	80(31.5) H; 77.5(30.5) W; 22.9(9) D; cm(inches)
Weight	27.3(60) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	50 to 250W
Recommended placement	Special stand
Frequency response within ±3dB at (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	85dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£640

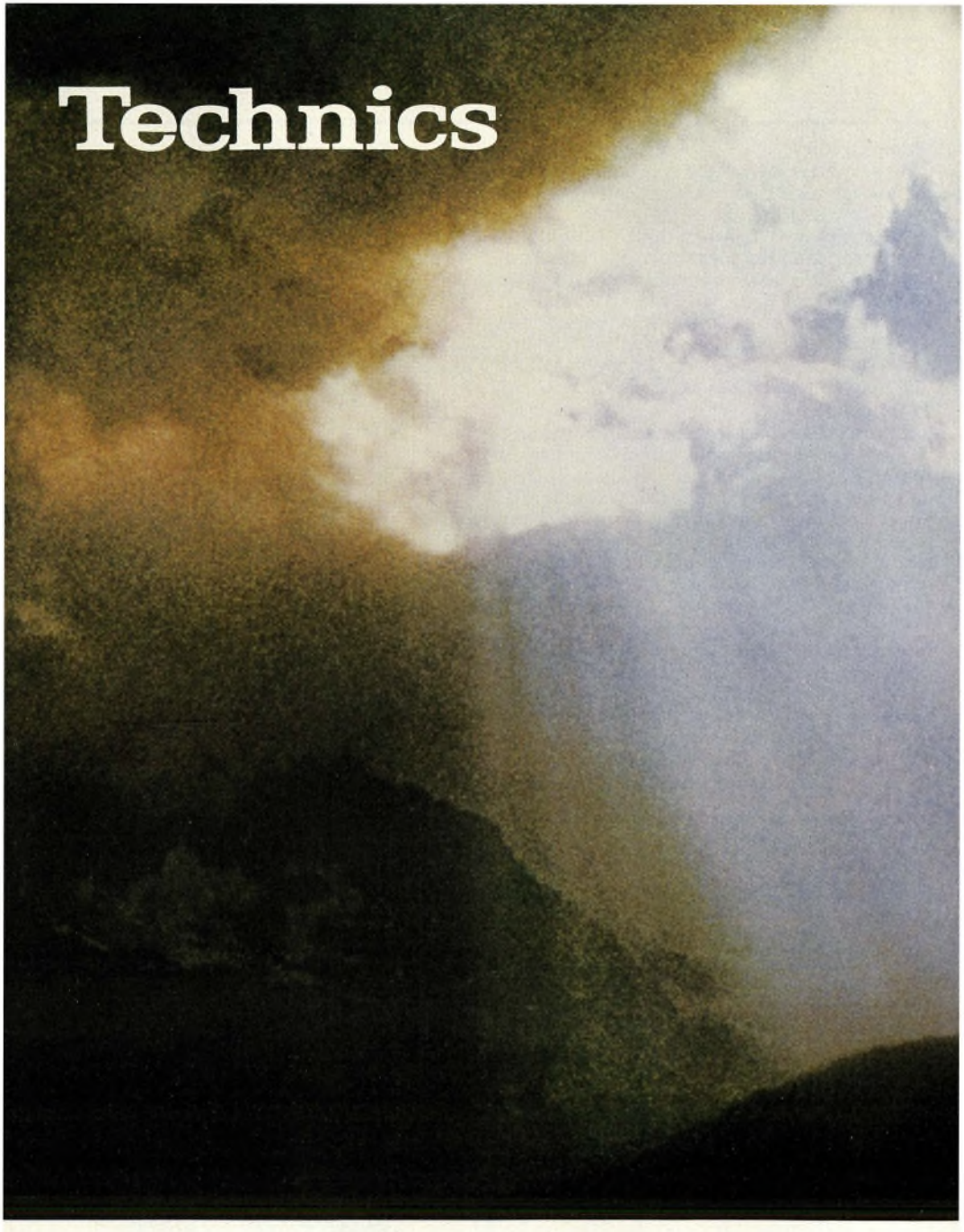
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

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



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





SEA1 Class A+DC Power Amplifier. 350 watts per channel RMS with 0.003% THD **£4,702.17.**
SUA2 All stage Class A DC Control Amplifier with 95 dB phono S/N ratio and 0.003% THD **£7,053.28.**
SL1000 MKII Broadcast standard, quartz-locked, Direct Drive turntable starts in 0.25 secs. **£1,328.74.**

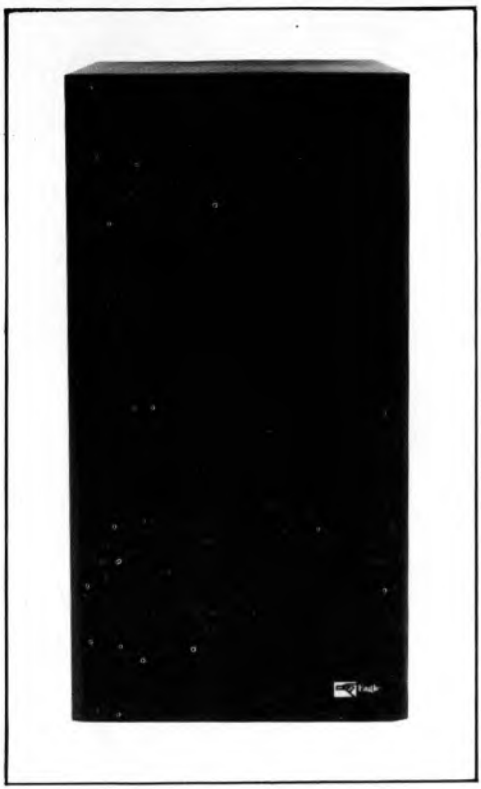
RS–1800 Quartz-locked Direct Drive 'Isolated Loop' Tape Deck with wow and flutter of less than 0.01% **£4,323.95.**
SB10000 'Linear Phase' 3-way horn type speaker with a sensitivity of 95 dB/watt at one metre **£3,577.73 each.**

Technics, 107/109 Whitby Road, Slough, Berks SL1 3DR. Tel: Slough 27516.

All prices inclusive of VAT and correct at time of going to press.

Eagle L7800

Eagle International, Precision Centre, Heather Park Drive, Wembley HA0 1SU.
01-902 8832.



A UK designed and built loudspeaker, this three-way model offers a usefully high sensitivity. Specified for free field measurement, it is presumably intended for stand mounting (the manufacturer's instructions were not available in time for this review.). The particle board enclosure was well finished in American Walnut veneer on our pre-production sample.

Technical details

With a vertical-in-line driver array, this reflexed enclosure utilises three Peerless drivers, with a 250mm pulp bass cone operating up to 600Hz, a 100mm pulp cone mid unit with an integral rear chamber, and finally, for frequencies above 3kHz, a 25mm fabric dome tweeter.

Lab results

An absolute sensitivity difference of the order of 1.5dB was noted, and with this taken into consideration the pair matching held to within 1.5dB up to 8kHz, beyond which a 2-3dB difference was measured. It is to be hoped that his aspect will be improved in production. The sensitivity measured 89dB which is fairly high, and was not compromised by the impedance characteristic, the latter measuring 5.5 ohms at 150Hz, with a typical value of 10 ohms. The speaker thus rates an 'average' rating for amplifier loading.

Very good third harmonic distortion figures resulted at the normal 96dB level, the readings remaining below 0.6% throughout the frequency range above 50Hz where a fine 2.5% was recorded. Clearly a carefully tuned system, the *L7800* demonstrated an extended –6dB low frequency point at 40Hz.

At 1 metre the sine wave response revealed some anomalies, notably a suckout at around 1.5kHz-2.5kHz, with some irregularity at 3.6kHz, the treble then rising to a maximum at 14kHz before falling off to –5dB at 20kHz. (A rear panel switch allows suppression of the 14kHz prominence in two steps.) ⅓ octave averaging at 2 metres altered the position marginally, the upper bass showing some emphasis with the output still not particularly good near to the upper 3kHz crossover. Essentially, however, the responses were quite even and showed good integration off-axis.

Sound quality

On commencing listening tests the speakers were found to rattle on the organ track. Investigation by the designer revealed that these pre-production models had not been fitted with the sealing gaskets, and with this corrected no further problems of this kind were encountered.

On the live sound comparisons the speaker scored 'above average'. Good low frequency power handling was demonstrated with up to 50W average of electric bass guitar accepted without distress. The LF register was fairly good in terms of depth, but did alter the harmonic timbre of the bass guitar.

Driven to high levels a form of saturation set in, the midrange rapidly hardening, limiting the maximum level to 98dBA, this corresponding to a 60 watt average input. Coloration was noticed

in the form of 'fizzy' hard effects, together with some 'hollowness'.

On the stereo tests the speaker did not fare so well and scored 'below average'. Imaging was not considered particularly precise although this might well be improved in future as the production standards settle down. The panel found that the speaker's balance sounded less even that the response suggested, and they noted 'gritty' effects together with nasality, hardness and emphasised distortion, with a 'plummy' quality that was reinforced by the depressed low presence range. Some felt it to be potentially a little fatiguing.

T.F. Comments

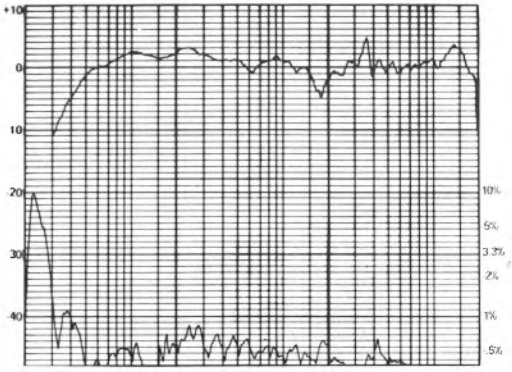
I found this speaker below average on stereo due to a phasey image and apparent uneveness in extreme HF plus a 'boxiness' evident on orchestral excerpts. In mono better comments were recorded, but still treble reservations.

Summary

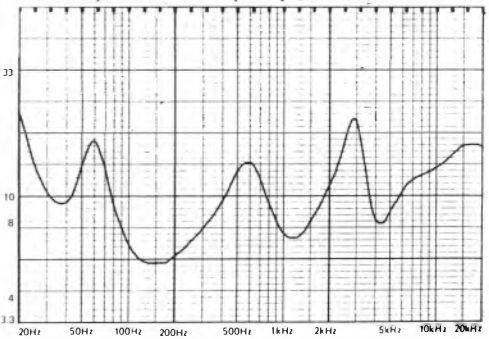
While the overall frequency response, sensitivity, distortion and impedance characteristics are all quite favourable for this loudspeaker, the panel did not greatly favour its subjective quality. This is not to say that the *L7800* is a poor loudspeaker by any means, just that it did not compare well enough with its competitors under the listening conditions employed to justify a recommendation.

Size	62(24.4) H; 33(13) W; 30.5(12) D; cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 50W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB 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)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£240

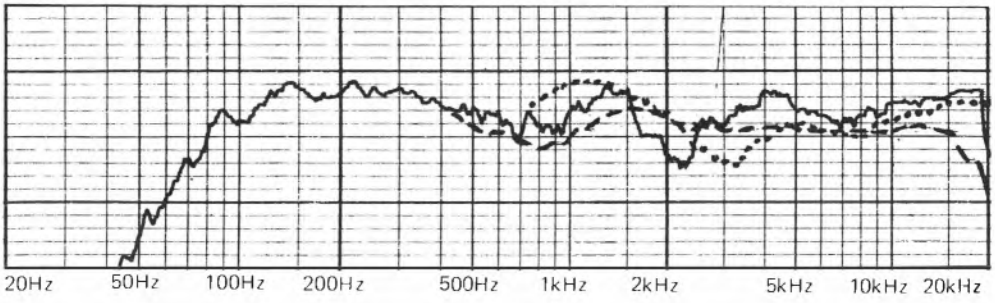
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref 0dB).



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



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



Goodmans Kappa

Goodmans Loudspeakers Ltd., Downley Road, Havant, Hants PO9 2NL. Tel: 0705 486344

Representing the middle sized model in the new Achromat Series from Goodmans, the *Kappa* is a small 25 litre, two-way sealed box system some 54cm high. Of unusual styling, the cabinet is finished in a soft-touch, grained leather-look vinyl, with the front edge framed in a lighter hardwood nosing. Constructional quality is good and the cabinet is braced internally, with full bituminous panel damping as well as an acoustic foam lining and an acrylic wool filling.

The 200mm transparent cone bass mid driver is made of pva doped pvc, and built on a good quality open die cast frame. This is fitted with Hitachi's patented double pleated doped fabric surround which is claimed to reduce distortion at low frequencies.

A new version of Goodman's established 25mm fabric dome tweeter is used for the high frequencies and this is loaded by a short flared horn. A 12-element crossover is incorporated, plus a quick blow fuse which did not fail on any of our tests.

Lab results

Pair matching was only fair with an imbalance of up to 2dB in the important 700Hz-4kHz region, although it was satisfactory elsewhere. The sensitivity was exactly to spec at 85dB/W with a -6dB low frequency point at 45Hz.

Although typical values were in the 0.3% range and thus the Kappa was rated as 'good' on third harmonic distortion, several higher values were in fact noted, for example, 0.6% at 600Hz and at 7kHz. The low frequency values were quite typical at 1%, 100Hz and 5%, 52Hz.

On power handling a satisfactory 97dBA maximum was attained, this corresponding to around 100W per channel on program. The results of the bass guitar test were not outstanding, only allowing clean reproduction up to about 20w programme.

Consistent with the manufacturer's 4-8ohms rating, the impedance curve fell to about 4.5 ohms at 140Hz, thus defining an 'acceptable' amplifier loading, although elsewhere the value was nearer an average of 12 ohms.

While the axial response was quite well balanced, it was rather lumpy, necessitating +2, -5dB amplitude containment limits. At 2m, several factors emerged: first of all, a general downtilt from 100Hz through to 2.5kHz was apparent, averaging 6dB overall; the 1/3-octave results did not help to smooth the response, which contained a clear prominence in the treble around 10kHz, coupled with an erratic depressed range extending over several octaves, 630Hz-8kHz. Nevertheless the agreement between the on-and off-axis responses was good, indicating satisfactory dispersion, while the 10° above vertical response was clearly superior. suggesting that the speaker should be positioned a little below ear level. (The dip at 2.5kHz was in fact deepened at 10° below axis.)

Sound quality

An average rating was denoted upon analysis of the live sound tests. Described as dull and recessed, the *Kappa* was nonetheless pleasant and not overcriticised on grounds of coloration. The bass register was unexceptional though essentially free of boominess and offering reasonable tonal discrimination.

Exactly the same overall rating was attained on the more elaborate stereo programme sequence, resulting once more in an 'average' rating on nearly all counts — stereo, accuracy, clarity and coloration. Comments on the latter were moderate in degree and related to a boxy 'dead' balance with some degree of emphasis of upper treble and a tendency to 'beam' in this region.

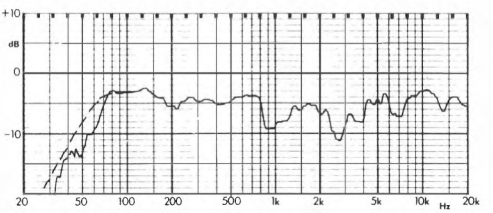
T.F. Comments

I was not too keen on the sound from this model, finding the treble disturbingly directional and the sound rather dry and dull.

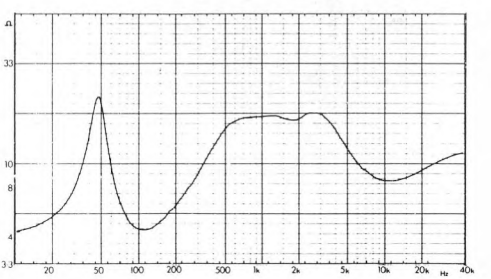
Summary

Although it was pleasant enough, the overall performance of the *Kappa* was a disappointment, the results suggesting that the ingredients were rather better than the recipe, and that the frequency balance could be improved by a crossover design change. In one respect at least it lives up to the description "Achromat" or "free of colour", as coloration levels were low in the true sense of the word, and the sound quality was dominated by balance defects; thus while it cannot be recommended it could be worth an audition.

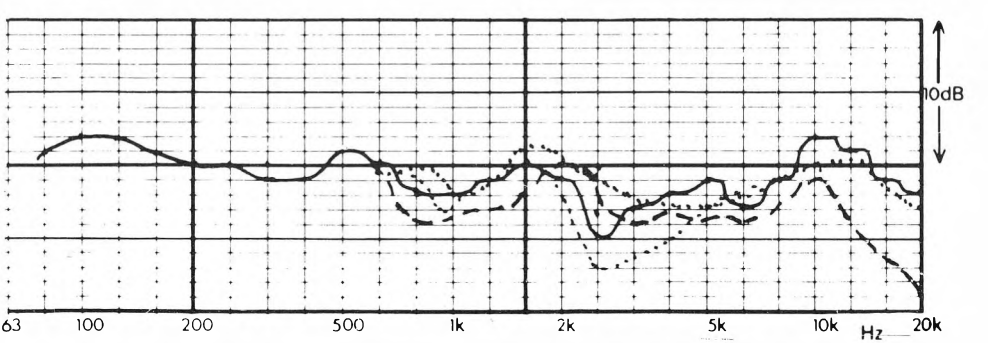
Size	54(21) H; 27(11) W; 27(11) D; cm(inches)
Weight	kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15-100W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	63Hz to 2kHz*
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	85dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	17dBA
Third harmonic distortion (96dB at 1 metre)	good 52Hz–5%, 100Hz–1%, 400Hz–0.3%, 600Hz–0.6%, 7kHz–0.6%, otherwise 0.3%
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	fairly good
Typical price per pair inc. VAT	£195



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



Impedance vs frequency (mod Z)

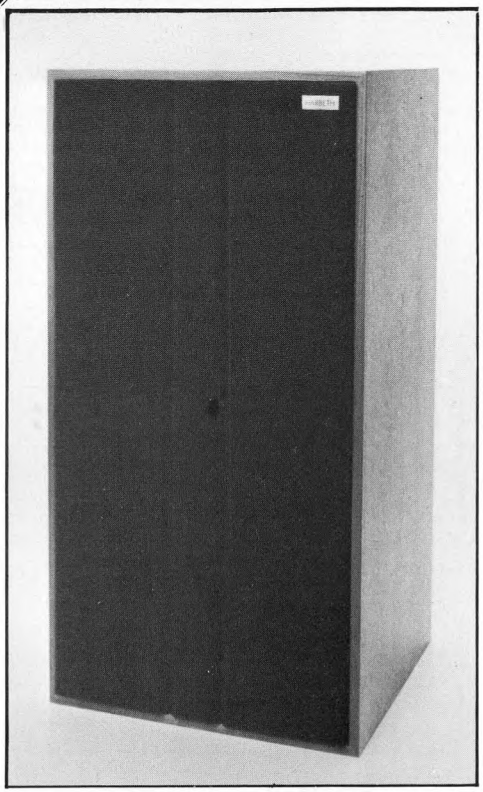


[1]3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

Harbeth HL1 II

Harbeth, 2a Nova Road, W. Croydon CR0 2TL. 01-681 7676.



This two way speaker was assessed in *Mk 1* form in the previous issue, where some quality control problems became apparent, and a cautious recommendation was thus offered based on the quality of the better samples provided. Now in *Mk II* form, this 50 litre, tunnel reflex loaded (62mm diameter) design is essentially unchanged, the improvements being of a detailed rather than a drastic nature.

Harbeth's own 200mm cast frame polypropylene unit operates up to 2kHz, beyond which the 25mm Audax soft dome tweeter takes over. The crossover is of high quality with a high power choke auto transformer allowing individual matching of mid and treble sensitivites. The BBC style thin wall birch multiply enclosure is bituminous panel damped with an acoustic foam lining, and is noticeably 'dead' to a rap with the knuckles.

Lab results

Pair matching up to 13kHz was very close — much better than before — although up to 3dB of difference was observed above 13kHz. Interestingly the sensitivity was rather high at 89dB/W, 2dB more than specified, while the –6dB low frequency rolloff was at 4Hz. Third harmonic distortion levels were low at typically 0.3%, with 0.2% in the 200Hz region, 1% at 100Hz and a fine 2% at 65Hz.

The power handling attained a reasonably good standard — in fact better than before — with no problems on up to 20W programme of bass guitar. On wide band program inputs, up to 200W was handled for short periods without any apparent distress. Rated as good on amplifier loading, the impedance to 2kHz was typically 15 ohms. Above this point it fell to a minimum of 6.6, thus confirming the specification. Clearly the high sensitivity has not been achieved at the expense of compromising the impedance.

Measured on axis the response curve was rather different to the model we had previously assessed, and while essentially smooth in character, it showed a clear 2dB plateau over the entire midband, extending from 300Hz to 3kHz. At 2 metres distance with $^1/_3$– octave averaging, this trend was again firmly outlined. The integration of the characteristic curves was excellent with closely matched off-axis responses.

Sound quality

The *HL1 II* scored high on the solo instrument, live sound comparisons, with some mild criticisms of sibilance exaggeration and a constricted, mid-forward effect.

On broad band stereo program the model was judged to be 'average' — not totally unexpected in view of the measured frequency reponse. The stereo presentation, although accurate in the lateral plane, did not show much depth, and many panelists commented on a 'middy' almost boxy quality, with a noticeable frequency imbalance. In particular, piano showed a noticeable deviation from what was expected.

T.F. Comments

With reasonably good stereo I found this model somewhat coloured in the midrange, with an uneven treble which placed it for me at just above average. I was able to audition the second samples (see Summary) and found distinctly

RECOMMENDED

less mid coloration effects, although the treble still seemed a trifle disappointing.

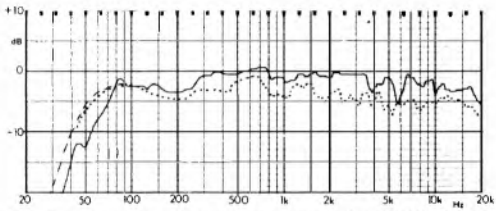
Summary

It was worring to evaluate the test results and find that the new version had in fact fared less well than its predecessor. In view of these findings we contacted Mr Harwood of Harbeth and a second pair of speakers was submitted, but these could not be fully measured or auditioned. The frequency response was however measured on axis (see dotted curve) and showed a better balanced midrange together with a reduction in sensitivity to the specified 97dB/W, while a brief audition confirmed a marked improvement over the first pair, sufficient in fact to establish a recommendation, albeit once again with some caution (for example, the new response curve showed that the range 300Hz-1.5kHz was not entirely under control.)

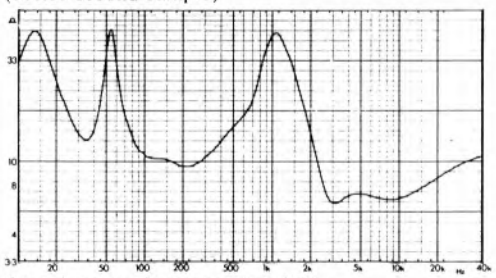
To conclude, the now hopefully correct *HL1 II* represents a reasonably low coloration design with a clean bass and good all round performance; however a personal audition is recommended to see how well its musical and engineering balance appeals to you.

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

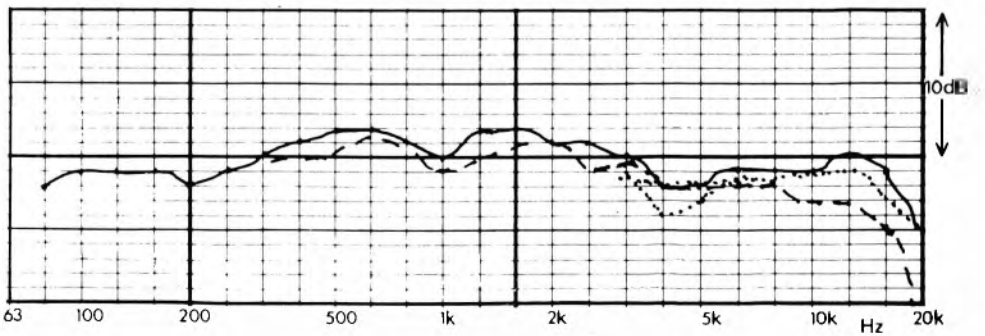
* Check text



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



Impedance vs frequency (mod Z)



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

IMF TLS80 II

IMF Electronics Ltd., Westbourne Street, High Wycombe, Bucks. (0494) 35576.

The Mark I version of this speaker was included in the previous *Hi-Fi Choice Loudspeakers*, the *TLS80* being a large, free-standing enclosure of imposing dimensions. A purpose built steel stand with an inbuilt angle of tilt is supplied with the speakers, which come in left/right mirror pairs and are provided with a switched HF control allowing nominal degrees of lift or cut to suit room acoustics and position.

Technical details

A KEF 30cm x 21cm wedge diaphragm bass unit operates up to 350Hz and is loaded by the large transmission line enclosure. From this point up to 3kHz a 110mm KEF bextrene-cone midrange unit comes into operation, its diaphragm especially treated. A Celestion 38mm hard-dome driver continues up to 13kHz, above which a Celestion 19mm plastic-dome tweeter takes over. The ducting is lined with a special grade of anechoic foam with surface contouring.

Lab results

Both left and right enclosures matched very closely, their curves overlaying within 1dB throughout. At 85.6dB the sensitivity was low, but not outrageously so, and while a minimum amplifier rating of 30 watts per channel is indicated to get them moving, the maximum power handling is potentially very great.

Assessed against the sensitivity, the maximum level attained was high at 105dBA, indicating compatibility with up to 250W per channel amps. The benefit of the large enclosure is evidenced by the —6dB LF point at a truly low 25Hz.

The low impedance values recorded (near 4 and with an average of 5 ohms) suggest that the speaker is not too easy to drive. It measured below 4 ohms near 20kHz, the value still decreasing thereafter, although the musical power should be falling away rapidly at this point. Bar a narrow region near 1.6kHz, the 3rd hasrmonic distortion results were remarkably good, as they were generally below the measuring threshold, and only recorded 1% at 30Hz with an extraordinarily low 2.5% at 20Hz, where the output was still considerable.

The reference sine wave trace illustrates the exceptional LF extension of this model, and reveals a generally even response, with a mild 130Hz suckout and a just detectable upper-mid droop. On $\frac{1}{3}$ octave averaging, the left/right 30° off axis assymetry was clearly evident, the correct 'handed' direction being much superior. Generally a very even trend was shown with good vertical plane integration, the only notable feature being a slight lift around 600Hz.

Sound quality

In general the basic rating for the *TLS80 II* was 'above average' on sound quality. On the live tests, the low frequency power handling was considerable, and up to 150W of mean electric bass power was accepted before breakup. The low frequency range was admirably extended, even a trifle excessively. A much larger listening room than the one used for *Choice* could well assist here. No new standards for mid and treble accuracy were

set, and coloration could be heard on occasion. Some loss of airiness and presence was observed, together with a rather 'small' voice sound and a degree of 'shallowness'. Two of the panellists remarked that this was a 'nice' speaker, clearly reflecting its generally smooth character.

More coloration was observed on the stereo tests, and at times the image itself was a little hazy. Piano reproduction possessed some 'honk' with parts of the frequency range reproduced rather better than others. The organ track, not surprisingly, was presented with great depth, space and scale.

T.F. Comments

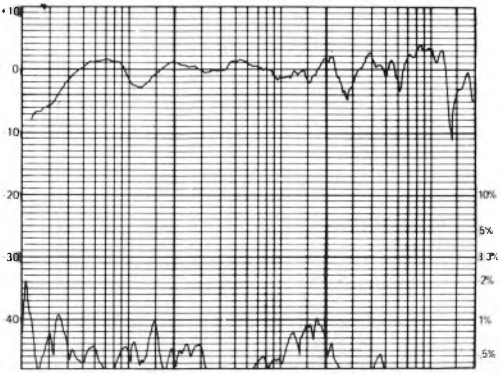
Above average overall, this speaker was warm and I am sure, easy to live with, if not strictly accurate; stereo imaging was just below average.

Summary

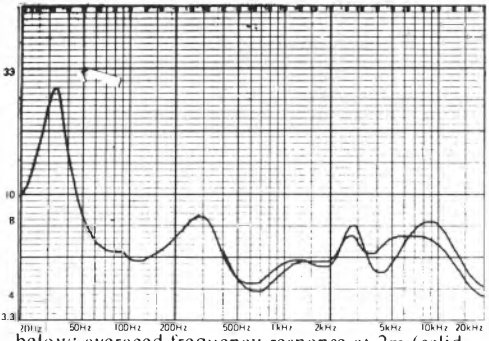
This unusual and large speaker offers a fairly good standard of sound quality, possessing an exceptional low frequency range together with great power handling and loudness potential, despite its lowish efficiency. It will however give of its best in large listening rooms.

Size	98(38.5) H; 46(18) W; 41(16) D; cm(inches)
Weight	37(81) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 50W
Recommended placement	stand supplied
Frequency response within ±3dB (2m)	55Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	25Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86.5dB at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	good
Typical price per pair inc. VAT	£700

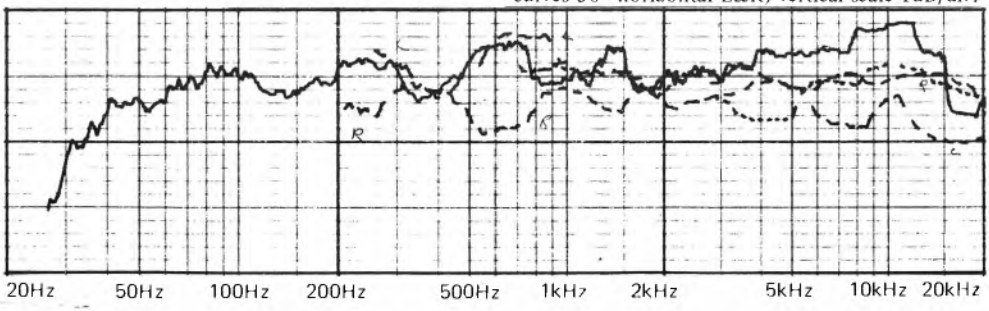
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z)

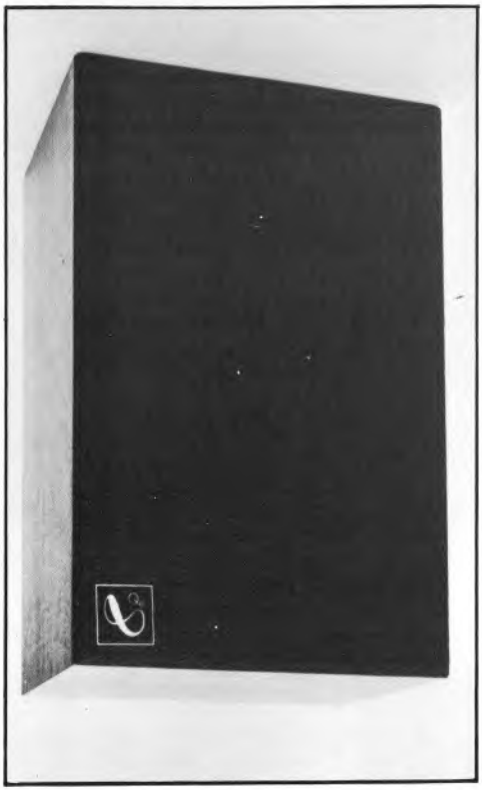


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal L&R) vertical scale 1dB/div.



Infinity Qe

Infinity Systems UK Ltd., PO Box 14, 17 St Martins Street, Wallingford, Oxon OX10 0EB
Tel (0491) 37353.



A small US made sealed box system, in common with so many other similar models the *Qe* unfortunately suffers from the transatlantic price penalty. A 25 litre two-way system, it employs a 200mm stiffened pulp cone bass midrange operating up to 2.5kHz, above which Infinity's own version of the orthodynamic ribbon tweeter takes over, this one called an *EMIT*. No cross-over arm is present for the bass/mid driver, and a test curve taken showed that it does not in fact rolloff until 4.5kHz. A two-element LC section feeds the tweeter, the latter employing samarium cobalt magnets and a four slot radiating aperture, some 52 x 12mm overall.

The cabinet quality was adequate with a printed 'walnut' vinyl wrap covering, but no panel damping or bracing was incorporated, just a modicum of dacron wadding. The thick grille panel was unchamfered. Connections were via spring clips, and the fuse-protected HF unit could be rotated through 90° to improve the dispersion when the enclosure is used on its side (though this is to be avoided if possible).

Lab results

The pair matching was pretty close bar a 2dB discrepancy in a small region about 4kHz. The *Qe* possessed a reasonable –6dB LF point at 52Hz, and while sensitivity appeared above average at almost 90dB/W, it was compromised by the low impedance; thus in practice it more closely approximates to a true figure of 86.5dB/W.

Some peculiarities were observed during the distortion tests, notably the production of spurious subharmonics from the tweeter although things were comparatively normal at lower frequencies in the lower octaves at 96dB, 1m; distortion was not particularly low elsewhere with values of up to 1.6% in the midrange and 3% in the treble. On bass guitar a good level was achieved, the system tolerating up to 100W, this improving to a substantial 200W of wideband rock program producing a high acoustic level of 104dBA.

The grille was found to influence the axial curve, particularly in the region of 3-8kHz, the published results being taken with it in position. A 2dB shelf above 250Hz was present together with some anomalies in the 1-5kHz crossover band, but otherwise the frequency balance was quite promising exhibiting some pretty smooth areas and with +/–3dB limits serving to qualify the 80Hz-20kHz range.

At 2 metres with 1/3-octave averaging, the speaker was best on or a little below axis. One consequence of the vertical geometry of the tweeter was the close resemblance between the 30° lateral and 10° vertical off-axis curves, and as this unit 'beams' more than most in the vertical plane, it should face the listener ideally. The minimal crossover content was reflected by the 2.5kHz dip in the lateral response while a mild mid bias was shown overall.

Sound quality

Scoring quite well on the live sound comparisons, some assorted colorations were evident to a moderate degree, namely 'boxy', 'nasal', 'hard' and 'dulled' effects, but fortunately the substantially even frequency balance and clarity won through. While not very

extended, the low frequencies were quite clean and well differentiated.

However it fared a little worse when auditioned on wide band stereo progam, scoring an 'average' rating. Colorations were rather more evident, with the stereo showing restricted depth and the whole sound exhibiting a rather brash quality with moderate characterisations of rough, edgy, hard, boxy, nasal and metallic effects.

T.F. Comments

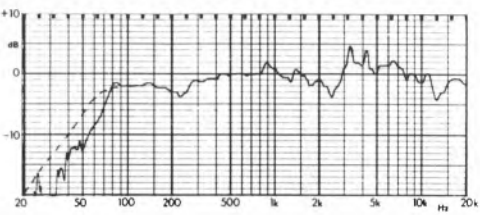
I was bothered by an apparent treble directionality in the vertical plane which placed a cancellation at my seating position. Just about average for me, with an uncomfortable effect.

Summary

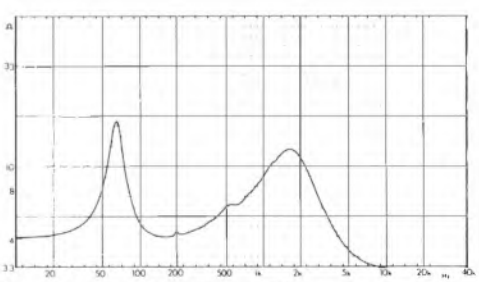
This speaker presents a difficult amplifier load, and exhibited certain colorations and aggressive effects as well as only just satisfactory distortion. Conversely, it could be driven hard and was capable of high acoustic levels, while the voltage sensitivity was usefully high and the general response balance and clarity to a good standard. Taken in all it represents a borderline case, and does not fall far short of recommendation.

Size	46(18) H; 30(12) W; 25(10) D; cm(inches)
Weight	18(40) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10-100W
Recommended placement	stands or open shelf
Frequency response within ±3dB (2m)	63 to 20kHz
Low frequency rolloff (−6dB) at (1m)	32Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89.5dB/W*
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	60Hz–3%, 110Hz–1.3%, 1.3kHz–1.6%, 4kHz–1%, 7kHz–3%, hf exhibits notable subharmonics at ≅0.6%
Impedance characteristic (ease of drive)	poor
Forward response uniformity	average
Typical price per pair inc. VAT	£140

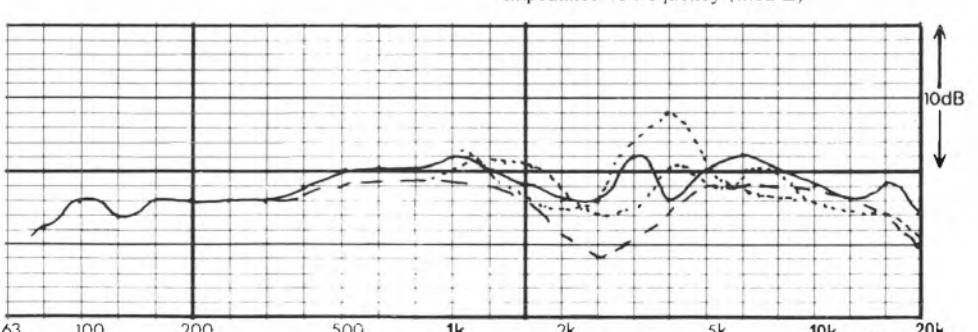
* See text



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

ITT8072

ITT Consumer Products (UK) Ltd., Chester Hall Lane, Basildon, Essex, SS14 3BW.
Tel: 0268 3040

The *8072* is the median model in a range of UK designed speakers that incorporate Audax drive units. Having a fairly squat appearance, a two section tilted-back grille is employed, the upper section being detachable to reveal two controls for adjustment of lower and upper treble. These frequencies are handled respectively by 37mm and 25mm soft dome units mounted laterally adjacent on a diffraction-inducing recessed panel above the 200mm bass midrange driver.

The 27 litre cabinet is reflex loaded by a small 50mm diameter tunnel port, some 115cm deep. Conventionally rated components are used for the 11-element crossover (this count excluding several resistors and the attenuator controls.) No cabinet damping is used apart from a little polyester wadding, and while the general constructional quality is good, the components were not sufficiently secure to prevent some rattles during the bass tests.

Lab results

Pair matching for this model was good and generally to within a dB or so over the range. The sensitivity was noted as 86dB/W which is fairly low, with a typical -6dB rolloff at 50Hz. In general, third harmonic distortion was a satisfactory 0.6-0.3%, while at low frequencies the values were quite average, measuring 1%, 100Hz and 5%, 56Hz. The power handling was fairly good, the absolute limit proving to be 150W programme which produced a modest 96dBA from a pair at 2 metres. I feel the manufacturer's claim of 107dBA at 1m is optimistic, although admittedly it would depend on how much distortion is tolerable. For solo bass guitar the average program maximum was 17W. Rated as good, the impedance never fell below 6.4ohms except with full treble lift, with the average value measured for this easy-to-drive model being near to 100 ohms.

However the response was without not without certain imbalances and although meeting –2.5, +3.5dB limits, on axis at 1m, a 2dB trough was present from 180-350Hz, while from 1.3-5.0kHz the trend was lumpy, furthermore above 8kHz the treble was shelf boosted by some 2.5dB with the controls set to 'zero.' These main trends were echoed by the $^1/_3$-octave averaged reponses at 2m. The off-axis curves were confusing and the 30° lateral off axis output was quite poor considering the wide intrinsic dispersion of the drivers involved.

Taking the vertical below axis graph, a charted dip at 2.5kHz (dotted) was present, the 10° above characteristic being rather better; use on a lowish stand is thus recommended. In the lateral planes the dip at 10kHz was probably due to cabinet diffraction, while in the '30° right' direction suckouts appeared at 2 and 4kHz, the latter 7dB deep. As such the lateral stereo symmetry is poor, and the imaging and sound of this system will clearly change more than most with different listening positions.

Sound quality

Ranked below average on the live sound comparisons, the panel found the sound to be somewhat veiled and boxy with a roughness in the treble. The frequency balance was judged

uneven, with some boom round 80-100Hz (see curves.)

A similar result was obtained on the stereo tests, where stereo imaging was marked well down, with criticisms of poor depth and a hazy effect which confused positioning. Hard, brittle edgy and boxy effects were included in the comments.

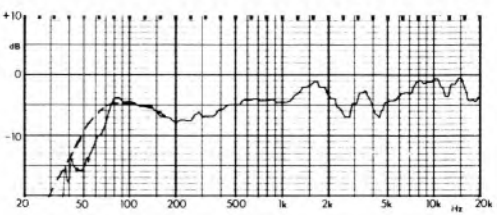
T.F. Comments

Finding this just below average with a constricted quality and lacking transparency, the *8072* did not flatter strings and gave a phasey, confused stereo image.

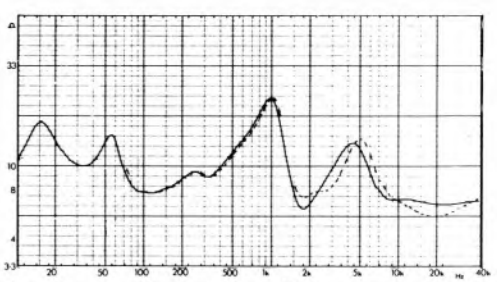
Summary

While good quality ingredients are used, certain aspects of the design, notably the laterally arranged drivers and diffraction-inducing cavities behind the grille, have combined to limit the performance to a level below that required for recommendation.

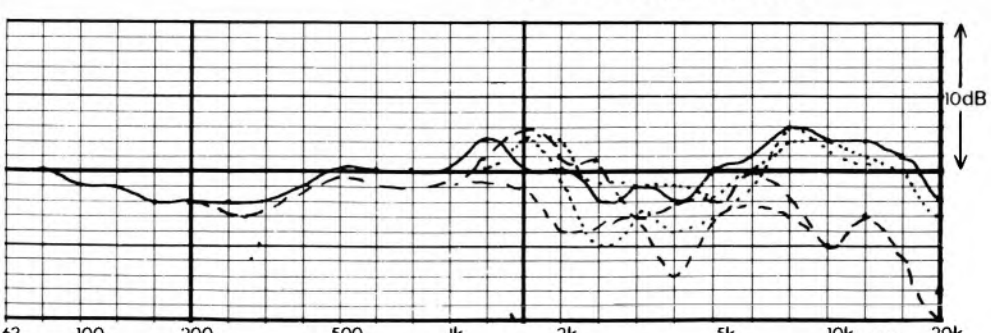
Size	47(18.5) H; 30(12) W; 27(10.5) D; cm(inches)
Weight	kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–100W
Recommended placement	stand, a little below ear level
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	96dBA
Third harmonic distortion (96dB at 1 metre)	average
	56Hz–5%, 100Hz–1%, 470Hz–1%,
	typically 0.6 to 0.3%, some rattles
Impedance characteristic (ease of drive)	good
Forward response uniformity	acceptable
Typical price per pair inc VAT	£175



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

JBL L19

Harman (Audio) U.K. Ltd., St. John's Road, Tylers Green, High Wycombe, Bucks. HP10 8HR. 049-481 5221.

A new compact system from JBL, the *L19* comes in an oiled walnut finish of excellent quality. It is in fact the domestic equivalent of an existing small studio monitor, the *4301*, and as it possesses a usefully high sensitivity (in JBL tradition) it should be capable of high sound levels.

Technical data

A bass reflex enclosure with a narrow ducted port, the low/mid spectrum is handled by a highly rigid 200mm pulp cone driver. This top class unit incorporates an excellent die cast frame together with a large 50mm motor coil. Crossing over at 2.5kHz, a 36mm pulp-cone tweeter continues the range, with a level control allowing adjustment of the HF output. The crossover comprises a 6-element 12dB/octave design network, this count including the level attenuator.

Lab results

Our sensitivity data placed the *L19* at 89dB, which is higher than specified, although an absolute 1.5dB level mismatch was recorded between the two speakers. Allowing for this discrepancy, the matching then held to within 1dB up to 8kHz, but deteriorated thereafter due to the erratic nature of the high frequency range. (The sharp edged grille baffle may be partly responsible for this.) The —6dB LF point was placed at 60Hz. Very good third harmonic distortion values were recorded above 150Hz, where the speakers measured close on the threshold value, only rising at lower frequencies to 1% at 100Hz and 3% at 60Hz. No further increase was noted thereafter until below 30Hz. With a 5.5 ohm minimum impedance at 5.5kHz and well-controlled reactances, the speakers were classed as presenting an average amplifier loading.

The 1 metre sine curve showed a rising trend with frequency, suggesting shelf mounting for optimum balance. A dominant feature was the fierce +8dB spike at 10kHz. At 2 metres the averaged characteristic response moderated the spike but it was still obvious. Other features included the upper-mid prominence of +3dB and the acceptable lateral dispersion. The off-axis curves showed plainly the lack of high frequency energy above 12kHz, the response measuring —10dB or more at 20kHz.

Sound quality

The L19 scored typically 'average' sound quality ratings, which is fair enough at the price. It could be driven to very high levels — 106dBA maximum — and tolerated 500W peaks on transients without damage.

Quite high subjective levels were also produced in the electric bass guitar test, although inputs over 10-15 watts average did induce mild buzzing which was thought to come from the rear panel.

On comparison with live sounds the *L19* appeared somewhat 'edgy' and 'hard' with 'thinned' and 'boxy' effects commented on with male voice. The loss in extreme treble was noticed and the overall balance was considered to be quite thin and bright. These characteristics were largely confirmed on stereo programme, which also gave rise to comments of sibilance and distortion

emphasis, 'fizz' (undoubtedly the 10kHz peak), and some metallic edginess. On the plus side the speaker was very clear and produced considerable detail. Shelf mounting and some treble cut would help to rebalance this system to advantage, but cannot of course cure the 10kHz peak in the treble range or the falloff thereafter.

T.F. Comments

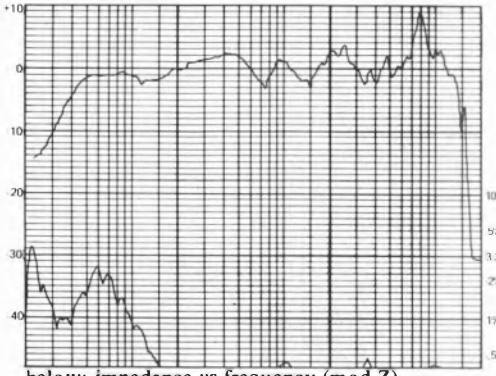
I found this system very clear, although with some excess of treble which tended to exaggerate any tape hiss. Although capable of high volumes, I found the treble became oppressively hard when played very loud.

Summary

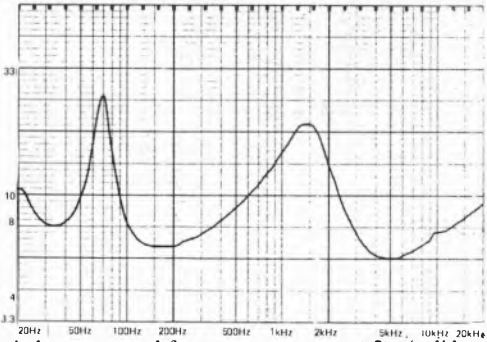
Clearly the *L19* contains some good ingredients and can be seen to have potential. Easy to drive and capable of high sound levels, the general feeling from the test data was that the treble unit let the side down, and thus prevented the system from attaining a 'good value' standard. Unless a really bright, punchy sound is desired (and the treble quality is not over important) the *L19* cannot really be recommended at its price; pair matching should also be improved.

Size	58.3(21) H; 33(13) W; 25.4(10) D; cm(inches)
Weight	13(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 100W
Recommended placement	shelf or stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB at 1m
Approximate maximum sound level (pair at 2 metres)	106dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£236

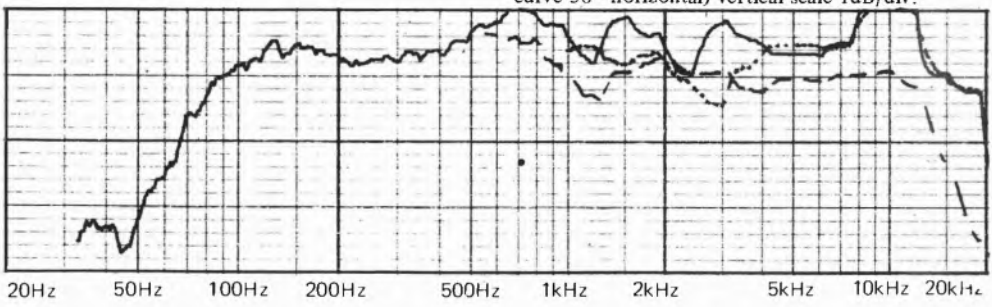
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



JBL L110

Harman UK, St Johns Road, Tylers Green, High Wycombe, Bucks. HP10 8HR.
Tel: 049 481 5221

Although possessing a small 42 litre internal volume by JBL standards, the overall construction quality is to the usual high JBL level. Reflex loaded by a sensibly large 75mm diameter tunnel port of 150mm overall length, a new 250mm bass driver has a 75mm diameter edge-wound coil, a die cast frame and a ventilated pole, the upper midrange above 1kHz being handled by a 100mm shallow pulp cone unit, crossing over at 4kHz to a hard doped 25mm fabric dome tweeter. The crossover is fairly simple, comprising 6 and 12dB per octave arms, employing high power components and incorporating two level controls for adjustment of upper mid and treble balance. The rigid oiled-walnut veneer enclosure is lined with dense fibre glass wadding but has no panel damping, and the grille is of a semi-transparent type.

Lab results

The speaker showed good pair matching with a nominal sensitivity of 87dB/W, and this is associated with a -6dB point at 38Hz — quite extended for the size of enclosure. In practice the system will sound louder than the mean sensitivity figure indicates because the aurally sensitive mid and treble range is closer to 90dB/W. Rated as very good on third harmonic distortion with 0.2% being typical over most of the range, the following are worst case figures down to the low frequency rolloff, namely 0.3%, 200Hz, 0.8%, 100Hz and 1.2%, 52Hz.

At what we considered to be the normal or 'two o'clock' setting of the level controls, the impedance did not fall below 6.4ohms and was thus considered an easy amplifier load. Power handling was also very good, with a high 104dBA achieved on the broad programme test, accepting up to a 250W input, and with the exception of a minor rattle at 30W, the speaker went on to accept 100W of electric bass guitar.

However the axial response was none too promising, and although this speaker was auditioned on open stands to reduce the effects of wall coloration, the step up in response above 250Hz indicated that it would tolerate open shelf mounting backed against a wall but clear of corners. Nonetheless, technically speaking the response step is still a little too sharp. Somewhat lumpy, the upper range showed a 8dB peak at 19kHz (similar to that observed in the previous issue for the big JBL *L212*), and while it should prove inaudible for most listeners, it is unfortunately spot on the tuner multiplex pilot tone frequency.

On $^1/_3$-octave averaging at a 2 metre microphone distance, the bumps were ameliorated although still apparent. The vertical in line array ensured excellent lateral dispersion, but a broad 5dB loss occurred from 4-6kHz in the 10° vertical response above axis. In some respects the 10° below curve was even better than that taken directly on axis, which suggests that if wall-mounted the tweeter should be above ear level, and if stand-mounted the speaker should be tilted back to achieve the same results.

The overall response was in fact similar in some ways to the *AR90*, but the intentional floor coupling of the latter is of course inapplicable to the L110.

Sound quality

Scoring better than the responses might suggest, a rating of 'good' was attained in the live comparison tests. The panel showed conflict in their scoring, with one or two of them noting a hard, coloured character, while others appreciated a clear tonal resolution and good bass quality, scoring it much higher.

On the more complex stereo programme the rating fell to 'average', although again the spectrum of panel criticism was wider than usual. Stereo was quite good in terms of lateral precision, but it lacked much depth, and some listeners felt the sound to be a trifle fatiguing, making comments of rough, wiry, edgy, hard and 'small box' effects.

T.F. Comments

I liked this speaker for its clear, open, if slightly bright character, and its accurate lateral stereo resolution, although it did occasionally sound a bit 'loud.'

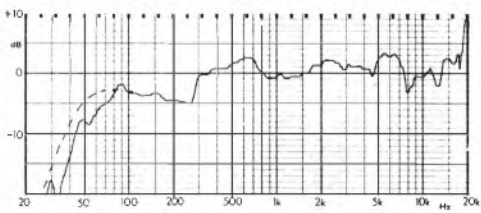
Summary

Although the standard of this book preclude a recommendation at the UK price, the *L110* is one of those interesting designs which should be personally auditioned before any final decision is taken. For its size its positive features included low distortion, clean extended bass and good clarity, with above average stereo and an easy to drive impedance.

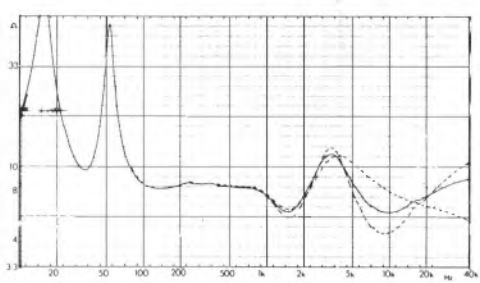
Dispersion was also fine, and it appeared accurate by comparison with live instruments, while engineering and finish were both to an excellent standard.

Size	59.5(23.5) H; 36(14.3) W; 29(11.5) D; cm(inches)
Weight	18(40) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 — 250W
Recommended placement	on stand or open shelf
Frequency response within ±3dB (2m)	250Hz to
Low frequency rolloff (—6dB) at (1m)	38Hz-20kHz*
Voltage sensitivity (ref 2.83V ie: 1 watt in 8 ohms)	87dB/W
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	v. good
	52Hz–1.2%, 100Hz–0.8%, 200Hz–0.3%, typically 0.2% elsewhere
Impedance characteristic (ease of drive)	good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£620

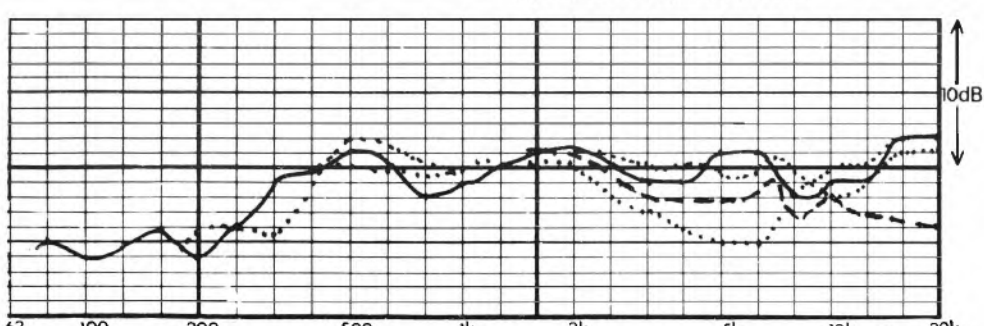
* See text.



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



Impedance vs frequency (mod Z)

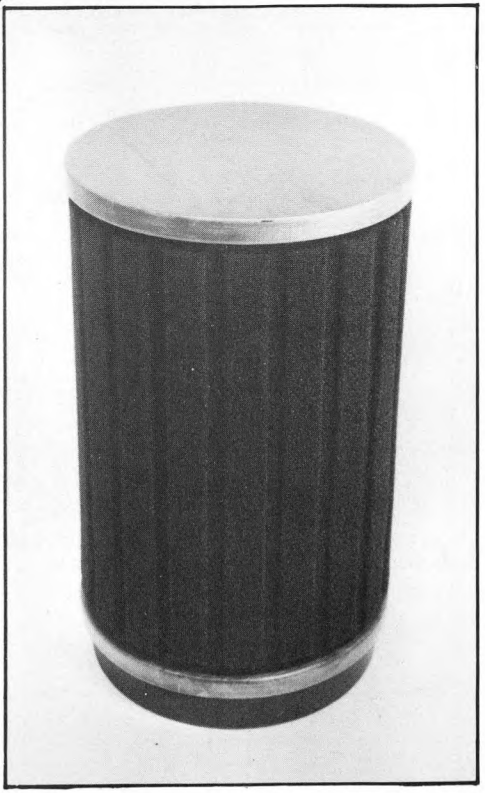


1/3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

JR 149

Tape Music Loudspeakers Ltd., 114 Ashley Road, St. Albans, Herts. AL1 5JR. (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 age). Reinforcing the slightly dulled impression gained on the live

RECOMMENDED

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

T.F. Comments

Personally, I did not find this speaker particularly exceptional. I was aware of the lack of deep bass and uneven HF, and found it rather enclosed and 'small-sounding'.

Summary

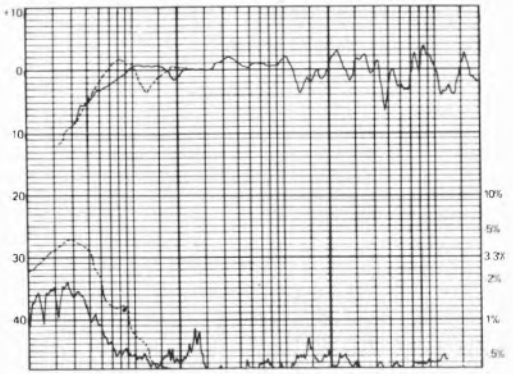
Despite a low sensitivity and low power handling capability, the *149* continues to score an impressive line of ratings.

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 rolloff (–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	£140

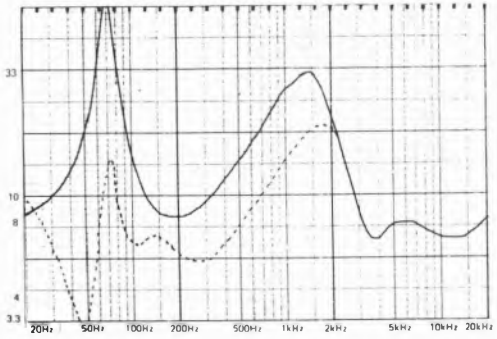
*See text.

distortion measured at 90dB

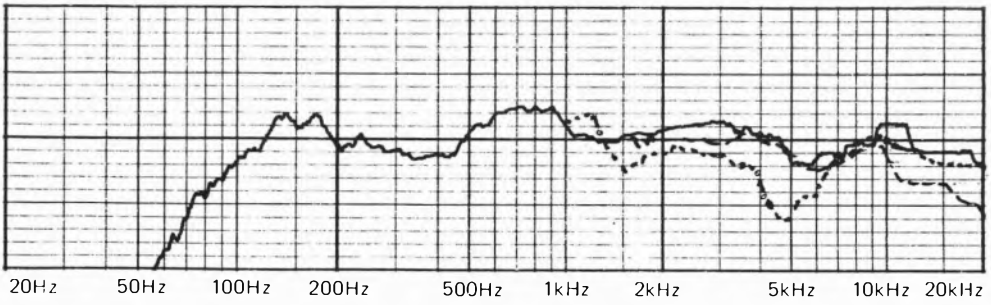
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref 0dB.)
(Ignore dotted curves).



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.



JR150

Tape Music Loudspeakers Ltd., 114 Ashley Road, St Albans, Herts. Tel: 0727 64337

The *JR150* is identical in style to the familiar, *149,* but some 30% larger; and while both are sealed-box types, the 20 litre *'150* contains two 110mm bextrene cone bass/mid units plus a 25mm soft dome tweeter, all manufactured by Audax. The units are mounted vertically-in-line and are integrated by a 15-element 2.5 amp fused crossover of good quality. The Declon foam and wood veneered exterior conceals a skillfully engineered sheet aluminium alloy enclosure with minimal resonances and possessing great rigidity, with the inner top and bottom plates domed for greater strength. The whole assembly is longitudinally tensioned by a steel bolt. The *'149* came with permanently connected cables plus DIN plug, but the more recent *150* simply has a pair of 4mm sockets at the rear, recessed in the foam wrap-around grille.

Lab results

A very good pair match was demonstrated, with the reference curves for left and right hand systems aligning to within +/–0.5dB. The mean sensitivity was 86dB/W, some 3dB greater than for the, *149,* but the damped nature of the bass response gave a poorer —6dB rolloff at 60Hz. Driven to 96dB, which is a highish level for this size of speaker, the third harmonic distortion was very good overall, and only rose to significant proportions at the LF limit, where a value of 12% was recorded at 60Hz. (This is where the super‚woofer would come to the rescue!)

On bass guitar the power handling was unexceptional with programme inputs greater than 15W causing distress. On more balanced wideband program the system could sustain higher inputs of up to 150W, although with some restriction evident regarding the maximum sound level obtained: 98dBA per pair at 2m. The impedance curve showed a dip to just over 5 ohms at close to 1kHz, thus qualifying the *'150* as an 'average' amplifier load. The mean value was 7 ohms, with the system resonance at 62Hz (note that a small frequency error is present on the printed graph).

On axis at 1m the sine wave reference response showed a smooth rising trend to 2kHz, at which point the output was stepped down by 4dB, thereafter rising slowly and gently to the 86dB/W reference line at 20kHz. Consequently in relative terms there is a presence band trough from 2.5-5kHz, and an early bass rolloff.

At 2m there was the suggestion of a mild hump at 12.5kHz, and the energy suckout in the presence band was confirmed. The off-axis responses in the vertical plane were not as tidy as some of those offered by the better models in this report, with '10° above' producing a mild dip at 4kHz and a more serious dip at 2.5kHz at 10° below axis. The lateral responses were pretty good.

Sound quality

This model scored a remarkably consistent 'average' throughout the listening tests. In fact it was one of the systems chosen for repeat insertion to check panel scoring accuracy, and over six tests the marks varied by as little as +/– 4.0%.

Compared with live sounds it was criticised for moderate hollowness, a suckout, dimness

and nasality, and an almost identical rating was attained on the stereo tests. In contrast to its smaller brother the *'149,* the stereo image was felt to be unexceptional, with several panelists commenting on a vague character which changed with the program. On occasion the upper treble appeared fizzy with the general sound a trifle small and boxy, with impaired clarity.

T.F. Comments

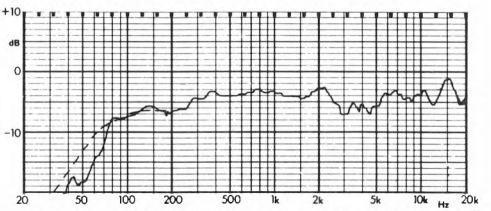
At times the stereo image seemed narrower than usual and was below average for me. Slightly hard and brittle, overall this speaker was just around the average mark.

Summary

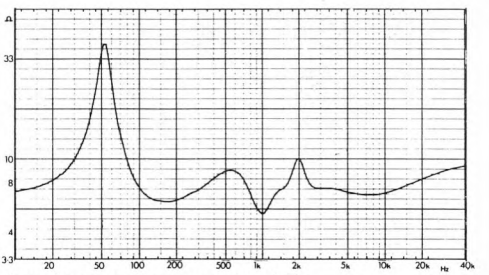
It is likely that the response imbalances and the less than optimum off-axis responses in the vertical plane did little to help the *JR150,* which in some respects did not match the standard set by the recommended *'149.* Despite its higher price, the technical performance was pretty average, and while this is in some respects a well constructed and well finished model, we just did not feel sufficient enthusiasm for it to justify recommendation.

Size	54.5(21.5) H; 28(11) diam. cm(inches)
Weight	11(24) 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)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	60Hz*
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	v. good 60Hz–12%, 100Hz–1%, 300Hz–0.4%, typically 0.3% overall
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£225

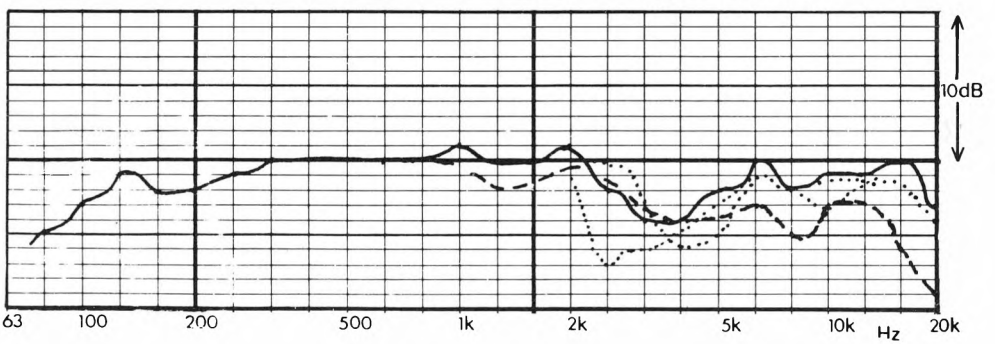
* See text



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

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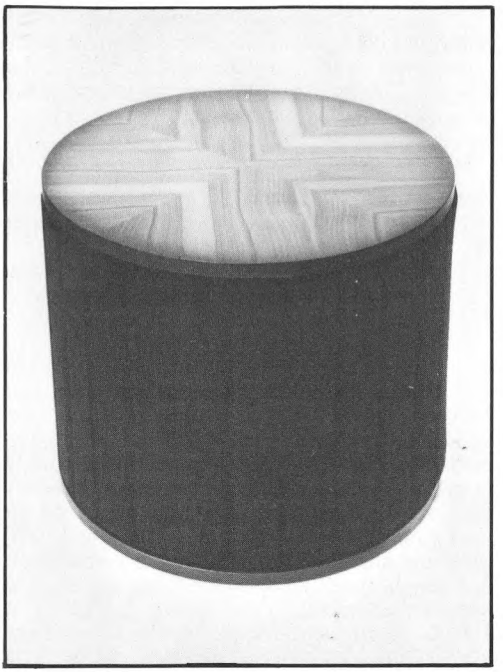
JR EX1 (subwoofer)

Tape Music Loudspeakers Ltd., 114 Ashley Road, St Albans, Herts. Tel: 0727 64337



Regular readers may recall the JR subwoofer from the previous edition, and its rather unsuccessful attempts to add bass extension and power to the *JR149* and other similar enclosures. It was then a passive design with a sealed box enclosure and massive internal crossover; since then it has been redesigned, and the new higher power version is more versatile, being reflexed for the same 50 litre volume, the drum now containing no crossover. The more elaborate version reviewed here drives the woofer from a compact 60w mono amplifier *(PA60),* this fed in turn by an advanced electronic crossover (the *EX1.*) In common with the Audio Pro *B2-50,* the feed to the satellite speakers may be electronically filtered, at 72 or 100Hz, 18dB/octave, thus improving their power handling, while the mono sound signal below crossover is diverted to the *PA60.* A low boost control is also provided together with gain matching. A cheaper drive system *(LPA)* leaves the drive to the satellites unchanged, driving the subwoofer with signals below 70Hz *via* a 30 watt amplifier.

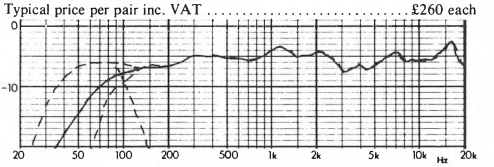
With a -6dB point at a relatively extended 30Hz, the woofer response was sensibly flat from 38Hz to the selected crossover points of 70 or 100Hz. A sufficient range of gain control, was available to easily accommodate all known satellite systems, and the 'tilt' adjustment worked correctly as described in the manual. High volume levels were available, sufficient to accommodate an overall program rating of 103dBA in conjunction with suitable ancillary speakers. Distortion was relatively low — mainly mild port chuffing, and while we experienced radio breakthrough (radio Moscow!), this has since been eradicted by a small production modification.

Our experience suggests that the location of the woofer is more critical than the manual implies, and that for unambigious imaging the nearer to the satellites the better. The unit did not in fact offer significant advantages if coupled with enclosures which already had reasonable bass to 50Hz or below, althoug it was apparent that what sound it added was possessed of good quality and depth. This subwoofer in fact really came into its own with small systems of 15 litres or less, by not masking their true character, but rather adding a good standard of 'large box' bass with a power handling advantage to boot. Coloration was moderate; just audible on the 100Hz setting, which nonetheless gave a smoother transition overall than the 70Hz setting with the several systems tried.

Summary

With such auxiliary units value judgements are difficult, although on an engineering basis the JR system is certainly cost effective; however a home audition is recommended before purchase.

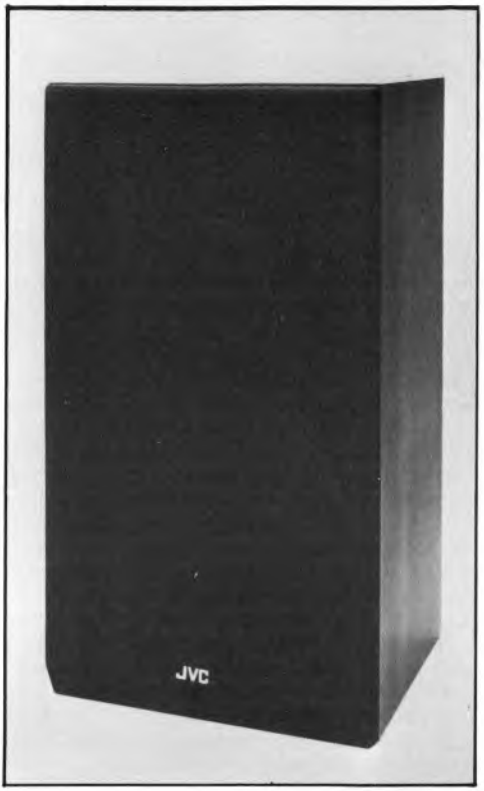
Size	47(18.5) H; 51(20) D; cm(inches)
Weight	17.5(38.5) kg(lbs)
Recommended placement	on floor near wall
Frequency response within ±3dB (2m)	34Hz to 100Hz*
Low frequency rolloff (—6dB) at (1m)	30Hz
Approximate maximum sound level (pair at 2 metres)	103dBA*
Third harmonic distortion (96dB at 1 metre)	v. good
	34Hz–3%, 100Hz–3%, 50Hz–3%
Typical price per pair inc. VAT	£260 each



Solid: axial sine wave reference *JR150*, dashing shows subwoofer extension (corrected) and crossover slopes.

JVC Zero 5

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



This superficially 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 midrange 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 aperatures backed by an overlong 300mm duct.

While the overall engineering was to a good standard, with an interesting curved deflector behind the bass unit to break up standing waves, the veneer (a rosewood laminate type) was unfortunately opening at several seams and the grille form was likely to worsen diffraction effects. Finally, the literature promised good response curves, which we were unable to match.

Lab results

While overall pair matching was good, the depth of the 6kHz trough varied between the two examples. A high 93dB/W sensitivity was recorded with a –6dB point at a satisfactory 45Hz. As is often found with higher sensitivity models, the distortion was excellently low. (In fact third harmonic distortion is often proportional to input power and not to sound pressure levels.) Never exceeding 0.4%, the values for the *Zero 5* were typically in the region of 0.2%. Power handling was correspondingly large, the system attaining a deafening 107dBA for a 250W/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, as while the closed box system resonance is at 60Hz, the speaker is not actually reflex tuned until a low 24Hz.

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 170Hz, and irregularities from 1kHz-4kHz were all apparent, with a 2dB notch at 5.8kHz and an erratic treble range thereafter. If the pair had not matched so well or had performed incorrectly in other respects, I might have suspected a fault. This situation was little improved at 2m, even with the more forgiving nature of the ⅓-octave band averaging. The bass range was revealed as an isolated region around 80-100Hz, with the 630Hz-1.3kHz mid range also dominant. A serious energy loss was apparent from 2-8kHz with the higher frequencies exposed as a prominence centred on 10Hz. Interestingly, the off-axis 10° above and below vertical responses showed some improvement at 4kHz, indicative of a phase error at the 5kHz crossover point, and if

corrected, the off-axis dispersion was potentially quite good.

Sound quality

A poor ranking was denoted from the live sound sessions, despite the good power handling on bass guitar. The bass quality was judged muddled and boomy, and the overall sound as boxy, hard and excessively dull.

Virtually no improvement was evident on the stereo program tests, and unfortunately nearly all the coloration characterisations given as guidelines to the panelists were applied to this speaker, including 'hollow', 'cuplike', 'nasal', 'honky', 'fizzy' and 'hard'. Stereo imaging was very disappointing, proving to be shallow and unstable.

T.F. Comments

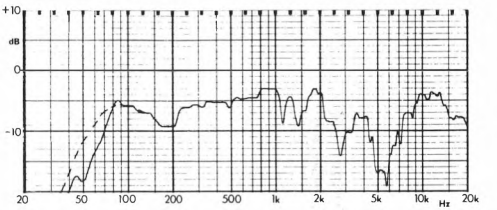
I did not favour this system in any respect. The stereo image seemed 'phasey' and the sound quality rather boxy.

Summary

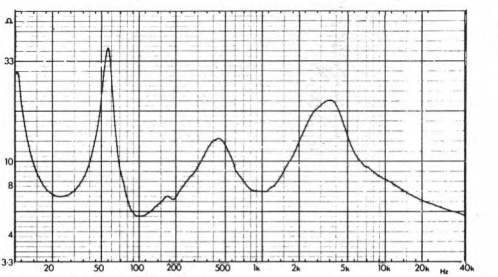
This model cannot be recommended. Its few virtues of high sensitivity, good power handling and low distortion were outweighed by severe coloration and deficient imaging, resulting in a low ratings for sound quality. The manufacturer's claims for frequency response were not met by the review samples although these were apparently not faulty; one can only conclude that perhaps some quality control failure was responsible for the discrepancy between claimed and attained performance.

Size	65.5(26) H; 37.5(15) W; 33.5(13) D; cm(inches)
Weight	kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	5w-250W
Recommended placement	stands at ear level
Frequency response within ±3dB (2m)	80Hz to 4kHz*
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	93dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	107dBA
Third harmonic distortion (96dB at 1 metre)	excellent 60Hz-0.4%, 100Hz-0.2%, 200Hz-0.2%, 2kHz-0.3%, 7kHz-0.1%
Impedance characteristic (ease of drive)	average
Forward response uniformity	average
Typical price per pair inc. VAT	£400

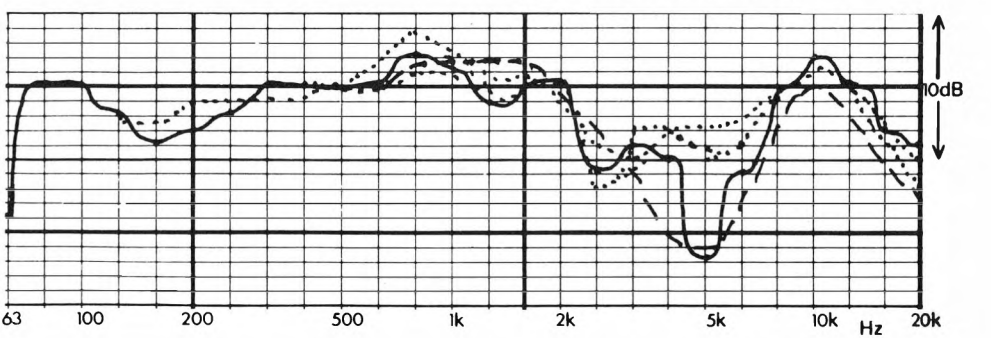
* See text.



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



Impedance vs frequency (mod Z)

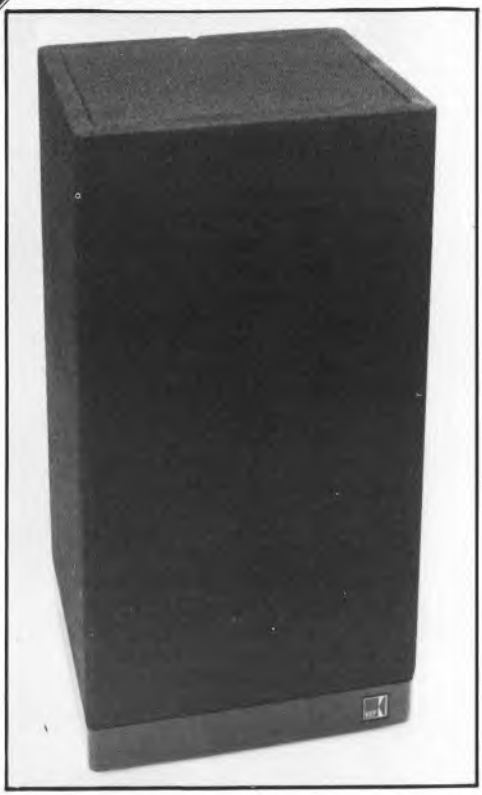


[1]3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

KEF Celeste III

Kef Electronics Ltd., Tovil, Maidstone 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 0hms, 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

RECOMMENDED

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

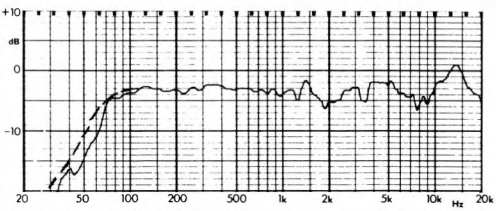
T.F. Comments

I found this speaker below average overall with some mid coloration, and in my central seating position a surprisingly unstable and phasey stereo image was presented.

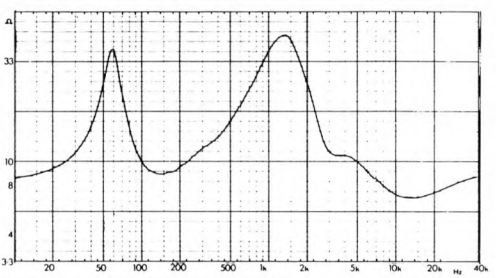
Summary

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.

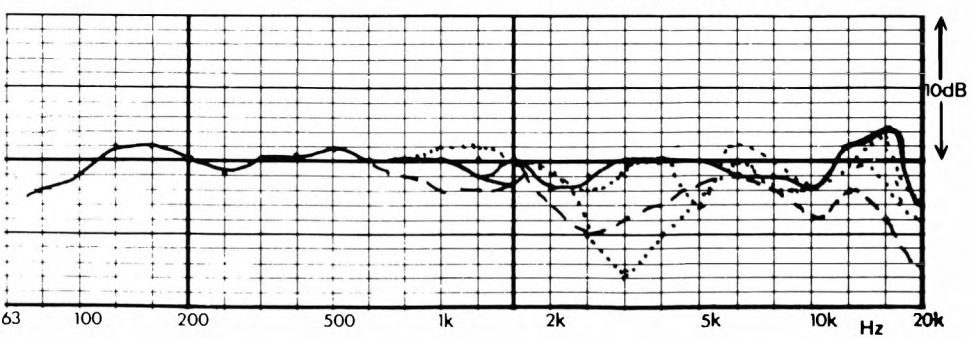
Size	50.5(20) H; 26.5(10.5) W; 23(9) D; cm(inches)
Weight	kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15-200W
Recommended placement	on matching pillar stands or open shelf
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	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	£95



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



Impedance vs frequency (mod Z)

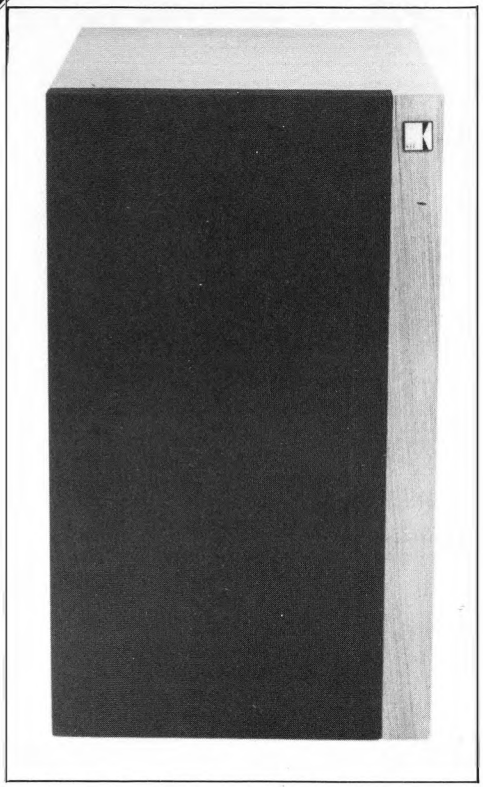


⅓-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

KEF Corelli

KEF Electronics Ltd., Tovil, Maidstone ME15 6QB. (0622) 672261.



A compact and attractively styled loudspeaker of slim proportions, the *Corelli* is supplied in mirror pairs and could be placed on an open shelf, but worked well on test when stand mounted. A recent design, it employs the latest 'Acoustic Butterworth' crossover for the treble driver, and as it is a relatively inefficient model, the manufacturers recommend the use of up to 50 watt amplifiers.

Technical details

A sealed box design, all the drive units are of KEF's own manufacture, as with the *R105*. A bextrene 200mm bass-midrange unit of new design with a high power 25mm motor coil is employed, the complex crossover transferring power at c.3.5kHz to a 19mm hard dome tweeter. The terminal panel is of the universal 4mm socket and DIN type.

Lab results

The nominal sensitivity worked out at 85dB, and although this is only 1dB less than the *R105,* it is nonetheless fairly inefficient. The —6dB LF point at 50Hz was typical for the size of enclosure, with the system resonance recorded exactly on specification at 58Hz.

Typically at the 8 ohm level, the impedance did dip fractionally below 6 ohms at 10kHz, and the speaker is classified as presenting an 'average' amplifier loading. Third harmonic distortion levels were very low, bar a small rise at around 7kHz. Distortion remained at under 1% even at 50Hz and did not exceed 10% at 30Hz — remarkable for a relatively small enclosure driven to the full 96dB test level.

The sine response illustrated an even, well balanced characteristic. A mild 2dB hump around 500Hz was evident together with a mild upper-mid suckout. Pair matching was very good and held within 1dB throughout the range.

At two metres, a mild mid-prominent trend appeared on the characteristic response, together with a dimming in the presence range. Inspection of the 30° lateral and 10° vertical off axis responses showed this loudspeaker to be very well integrated and it should offer a predictably consistent sound balance over a usefully wide listening area.

Sound quality

The Corelli established an 'average' rating on sound quality overall — a good result considering its price level.

Some weaknesses were shown on the live sound comparisons, where the quality was judged marginally 'below average'. Cymbal reproduction was a trifle brittle, voice somewhat 'boxy' with slight nasality and hardness, and the balance a little on the 'dead' side. Driven hard, compression saturation set in in the midrange, limiting the maximum sound level to a fair 98dBA. On the plus side the low frequency range was judged clean and deep, with good power delivery. Up to 50W average of electric bass could be sustained before overload, though some mild buzzing was apparent from the rear terminal panel at lower powers.

Rated as 'above average' on the stereo sessions, the *Corelli* generally sounded

RECOMMENDED

smooth, clear and even, with fine rendition of detail, and provides good stereo depth and locational information. On occasion it appeared a little 'edgy' with dulled presence and a rather 'small' middy character, but as with the live tests, the low frequencies were praised.

T.F. Comments

This speaker had a dull rather than bright balance, with clean bass but slightly ragged top. It performed well on the stereo tests, and about average on the live comparisons.

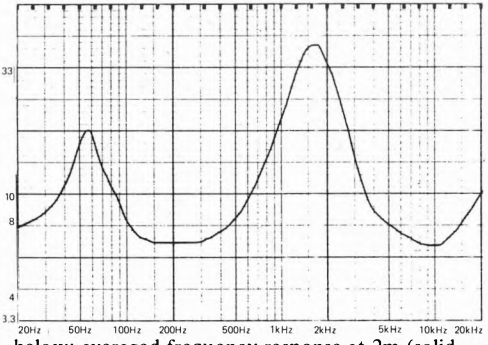
Summary

Exhibiting only mild coloration, an essentially even frequency balance, with very good off-axis uniformity, the *Corelli* offers fair power handling with a fine low frequency range, all contained in a compact package. It is well engineered, easy to drive and low in distortion, and its 'above average' rating on stereo sound quality indicates a clear recommendation in view of its price.

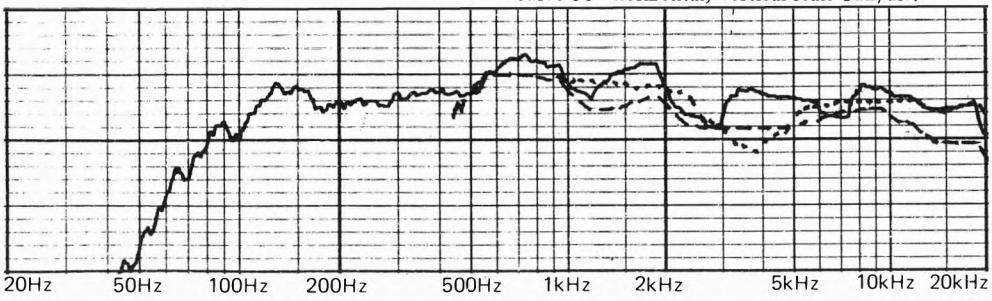
Size	47(18.5) H; 28(11) W; 22(8.7) D; cm(inches)
Weight	9(20) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	85dB 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)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£145

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

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

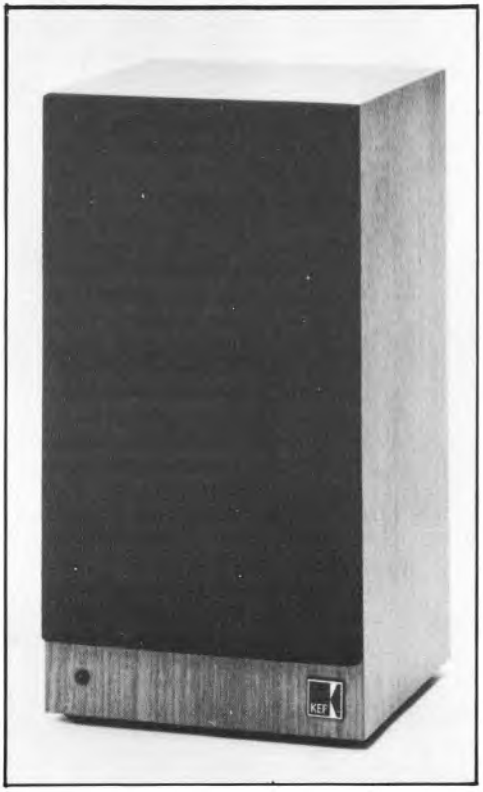


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



KEF R101

KEF Electronics Ltd., Tovil, Maidstone 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 400μf 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.

Lab results

The pair match was excellent, typically +/– 0.25dB and thus confirming 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, presumeably to the correct design specification.

T.F. Comments

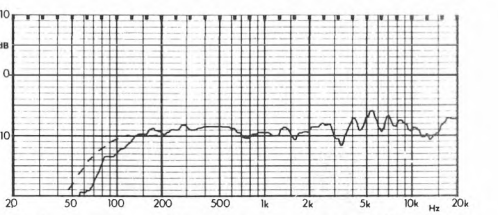
The lack of real bass was a problem on rock, full orchestral and piano reproduction. Stereo imaging was very clear, but overall the bright, bass-light balance resulted in a below average mark.

Summary

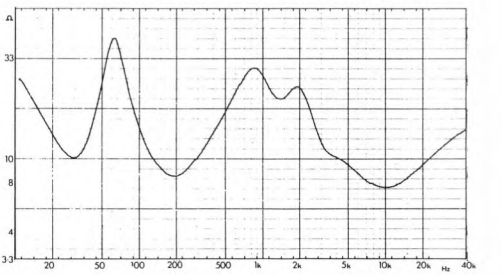
Despite a good technical performance, this diminutive and inefficient speaker possessed a balance of response and coloration which resulted in far less favourable subjective results than for its established relative, the *LS3/5a*.

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, but at its price level in the context of this report, the *R101* does not gain a recommendation.

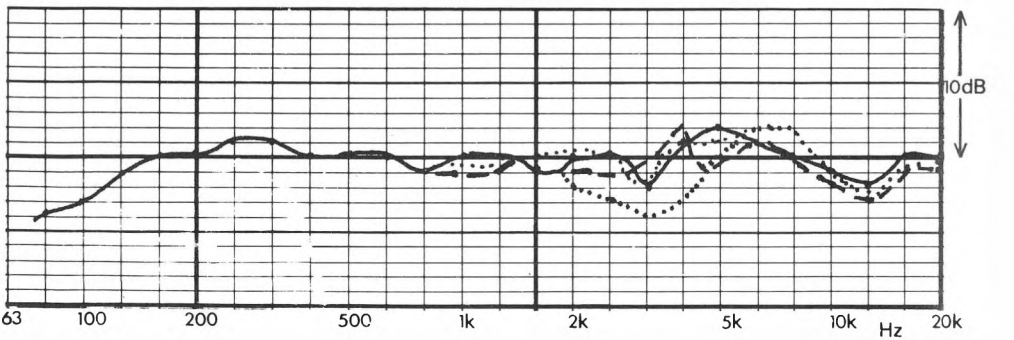
Size	34.5(13.5) H; 18(7) W; 19(7.5) D; cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	50-100W
Recommended placement	on stands or open shelf
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	60Hz
Voltage sensitivity (ref 2.83 V, 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
	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	£180



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

KEF R105 II

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

The *R105* review from the previous issue is largely rewritten here, together with the addition of some new graphs to correct a minor measuring axis error, as we learnt that a *Mark II* version was in the offing. We pressed for samples which were supplied in prototype form, but sufficiently to specification to justify a new photograph and reference curve (dotted line), as well as full stereo program testing.

Essentially both versions are very similar, with the same three drive units. These comprise a 305mm bextrene-coned bass unit, now on a three point fixing to facilitate the resilient mounting arrangement (see *R101*); KEF's recent 110mm bextrene cone midrange driver operating from approximately 400Hz to 3kHz; a 38mm melinex dome tweeter completes the vertical-in-line array. The low diffraction 'head' has been retained, now in a low resonance moulding, while the bass assembly has been changed, with the promise of reduced coloration. The fusing has been replaced by sophisticated electronic protection (see *R101*), which in this model also monitors bass driver excursion. The sighting and peak-reading LED remains, with revised mechanics for the adjustable 'head'. The advanced crossover is designed to attain 24dB/octave acoustic filter respones, in conjunction with the delay-compensated driver positions.

Lab results

(primarily relating to the Mk I version)

Excellent pair matching was demonstrated to within +0.25dB throughout the range until 16kHz, with a minor deviation thereafter. At 86dB/W the sensitivity was below average (*MK II* 84.5dB/W), with a well extended low frequency response to –6dB, at a now rechecked 32Hz. At low frequencies the third harmonic distortion was excellent with just 1%, 40Hz. The *MK I* showed some mild midrange distortion: 0.8%, 600Hz-2kHz and 0.6%, 6-9kHz; unfortunately comparable figures for the *Mk II* were not available. The already fine *Mk I* impedance characteristic (dashed line) was even better for the *Mk II* (solid line).

The frequency responses in the forward plane were quite exceptionally good with near perfect integration and uniformity of both the on- and off-axis curves. The response of the *Mk II* is superimposed on that of the *Mk I* 1m reference curve, and shows an even smoother mid and treble balance, albeit with a small notch at 1kHz (traceable to a reflection from the bass cabinet edge that is somewhat dependant upon measuring distance and axis.)

Sound quality

The *Mk I* demonstrated a fine performance on the live sound comparisons tolerating up to 150W of bass guitar with a clean and deep presentation. However, mild criticisms were made of a trace of mid coloration, mainly in the form of hollowness and nasality. On the stereo sessions it maintained the high score level attained by the original samples in the previous issue, with moderate criticisms of some hardness on piano, and a slightly boxy dulled effect.

Auditioned on the same day, the *Mk II* score improved on that of the *I* by about 15%. The touch of middy 'cold-in-the-head' quality exhibited by the latter seemed to be somewhat

RECOMMENDED

ameliorated, with a better integration of the upper bass/lower mid. The *II* was noticeably smoother with a richer balance but remaining very detailed; however occasional comments were made to the effect that the bass tended to slight boominess using wide band master quality programme, at least as far as our room was concerned. Finally, the stereo presentation of the *Mk I* was if anything further improved.

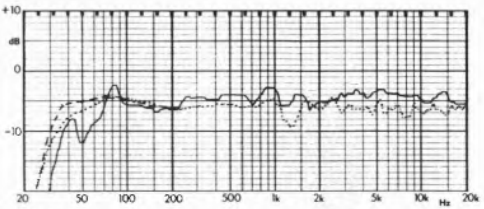
T.F. Comments *(Mk II)*

Apart from a slight bass boom, this speaker was my favourite in this test group, both for its precision and clarity of stereo as well as its full frequency range reproduction.

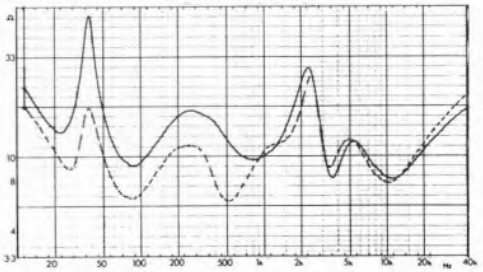
Summary

The *R105* represents the best of the larger three-way designs we have tested, and has been subtly refined since initial production. Unfortunately the sensitivity has been reduced, but the load is now easier to drive and the high power handling means that amplifiers of almost any size may be used on program, with the protection circuitry guarding against misuse. The sound quality has significantly improved if now a touch richer in the bass, while the stereo quality is extremely analytical. While the usual suggestion for auditioning prior to purchase still holds, this design carries our firm recommendation.

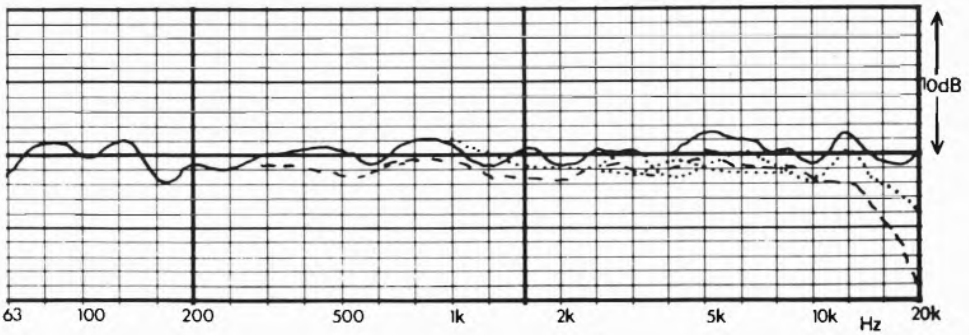
Size	100.5 (39.5)H; 41.5(16)W; 42.5(17)D cm(inches)
Weight	28(61) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25-300W
Recommended placement	on floor well clear of corners and walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	32Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	84.5dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	v. good (Mk I) 40Hz–1%, 100Hz–0.3%, 600Hz–0.8%, typically 0.3%
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	excellent
Typical price per pair inc. VAT	£700



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.) (solid curves Mk I, dotted Mk II.)



Impedance vs frequency (mod Z)



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

RECOMMENDED

KLH317

Webland International Ltd., PO Box 70, Unit 7, 129 Waltham Green Court, Moore Park Road, London SW6. Tel: 01-385 9478

Although made in the States, the usual trans-atlantic price penalty does not seem to apply to this two-way sealed box design of approximately 20 litres internal volume. It employs a 250mm pulp cone driver plus a 25mm soft dome Peerless tweeter concealed behind a grille (the latter company is now in fact part of KLH.) While the external finish comprised an attractive vinyl wrap in the form of a hickory print with convincing 'knots' unfortunately the standard of internal construction gave rise to some misgivings. For example, the woodscrews used to secure the drivers had fragmented the inside surface of the baffle, leaving loose woodchips near the bass driver, while the thick grille panel was not chamfered and no panel damping was present, simply a loose Dacron fibre fill. No soldering was employed in the 3-element crossover, 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, but these comments still did not deter listeners from marking it favourably.

RECOMMENDED

T.F. Comments

I marked this speaker consistently above average. It was on occasion a little overbright but gave good clear stereo and produced high listening levels competantly.

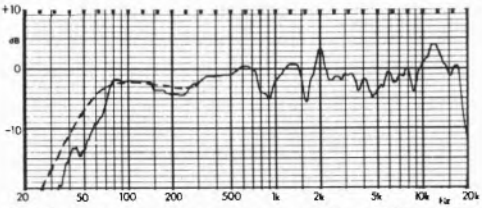
Summary

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

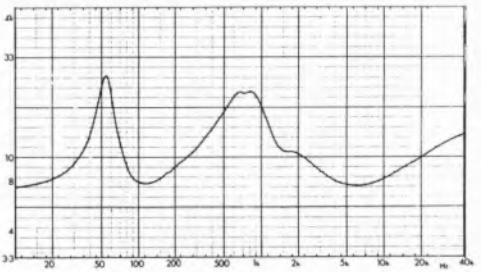
Essentially the *317* offered trim dimensions, a good appearance and high maximum levels, as well as usefully high sensitivity and a very good amplifier loading. The sound was generally neutral and relatively free of coloration, with clean, powerful bass and low distortion — all at attractive price.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

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

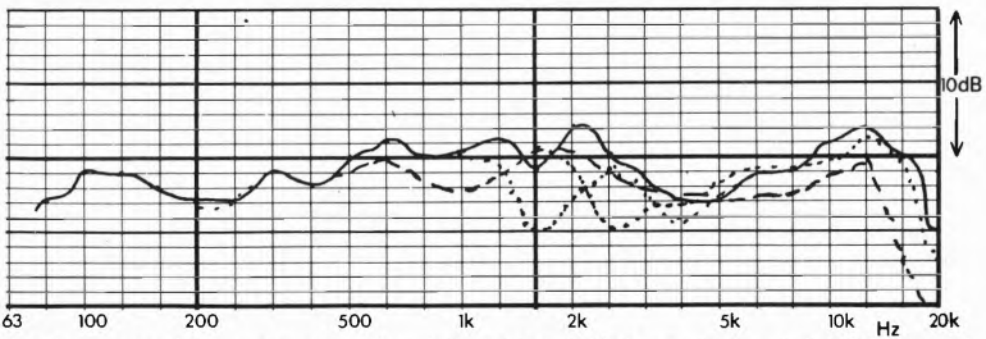
Size	58.5(23) H; 30.5(12) W; 25(10) D; cm(inches)
Weight	13.2(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10-100W
Recommended placement	stand or open shelf
Frequency response within ±3dB (2m)	80Hz-18kHz
Low frequency rolloff (—6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	v. good
	66Hz–1%, 100Hz–0.25%, typically 0.5%
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	good
Typical price per pair inc. VAT	£150



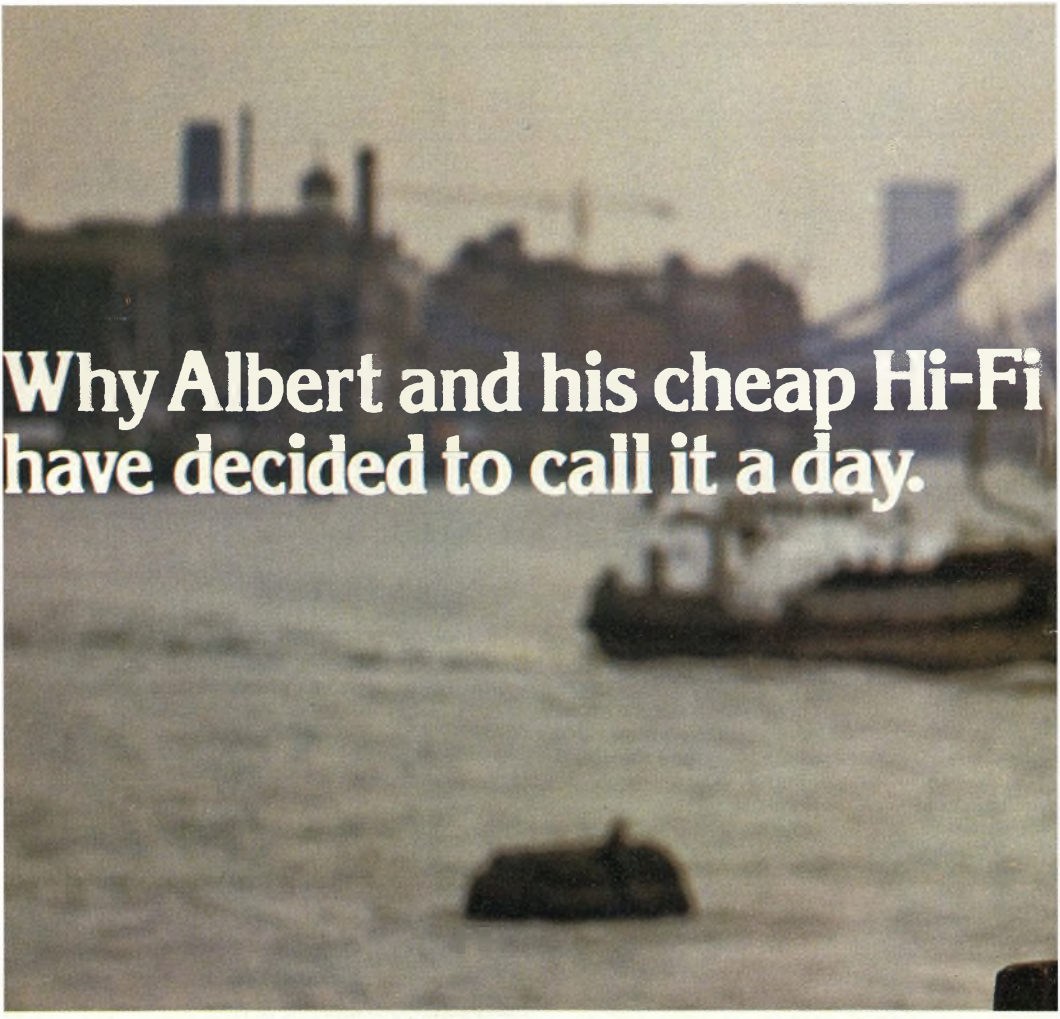
Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)



Impedance vs frequency (mod Z)



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



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Lentek S4

Lentek Audio Ltd., Edison Road Industrial Estate, St. Ives, Huntingdon, Cambs. PE17 4LE. (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 comparitively 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

RECOMMENDED

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

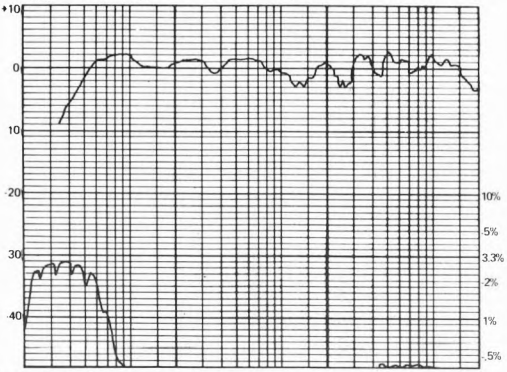
T.F. Comments

I found this speaker consistently above average, with mellow qualities and good overall clarity. Extreme HF seemed slightly lacking, and another HF problem affected string quality and emphasised sibilants; no strong criticisms, however.

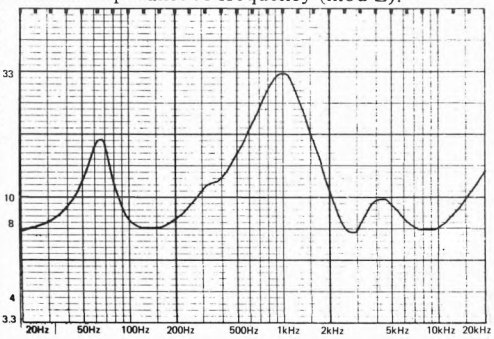
This design packs an attractive performance into a small box. The clean and consistent lab results and above average structural quality indicate skilful production engineering,m and while it is incapable of very high sound levels, at volumes within its compass a clean, wide-range sound is produced. It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

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 (2 m)	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	£220

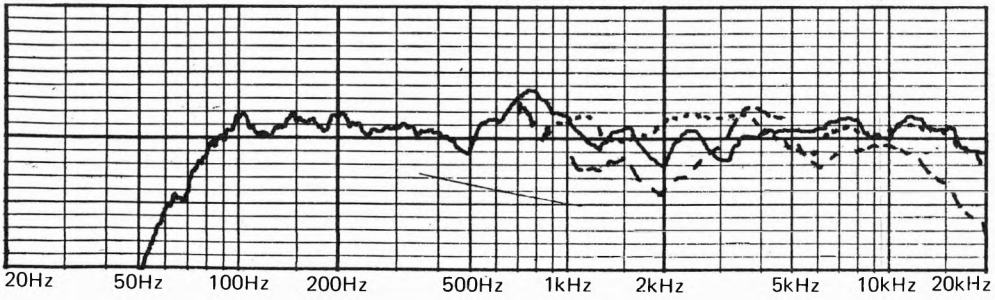
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



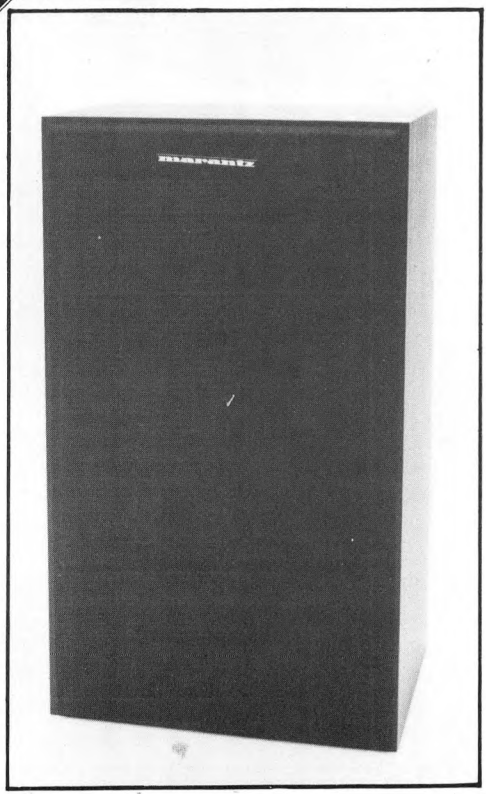
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Marantz 440

Marantz Audio UK Ltd., 193 London Road, Staines, Middx. Tel: 0784 50132



This relatively inexpensive speaker did quite well in a similar test for Hi Fi For Pleasure a few months before this test. However, then it was assessed as part of a rather more limited group of speakers, and as the systems included in *Choice* represent a more exacting standard, it was interesting to see how well it would do in this new situation.

A compact 20 litre enclosure of the sealed box kind, the response of this model coupled with its overdamped bass strongly suggests close wall mounting clear of corners. The dark walnut veneer was in fact a vinyl print, and the enclosure was built of chipboard (a piece of which was left loose inside.) Three drivers are used, namely a 200mm pulp cone bass/mid unit operating up to 2kHz and a 90mm cone tweeter plus a second 90mm unit, the latter working above 8kHz. The crossover is almost non-existent, consisting of only two capacitors feeding the two HF units, and as the drivers are not mounted in a vertical line, no common axis of symmetry exists.

Lab results

Referenced to the mid and treble ranges, the sensitivity was very high at 93dB/W. Inevitably the —6dB low frequency point was also high at 80Hz, although the power handling suggests that bass lift can be used. The pair matching proved good to 2kHz (the first crossover point), thereafter exhibiting imbalances of 2dB and more which are partly attributable to driver interference and asymmetry problems. Rated as good on distortion, values were typically 0.5% with 1.4% noted at 200Hz and 1.5%, 68Hz. A very loud 107dBA was recorded during the power handling test, the speaker partially aided in this respect by its "A" favoured frequency response. Over 100W of programme was well handled (more than enough level at 113dB 1in at 1m). The speaker was also strong on electric bass guitar, surviving 100W without rattles or gross distortion. Rated as an acceptable amplifier load due to a fall to 4.5 ohms at 15kHz (in practice this is not particularly serious), the average impedance was around 6 ohms.

On axis at 1m, the output rose by some 1.5dB from 80Hz to 1.5kHz, while +/—3dB amplitude limits could be applied from 250Hz to 19kHz, thus defining a fairly irregular but suckout-free response. The 80Hz —6dB limit is in fact less pessimistic that it at first appears, since it is reasonable to expect an improvement to 50Hz with close wall mounting.

Measured using 1/3-octave averaging at 2m, the step in the response above 300Hz was plain enough, indicating back-to-wall mounting. The axial trend was pretty uniform above 400Hz, but the off-axis curves proved quite erratic, 10° above showing a 12dB dip in the 1.5kHz band, 10° below, a 6dB trough at 4kHz. The driver asymmetry was emphasised by the 30° lateral curve which also dipped severely at 12.5kHz. These responses suggest that the speaker should be lined up and directed quite carefully at the listener.

Sound quality

For the price, the *HD440* achieved a respectable average rating on the live sound comparisons, helped by its good power handling and clean bass guitar reproduction. While low bass in the real sense of the word was lacking, percussive

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instruments were handled well, although it did appear a trifle aggressive and coloured, with criticisms made of edgy, sibilant, honky and boxy effects.

On the wideband program, the stereo reproduction was considered weak, particularly for listeners not directly in line with the driver axes. Directional biases in some parts of the range were also obvious, even in mono. While pop program was competantly produced and overall clarity was good, this was countered by a hard, slightly 'megaphonic' quality, and several panelists commented on a fatiguing tendency, particularly on orchestral pieces.

T.F. Comments

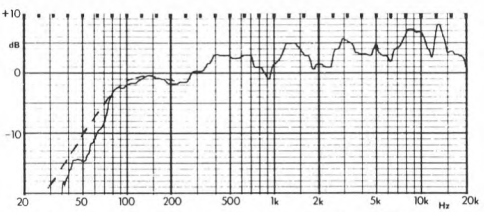
With a confusing stereo image particularly at high frequencies, I also found this speaker to have a hard and edgy balance, this resulting in a below average rating for me.

Summary

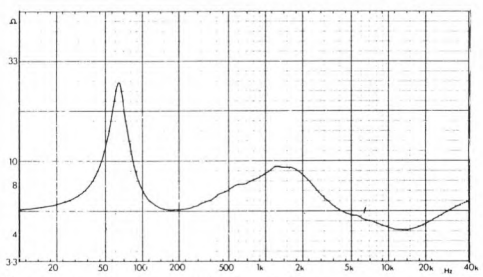
This nicely finished and inexpensive speaker suffers from coloration effects and a forward, slightly aggressive quality, but fortunately these may be countered to a great extent by tone control adjustment and wall mounting. While the weak stereo cannot be improved, this aspect may well prove of secondary importance to some users, who might value greater the system's exceptional loudness, sensitivity and good clarity. Rock program suited it better than classical, and on this basis it can be recommended, albeit with a proviso to audition it first.

Size	49(19) H; 28(11) W; 23(9) D; cm(inches)
Weight	kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	5-100W
Recommended placement	open shelf, back to wall
Frequency response within ±3dB (2m)	300 to 16kHz*
Low frequency rolloff (−6dB) at (1m)	80Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	93dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	107dBA
Third harmonic distortion (96dB at 1 metre)	good 68Hz–1.5%, 200Hz–1.4%, 400Hz–0.3%, typically 0.5% overally
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£95

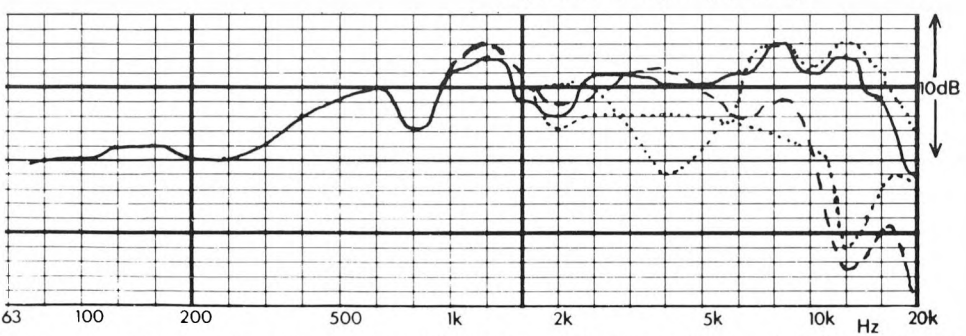
* See text.



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



Impedance vs frequency (mod Z)



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

RECOMMENDED

Mission 770

Mission Electronics Ltd., Unit 9A, George Street, Huntingdon, Cambs.
Tel: 0480 57151

When reviewing Mission equipment I seem to be fated to endure a succession of updates and improvements, largely deriving from the obsessive dedication of the Company's founder to upgrading and improving the performance of his products. Three samples of *770* were in fact evaluated during this project, and an attempt has been made to link up the results, reporting more fully on the final sample which we are assured is the last! In fairness, it must be said that the changes in fact involved detailed refinements rather than drastic alterations.

The well finished 38 litre damped-panel box carries a screen-printed Mission insignia on the driver panel beneath the removeable Declon front. Both drivers are made by SEAS, with the exclusive 210mm polypropylene cone bass/mid unit operating up to 2.7kHz, reflex loaded by a small 55mm diameter tunnel port. The 25mm plastic dome tweeter is a special ferro-fluid damped unit, a technique which offers a large power handling capability. The crossover is a relatively simple design, comprising 6dB/octave bass and 12dB/octave treble slopes, and uses high power components; unfortunately it was not properly fixed to the cabinet, just glued to the back in a fold of thin foam plastic. A low purpose-designed stand is included with the speakers.

Lab results

At 86dB/W the sensitivity was low, although typical for this class of enclosure, and it was to its advantage that the impedance classified the *770* as a very good amplifier load. The LF point was quite well extended at 42Hz —6dB, and the pair match was to a very high standard. Generally good on third harmonic distortion, the results were typically in the 0.3 to 0.2% region, although somewhat worse at low frequencies, rising to 10% at 52Hz. A strange harmonic distortion spectrum extending to, for example, the 11th harmonic at 96dB, 52Hz was also found, although the amounts measured were at low levels of around 0.2%. It was suspected that the SEAS eddy-current overdrive damping rings on the voice coil of the bass driver might be responsible. Power handling proved very good on music, with 150W of electric bass guitar cleanly reproduced, together with 200W peaks on wideband program. Impedance curves showed no significant deviation between samples, with the typical value at 10 ohms and a 6.6 minimum at 20kHz.

Axial responses for a 1m sine wave drive refer to the first and last (dotted) speakers supplied. They revealed +/—2.5dB limits for the 55Hz-16kHz range, and looked promisingly smooth and balanced.

At 2m (for sample 1, but should be representative), the responses were quite smooth and undoubtedly well integrated. This was particularly the case with the 10° above and lateral axes, the less useful 10° below vertical curve being the one with dips at 2 and 4kHz. Thus despite the simple crossover, the driver outputs were nonetheless skilfully married.

Sound quality

Judged by the first sample, the comparisons with live sounds denoted an unpromising 'average' rating, with criticisms of a mild 'boxy woodeness' to the sound, and a slightly dull impression overall.

Mission 770

RECOMMENDED

On stereo program there was time to audition the final pair, which fortunately did well, and might have returned better marks on the live tests. With its lower coloration and more open balance. Highly rated on clarity, the stereo presentation was also good with a fine depth transparency, although not without hints of a forward detachment to transient sounds, which is believed to be due to a mid-treble imbalance. Overall the frequency balance was a trifle too 'open', verging on the metallic, and a touch of sibilant exaggeration plus mild 'boxy' coloration was also apparent.

T.F. Comments

Although definitely above average, I did find that this speaker was forward in the treble, giving an impression of a suckout and distorting the front to back stereo perspective by placing transients in front of everything else.

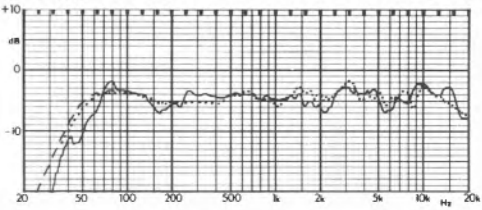
Summary

This compact model offered presentable bass considering its size, as well as a good amplifier load and fine stereo, with moderate distortion and good power handling. Coloration levels were quite low, while the frequency balance was better than usual, with favourable overall subjective results.

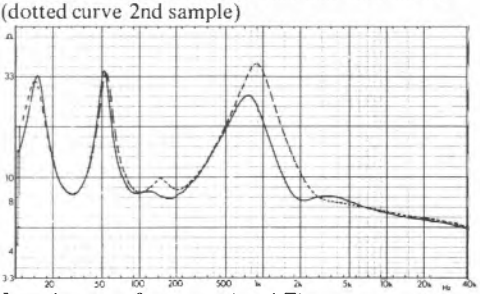
However, while these factors all combine to produce a good class speaker with a final performance that justifies recommendation, it must be said that the results showed a balance which tends to brightness, and this may or may not favour a given environment and/or ancillary equipment; careful auditioning is clearly desirable.

Size	59(23) H; 30(12) W; 30.7(12) D; cm(inches)
Weight	12.7(28) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20-150W
Recommended placement	on stand clear of boundaries
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	42Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	100dBA
Third harmonic distortion (96dB at 1 metre)	good* 52Hz–10%, 100Hz–1%, 500Hz–0.3%, typically 0.3 to 0.2% overall. Low frequencies show wide distortion spectrum
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£350 (inc stands)

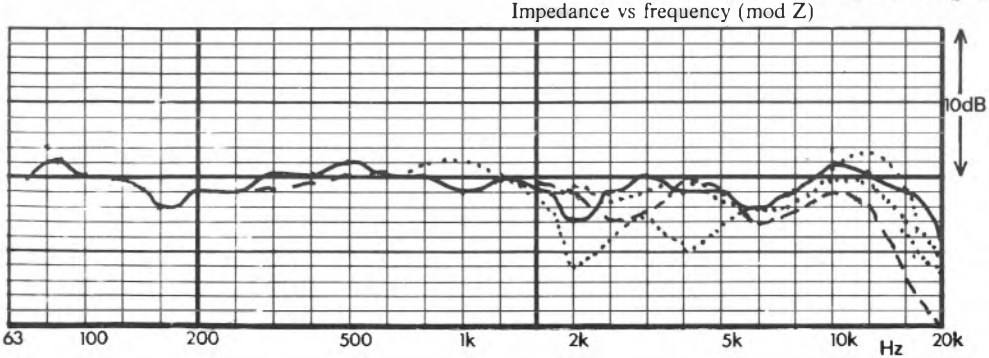
* First sample



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.) (dotted curve 2nd sample)



Impedance vs frequency (mod Z)



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

RECOMMENDED

Monitor Audio MA6

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

Partnering 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. With a lowish sensitivity at 86dB the manufacturer's claim of high efficiency was not verified, although the measured sensitivity is in fact exactly to specification. A typical –6dB point of 46 Hz 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 trifle low at 96dBA but nonetheless 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 just 'acceptable' 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.

However when fed with a more complex stereo diet, its overall ranking improved to above average, with a comparatively good mark for stereo imaging. The latter showed reasonable depth, albeit with some lateral imprecision, and while the upper treble was a trifle fizzy, it balanced the moderate bass emphasis which lent a subdued overall effect. Some boxy coloration was present, but the clarity was to a normal

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standard and the midband also seemed quite unstrained and neutral.

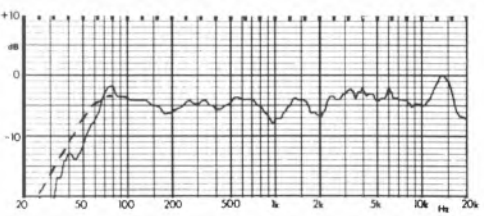
T.F. Comments

Overall I rated this speaker at just above average albeit with an uneven frequency balance and response.

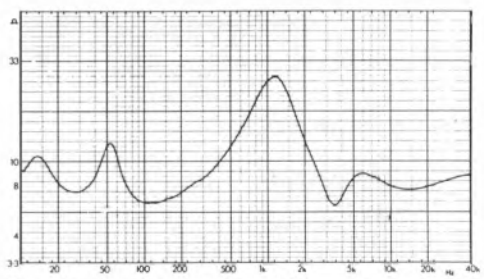
Summary

A well finished speaker of clean appearance, the *MA6* was not sufficiently accurate in the absolute sense to do well on the live sound comparisons, but nonetheless 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. While high sound levels were impossible, the *MA6* was easy to drive, showing quite good response uniformity and off-axis integration as well as low distortion; as such it merits recommendation in view of its well below average price.

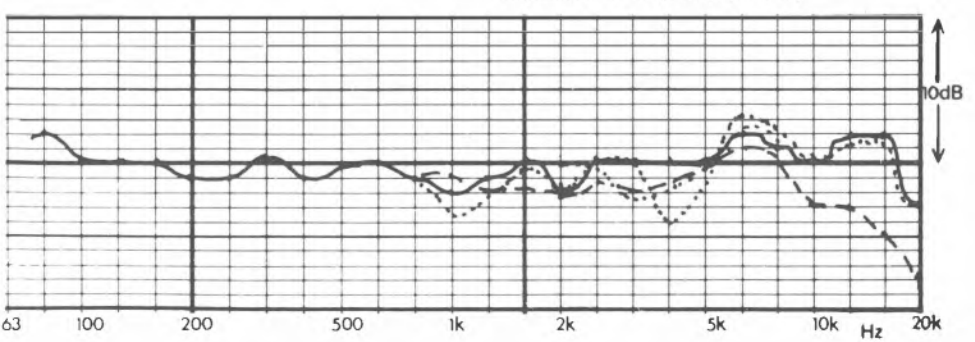
Size	58(23) H; 30(12) W; 28.5(11) D; cm(inches)
Weight	13(28) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20-150W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	63Hz to 18kHz
Low frequency rolloff (—6dB) at (1m)	46Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	96dBA
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



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

Monitor Audio Mini Monitor

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

As regards size and drive units, this low efficiency speaker, developed from the *MA8* reviewed in the previous issue, appears broadly similar to both the Ram *Mini* and Audiomaster *MLS1*.

A sealed box model of some 10 litres volume, the bass-midrange is supplied by a 65mm frame bextrene coned Audax driver, with the ubiquitous 25mm soft dome Audax tweeter completing the lineup. A complex 12-element crossover is incorporated, built with good quality components.

Excellently veneered in American walnut, this speaker had a substantial multiply driver-baffle with bituminous panel damping on the cabinet walls, and in addition to an acoustic foam lining, polyester fibre filling is also included. Standing some 38cm high, it is undoubtedly in the ultra-compact bookshelf class, but in common with other similarly sized models such as the *LS3/5a*, the sound quality benefits from stand mounting in free space.

Lab results

Generally within 1dB of each other, the two axial response curves were quite well matched, and while easy to drive, the sensitivity was very low at 81.5dB/W; however, the 50Hz -6dB point was good for this size of enclosure. At 90dB distortion was fine, but at the 96dB standard level, 1 metre the bass unit was clearly running out of breath, although all was well at this power level at the higher frequencies. The power handling on electric bass guitar was limited to an average of some 15W but the bass was relatively clean and neutral to this level, if lacking real depth on the fundamental. On wideband program it attained a decently loud 99dBA, absorbing a peak power of up to 250W per channel to attain this level, which in practice is well above the safe continuous rating. With an average impedance of 9ohms and never falling below 7, the *Mini Monitor* was a very good amplifier load, which serves to marginally offset the effects of the low sensitivity reading.

On axis the response was untidy, with an elevation from 300Hz-2kHz, followed by a sucession of +/-5dB peaks and troughs before the treble settled down above 7kHz. ⅓-octave averaging at 2m did not improve matters a great deal, and showed that if anything the treble band was mildly supressed. The more often used 10° above vertical axis imparted a 8dB crossover trough at 3kHz with the less useful 10° below characteristic undoubtedly superior, giving a better response than on axis. By implication, the speakers should either be tilted up to face the listener, or if this is impossible, in the absence of a highish shelf position, they could be inverted. At 30° off-axis laterally the response was quite well integrated.

Sound quality

Based on the results of the live sound comparisons, the *Mini Monitor* scored a quite respectable 'average' rating, as these smaller boxes often do. The panelists described several colorations, notably 'middy', 'boxy' and 'hollow' effects, with the balance felt to be a little too mellow.

Wideband stereo program did not suit it so well, giving a 'below average' score. While the

stereo image was quite presentable, the speaker was felt to be slightly fizzy in the treble, clarity was unexceptional, the bass lacked power and firmness, while some hollow and boxy effects were also present.

T.F. Comments

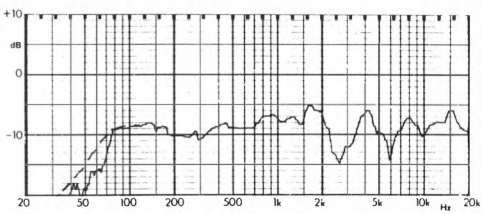
For me this speaker's sound balance resulted in a lack of real bass and a somewhat dulled but fizzy string quality. Stereo imaging was however better than average.

Summary

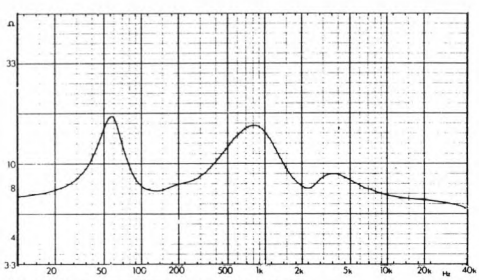
Representing an improvement over its predecessor, the Mini Monitor was an inefficient but easy to drive speaker, and while its bass extension was limited it was nonetheless good for its size, and reasonably high sound levels could be attained by using a large enough amplifier. However, despite these promising aspects, when judged by the high standards set by certain other models in this report, its overall quality does not merit recommendation.

Size	38(15) H: 23(9) W: 19(7.5) D: cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	45-100W
Recommended placement	on 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)	81.5dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	99dBA
Third harmonic distortion (96dB at 1 metre)	good
	60Hz -12%, 100Hz-2%, 2kHz-0.8%,
	typically 0.3 to 0.5%
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	average
Typical price per pair inc. VAT	£100

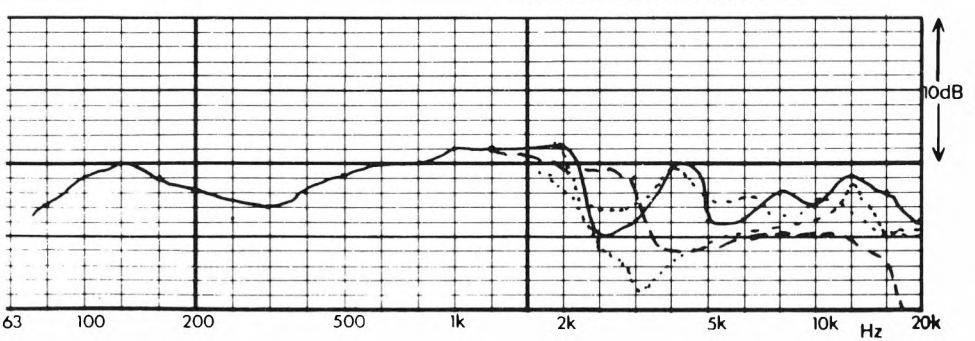
* See text



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



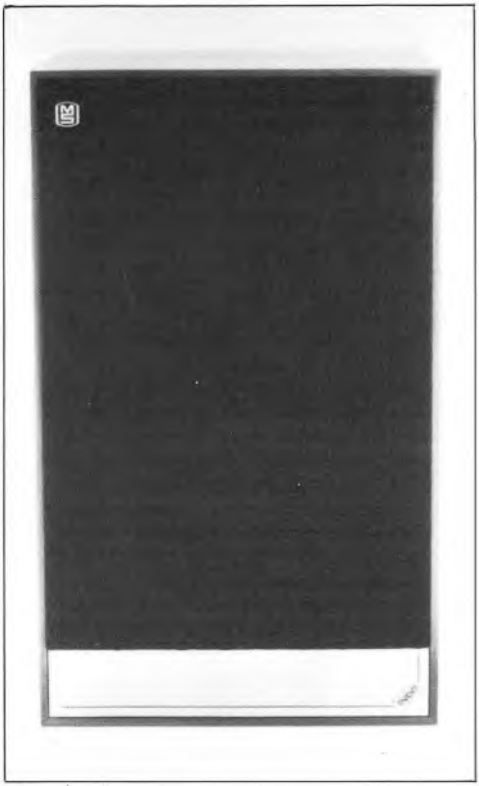
Impedance vs frequency (mod Z)



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

Mordaunt-Short Pageant 2

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



Another model which was assessed in the previous edition of *Loudspeakers*, the *Pageant* has since undergone slight revision, with the Isophon tweeter now altered to remove a previous rise in harmonic distortion at 10kHz. A slim, compact design, stand mounting is recommended, but an open shelf is also permissible. Mid and HF attenuation are both provided, giving 2dB of shelf cut.

Technical details

Mordaunt-Short's own 200mm bass-mid unit is incorporated, this having a flared pulp-cone diaphragm treated with a doping compound and operating throughout the bass and mid-range. An Isphon 25mm plastic-dome unit continues the response above 3.5kHz, and reflex loading is provided via a small ducted vent. The precision crossover uses 12 and 18dB/octave rolloff slopes.

Lab results

Generally very good pair matching was noted, with a narrow area from 1-2.5kHz where a moderate 1.5dB difference was apparent. The sensitivity was above average at 88dB (and this is also higher than for many similar enclosures) with the —6dB LF point placed at 50Hz.

Performing well on the distortion tests, the low frequency third harmonic content was commendable at 1%. 50Hz and 5%, 30Hz, although minor spikes of about 1.5% were also present at 200Hz and 2kHz. The good LF power handling indicated that bass lift could be applied without trouble if this appeared necessary. With a minimum impedance of 6 ohms and averaging 9, good amplifier loading is indicated, and the reactive elements were also well controlled

The 1 metre sine wave curve showed a +4dB lower-mid hump centred on 400Hz. Some irregularity was apparent in the treble band, with a rapid falloff above 16kHz; for example, to —7dB at 20kHz. Out at the 2 metre mike spacing, the mid was still prominent, with a well controlled low frequency rolloff below. Essentially the trend was even and well balanced. The 30° and 10° off-axis curves showed close conformity with the axial master response, and the forward output was very well integrated and dispersed. Above 12kHz the 30° off-axis rolloff was significant — a not uncommon result.

Sound quality

Taken overall the Pageant scored an average placing, which is good in relation to its price. It did its best in the stereo session, where it was reckoned to offer clean, precise imaging with with excellent rendition of musical detail. Not too much stereo depth was apparent, this attributable to the presence of certain colorations, described by the panel as moderate 'middy', 'boxy', 'hard' and slight 'fizz' effects.

Compared with the live sounds these colorations seemed to be more obvious, with clear indications of 'hollow', 'boxy', 'hard', 'brittle' and 'brash' effects in moderate quantity. The speakers did not like being driven too hard, with saturation effects limiting the maximum level to a nonetheless fair 98dBA. Buzzes and chuffs were clearly

heard above 10 watts average of bass guitar.

T.F. Comments

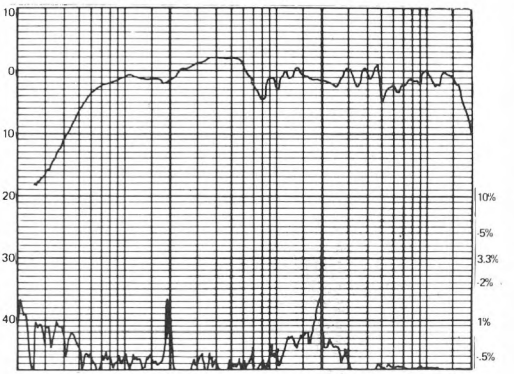
Just below average, I noted a slight bass boom, some hollowness, and also some treble brashness.

Summary

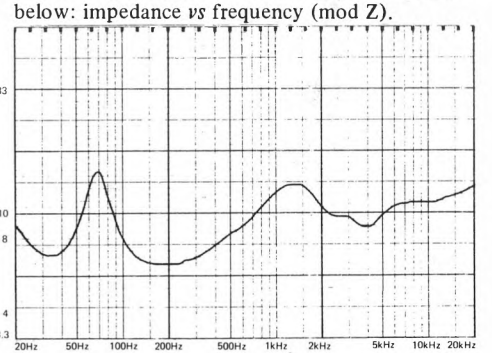
Still quite good value for money, the Pageant offers slightly above average sensitivity and is easy to drive. It is fitted with response controls, is well engineered and is also capable of precise stereo. Since last assessed, the competition in its price bracket is rather fiercer, particularly in terms of coloration levels, and it is this aspect more than anything which prevented it gaining a recommendation.

Size	53.3(21) H; 33(13) W; 23(9) D; cm(inches)
Weight	9.6(21) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 50W
Recommended placement	stand (shelf?)
Frequency response within ±3dB (2m)	90Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc. VAT	£160

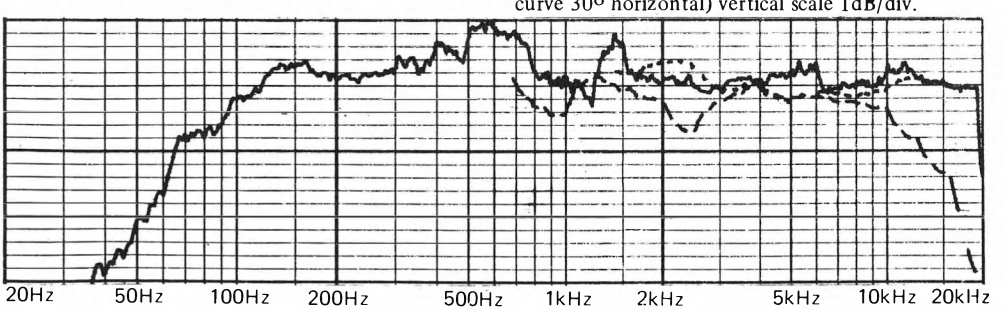
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref Od**B**).



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



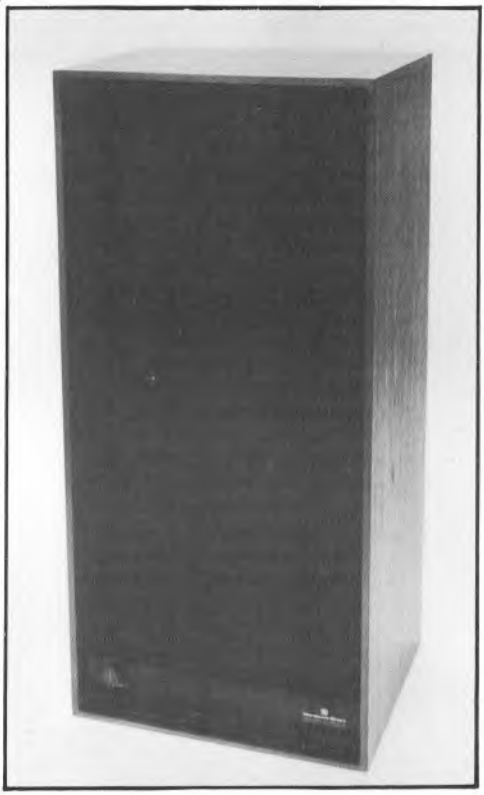
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1d**B**/div.



RECOMMENDED

Mordaunt-Short Signifer

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



This brand new system 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. (This was despite a fault in the impedance characteristic of one of the samples, which does not appear to have affected either pair matching or subjective results.) Of lowish 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 atypically 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) related 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.

RECOMMENDED

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, 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.

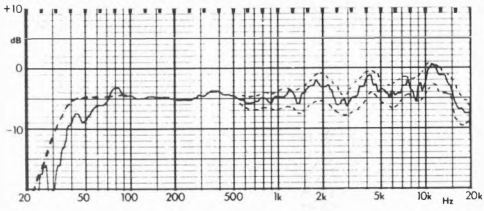
T.F. Comments

With a slightly rough upper treble, I found this model a little dull in balance, but nevertheless marked it well above average. Good stereo imaging was in its favour.

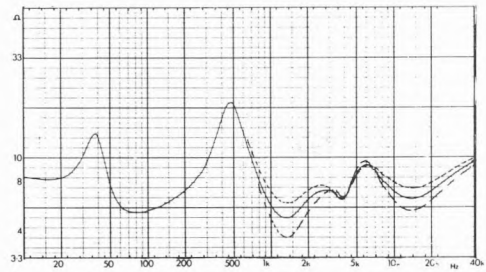
Summary

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.

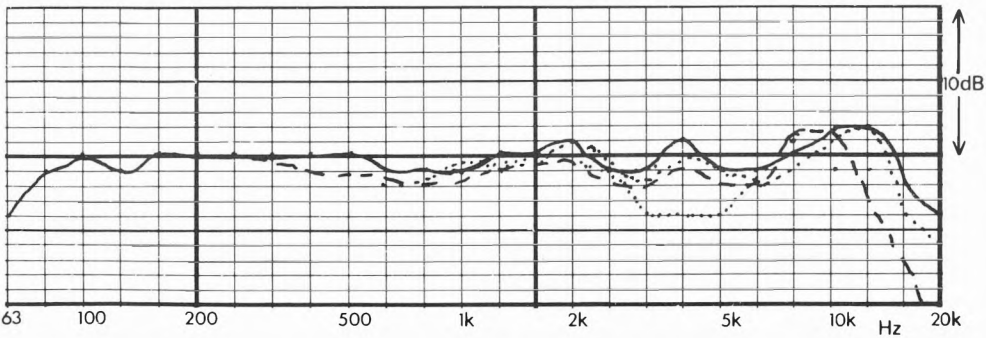
Size	81(38) H: 38.5(15) W: 33(13) D: cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–250W
Recommended placement	on M/S stand well clear of walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	33Hz
Voltage sensitivity (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	£475



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

Philips AH587

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

A highly compact 19 litre enclosure, the *587* sports a vertical-in-line array of three drivers, these comprising a 200mm pulp cone bass unit working to 650Hz, a 50mm soft dome midrange, and finally a 25mm soft dome tweeter which takes over above 3.5kHz. Although the price of around £420 per pair may seem high on first sight, it includes six power amplifiers (one for each drive unit), full electronic crossover circuitry plus motional feedback, the latter applied to the bass to extend the response and reduce distortion. Furthermore, three adjustments to the low frequency response are available, and can be selected to correct for 'rear-to-wall', 'floor-standing' and 'side-to-wall' anomalies.

The model is well engineered, particularly on the electronics side, the cabinet being excellently finished in black veneer and the drivers highlighted by bright alloy trims. 'Stand-by' and automatic switch-on electronics are inbuilt, while both gain and alignment controls are easily accessible, with generous mains and signal interconnection cables provided, as well as good instructions.

Lab results

Except above 15kHz where differences of up to 2dB were present, every minor irregularity was common to both models to within 0.5dB. The input is very versatile, offering a high (10kΩ) impedance and 1-3v sensitivity to match typical pre-amp outputs, or a 1kΩ impedance and variable sensitivity up to 25v so that it may be driven directly from the power outputs of an amplifier or receiver.

The –6dB point of 43Hz was low for such a small system and can be attributed to the *MFB* system. Overall the distortion was excellent, although 3% was recorded at 54Hz with 0.5%, 100Hz. The power handling was simply limited by headroom in the internal amplifiers (50W bass, 20W mid and 5W HF). Levels of the order of 100dB lin at 1m were possible above 60Hz, and on program a quite high maximum reading of 100dBA was attained. Bass guitar was reproduced with good eveness and fair power.

While fundamentally good, the response when measured on axis at 1m showed two suckouts at 2kHz and 6kHz. The grille frame was suspect in this context, and when removed, the depth of these notches was actually halved. A gentle rise was also apparent with increasing frequency, amounting to 3dB from 100Hz to 10kHz. At 2m the $^1/_3$-octave averaging provided some flattening of the characteristic. The 10° above axis resulted in the 5kHz suckout, so this system should either be at ear level, or alternatively, tilted up towards the listener. This aside however, the responses showed good uniformity and integration.

Sound quality

Compared with live sound the *587* scored 'average' overall. Colorations described included sibilance on voice, a hard nasality and some treble uneveness. The bass was good for the size of box but not outstanding in comparative terms.

On the stereo program the sound was less favoured, rating as 'acceptable', which is well

below average. (For all the subjective tests the controls were set flat and the speakers used on open stands, as with the other models.) The sound balance was described as thin, with 'cup-like' 'nasal', 'reedy', and 'boxy' colorations. Despite a creditable performance in terms of imaging, the stereo lacked depth even though the speaker initially gave an impression of clarity and 'openess'.

T. F. Comments

Tony Faulkner was not present during this model's auditioning.

Summary

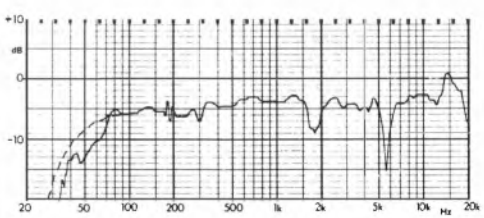
Value judgments are complicated here by the presence of the built-in power amplifiers and their associated electronics, together with the bass equalisation compensation controls. The complete price of around £420.00 a pair can be broken down into two separate sums which we estimate as c. £220 for the electronics and c. £200 for the loudspeakers. Unfortunately assuming this 'comparative' price and judged by the standards set by other models in this report, they cannot be recommended.

Incidentally, Philips own conventional (passive) *RH487* design set its own high standards by which this model must be judged; warmly recommended in the last issue, the *487* is unfortunately now virtually withdrawn from the market.

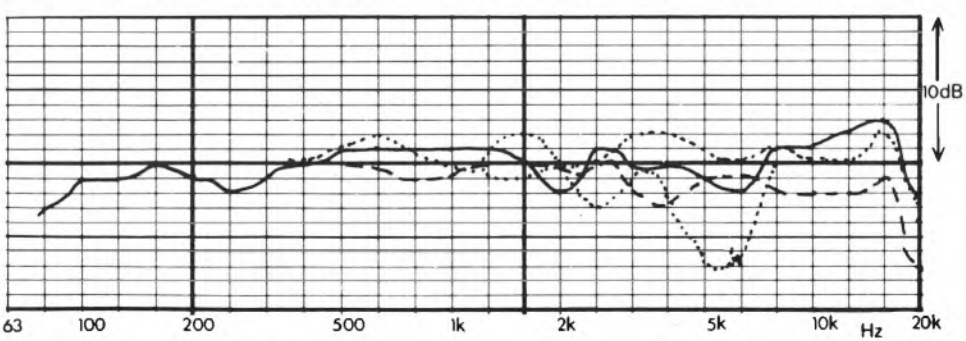
Nevertheless the facility to adjust the response electronically for different room locations could well be useful, and some of the response anomalies criticised could also perhaps be countered by means of some rear presets, though these appear to be intended for factory adjustment only, and no calibration was provided.

Size	48.7(19) H; 30(12) W; 23.7(9) D; cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	built in amplifiers
Recommended placement	stand or shelf*
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	43Hz
Approximate maximum sound level (pair at 2 metres)	106dBA
Third harmonic distortion (96dB at 1 metre)	excellent 54Hz–3%, 100Hz–0.5%, 200Hz–0.2%, 1.4kHz–0.1%; typically 0.15% elsewhere
Forward response uniformity	v. good
Typical price per pair inc VAT	£420

* See text.



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



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

Pioneer HPM100

Shriro (U.K.) Ltd., Shriro House, The Ridgeway, Iver, Bucks, SLO 9JL. 0753 652222/7.

This substantial system features the unusual High Polymer (HP) upper treble unit developed by Pioneer, in the form of a cylindrical section of piezo-electric film, covered by a fine metal grille. The use of a carbon fibre blend for the bass driver is also described in the brochure. Classified as a 'bookshelf' model by the manufacturers, its large size suggests stand mounting, the latter successfully adopted on test.

Technical details

A four-way design, the enclosure is reflex loaded by a long pipe. The massive framed 305mm LF driver employs a ribbed pulp cone, and operates up to a surprisingly high 1.2kHz point. A 100mm cone driver takes over at frequencies between 1.2 and 4kHz, followed by a 45mm lower treble unit working from 4-12kHz. Above this range the tweeter finally takes over with less than half an octave of useable audible bandwidth remaining. The crossover is relatively primitive for such an array, although the components are of good quality.

Lab results

The correspondance between the reference curves was not particularly good with these samples. A pair mismatch of the order of 5dB existed between 2 and 8kHz, no doubt partly due to the poor integration. Outside of this range the matching was much better. The measured sensitivity was high at 92dB. The usefully low 6dB cutoff point was at 38Hz, and while only small phase shifts were present in the impedance, a dip to 4 ohms was present at 10kHz, placing the amp loading in the 'acceptable' category.

Very good third harmonic distortion levels were recorded, with moderate maxima of 0.6% at 7kHz; even the 50Hz reading was still fine at 0.8% with only 3% at 30Hz.

At 1 metre the sine wave reference curve showed rather severe phase and driver integration anomalies, paticularly above 2kHz. A +3dB, 500Hz mid-prominence was apparent, with an additional emphasis in the treble range. The mid emphasis was confirmed on the 2 metre characteristic response. An early rolloff was shown on all measurement axes, suggesting that the super tweeter output was inadequate. The off-axis response did not exhibit good integration of driver outputs, but indicated that the optimum listening postion for this model was about 20° lateral and 10° above the main axis; for example when used with the loudspeaker axes crossed in front of the listener.

Sound quality

The perceived frequency balance and quality was found to be position dependant, thus confirming the curves. Despite this problem, an 'above average' sound quality was assessed from the panel scoring. Under the circumstances, the 'acceptable' stereo image rating is understandable.

On stereo programme, clarity was good with a fine low frequency extension, but some panellists felt the strings were poor, with a lack of extreme high frequencies. 'Boxy', 'middy' and 'hard' colorations were all

present to a degree.

An 'average' truth-to-life rating was assessed, with the maximum power input limited to a 125W peak. Due to the onset of aggressive effects, the corresponding maximum loudness level was set at a fair 101dBA, but the bass power handling was excellent, the speaker sustaining up to 200 watts average of electric guitar with only the slightest suspicion of a rattle. The speaker was, however, considered to be moderately coloured by comparison with live sounds, with some 'brittle', 'nasal' and 'shrill' effects.

T.F. Comment

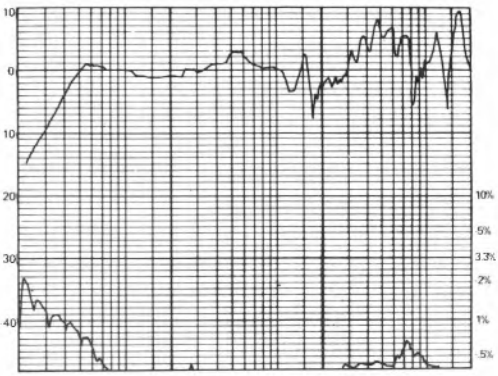
Despite a poor mark for stereo image, which I found confused, this system was only just below average. Extreme HF seemed to consist of pencil-beams which changed the overall quality and balance with head movement.

Summary

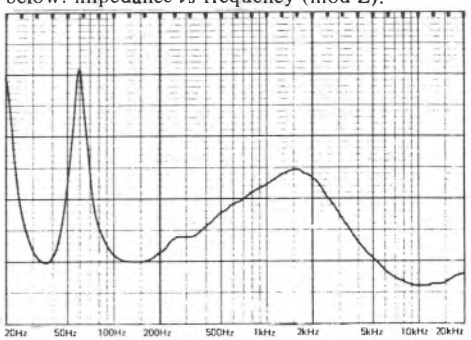
A sensitive loudspeaker offering good clarity, fine sensitivity and outstanding bass, the *HPM100* is clearly marred by moderate levels of coloration, a fairly difficult amplifer loading, and a strong position-dependant frequency balance. It is this latter unpredictability which largely prevents this speaker from gaining a recommendation.

Size	67(26.3) H; 39(15.3) W; 39.3(15.5) D; cm(inches)
Weight	26.7(59) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	38Hz
Voltagesensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	92dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£400

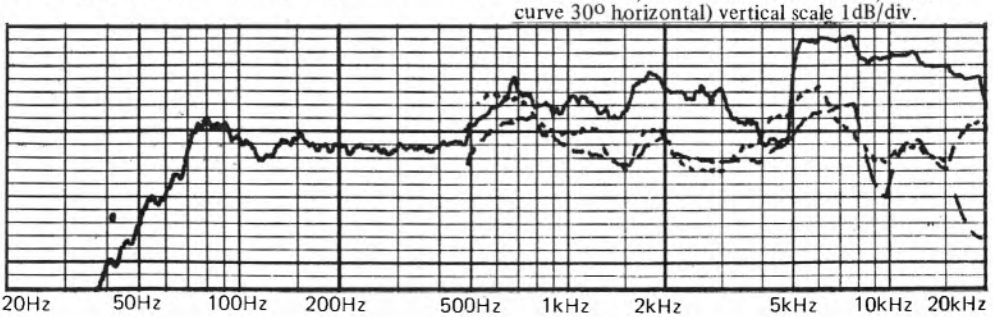
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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

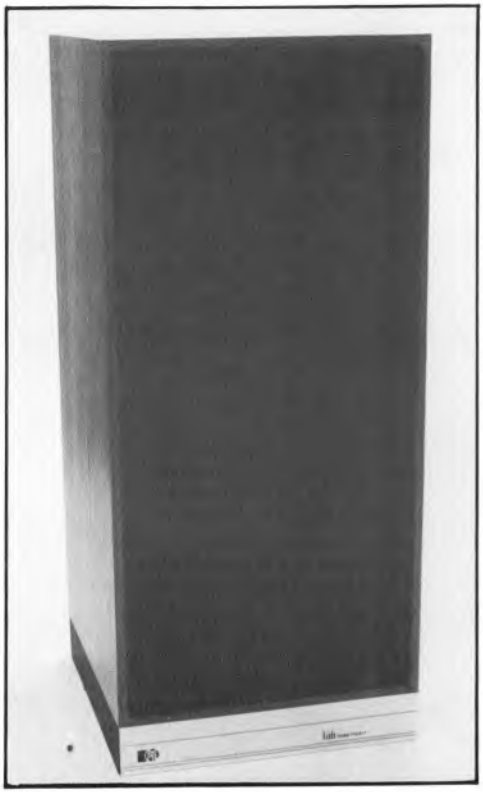


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Pye 5777

Pye Ltd., 137 Ditton Walk, Cambridge, CB5 8QD. Tel: 02205 2781



These slim loudspeakers are fitted with a small plinth to allow floor mounting, their 40 litre sealed box loading the 250mm Audax pulp cone bass unit (this version fitted with a fairly small magnet.) Two further units from Audax complete the vertical-in-line array, namely a 37mm soft dome upper mid driver and a 25mm tweeter. The basic 9-element plus resistors crossover is of good component quality, working nominally at 900Hz and 7kHz, although it is suspected that the 7kHz region is faulty in design, (see impedance results).

The light chipboard cabinet has no panel damping, the internal volume absorption provided by a moderate polyester wadding fill, while the 12.5mm thick grille panel was not chamfered on the edge adjacent to the treble drivers. No controls are provided, the connections made being made via a universal panel; 4mm sockets or DIN plugs may be used.

Lab results

It was clear on test that one of the first pair was incorrect, for although it worked, it was noticeably less even in response. Accordingly we obtained a second pair which we used for all subsequent testing, and these in fact exhibited quite a good pair match, with a low-to-average sensitivity of 87dB/W. The -6dB LF point was fairly typical at 45Hz. Very good third harmonic distortion results were obtained ranging from 3%, 53Hz to a typical 0.2%-0.3% over the remainder of the frequency range.

A mild rattle was noticed on 15W of bass guitar, but beyond this level up to 100W average was accepted, which is a fine result. 101dBA resulted from an input of 200W peak, but the subjective result was rather aggressive. Rated as poor on impedance, the *5777* dipped to a low 3 ohms at an important part of the spectrum where full program peak power is often encountered, namely 7kHz. It appears likely that the manufacturers may have overlooked this problem, as elsewhere the mean impedance was of the order of 8 ohms. On axis at 1m, the curve showed some balance irregularities, notably a mid dominant response with an uneven, depressed treble. The upper bass was also a trifle prominent.

At 2m the general characteristic was largely unchanged and the spectral imbalances more clearly defined. Up to 6kHz the off-axis curves were well integrated, but above this point the results deteriorated. In the vertical plane the 10° above response demonstrated a 11dB loss at 8kHz, while the 10° below axis response gave a suckout at 10kHz. As expected, however, the lateral 30° responses were rather better since crossover interference problems cannot upset these results unduly.

Sound quality

As the testing progressed, it soon became apparent that the sound quality of the *5777* was just not good enough, and after the full statistical analysis had been conducted, a 'poor' rating was indicated for both program sequences.

By *Choice* standards the *5777* sounded rather coloured with characterisations of 'hard', 'ringing', 'thick', 'boxy', 'edgy', 'nasal', 'boomy' and 'fizzy' effects frequently made by panelists. Details in the music were withdrawn, the sound regarded as fatiguing and the stereo imaging as

disappointing.

T.F. Comment

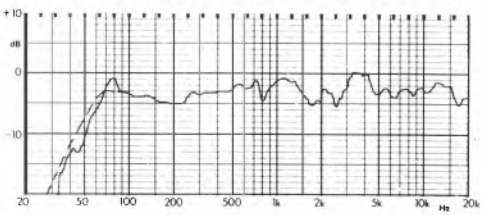
Marked well down on the average, this model gave unstable stereo, together with mid coloration and some boominess.

Summary

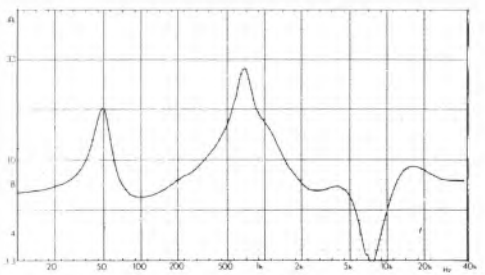
There would appear to be a little positive to say about this model, possessing as it did a relatively poor standard of sound quality, a difficult amplifier loading and a very average performance in all other respects.

Size	67(26·3) H, 30(12) W, 30(12) D: cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–100W
Recommended placement	floor standing
Frequency response within ±3dB (2m)	63Hz to 20kHz*
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2·83V, ie: 1 watt in 8 ohms)	87dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good 52Hz–3%; 100Hz–0·18%; typically 0·2 to 0·3% overall
Impedance characteristic (ease of drive)	poor
Forward response uniformity	average
Typical price per pair inc. VAT	£200

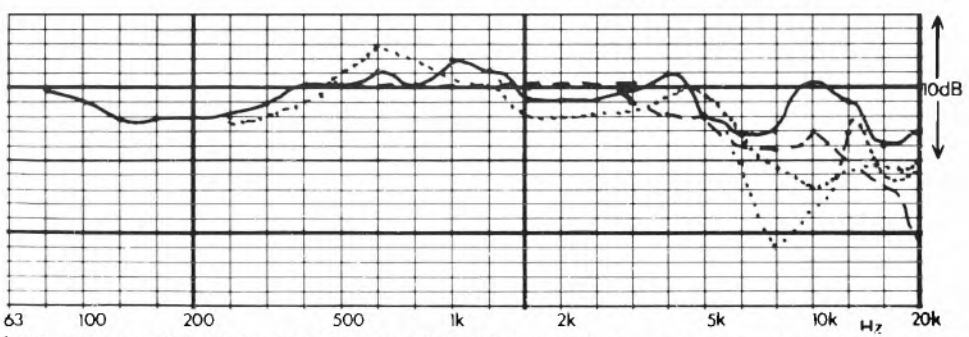
* See text



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



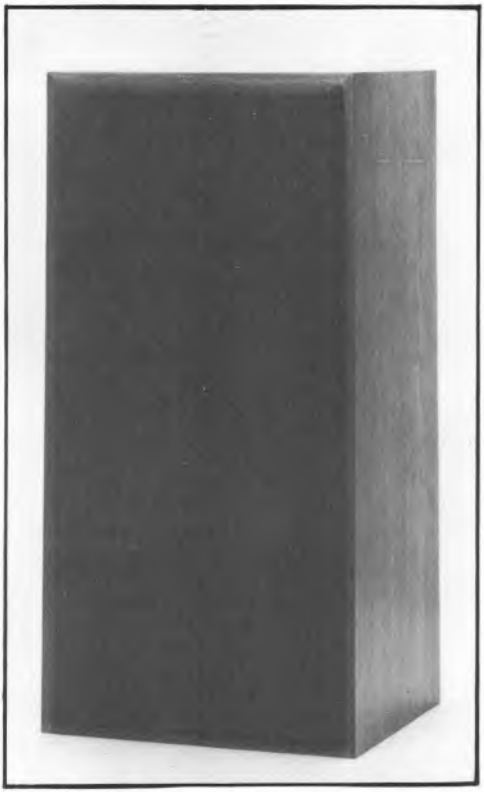
Impedance vs frequency (mod Z)



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

RAM 150

RAM Loudspeakers Ltd., 19 Old High St., Headington, Oxon.
Tel (0865) 60347.



Although this speaker was assessed in the previous edition, sufficient detail changes have been made since that time to justify a complete reappraisal. A relatively compact and slim enclosure in fine American walnut veneer, this speaker is in fact smaller than it looks with a 22 litre internal volume. Three drivers are arranged vertically in line; a 200mm passive bextrene cone bass radiator, a driven 200mm Dalesford bextrene cone bass/mid, and an Audax 25mm soft fabric dome tweeter.

The crossover is nominally a 12dB/octave network, but as only medium power rating components are used, it was felt that mild distortion might possibly be measured at 96dB, which in fact proved to be the case, although there was no listening test correlation. Substantially built, the braced enclosure uses thick bituminous damping pads and an acoustic foam lining, but no serious attempt has been made to reduce cabinet diffraction by chamfering the grille baffle edges adjacent to the drivers.

Lad results

While the pair matching was generally good, the 2.5kHz crossover region possessed a 2dB imbalance between left and right hand systems. An average sensitivity of 87dB/W was recorded, with the -6dB low frequency point at 44Hz, which is good for this size of enclosure. On third harmonic distortion measurements there was evidence of the beginnings of crossover saturation in the upper mid and treble, although the low frequency results were better than usual.

A substantial 103dBA was measured on the high level tests although the sound progressively hardened, the speaker sustaining a 200W peak program input. On electric bass guitar slight distortion was audible at a 20W program input, but gross overload did not then occur until a high 250W level. Rated as an average amplifier load, a dip in the impedance to almost 5 ohms occurred at 3.5kHz, with the mean value at the 7 ohm level.

Measured on axis at 1m the sine wave reference curve met +/–3dB limits from 50Hz to 20kHz, though this excludes a problem area from 5-7kHz. Further more the midband was a trifle uneven, with a forward bias, which contrasts with the set back presence range. Above 10kHz the treble response was smoother than usual bearing in mind the use of the Audax driver.

At 2m the $^1/_3$-octave integration improved matters considerably although still showing the mid forward balance particularly from 1-2kHz. In this respect the *Mk II* represents a contrast to its predecessor, which was depressed in this region. Off-axis the dotted dip at 4Hz occurred at 10° above, so ear level mounting or an upwards tilt is preferably. Overall the off-axis curves were fine and faithfully mirrored the presence trough as well as the depressed treble region evident from the main axial response.

Sound quality

The *150 Mk II* did quite well on the mono live sound comparisons. On bass guitar it possessed good extension coupled with substantial acoustic power, the criticisms being mild and degree and largely referring to a slightly dull

effect with some 'tunnel' and 'box' sounds. This verdict in fact reverses the result for the *Mk I*.

Conversely, on the wideband stereo program where the *Mk I* had scored above average, this new version's performance placed it below average. While good stereo imaging was maintained with fair depth rendition, the sound was found to be almost 'pinched', with a 'thin' vocal balance. A 'shut-in' presence range was also described, which exaggerated the moderate 'boxiness', while the treble register appeared uneven and a little fizzy. Clarity was also below average.

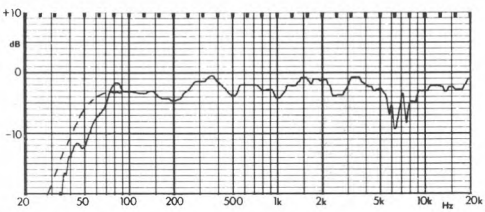
T.F. Comments

Tony Faulkner was not present during this model's auditioning.

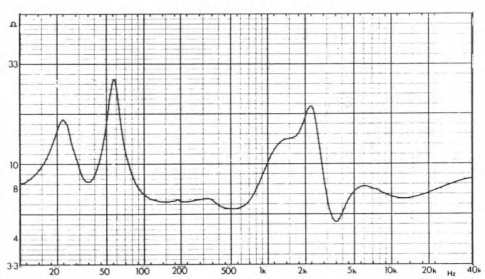
Summary

While some points are in this speaker's favour, notably good power handling, bass, stereo imaging and maximum sound levels, the vital sound quality ratings were disappointing. It just missed recommendation in the previous issue, and despite some detail changes must continue to so in its current form.

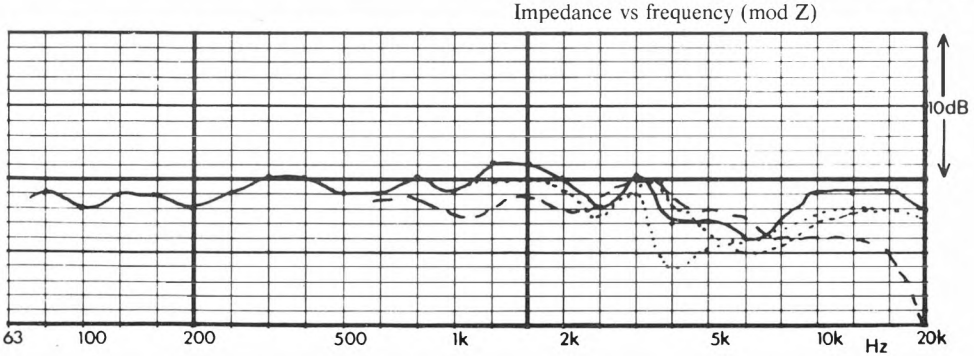
Size	58.5(23) H; 29.2(11.5) W; 25.4(10) D; cm(inches)
Weight	13.3(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15–150W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	44Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	87dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	good 56Hz–1.6%, 80Hz–1%, 400Hz–0.15%, but 1.2kHz–1.1%, 7kHz–0.7% – higher than usual
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£210



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



Impedance vs frequency (mod Z)

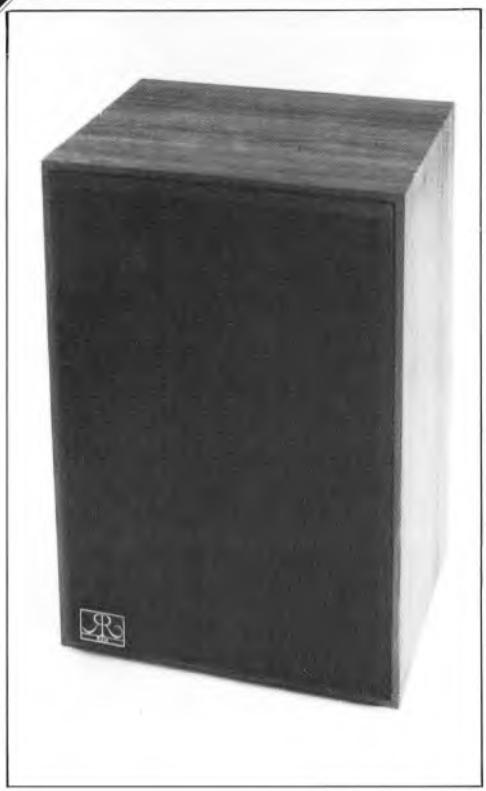


[1]3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

RAM Mini Bookshelf

R.A.M. Ltd., Clarke Road, Mount Farm, Milton Keynes, Bucks. (0908) 74764.



The smallest of the UK built range of RAM loudspeakers, the *'Mini'* is similar to the Audiomaster *MLS1,* as both systems use comparable components in a box of roughly similar dimensions. Furthermore, the two are also quite close in terms of performance and price. The *Mini* is certainly small enough for shelf locations, but its free field type response suggests that the most natural sound will be produced by stand mounting.

Technical details

A sealed box enclosure again incorporating drivers from Son Audax, a 170mm bextrene-cone unit covers the low and mid frequencies, with the ubiquitous 25mm soft-dome tweeter continuing the range above. The crossover is a complex one for a small and inexpensive speaker, containing 9 elements in a good quality assembly. Foam and bituminous treatments have been used to control enclosure resonances.

Lab results

The system resonance occurred at 72Hz with a corresponding —6dB LF point at 56Hz, this referred to the low sensitivity reading of 84dB. With about 6 ohms measured at 500Hz, the impedance was classed as 'average' in terms of amplifier loading, and the reactive content was quite well controlled.

Using a reduced 90dB reference level for the distortion trace, quite good results were obtained. A small region of 0.4% was apparent at 2kHz, with a rapid increase at the lower frequencies to 1% by 100Hz, and 8% at 50Hz; below this, the continuing rising trend indicated that a low filter at 45Hz or so might be desirable, to prevent overload at high sound levels.

From the 1 metre reference trace it can be seen that the general characteristic was quite even and balanced. However, a mild 2dB hump around 600Hz was followed by a recessed presence band, the characteristic Audax prominence at 14kHz was clearly indicated by this curve. At 2 metres the responses showed excellent conformity and integration, although they also exhibited some a mild uneveness, with the 15kHz prominence still apparent (the latter true of most systems employing the Audax driver.)

Sound quality

The Mini did remarkably well on the listening sessions, scoring 'above average' throughout, this all the more commendable in view of its very low relative price.

A reasonable 98dBA was achieved on the maximum loudness test, and while the low frequency power handling was clearly restricted, up to 10 watts average of electric bass guitar was tolerated without ill effects — the bass described as quite even, if lacking weight on the 'E' string.

Coloration and balance faults were obviously mild in degree and related to a 'small box' sound. Comments of 'tubby', 'nasal', 'occasional sibilance' and 'edginess', were made, together with upper treble prominence, cello range emphasis and slight 'hollow' and 'honky' effects.

RECOMMENDED

T.F. Comment

My enthusiasm for the *Mini* was not as great as that of the rest of the panel. The lack of bass 'miniaturized' the program sources too much for me, but my marks were still close to average, which is a good result for the price.

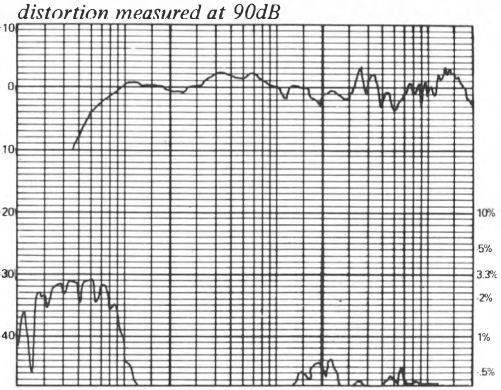
Summary

Scanning the comparison chart, it can be seen that no parameter has been awarded a less than 'good' score, with several 'very good' ratings also appearing; for example, for stereo imaging. Accepting its small size and consequent power handling and bass response limitations, the *Mini* remains a fine loudspeaker, well deserving of its recommendation.

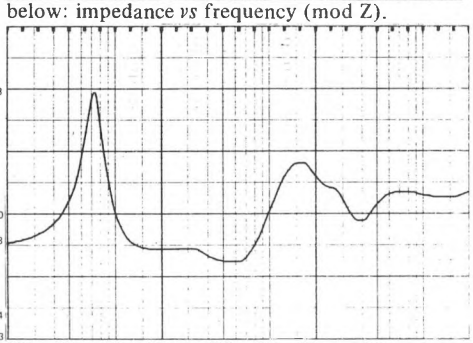
Size	41(16) H; 25.9(10) W; 23(9) D; cm(inches)
Weight	8.75(19.3) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 50W
Recommended placement	stand (! see title)
Frequency response within ±3dB (2m)	75Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	56Hz
Voltage 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)	good
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£110

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

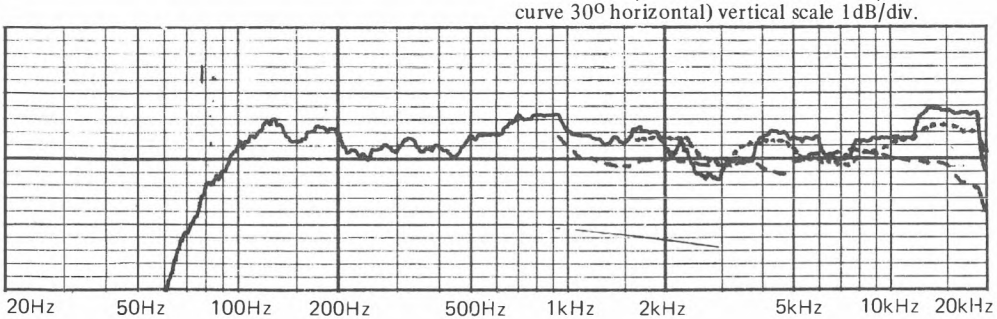
distortion measured at 90dB



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



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



Revox BX350

F.W.O. Bauch Ltd., 49 Theobald Street, Borehamwood, Herts. WD6 4RZ 01-953 0091.

The *BX350* represents a new and serious entry into the loudspeaker market for Revox. A 'linear phase' system, the treble driver is set back on the stepped front baffle to bring it into time alignment with the bass-mid array, an open frame grille exploiting the gap to the upper cabinet step as a deliberate visual feature. Pushbuttons allow selection of treble output in 2dB steps, and as the system is quite compact, it is presumably primarily intended for shelf mounting.

Technical details

This sealed box enclosure uses four 122mm pulp-cone bass-mid units, operating in parallel, with the driver panel being concave in pyramidal sections to angle each driver onto a central axis. The crossover is set at 3.5kHz, above which a 25mm fabric dome tweeter takes over.

Lab results

Matching between left and right hand systems was excellent to 3.5kHz, above which an acceptable 1.5dB difference occured. An average 88dB sensitivity was noted which is marginally prejudiced by the low impedance characteristic; with minima of 4 ohms at 160Hz and 3.5 ohms at 3.9kHz, the typical value was close to 5.5 ohms. The system resonance came in at 60Hz, with a corresponding —6dB rolloff at close on 50Hz.

Coincidentally, the Revox spec on distortion relates only to third harmonic values, and so our own results could be directly compared with those of the manufacturer. In fact the *BX350* attained an 'excellent' rating, the spec quoting 1% max. at 50Hz to 20kHz at a similar measurement test level to our own 96dB at 1 metre, while our test showed the whole range above 100Hz to be essentially at the threshold value, with 1% at 50Hz and a reasonable 10% at 30Hz.

The 1 metre sine wave reference curve showed how misleading curves for this type of speaker can be; for example, a 15dB notch was visible at the crossover frequency. At 2 metres things improved somewhat, although certain anomalies were still in evidence; for example, a 3-4dB hump at 200Hz; a gentle LF rolloff below 100Hz; a mildly tilted upper midrange; and a significant fall in treble output above 12kHz. The off-axis responses were also weak, the characteristic nulls and suckouts near crossover indicating poor driver integration even at this measuring distance. The bass-mid driver array proved to be surprisingly directional, although away from the crossover region the responses were much improved.

Sound quality

On an overall basis the Revox scored 'average' for sound quality. Live comparisons resulted in a higher mark, as the speaker was found to produce a fairly clean bass spectrum, and also proved capable of accepting up to 50 watts average of electric bass guitar. However a general feeling of increasing hardness with volume set the subjective limit on the maximum level test at 101dBA, which is nevertheless pretty loud.

Colorations were moderate in degree and included 'hard', 'honky', 'boxy', 'tubey'

effects, with a mild dulling and loss of extreme treble.

On the stereo tests imaging was consided to be below average, this result conflicting with the design intentions. Coloration and balance imperfections were more noticeable here — comments of 'shut-in', 'leaden', 'boxy', 'sibilant', 'hard' and 'nasal', plus a lightish balance to the mid-range, were all recorded. These were, however, mild enough to justify the 'average' rating.

T.F. Comment

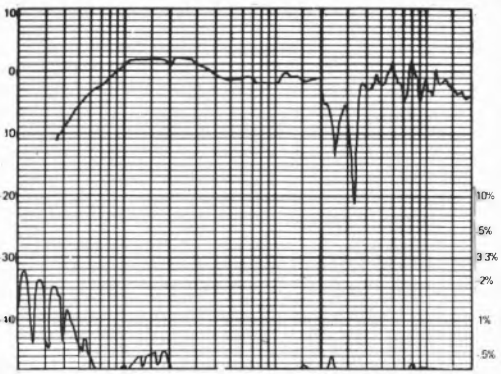
Around average, my main reservations concern the slightly confused stereo image, occasionally hard treble and lumpy bass. Overall balance and accuracy were above average, but at this price rather better results might be expected.

Summary

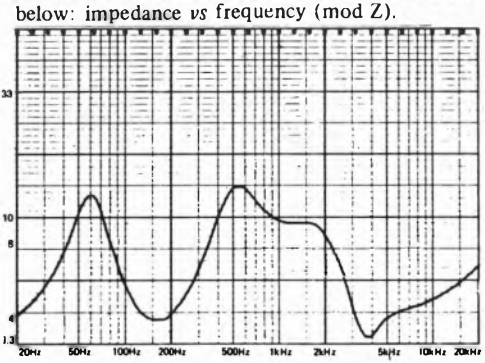
This speaker offers little advantage over its competitors in terms of response, sensitivity, amplifier load, coloration levles or stereo imaging, although its power handling was good as were the third harmonic distortion results. With an average performance at a marginally above average price, it is not the stuff of which recommendations are made.

Size	52(20.5) H; 35(13.8) W; 29.5(11.6) D; cm(inches)
Weight	14(31) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 50W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	poor
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£350

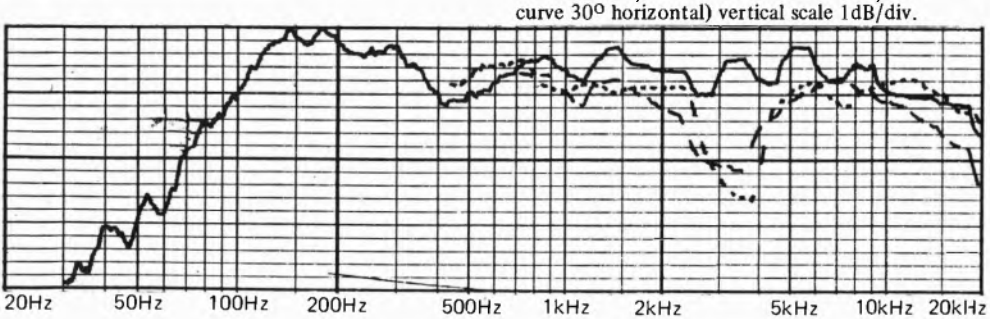
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



RECOMMENDED

Rogers LS3/5A

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

The other two companies licenced by the BBC to produce the *LS3/5a* were covered in the previous issue of *Loudspeakers*, and now it is the turn of Rogers. Early on during testing it was noted that these speakers sounded marginally different to the previous *3/5a* models I had heard, and accordingly this matter was taken up with the manufacturers. It transpires that small balance changes can occur within the official specification, due to slight batch alterations in the response of the bass-mid unit. This is under review by the BBC and by all the licensed manufacturers concerned, as the variation is a common problem to all. Its should be said that while the change is audible, it is neither severe nor does it appreciably alter the sound of the *LS3/5a* concerned, but I personally feel that a more, for want of a better word, 'typical' *LS3/5a* would have performed a little better on the listening tests.

Technical details

A very small sealed box system, the *LS3/5a* incorporates a precision crossover to provide subtle equalisation and give a neutral sound balance. Fine level matching for unit sensitivity differences is also present. Two KEF drivers are used, namely a selected 110mm bextrene-coned bass/mid unit, and a 19mm plastic-dome tweeter.

Lab results

In the crossover region a mild 1-2dB mismatch between left and right reference traces was noted, but elsewhere an excellent correspondance existed. A low 82.5dB sensitivity was measured with the —6dB point at 59Hz. The system resonance was placed at 75 Hz, 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 mid band, 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 400 Hz.

Sound quality

The table showed that the sound quality was about 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

RECOMMENDED

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

T.F. Comment

On the live comparison tests I found the LS3/5A one of the very best. Despite some chestiness on speech, this was one of the few systems to convince. On the stereo tests I was less enthusiastic, due to the lack of bass and rather 'wiry' top.

Summary

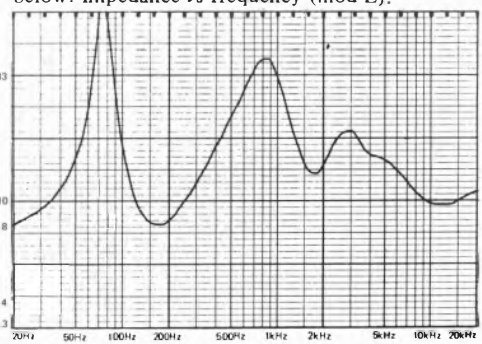
Although the original review pair were considered a little 'mid-distant' in balance, giving rise to comments of slight treble lift and bass uneveness, they nevertheless warranted recommendation.

A new pair assessed in the latest tests have allayed our fears with a better overall balance and fewer criticisms from listeners. Both Chartwell and Rogers *LS3/5As* are now assembled in the same factory; the other licensee at this time being Audiomaster.

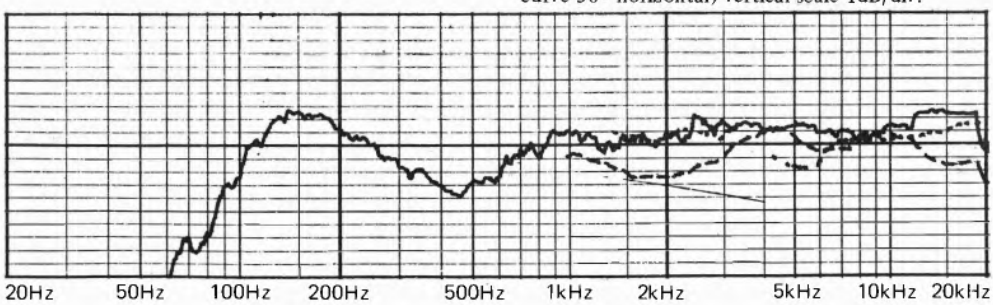
Size	30(12) H; 18.5(7.5) W; 16(6.5) D: cm(inches)
Weight	5.5(11.5) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 50W
Recommended placement	high stand (or shelf)
Frequency response within ±3dB (2m)	90Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	59Hz
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 (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£175

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

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



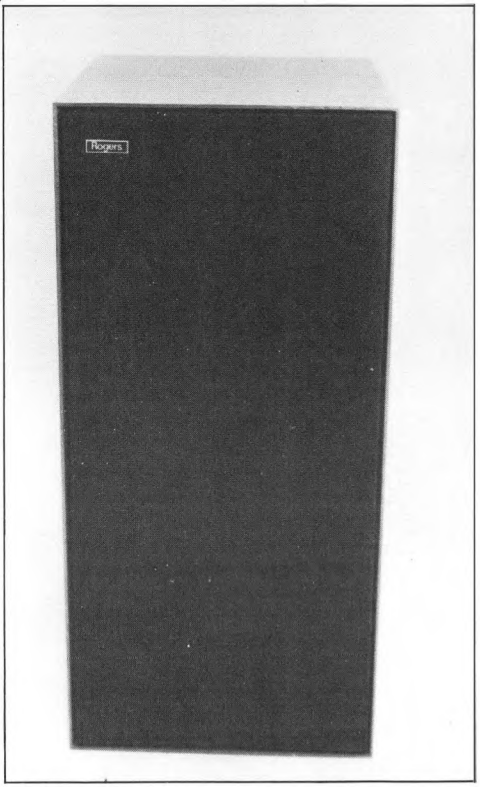
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Rogers Export Monitor

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



Rogers' experience in the production of the BBC LS3/6 loudspeaker has stood them in good stead in the design of their own new model, of identical proportions. This employs a different bass-mid driver and a revised crossover eliminating the costly auto transformer. Stand mounting is recommended, clear of room corners.

Technical details

A bass reflex enclosure with a small port, the low and mid ranges are alloted to an exclusive 200mm bextrene-cone driver manufactured by Dalesford. The range 3-13kHz is handled by a version of the Celestion HF1300 hard dome tweeter, with an additional Celestion HF 2000 supertweeter filling in the final octave. The top quality crossover uses the best components in a 17 element circuit, and the cabinet is built from bitumen loaded 12mm multiply panels.

Lab results

The left and right pairs aligned within a fine 1dB tolerance as judged by the reference curves. The corresponding sensitivity was slightly below average at 86dB, with the —6dB LF point at a fairly low 43Hz. Above 100Hz the distortion figures were very good at less than 0.5% third harmonic. Increasing values were recorded at the lower frequencies, with 2.5% at 75Hz, 7% at 40Hz and 20% at 30Hz. The latter suggests that if the system is to be driven hard, a low filter on the amplifier may be desirable, at say 35Hz. Showing a fair reactive content; for example, the impedance modulus registered 6 ohms, at 4.5kHz falling to 5 ohms at 10kHz, and 4.7 ohms at 20kHz. As such the amplifier loading was judged 'acceptable.'

The sine reference curve at 1 metre was a good one, with a mild —2.5dB suckout in the mid, 400Hz to 2kHz, and the treble range slightly elevated by comparison.

At 2 metres the characteristic responses were also pretty uniform, being very flat up to 700Hz, slightly irregular on to 5kHz, and then rising in the treble by 1.5-3dB, up to 13kHz. The off axis curves corresponded well, with no suckouts or symmetry anomalies.

Sound quality

While the price is at the mean level for the test group, the overall sound quality rating was placed firmly above average.

The Export Monitor performed well on the live sound sessions although with some slight reservations. For example, the LF power handling was very good, sustaining up to 100 watts average of electric bass guitar, but a minor rattle was noticed on the 'D' string.

The speaker produced a fairly loud 98dBA maximum level, at which point it sounded a little muddy and hard. Slight colorations were observed: 'chesty' on voice, plus, 'sibilant', mid-recessed and 'steely' effects, with a tilted HF spectrum.

The speakers performed less well under stereo testiong, although the imaging itself was of a high order. Some panellists complained of a slightly dulled treble which was 'breathy' higher up the range. Disc distortion showed some emphasis, and mild 'boxy', 'hollow' and 'hard' effects were also present, with a metallic quality on occasion.

RECOMMENDED

T.F. Comment

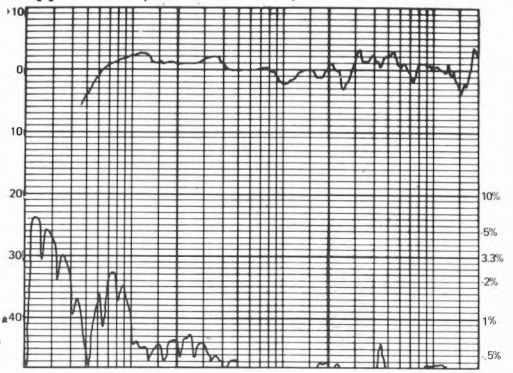
I found this good performer above average in all respects overall; the bass was slightly boomy and the treble a little uneven, and the system sounded marginally less good at higher sound levels.

Summary

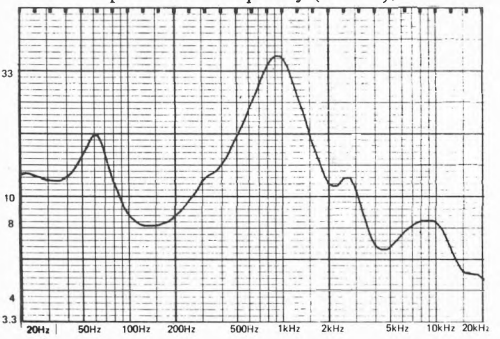
Put in perspective, this model demonstrates an impressive line up of 'good' and 'very good' scores on the comparison chart, which is a significant achievement at the price. Coloration and balance faults were slight in degree and did not significantly prejudice its subjective qualtiy; a hallmark of its sound engineering was the fact that the various performance parameters appeared to present a reasonable balance. On this basis, the Export Monitor clearly belongs to a necessarily restricted group of recommended speaker systems.

Size	63.5(25) H; 30.5(12) W; 30.5(12) D; cm(inches)
Weight	14(31) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	60Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	43Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB 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)	acceptable
Forward response uniformity	v. good
Typical price per pair inc. VAT	£275

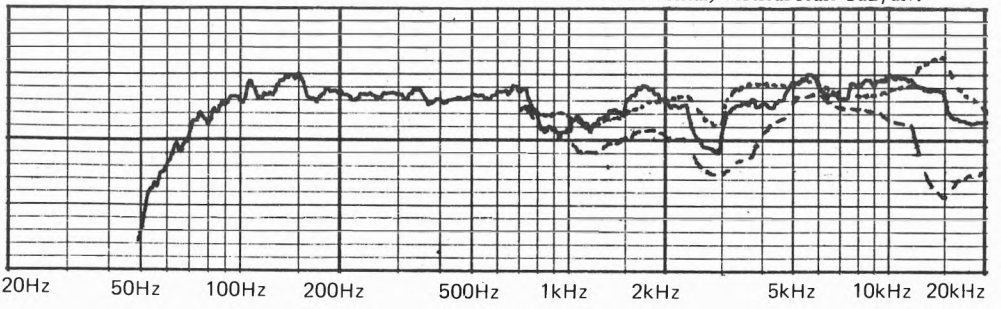
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



RECOMMENDED

Sansui ES207

Vernitron Ltd., Thornhill, Southampton SO9 5QF (0703) 444811

Showing how seriously a Japanese manufacturer has taken British standards of sound quality, the *ES207* is the first of a new range of speakers from Sansui to utilise UK design techniques. Assembed at their Belgian factory, the drive units for this model are made in Japan, the *ES207* being a compact enclosure designed for vertical positioning. Open stand mounting is recommended, and response control is afforded by a high frequency level adjustment under the open cell foam grille. The finish is in a dark 'walnut' vinyl.

Technical details

A two-way bass reflex model, the vent action is provided by a 200mm passive radiator. Bass/midrange coverage comes from a synthetic surface-treated cone of optimised flare, based on a 200mm long throw chassis. A complex 18dB/octave crossover divides power at 2.5kHz, the treble arm resembling the KEF Acoustic Butterworth network, with a 25mm plastic-dome unit operating over the treble band. The enclosure panels are damped with bituminous material and lined with acoustic foam.

Lab results

Up to 10kHz, a fine 1dB match was recorded, with the range above reasonable at a 2dB difference (pre-production prototypes.) A typical low sensitivity of 86dB was recorded, with a usefully extended 40Hz, —6dB LF point. Very easy to drive, the impedance did not fall below 8 ohms throughout, and on third harmonic distortion, good 0.5% readings were obtained in the mid band. Some rise was apparent at higher frequencies, but the overall curve was very good, particularly in the bass where the readings did not attain a 2% level until 40Hz. The rise below this suggests that a low filter at 35Hz might be worthwhile if the speakers are to be driven hard.

The sine wave reference trace illustrated a commendably extended and uniform response to 700Hz, followed by a mild 2-3dB trough up to 2kHz, beyond which the HF recovered. A gentle rolloff above 14kHz was also apparent. At 2 metres the characteristic frequency response was little altered, although the 500 – 700Hz area looked a trifle exposed, and the balance was slightly 'rich'. Overall, the on- and off-axis responses were well integrated in all planes.

Sound quality

Despite its reasonable price, the high sound quality of the *ES207* is unmistakeable, with an 'above average' ranking on all counts. On the live sound comparisons it absorbed the full 500W peak output of the source amplifier without distress, generating a farily loud 100dBA. The low frequency range was highly praised, being considered both even and powerful. In fact, the ES207 accepted a high 50W average of electric bass guitar, producing a satisfying bottom 'E' note, with no audible rattles. Coloration was felt to be mild, and included 'hollow', 'quack', 'boxy', 'hard' and 'brassy' effects, with a thickened balance and some uneveness in the treble register.

On the stereo tests, good imaging was apparent, with realistic scale and depth rendition on the classical organ program.

RECOMMENDED

Slight 'sibilant' and 'edgy' effects were noted, the sound occasionally 'honky' and 'middy' (for example, on piano), with the overall character a trifle rich and heavy.

T.F. Comment

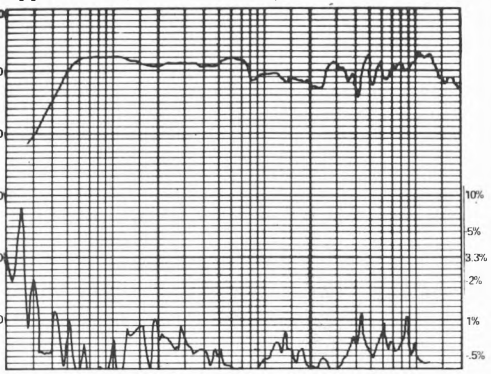
Overall slightly above average, most criticisms were aimed at the treble, which was slightly rough and uneven, noticeable on strings and worn disc. It is certainly good overall at the price, nevertheless.

Summary

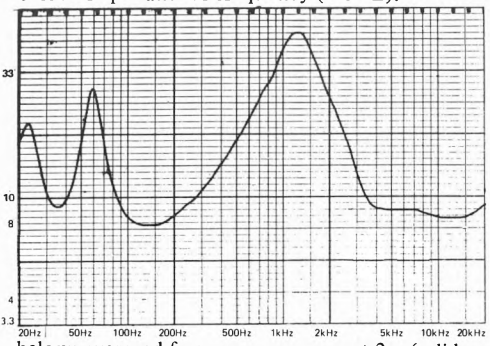
This is undoubtedly a fine loudspeaker system, the mildness of panel comment in the listening sessions reflected in the high scores attained; the bass performance was exceptional, neutrality high, coloration moderate and frequency balance pleasing. Easy to drive, it could produce satisfying levels, although it did require a fair amount of power to do so. A visual scan over the comparator table reveals its true merit, and at the price asked the *ES207* is certainly worthy of recommendation.

Size	59.3(23.3) H; 28.2(11) W; 28. 1(11) D; cm(inches)
Weight	13. 2(29) 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)	60Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	102dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	good
Typical price per pair inc. VAT	£160

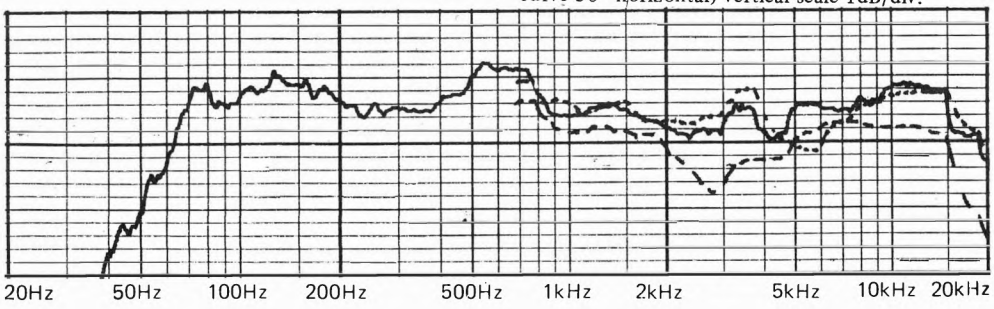
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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

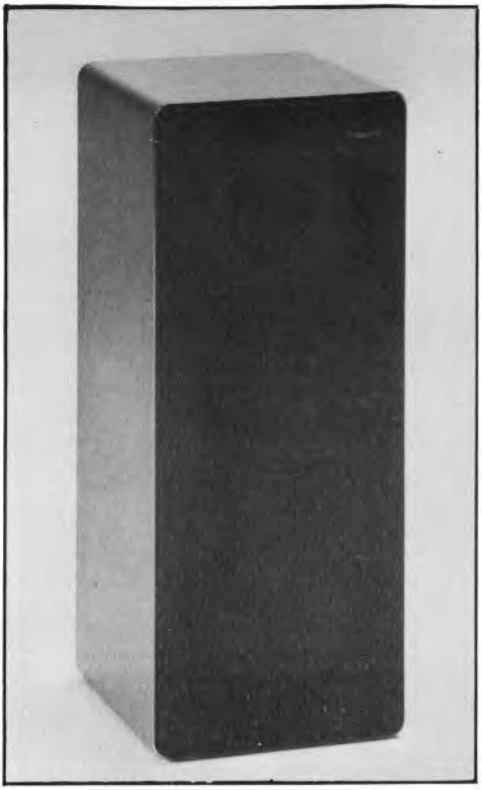


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Sansui J11

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



An ultra compact Japanese design, this bright satin alloy enclosure has an internal volume estimated at a tiny 3.5 litres. With rounded corners, the thin-wall cabinet is made by folding 1.5mm thick sheet metal, the front and rear baffles being secured by a heavy duty adhesive. A bituminous laminate is used to control panel resonances, and the narrow enclosure contains a total of three drive units. An auxiliary bass radiator with a stiffened pulp diaphragm is partnered by a 100mm pulp cone bass/midrange unit and finally a 25mm dome tweeter, the whole exquisitely engineered and assembled. A good quality 6-element crossover is employed, the interior of the cabinet filled with a tightly packed roll of polyester fibre wadding.

Lab results

A strong step was present in the axial frequency response, dictating a back-to-the-wall positioning. On this basis the sensitivity comes out at a lowish 86dB/W, although in practice this is actually somewhat greater than for other similar systems. Referred to this level, the -6dB low frequency point is a restricted 80Hz, but this could well be subjectively improved by wall mounting. The speakers demonstrated a very good pair match throughout the spectrum, while at a reduced 90dB sound level, the third harmonic distortion results were good overall, though understandably poorer at low frequencies; for example, 10%, 70Hz. Clearly it is unfair to expect wideband high power levels from tiny boxes.

The rising response helped to achieve a surprisingly good maximum sound level of 100dBA, while peak power inputs of 100W or more were accepted without complaint. Bass guitar was markedly lacking in power in the lower registers, but nevertheless free of breakup until a quite respectable 20W input. A compromise was apparent from the impedance characteristic, which was typically 6 and fell to 4 ohms at 250Hz and 10kHz, denoting an 'acceptable' load rating.

While areas of the response were promisingly uniform, the axial curve clearly shows the difficulty we encountered when defining the sensitivity. The 2-20kHz range is in fact at a 89dB/W level which in part accounts for its high dBA-weighted loudness. The step at 1kHz mainly relates to the tiny cabinet size working under anechoic conditions, and was largely compensated for by close wall mounting.

At 2m the potential subjective character is easier to establish. A response peak was present centred on the 1.6kHz $^1/_3$-octave band, followed by a mild presence trough and then a smooth upper treble. Typical for such a tiny enclosure, the group of off-axis responses were remarkably well integrated, tracking the axial trend to within one dB until 10kHz and beyond.

Sound quality

Severe frequency balance and response faults are often less obvious on live sound comparisons although coloration in the true sense is rarely masked, and this was certainly true of the *J11*, which did well on the live sound comparisons. despite an understandably poor showing on electric bass guitar. Transient attack was faithfully portrayed but with some 'middy' 'small box' effects and a 'brittle' quality.

However, on the stereo programme and located in free space, the wide frequency range of the music ruthlessly exposed the thin balance of this model, resulting in a just acceptable rating, although both clarity and stereo imaging were good. The balance improved tremendously when wall mounted, but with a consequent increase in room excited coloration and a degradation in stereo imaging. However the latter condition with all its limitations was still preferable to the otherwise thin balance.

T.F. Comments

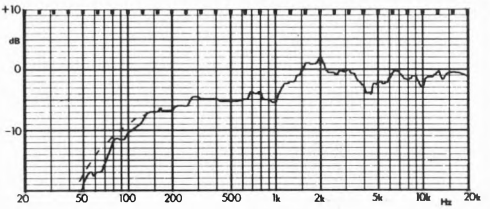
Ranked below average, the distinct lack of bass in this system proved disappointing, and was accompanied by some mild coloration and 'scratchy' effects in the treble.

Summary

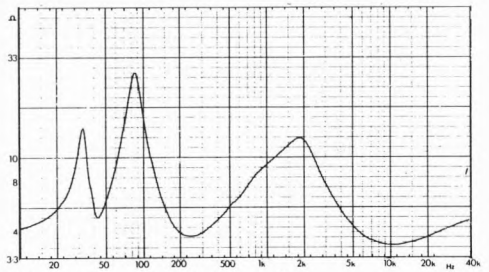
This tiny and beautifully made speaker possessed some good qualities, and while the price is not high in terms of the size/engineering compromises involved, it is excessive in view of the level of sound quality attained. The *J11s* could prove useful in difficult situations or as apart of a 'micro component' system, but in a true hi fi context they cannot be recommended.

Size	29.5(11.5) H; 12.5(5) W; 13(5) D; cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–60*
Recommended placement	on open shelf, back against wall
Frequency response within ±3dB (2m)	1kHz to 20kHz*
Low frequency rolloff (—6dB) at (1m)	80Hz*
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	100dBA
Third harmonic distortion (90dB at 1 metre)	good
	70Hz–10%, 100Hz–1%, 500Hz–0.35%
	typically 0.3% overall
Impedance characteristic (ease of drive)	poor
Forward response uniformity	good
Typical price per pair inc. VAT	£105

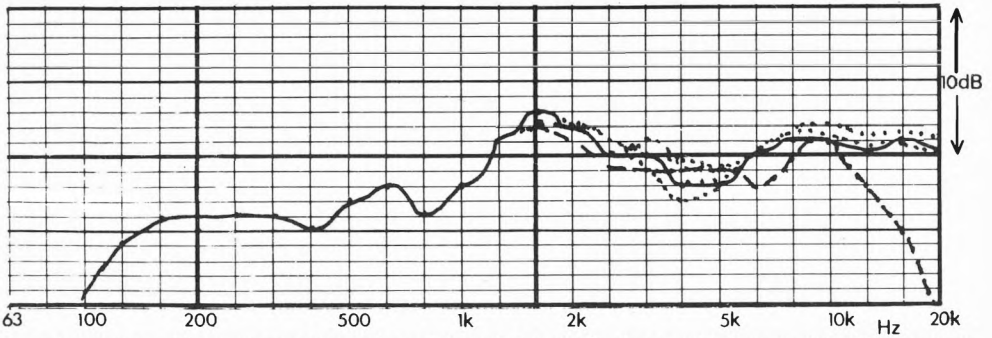
* See text



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



Impedance vs frequency (mod Z)



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

RECOMMENDED

Sanyo Hi-Fi One

Sanyo Marubeni (U.K.) Ltd., 8 Greycaine Rd., Watford, Herts. Watford 46363.

Hard on the heels of the Sansui *ES207* comes this Sanyo model, one of three models made in the UK, using Son Audax drive units. A compact system, the *Hi Fi One* is ostensibly intended for open-shelf locations, but as their response is specified flat in free field anechoic conditions, stand mounting at a realistic height should also be permissible. Despite its modest price the *One* was immaculately presented with full surface veneering, flush mounted drivers, and a contoured foam grille. Connections are via a DIN socket with cables supplied.

Technical details

A sealed box system, with a vertical-in-line driver arrangement, the low- and mid-frequencies are handled by a 200m bextrene-cone unit, with the range above the crossover at 3kHz or so alloted to a 25mm fabric-dome tweeter.

Lab results

An excellent pair match was observed, with a reasonable 50Hz, —6dB LF point, this referenced to a typically low 86dB sensitivity. The system resonance was placed at 62Hz, and with its nomial impedance of 10ohms and a minimum value of 7.5, this speaker clearly represents an easy amplifier load.

Measured at the higher 96dB test level, and apart from a mild distortion rise to 0.8% at 200Hz, the third harmonic content was low. Below 100Hz, a fair rise occurred; for example to 6% at 50Hz, but no further increase was recorded at the lower frequencies.

On sine wave, a flat response was apparent to 1kHz, as well as throughout the treble range. The 1-4kHz range, however, showed moderate irregularities. Moving out to 2 metres with $\frac{1}{3}$-octave averaging, the trend was less uniform, the whole showing a mildly mid-prominent character, 600Hz-2kHz. The lateral responses were good, as was the 10° vertical trace, with the exception of a mild 5dB suckout near the crossover point at 3kHz. Nevertheless, the curve was considered to be pretty good, bearing in mind the system price.

Sound quality

Without reservation the sound quyality ranked as 'very good' — a truly excellent result at the price. Admittedly these results do apply to pre-production samples, but providing reasonable care is taken in manufacture, there is no reason to suppose that this performance standard cannot be maintained.

A high 103dBA was achieved on the loudness session, the speaker accepting a 500W peak input. While a slight bass buzz was apparent at some low frequencies (10W), the speaker could take up to 50W average of electric bass before overloading. Criticisms of the sound were clearly very mild, though one or two panellists did find parts of the range less than pleasant. Voice was considered to be a little 'thin' and 'boxy' with dulled presence and some hardness, while extreme low frequencies were down in output.

On the stereo testing the image was highly rated and coloration comments were still of a mild nature — 'metallic', 'gritty', 'fizz', 'quack' and 'hollow' effects were all noted. Overall the frequency balance sounded pretty

RECOMMENDED

neutral.

T.F. Comment

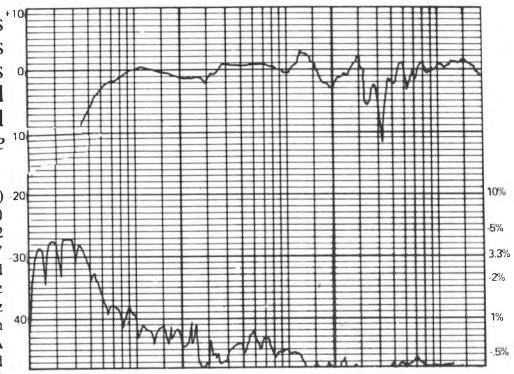
On or above average throughout, this speaker was slightly overbright, brittle, and lacking in deep bass. At its price the performance must be considered very good.

Summary

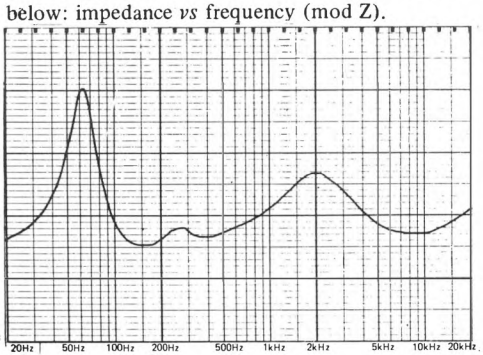
All the speaker's performance parameters were classed as either 'good' or more often, as 'very good', and while it was not quite as subtle as some of the more expensive and highly rated models, its ability to cope well with every test was remarkable. The *Hi Fi One* is thus strongly recommended.

Size	45.5(18) H; 21.5(10.8) W; 17.8(7) D; cm(inches)
Weight	7.5(16.5) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	102dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	good
Typical price per pair inc. VAT	£95

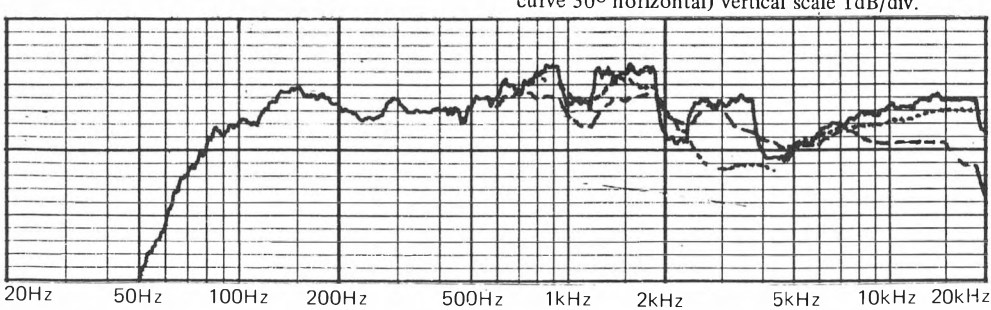
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



RECOMMENDED

Sony G1

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 (see front cover) 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 55Hz, being typical for the size and sensitivity. (It is in any case amenable to bass lift).

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

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

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

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

Sound quality

Largely confirming the results of a similar panel test conducted earlier this year for Hi Fi News (June 1979), the *G1* performed very well on all listening test sequences. Rated as very 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.

Again ranked as 'good' on stereo programme, the imaging was commended with satisfactory stability and a fair depth impression. Possessing above average clarity, nonetheless it did not

RECOMMENDED

escape certain criticisms of coloration, these mainly concerned with mild 'hard', 'wiry', 'nasal', 'boxy' and 'brash' effects whose subjective importance will tend to vary with each listener.

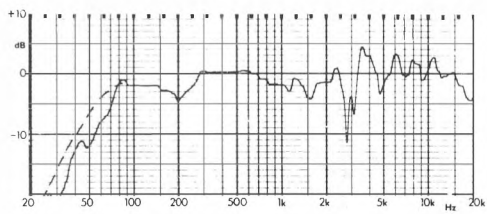
T.F. Comments

The overall quality was very clear with good stereo imaging, although it was a little forward and hard sounding.

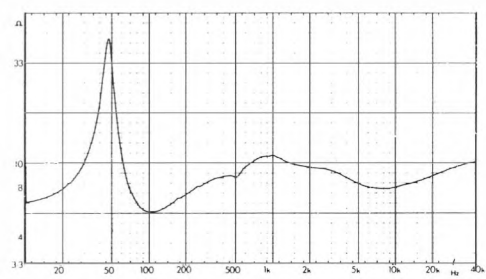
Summary

This good looking and well engineered system offered a fine all round subjective performance with firm bass amenable to lift if desired. A very high maximum sound level was attained with high sensitivity, excellently low distortion and an 'average' amplifier rating. Recommendation is clearly in order, but as the *G1* was on occasion a touch aggressive, personal audition would be worthwhile.

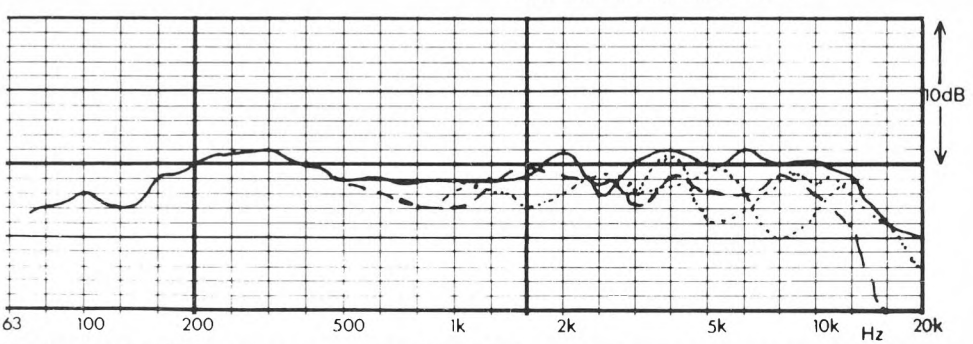
Size	59.5(23) H; 33.4(13) W; 30(12) D; cm(inches)
Weight	13(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10–100W
Recommended placement	stand or open shelf
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	55Hz
Voltage 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	£190



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

Sony G5

Sony (U.K.) Ltd., 134 Regent Street, London W1R 0DJ. 01439 3874.

A costly enclosure from Sony, the *G5* is the smaller brother of the substantial *G7*. Some special features are incorporated, the most noteworthy being the the high sensitivity and the unique 'grooved lattice' front panel, the latter termed 'AG' pair of specially designed stands were supplied to us with the enclosures.

Technical details

The 300mm low frequency driver has a pulp cone with a proportion of carbon fibre, and a large motor coil. Covering the 600Hz-5.5kHz range is a cone/dome mid unit, 80mm diameter and with a small cone-section edge. A 25mm dome tweeter completes the vertical-in-line array, the units positioned so that their effective sound origins are also in line. The enclosure is reflex loaded by a ducted port, and the crossover, a good quality assembly with 12dB octave slopes, comprised 14 elements including attenuator sections.

Lab results

With less than 0.5dB difference between curves, the speakers demonstrated excellent pair matching. The sensitivity was exactly as specified by the manufactureres at a very high 93dB, although the LF range was somewhat curtailed for this size of enclosure, possessing a 60Hz, —6dB rolloff point. The mean impedance value was 7 ohms, with minimum figure of 5 ohms occurring at 12kHz; hence the speaker is described as possessing 'average' amplifier loading characteristics.

Truly excellent third harmonic distortion curves were measured for the *G5*, values being at or below threshold throughout, except for an insignificant rise to 0.5% at 90Hz (the upper system resonance.)

On the sine reference trace some irregularities were observed, which are considered to be significant. At low frequencies the early rolloff was accentuated by a +2dB hump at 100Hz, while another +3dB hump appeared at 500Hz, to be followed by a trough. The range above was none too smooth, with the high treble also curtailed beyond 15kHz. At 2 metres the characteristic response was more even, although the trough at 15kHz was still present. The HF band was somewhat better, although both a peak at 12kHz followed by an early rolloff were still apparent. The response at 10° above was poor, exhibiting 10dB suckouts, and hence an axial listening position is essential. In the lateral plane the characteristic was much improved, showing fairly good integration up to 10kHz.

Sound quality

Having balanced the listening test results, the *G5* attains an overall 'average' rating which is rather disappointing in view of its high price. However plus and minus aspects were recognised, which means that this is an interesting speaker which might well suit certain applications.

For example, a very high 108dBA maximum level was recorded and at this level the general sound quality still held together. Good power hanling was also demonstrated at low frequencies', the sound, although slightly reduced in output on the 'E' string, was described as powerful, even and clean.

A fair amount of coloration was described which caused the speaker to be marked down

to 'poor' on the domestic stereo sessions. This rating also applied to the stereo imaging which appeared to have very little 'depth'. The panel described the speaker as 'hard', 'tubey', 'middy', 'boxy', low bass deficient, 'coloured', fizzy', and 'honky', with suckout effects, while distortion in program was emphasised. However, it should be noted that one or two panellists favoured the *G5* sound, and thus as a whole the group clearly had rather mixed feelings about this speaker.

T.F. Comment

I found this speaker's performance rather poor, with an unstable stereo image (producing transients unpredictably) and exaggeration of record surface noise on the stereo tests; although better on live comparison, I did not like it overall.

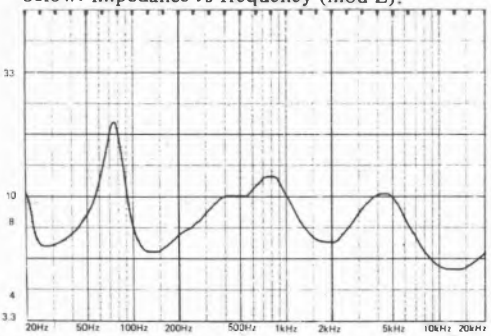
Summary

A costly loudspeaker, the *G5* was certainly finished and engineered to the expected high standard, but fell short in terms of its sound quality. Stereo imaging was really only just acceptable in the context of this report, and although sensitivity, distortion, power handling and maximum level were all excellent, the frequency response was restricted at the audio band extremes.

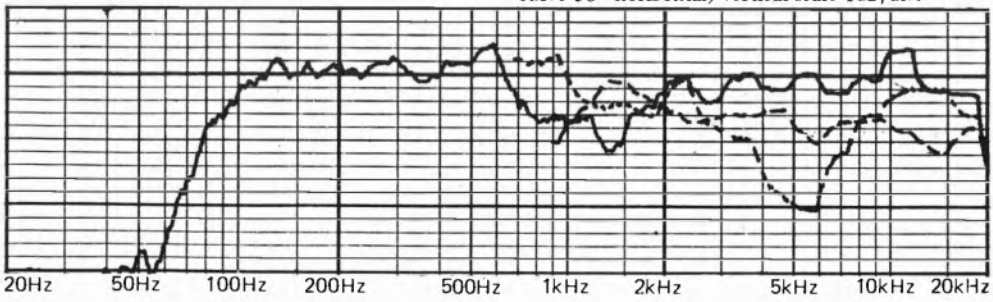
Size	72(28.4) H; 41.5(16.4) W; 35(13.6) D; cm(inches)
Weight	26(58) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 18kHz
Low frequency rolloff (—6dB) at (1m)	60Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	93dB at 1m
Approximate maximum sound level (pair at 2 metres)	108dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	average
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£420

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

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



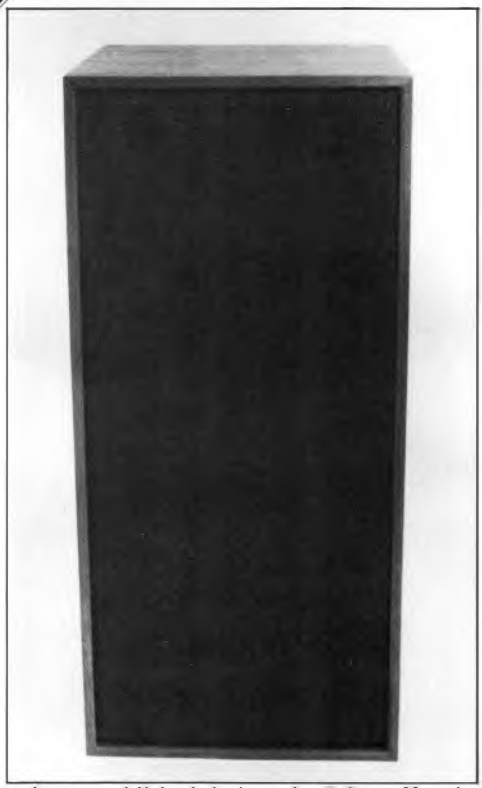
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Spendor BC1

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



A long established design, the BC1 suffered a little in recent years from slight production changes. A year or two ago an alteration in cone surround exaggerated a known power handling and bass response problem, and the previous issue of *Loudspeakers* reviewed a pair of these speakers which were censured on these grounds. Further development provided a solution, and our test programme commenced with a pair of these improved speakers. However on early auditioning we still felt they were not quite right in terms of the mid/treble accuracy of the earliest *BC1s,* and Spendor revealed that the Celestion HF13000 had been responsible for a hitherto unsuspected coloration effect. Accordingly, with this identified and now under control, a second pair of speakers was delivered to *Choice*. These new speakers also incorporated a minor port modification consisting of a 7mm thick foam ring lining, this appearing to smooth out and extend the bass response a little.

Technical details

Low-mid frequencies are provided by Spendor's own 200mm bextrene-cone driver. The main HF range is allotted to a Celestion HF1300 hard-dome tweeter, which has undergone a rigorous programme of selection, with the final half octave covered by a Coles(S.T.C.) 19mm plastic-dome. The complex crossover incorporates full equalisation and sensitivity matching, and the ported enclosure has critically damped multi-ply walls.

Lab results

Excellent pair matching was recorded with only minor isolated 1dB differences at 10kHz and 15kHz. Sensitivity was fairly low at 86dB with the —6dB LF point at a 45Hz (43Hz with port liner). The amplifier loading is rated as 'good', the minimum figure of 6 ohms occurring at an unimportant 18kHz. Excellent third harmonic distortion readings at or near threshold were obtained above 100Hz, using the 96dB test level. Moderate values were recorded at the lower frequencies, for example 1% at 60Hz and 3.5% at 50Hz and 40Hz, but they rose quickly below this and, if driven hard, a low filter on the matching amplifier at 40Hz might be an advantage.

The excellently even sine wave response was characterised by a mild +2dB hump in the bass, a mild hump at 12kHz on axis, and some inevitable irregularity at the high crossover point. The 150Hz-3kHz range was outstanding, and on the 2 metre characteristic trace excellent conformity and integration was apparent, although the overall trend was somewhat less uniform at this increased measuring distance.

Sound quality

Despite my personal initial reservations, on checking the test results the first pair were found to have performed well on the stereo sessions (they were not included in the live comparisons); however the second pair were outstanding in almost every respect.

The *BC1* tolerated a full 500W peak input producing a maximum 101dBA which did not sound unbearably 'loud'. The low frequency performance was now quite good, with an

RECOMMENDED

even, powerful and accurate output on electric bass guitar.

Stereo imaging was very good, with precise loational focuseing and excellent depth and ambience. The speaker sounded quite transparent, by comparison with certain other models in the group. The colorations which were described were small in degree; slight 'box', 'hard', and 'plummy' effects were all noted, together with moderate restriction felt at low frequencies. The mid-treble balance was near perfect on axis, with the HF register outstandingly accurate.

T.F. Comment

Despite slight bass boom and a generally warm balance, the *BC1* received some of my highest marks . . . the sound was well focussed with clear stereo image and perspectives.

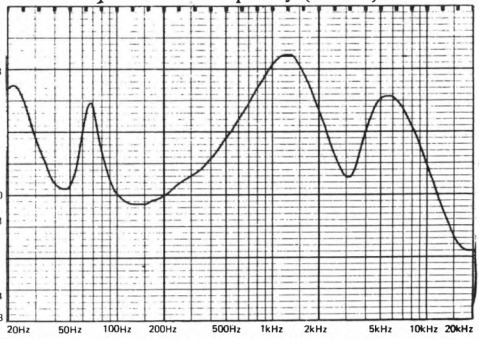
Summary

It would appear that after a minor detour the *BC1* is back on the tracks again. The mid and treble were exceptional, the bass much improved, with an overall large increase in power handling. Stand mounting clear of room corners is essential for the least coloration and best balance, and at its still moderate price, this latest *BC1* can be strongly recommended.

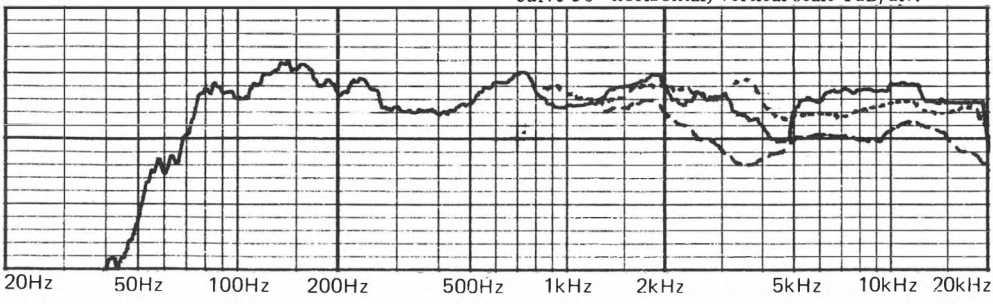
Size . . . . . 63.5(25) H; 29.8(11.7) W; 30.5(12) D; cm(inches)
Weight . . . . . 14(30.8) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) . . . . . 30 to 150W
Recommended placement . . . . . stand
Frequency response within ±3dB (2m) . . . . . 70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m) 44Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) . . . . . 86dB at 1m
Approximate maximum soundlevel (pair at 2 metres) 101dBA*
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 £300

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

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



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



RECOMMENDED

Spendor SA1

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

A recent introduction to the Spendor range, the diminutive *SA1* has some features in common with its larger brother the *BC1*, namely the same damped box technique, a free field or stand mounted frequency balance, and a complex high quality crossover. Clearly a 'no compromise miniature' (if this is not a contradiction in terms), the *SA1* is consequently quite expensive.

Technical details

Spendor's new 165mm bextrene-coned bass-mid unit is employed, the enclosure being of the sealed or so-called infinite baffle variety. Above about 3kHz, a selected Son Audax 25mm fabric-dome tweeter takes over.

Lab report

Excellent matching was observed, with less than 0.5dB difference throughout the range. A very low 82dB sensitivity was recorded, indicating a minimum amplifier power of 25-30 watts per channel. The —6dB point was measured at 53Hz, about average, this corresponding to a system resonance at 63Hz.

Reactive components were present in regions of high impedance, and with a minimum modulus of 9 ohms and a typical value of 12, the *SA1* was particularly easy to drive.

At the reduced 90dB test level the distortion results were excellent at under 0.4% even at 50Hz; clearly this small box could have tolerated a higher input power without any real problems. On sine wave excitation at 1 metre mike spacing, the response was commendably even; a slight +2dB lift could be seen from 80-140Hz, with a similar lift at 15kHz and a gentle rolloff thereafter.

Out at 2 metres, the overall response met fine ±2dB limits from 80Hz to 15kHz. While the low frequency range showed an early rolloff, no hump was present higher up, so bass lift is permissible when needed. A mild prominence at 700Hz was also visible on the response. Examination of the family of on- and off-axis curves show that they were both consistent and uniform, and hence well integrated. As such, the system has predictable frequency balance which is not critical of listening axis.

Sound quality

An 'above average' overall sound quality ranking was achieved by the *SA1* which is commendable at the price, and perhaps surprising considering its size.

It was discovered on decoding the test sheets that the *SA1* had sustained the full 500 watts peak output on the high level test, attaining a respectable 98dBA. On electric bass guitar it was also surprisingly good, accepting a not inconsiderable 25W average with fair eveness and depth.

It scored consistently 'above average' on both the live and the stereo sessions, and while the panel were aware of coloration and balance defects, these were considered to be only slight, and included 'fizz' and 'sibilance,' 'dull,' 'boomy,' 'rich,' 'gritty,' 'tubby' and occasional 'thin' effects.

T.F. Comment

I scored this speaker above average in all respects except stereo image, which I found slightly overwide and out of focus. Slight

RECOMMENDED

tubbiness and sibilance were also noted, but overall performance was good.

Summary

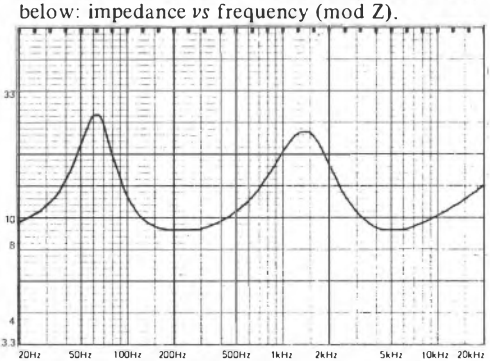
Despite the fact that some coloration could be heard, it was not severe enough to spoil the brew, and hence the overall quality rating was a good one. The speaker was easy to drive, possessed good power handling of excellent distortion with fine matching and uniformity in evidence, all this contained within exceedingly compact dimensions. The *SA1* certainly makes the grade and, while it is especially recommended for those seeking a 'small' system, it could well appeal to purchasers for whom size is not the prime consideration.

Size	30.4(12) H; 22.5(8.9) W; 21.6(8.5) D; cm(inches)
Weight	7.2(15.8) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 75W
Recommended placement	high stand (open shelf)
Frequency response within ±3dB (2m)	95Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	53Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	82dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA*
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	excellent
Typical price per pair inc. VAT	£190

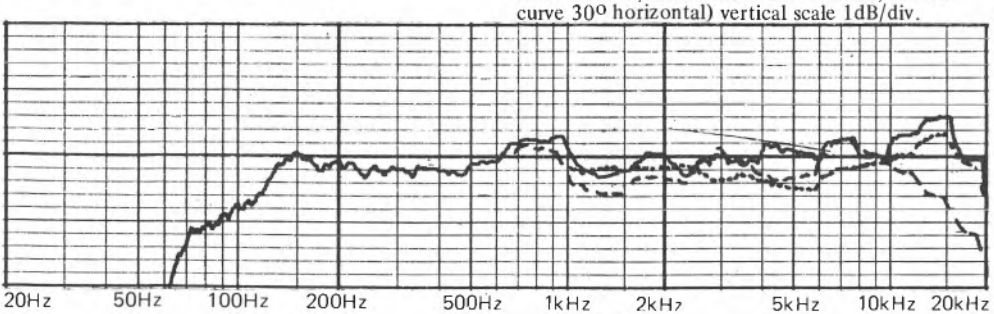
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

distortion measured at 90dB

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

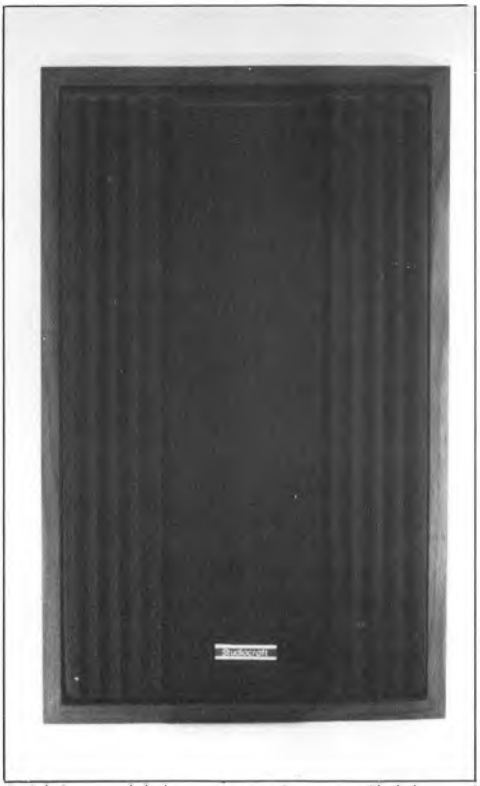


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Studiocraft 330 II

Bose U.K. Ltd., Trinity Trading Estate, Sittingbourne, Kent ME10 2PD. 0795 75341/5.



A high sensitivity system from a division of the American Bose Corporation, the *Studiocraft 330* achieved success a year and a half ago, in another group test (*HFP* Sept/Oct '76). These more recent samples, however, performed less well, and even taking into account the different test procedures, location, panel and programme involved, the conclusions were too divergent for a change in the design not to have occurred in the interim. In fact, comparisons of the response curves and impedance runs for the earlier and later *330*s confirmed that some alteration had been effected.

Technical details

A bass reflex system of compact dimensions, the *330* uses a 200m pulp-cone bass-mid unit and (if the enclosure is positioned vertically), two horizontally angled c.75mm tweeters. A simple crossover is included, the input connections made via binding posts on the rear panel. A large ducted vent is fitted, this tuning the system to a fairly high resonance.

Lab results

Above 15kHz the pair matching was erratic due to interference effects on the response curve, but below this frequency the matching was judged as very good. A high 92dB reference sensitivity was recorded, in no way prejudiced by the impedance, and the speaker was also rated as presenting a 'good' amplifier load, as no value below 7ohms was recorded (the old version measured 5.5Ω at 10kHz.)

Quite good third harmonic distortion curves were demonstrated at the higher 96dB test level, typically 0.5-0.6% up to 1.5kHz. A good 1.3% was measured at 50Hz but values rose at lower frequencies, for example to 25% at 30Hz, so a low filter on the amplifier at 40Hz would not come amiss under high level drive conditions.

The trend showed a tilted up response, suggesting that shelf mounting would give the best subjective mid balance, albeit at the expense of increased room coloration relative to a stand location. An axial prominence 6dB high was evident at 2.5kHz.

Out at 2 metres with ⅓-octave averaging the curve should have smoothed out sufficiently for the characteristic balance and uniformity to be classified. However, considerable variation was exhibited by the three curves, with the 10° vertical traces the best. Averaging through these forward responses, the forward energy can be seen to be fairly even, but the actual perceived frequency balance changes rapidly with angle. Noteworthy was the limited band-width of the system.

Sound quality

The *330* scored an 'acceptable' or 'below average' rating for sound quality which is not impressive, even taking into consideration its price.

While the system offered a high sensitivity and will thus work with amplifiers of as little as 10 watts per channel, the maximum sound was found to be limited to a nonetheless fairly loud 101dBA, above which the quality rapidly deteriorated.

The *330* coped better on the live sound comparisons, achieving an 'average' rating. While moderate power inputs caused minor

rattles, the speaker went on to accept a very high 100W average of electric bass guitar and sounded surprisingly good — a clear affinity is indicated here! The treble range was disliked by some panellists who noted 'brittle', 'brash,' 'sizzle,' and 'accentuated' comments, but felt that it was lacking in very high frequencies. 'Boxy,' 'tubby,' and 'hard' effects were also heard.

Image quality was fairly weak, particularly at the higher frequencies, and on these stereo tests, the overall quality was ranked as 'poor'. Numerous colorations were described and the restricted bandwidth was also apparent.

T.F. Comment

I found this speaker rather fatiguing, with considerable mid band coloration and weak imaging. Although capable of high sound levels, it was harsh in the top and not to my taste.

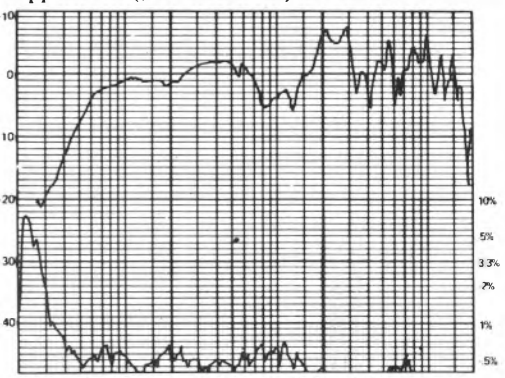
Summary

This loudspeaker's strong point was undoubtedly its powerful handling (by hi-fi standards that is) of electric bass guitar, and this suggests that if realistically loud sound levels on relatively punchy rock programme is the prime objective, the moderately priced *330*s might fit the bill, particularly in view of their modest amplifier requirements.

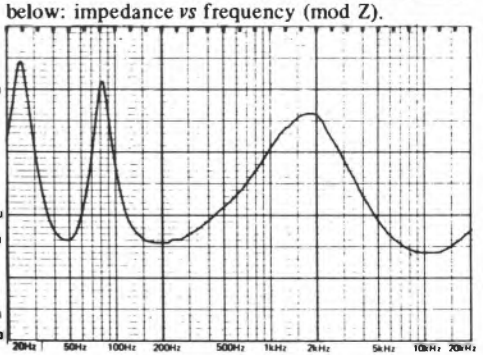
Size	53.3(21) H; 34.3(13.5) W; 22.3(9) D; cm(inches)
Weight	15.5(34) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 50W
Recommended placement	shelf
Frequency response within ±3dB (2m)	NA*
Low frequency rolloff (—6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	92dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA*
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	good
Forward response uniformity	average
Typical price per pair inc. VAT	£160

*See text.

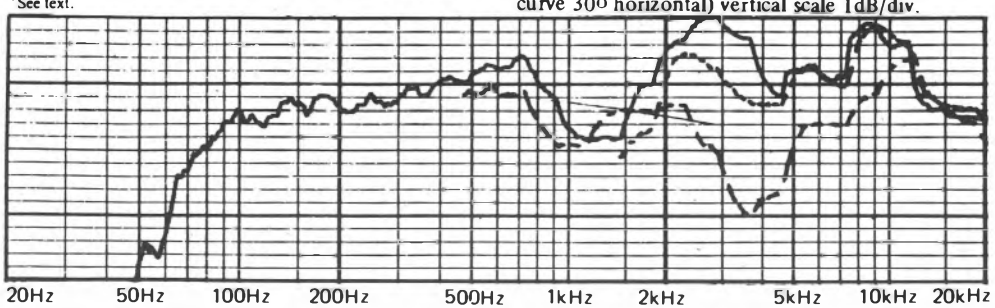
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



Swallow CM70

Swallow Acoustics, 'The Old School' St Annes Lane, Godmanchester, Nr Huntingdon, Cambs. Tel (0480) 59910.

This 14 litre sealed-box system is only 36cm high — just about the smallest enclosure that could take a 200mm Dalesford bextrene cone mid/bass driver, and a KEF *T27* tweeter. The crossover is a fairly simple 8-element type, built with fine, high power components.

During the report we were informed by the manufacturers that the design of the speakers we were reviewing had been refined. This involved no change in drive units or alteration to the crossover (a fact confirmed by the impedance curve for the first and second samples;) nonetheless they did sound different, the second pair possessing a better subjective balance. To our surprise the change simply meant that the bituminous cladding and anechoic foam interior of the first had been abandoned in favour of a light filling of sheep's wool; this is not to say that wool is inherently superior, rather that it suited this system better.

Lab results (1st samples)

The pair matching was just reasonable, with a 1-2dB imbalance and further differences in the treble range, while the sensitivity was low at 84dB/W, and the -6dB low frequency point not very extended at 55Hz. Driven to 96dB linear at 1m, the third harmonic distortion was fairly good, particularly at low frequencies, but it was let down a little by the 1% measured at 1kHz.

Rated as good on amplifier loading, the speakers did not fall below 6.4 ohms, and this was at a relatively uncritical 13kHz level, while the typical value was in fact closer to 10 ohms. The dotted and solid curves present the new and old speakers respectively, and are virtually identical. The power handling was exceptional for the size, the *CM70* happily tolerating 150W of bass guitar and 250W peak programme on wideband rock, providing a high 107dBA sound level from a pair at 2m in our listening room.

Swallow claim +/–3dB limits for the 1m axial response which I feel is optimistic, +/–4dB being nearer the mark. An unpromising plateau was evident from 600Hz to 2kHz, then shelving down 4dB into the moderately uneven treble band. $^1/_3$-octave averaging at 2m did not particularly improve the shape of the characteristic response, although with the upper and mid humps excepted, the trend was smooth and balanced. Some off-axis integration problems were apparent near the crossover point at 4kHz, with the 10° below axis direction imparting the serious 5kHz dip. Overall the output could be regarded as reasonably well integrated.

Sound quality

Personally I could not have correctly predicted the subjective ratings from the somewhat unpromising responses above, as the *CM70* did in fact do reasonably well on audition. Rated as 'average' on live comparisons, the sound was felt to be very neutral, albeit with a nasal and thickened quality as well as some bass coloration.

It fared better on the stereo program tests achieving an above average placing, although some disagreement among the panelists was apparent. Stereo imaging was not its strongest point, with comments of poor positional focusing and loss of depth, and while 'cuplike', 'nasal' and

'hard' colorations were also evident, nevertheless the whole appeared to be greater than the parts so that a quite pleasant musical sound resulted, with relaxed unfatiguing treble and relatively clean bass.

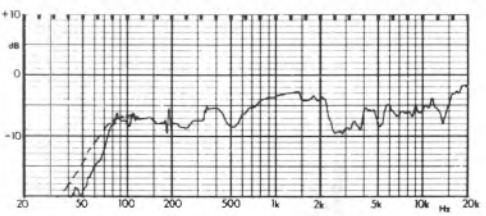
T.F. Comments

Full orchestral music was least successful and rather coloured with this model, and together with a disappointing stereo effect, resulted in average marks overall.

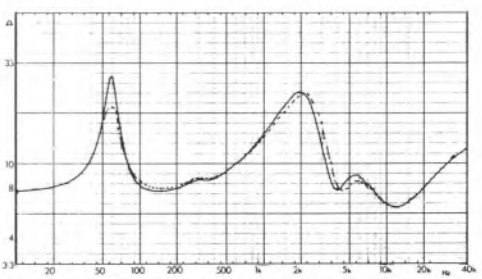
Summary

Undoubtedly worth auditioning in view of its ability to sound better than other larger and more costly systems in this report expecially on disc program, the *CM70* still falls a little short of recommendation at its price. Capable of a decent sound level, easy to drive and with moderate distortion levels, this inefficient system worked best with a larger amplifier, and also benefited from a little bass lift.

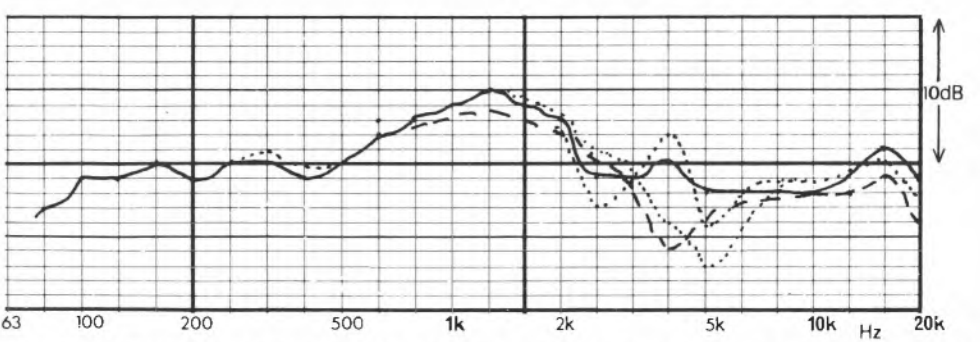
Size	36(14) H; 24(9.5) W; 24(9.5) D; cm(inches)
Recommended amplifier power per channel (for 90dBA per pair at 2 metres minimum)	25–150W
Recommended placement	on high stands clear of walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie. 1 watt in 8 ohms)	84dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	good
	66Hz 2%, 100Hz 1%, 400Hz 0.1%,
	but 1kHz 1%, 6kHz 0.35%, latter typical
Impedance characteristic (ease of drive)	good
Forward response uniformity	fairly good
Typical price per pair inc. VAT	£170



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



Impedance vs frequency (mod Z)



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

RECOMMENDED

Tangent RS2

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

A compact enclosure, the *RS2* carries a five year guarantee in common with the *RS6,* both systems being designed and built in the UK. The *RS2* is rated for use with amplifiers of up to 60 watts per channel, and no response controls are included.

Technical details

A two-way design, the enclosure is of the sealed box type. A 200mm bextrene-cone bass-mid unit (Audax) operates up to 3.5kHz, above which a KEF 19mm plastic-dome unit continues. Thick foam absorption is provided within the enclosure, but the walls themselves are not damped. A 10-element crossover using good quality components is incorporated. Only four screws are used to fix the driver baffle, which might account for the minor buzzes heard in one test.

Lab results

Pair matching could have been better, with up to 1.5dB difference noted in the midrange. The reference sensitivity was low at 83dB, although the —6dB LF point at 45Hz was good for this size of enclosure, this aligning with the system resonance at 60Hz. With a minimum impedance value of 6.5 ohms at 15kHz, and the reactive components well controlled, the system clearly offered a 'good' amplifier load.

Third harmonic distortion readings were very good, vastly better than for the larger *RS6,* with typical values at 0.6% or less from 100Hz upwards. Even at 50Hz a moderate 3% was recorded, this at the relatively high 96dB test level.

The 1 metre sine wave trace showed a fairly even trend, but with a small mid prominence, a presence band suckout, and a mildly erratic treble range. Moving out to a 2 metre mike position, the characteristic responses demonstrated a mild 4dB trough above 400Hz, which left the region above, 700Hz- to 2kHz, a trifle prominent, and with a —6dB presence dip beyond that. The off-axis responses however showed fine uniformity and integration referenced to the axial trend.

Sound quality

Overall the *RS2* scored 'above average' which is a notable achievement at the price. Faring best on the domestic stereo sessions, the imaging was highly rated with precision and depth both apparent. Some moderate colorations were noted, these partly associated with the mild reponse irregularities previously mentioned. The panellists commented upon treble lift and low bass deficiency, with 'small', 'fizz', 'chesty', slight 'box', 'hard' and 'presence dull' effects noted.

Scoring a reasonable 'average' on the live comparisons, a loud 104dBA was raised on the high level test, the speaker accepting the 500W peak input without distress. While minor buzzes and chuffing was heard, the bass performance was also commendable; up to 50 watts average of electric guitar could be applied before overload though the sound lacked some low frequency differentiation. The speaker at times appeared muffled and yet it generally gave a good rendition of musical detail; as with the *Sony G5,* panel opinion was divided, some favouring the sound while others did not.

RECOMMENDED

T.F. Comment

In the stereo tests I found this speaker very easy to listen to, albeit with a slightly 'wiry' top. The bass boomed a little, but the image remained well-focussed.

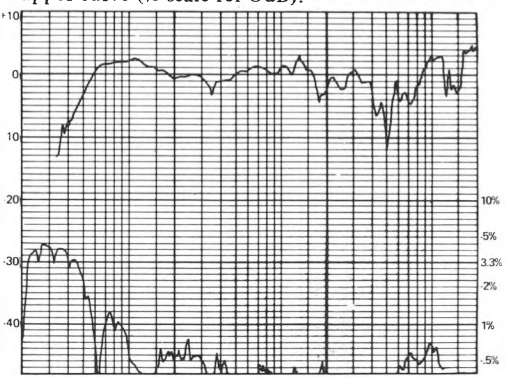
Summary

The *RS2* was easy to drive and has a good power handling capacity, which is essential when its low sensitivity is taken into consideration. A glance at the comparator table reveals that it achieved good ratings on many aspects, sufficient to gain a recommendation at the price; in fact, by the standards of this report, its performance comfortably exceeded that of its larger brother, the *RS6*.

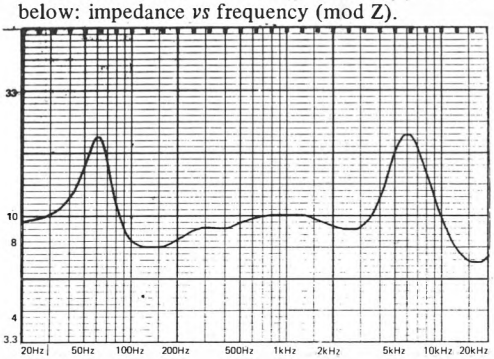
Size	37(14.6) H; 25.5(10) W; 28.5(11.2) D; cm(inches)
Weight	4(8.8) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	NA*
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	83dB at 1m
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc. VAT	£162

*See text.

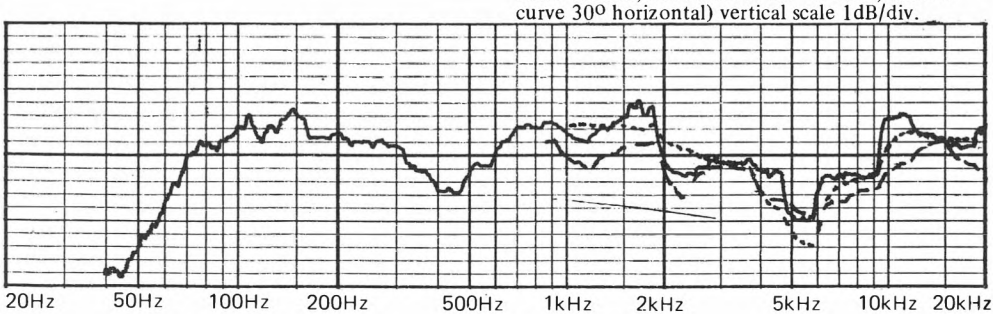
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



RECOMMENDED

Toshiba SS100GB

Toshiba (UK) Ltd., Toshiba House, Frimley Road, Frimley, Camberley, Surrey GU16 5JJ. Tel: 0276 6222

In common with several other European marketing divisions of Japanese companies, Toshiba (UK) have commissioned a series of speakers in co-operation with the design services of Son Audax. The largest of these is the *SS100GB*, a three way sealed box of some 45 litres internal volume. The vertical array of drivers consists of a 250mm flared pulp cone bass unit with a 45mm diameter voice-coil operating up to 650Hz, the midrange to 5.5kHz handled by a 100mm heavily doped pulp cone and the high frequencies by a 35mm soft dome tweeter. All the units are made by Audax, the crossover which is basically 12dB/octave employing 11 elements, including two resistors.

In some respects clearly built to a price, the chipboard cabinet is finished in a vinyl walnut colour laminate with no internal panel damping, while the thick grille baffle is not rebated or chamfered on the edges adjacent to the drivers. Internal absorption is provided by a quantity of polyester fibre wadding.

Lab results

Good pair matching was demonstrated to within +/–0.5dB and an average sensitivity of 87dB/W was provided, with a correspondingly low frequency point at 50Hz (rather higher than the 35Hz claimed.) The bass rolloff was well damped, however, and would accept some bass lift. Rated as good on third harmonic distortion, values were typically 0.3% although with 1% at 200Hz which is higher than usual but not serious. The figures were fine at low frequencies.

The 'poor' rating on amplifier loading was denoted by the dip to fractionally above 4 ohms at an important area of the spectrum, namely 4.5kHz; elsewhere the mean impedance was 8 ohms or so. The power handling was very good with a 250W peak program input comfortably handled and producing a fairly loud 100dBA maximum level. An astonishing 200W of electric bass guitar produced no audible distress.

On axis at 1m a presentable curve was produced, and bar a small dip at 4kHz, it met +/–2dB limits from 80Hz to 20kHz. Out at 2m, the characteristic remained quite even with a suspicion of mild elevation, 300Hz — 2kHz, and a trifle depressed treble thereafter, resulting in a 'richer' balance. The off axis family of responses were fine, with a worst case but nonetheless mild dip at 4kHz present in the 10° below direction.

Sound quality

Another of those models of the slightly 'rich' and 'coloured' type which tend to suffer on live sound comparisons, the *SG100GB* only achieved an 'acceptable' rating for these tests. The bass was a little 'light' though quite even in the upper register, and listeners criticised the sound as mildly dull and boxy, while the tonal impression on acoustic guitar resulted in an enlarged impression of the instrument's size.

However, on the recorded stereo programme the richer frequency balance was quite acceptable, and although not free of audible coloration with some 'hollow', 'cuplike' and 'fizzy' effects, the overall result appeared unfatiguing to nearly all the panelists. Both clarity and stereo presentation were to a high standard, and the speaker in fact attained good marks.

Toshiba SS100GB

RECOMMENDED

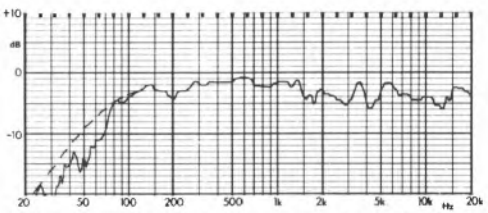
T.F. Comments

This speaker was easy to listen to although apparently deficient in the extreme bass. For me it was above average in all respects although not dramatically so.

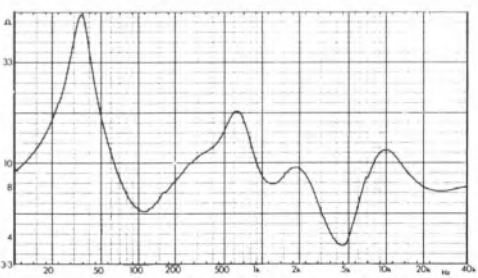
Summary

Bar a reservation concerning the impedance dip at 5kHz, the *SG100GB* did well enough to merit recommendation. The low frequencies were free of boom and the power handling excellent, with ample maximum level, moderate distortion, and a response uniformity well above average. While not wholly accurate, in this respect it was no worse than many others in the report, and had the virtue of a relaxed musical sound attained without an apparent sacrifice of detail.

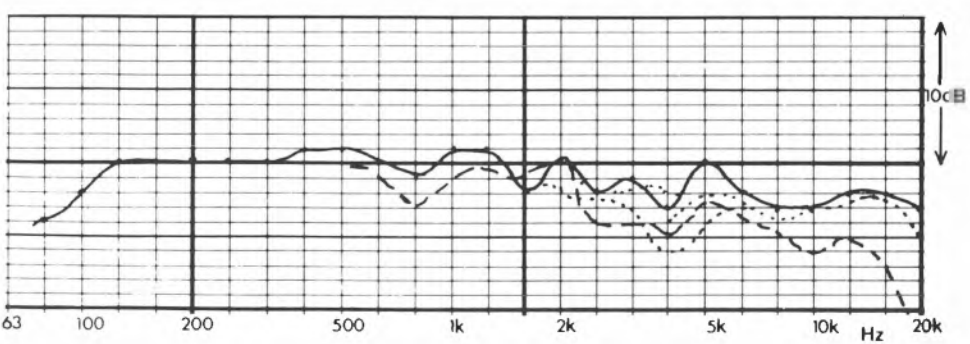
Size	63.5(25) H; 34(13.4) W; 29(11.4) D; cm(inches)
Weight	15.7(34.5) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15–150W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	62Hz to 20kHz
Low frequency rolloff (−6dB) at (1m)	50Hz
Voltage sensitivity (rel 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)	good 68Hz–1%, 500Hz–0.5%, 200Hz–1%, typically 0.3% elsewhere
Impedance characteristic (ease of drive)	poor
Forward response uniformity	good
Typical price per pair inc. VAT	£170



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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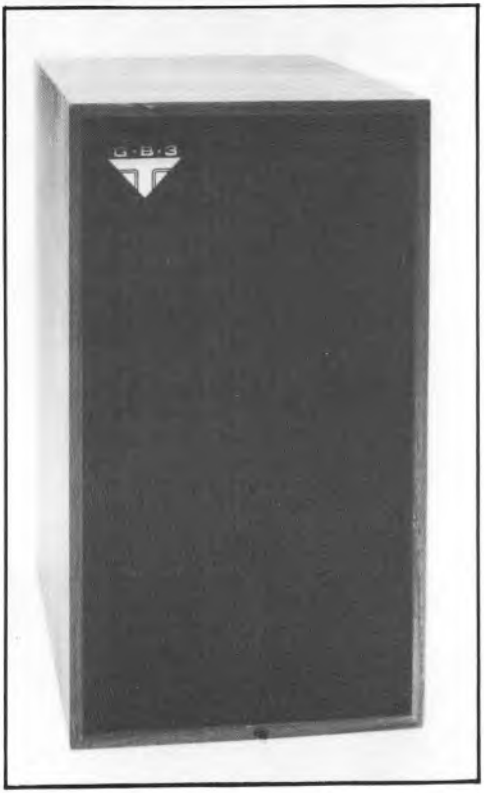


Developed from their established *Minimax* model, this diminutive 5.5 litre sealed-box enclosure is built in Hungary by Videotone to Videotone UK's specifications. The major difference between the two systems is in the choice of high frequency unit, with the 100mm cone Minimax version replaced here by a 25mm heavily doped dome unit. Bass and midrange is produced by a 130mm puip cone driver with a a large magnet and die cast frame, the system resonance appearing at 65Hz. The crossover has also been revised using good quality components, and while the construction quality is modest, it is nonetheless adequate at the price.

Lab results

The pair match was only 'acceptable', with up to 4dB imbalance at 3kHz and relatively dissimilar treble responses from left and right hand enclosures. Sensitivity was very low at 82dB/W with a corresponding -6dB low frequency point at 55Hz.

At a reduced 90dB sound level, the third harmonic distortion was good except at the lowest frequencies, but the higher 96dBA level simply resulted in overload. In practice, however, the power handling on program was rather better than this and 150W peaks of rock music were accepted, although this nevertheless produced a quite low 93dBA maximum sound level. On bass guitar a 20W input was possible, and when required moderate bass lift was accepted without complaint. The speaker offered a very good amplifier load, with an impedance minimum of over 7 ohms, the typical value being 15.

On sine wave at 1m, the response was distinctly uneven, with a 900Hz prominence and a chain of treble irregularities of the type produced by grille baffle diffraction. The treble was also shelf-boosted by 2dB.

1/3-octave averaging helped to disguise the diffraction effects, but largely confirmed the response trend which was fairly close to the kind which suits wall mounting. Off-axis the uniformity with the axial characteristic was pretty good except for the vertical 10° above, where the presence suckout deepened to extend from 1.5-3.0kHz. As with most tiny enclosures, the dispersion was well above average.

Sound quality

In comparative terms the *GB3* did badly on the listening tests, attaining an acceptable rating when compared with live sounds and a poor rating on stereo program. The significant colorations were described as 'small box', 'tunnel', 'congested', 'peaky', 'hard' and 'nasal' on the live tests, while on the stereo program, additional comments of 'fizzy', 'steely' and 'thin' were made. The speaker sounded reasonably clear, but coloration undoubtedly impaired the stereo image.

T.F. Comments

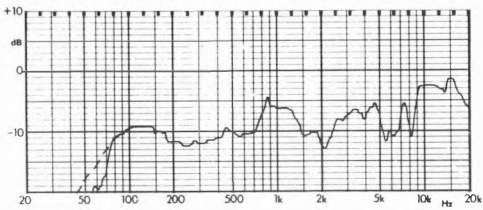
Clearly well below average, this speaker showed serious lack of bass on full orchestra and rock music, with a small and 'hissy' treble quality.

Summary

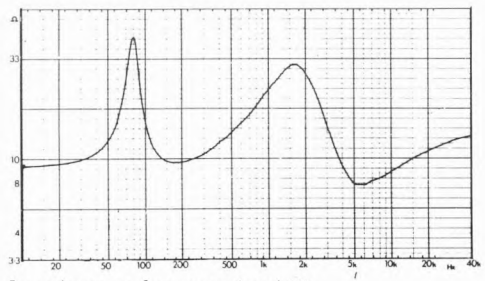
While this model is very small, easy to drive and offered good dispersion all at a very low price, the sound quality was not really suited to hi-fi

applications, and hence it cannot be recommended. However if space and budget are limited, it might be worth an audition.

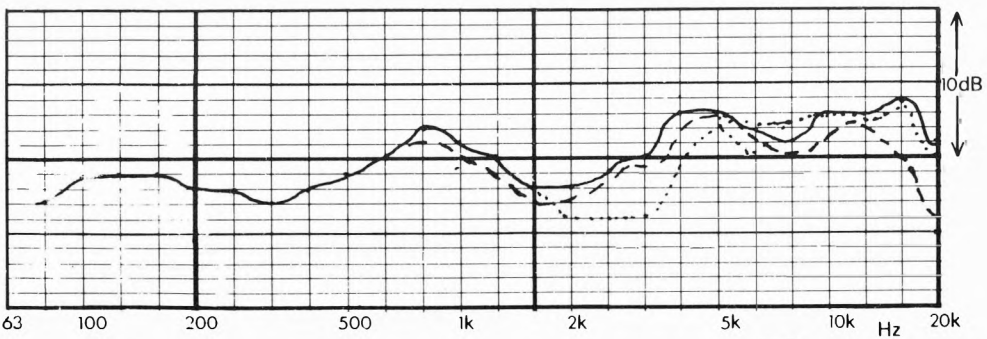
Size	26(10) H: 15(6) W: 22(8.7) D: cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	45–75W
Recommended placement	stand or open shelf
Frequency response within ±3dB (2m)	80Hz to 12kHz
Low frequency rolloff (−6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	82dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	93dBA
Third harmonic distortion (90dB at 1 metre)	good 66Hz–10%, 100Hz–1%, typically 1% improving to 0.3% at high frequencies
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	average
Typical price per pair inc. VAT	£70



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

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Visonik David 502

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Misgivings were expressed as to whether this diminutive loudspeaker could lay any real claim to enter a hi-fi survey such as this. In volume it would take four Visoniks to make up one *LS3/5A,* and that system is small enough! On test no concessions to its size were made, bar the reduction of the distortion test level to 86dB, but in the event, enough good points were revealed to warrant serious attention.

Technical details

Possessing an internal volume similar to a large breakfast cup, this two-way sealed box design incorporates a 70mm long-throw bass-mid unit, and a 19mm fabric-dome tweeter, these two together occupying the entire front plate of the enclosure. An LED power overload lamp is fitted, this being a necessary safeguard, as the speakers were found to accept considerable power without audible distress.

Lab results

Very good pair correspondance was shown, within 1dB throughout. The reference sensitivity was very low at 83dB (only to be expected of such a small enclosure), but was not unduly compromised by the low impedance which measured typically 5.5 ohms, with minimum of 4 at a relatively unimporant 20Hz. An 'average' amplifer loading was applicable, the system resonance being at a high 135Hz, with the —6dB LF point at 95Hz.

Noting the 10dB reduction in test level, the third harmonic distortion results were good, except for an 0.8% peak at 1.5kHz. The third harmonic distortion values were at the threshold level (the noise floor is due to the lower output from the this speaker) and did not rise significantly until 100Hz, reading 1%. Even at 50Hz a reasonable 4% was recorded.

While the sine wave response was generally flat, a noticeable +5dB rise occured at 20kHz, as well as a rolloff below 100Hz and a gentle uptilt of output with increasing frequency — in other words a 'light' balance.

At 2 metres the LF range could be seen to fall away rapidly with a hump at 200Hz under these anechoic conditions. Mounted flush in a wall of books, this rolloff may at least be subjectively restored to a large extent. As expected, the tiny enclosure demonstrated superb off-axis dispersion and integration, the 30° lateral curve, for example, barely distinguishable from the main axial trend.

Sound quality

Such a speaker could not be expected to excel in a test of this sort, due to the great technical limitations imposed by its small size. However, it scored an 'acceptable' overall rating, with its stereo image commended, and in view of price and more particularly size, this result should be seen as outstanding.

This game little box withstood 500W peak without damage, attaining a respectably loud 98dBA in virtually free field conditions. Though light and thin with only the harmonics effectively reproduced on electric bass guitar, the *502* tolerated 15 watts average input before overload, and was free of buzzes and rattles up to this point.

It sounded worse on the stereo sessions

where its obvious lack of bass and thin balance excited censure. Coloration was however fairly good — mainly of the 'small box' type, and the clarity was always excellent. The emphasis in the high treble did not pass unnoticed, and did exaggerage distortion somewhat, with some 'tizz' also ascribed to the sound.

T.F. Comment

Except for the stereo image, this speaker did not fare particularly well, due to an apparent complete absence of bass. Extreme treble also seemed rather excessive, producing 'birdies'.

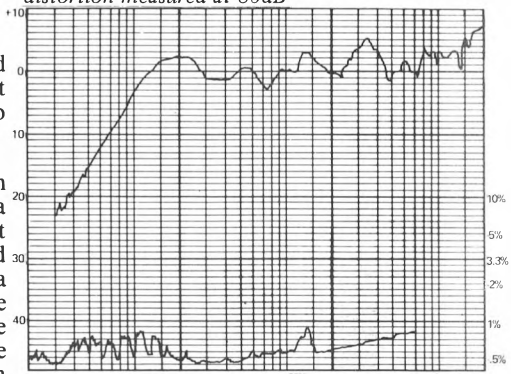
Summary

Some might regard the *502* as a joke, but in context it did not fare all that badly against a large number of vastly bigger and in most cases costlier models. Its sound quality and light balance do not permit a recommendation, but conversely it cannot be dismissed out of hand. In circumstances where a 'visible' loudspeaker cannot be tolerated, the 502 offers an alternative; moderately driven with some treble cut and mild bass lift, fitted close to a wall or in a shelf of books, a reasonable sound quality is possible, with very little loss of midrange or treble detail.

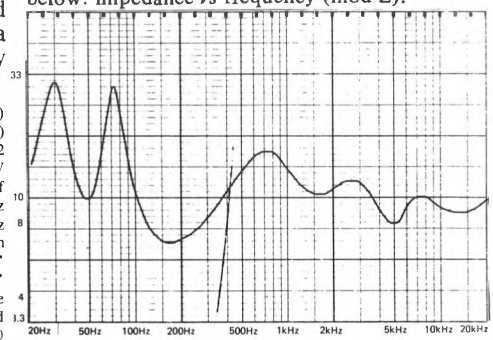
Size	17(6.7) H; 10.3(4) W; 10.7(4.2) D; cm(inches)
Weight	2.5(5.5) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	shelf
Frequency response within ±3dB (2m)	130Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	95Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	83dB at 1m
Approximate maximum sound level (pair at 2 metres)	98 dBA*
Third harmonic distortion (96dB at 1 metre)	good*
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£100

*See text.

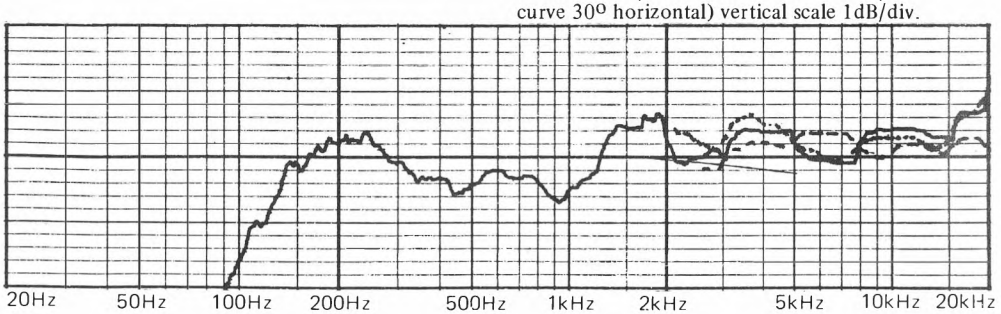
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.
distortion measured at 86dB



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



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



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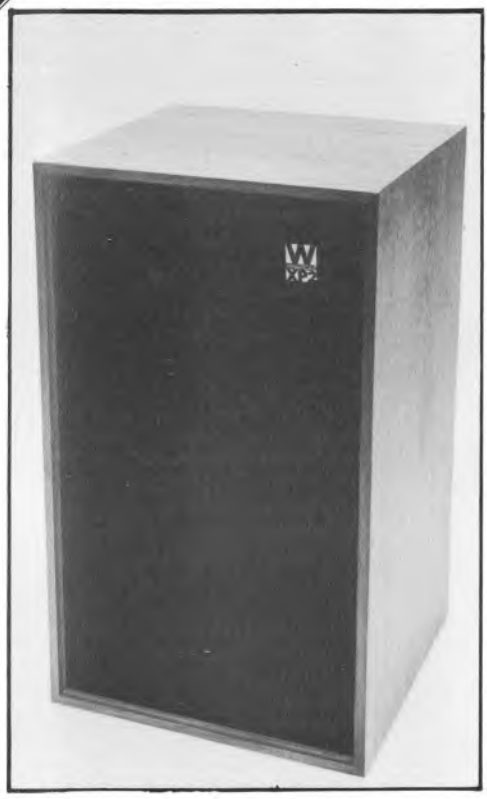


The *Shelton XP2* forms part of the budget range of Wharfedale speakers, and is a little larger than the familiar *Denton.* A small sealed-box design of 15 litres internal volume, the bass/midrange is covered by a 200mm pulp cone driver with the treble above 3.5kHz allocated to a 19mm plastic dome tweeter. Both units are made by Wharfedale, as is the cabinet, these facts contributing towards explaining the low cost (incidentally, this practice is also true of Castle Acoustics, a neighbour of Wharfedale in Yorkshire.) The general standard of construction was good, though the formation of both the grille baffle and cabinet edge is not conducive to low diffraction.

Lab results

This speaker was more critical of axis in the vertical plane than most, and at 1m the usual mike position between the mid and treble units gave a poor result, the axis at or a little above the tweeter being clearly preferable. Pair matching was good as judged by the reference curves, with a sensitivity of 86dB/W together with a -6dB low frequency point at 55Hz, which is reasonable for this size of enclosure. Driven to a high 96dB the distortion was acceptable but improved at a more forgiving 90dB level, which is in any case more appropriate to this speaker's size and price.

In the event power handling did not appear to have been compromised, with 20W of electric bass guitar and 150W of peak program on rock material accepted, the latter generating a reasonable 96dBA for a pair in the listening room at 2m. Specified by Wharfedale as a 6 ohm model, the impedance curve in fact showed a dip to below 5 ohms (c.4.5) at 10kHz, which technically speaking rates it as a poor load. However since the average value was nearer 10, the matching amplifier should not have too difficult a task.

On the treble axis the response was quite good at 1m, and except for minor dips at 2.5 and 7.2kHz, it met +/–2.5dB limits from 70Hz to 12kHz. Above this the top end did however break away, lifting to +6dB at 18kHz, while when nearer the bass driver axis a 7dB crossover cancellation occurred at 2.5kHz.

Out at 2m the characteristic was less tidy although in the main this was due to our choice of measurement axis, particularly in the case of the 30° lateral response. If this measurement was taken nearer the cabinet in a + 10° vertical direction, the integration was much better than that reproduced here. The relatively good dotted curve was in fact the result on the 10° above vertical axis, and indicates that stand or shelf mounting somewhat below ear level is desirable. This should not be hard to achieve, and is in fact close to the listening position adopted for our auditioning.

Sound quality

In an absolute sense the *Shelton* was fairly coloured with boxy and boomy effects as well as an uneven impression regarding the frequency response, particularly in the treble. The overall rating was poor for the live sound comparisons, but like the Toshiba *SS100GB,* the *Shelton* fared rather better on the stereo program sequence, achieving an average placing. Several panelists liked the system, and both stereo

RECOMMENDED

reproduction and clarity were reasonable. Aside from some coloration which included 'fizz' in the upper treble, the sound was quite pleasant.

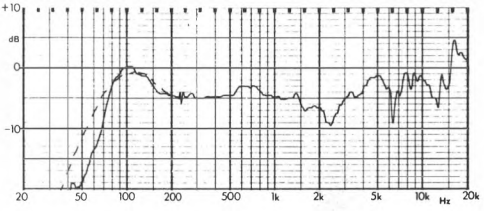
T.F. Comments

For me this speaker was a little below average, and I was aware of some hollowness and fizz together with a poorly focused stereo image.

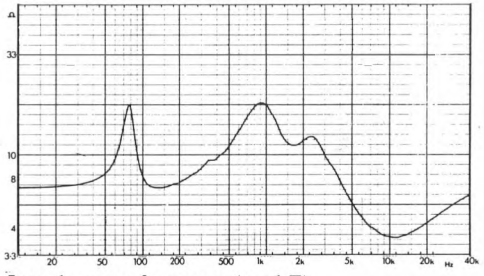
Summary

If its remarkably low price is taken into consideration the *Shelton* can be seen to have done well, despite the above criticisms. If care is taken in positioning, fairly good subjective results are possible, and the general balance of performance was a reasonable one. A recommended budget model.

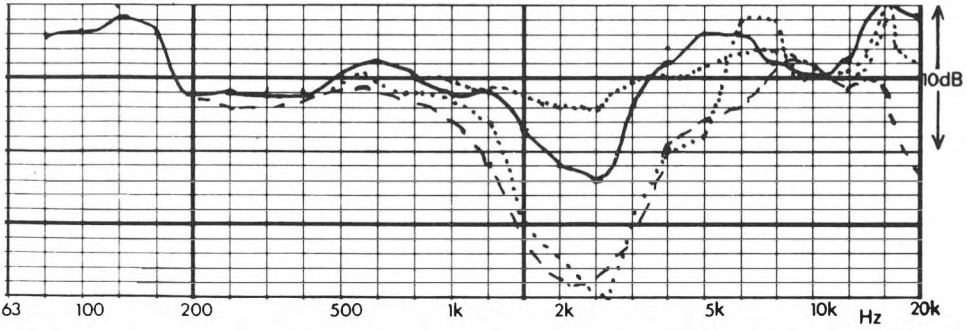
Size	4(16) H; 24.5(10) W; 24(9.5) D; cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20–50W
Recommended placement	stand or shelf
Frequency response within ±3dB (2m)	see text
Low frequency rolloff (—6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	96dBA
Third harmonic distortion (96dB at 1 metre)	acceptable 60Hz–12%, 85Hz–10%, 100Hz–25%, 250Hz–1.5%, 2.5kHz–5%
Impedance characteristic (ease of drive)	poor
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£65



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



Impedance vs frequency (mod Z)

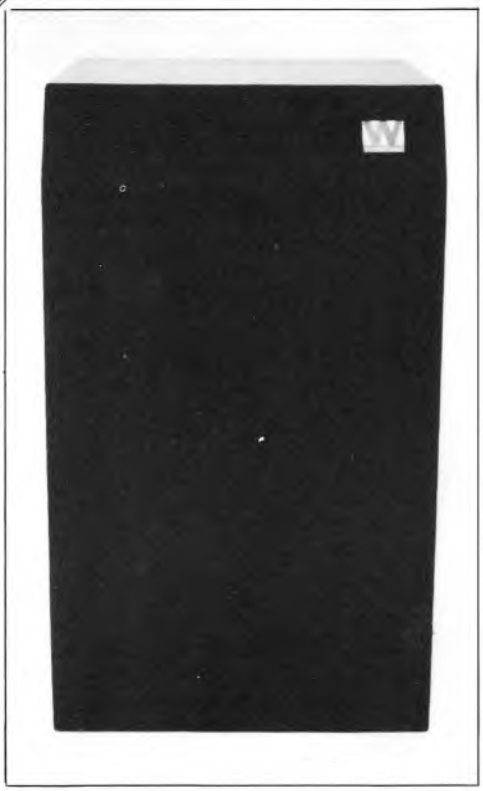


[1]/3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

Wharfedale Teesdale

Rank Hi-Fi, PO Box 70, Great West Road, Brentford, Middx. TW8 9HR. 01-568 9222.



A recently introduced model from Wharfdale, the *Teesdale* is a full three-way system which sells at a very modest price. The HF unit incorporates a type of isodynamic ribbon element patented by Rank, all three drivers being of Wharfedale's own manufacture.

Technical details

The 200mm bextene-cone bass unit is loaded by a reflex enclosure, the latter tuned by a substantial ducted port. Mounted above is the established Leak/Wharfedale 100mm bextene-cone midrange unit, this operating over the 800Hz-5kHz range. Above 5kHz, the new ribbon tweeter takes over, the longer dimension of its rectangular window being vertically mounted, in order to maximise the lateral directivity. For the same reasons, all three drivers are positioned vertically-in-line.

Lab results

A fine 1dB match was shown throughout, with the reference sensitivity established at an average 88dB, and a usefully low —6dB cutoff point at 40Hz. Some reactive components were present in the impedance curve and this fact, together with a nominal value of 6 ohms plus a dip to about 4 ohms at 12kHz, means that only an 'acceptable' loading characteristic was indicated.

Apart from a minor rise in third harmonic distortion to 0.8% at 2kHz, and a suspicion of some distortion at the edge of the frequency band at 12kHz, the distortion values were low, right down to 70Hz. At 55Hz a fine maximum value of 1.5% was recorded, with no further deterioration occurring until 30Hz. Considering the 96dB test level, these are good results.

An extended, even and accurately tuned low frequency band can be seen on the reference trace, but a small prominence does occur at 600Hz, followed by a 2dB trough to 3kHz and a mildly erratic treble beyond.

At 2 metres with $\frac{1}{3}$-octave averaging, the characteristic trace showed a pretty even trend, albeit with a touch of lift at 700Hz, and some further boost from 4-7kHz. 10° above axis an 8dB notch near the upper crossover point appeared, so for the best results the listener should face the mid unit. In the lateral plane the 30° off-axis curve was very good, and due to the HF unit geometry, it is actually better maintained at 15kHz than was the 10° above response.

Sound quality

On an overall sound quality basis the Teesdale scored 'good'; in other words an 'above average' rating which is a fine result at the price. On the live sound sessions a fairly loud 101dBA was raised, with 500W peak input causing no audible problems. However, its handling of electric bass guitar was weak, with power inputs in excess of 5-8 watts average causing overload. The bass quality up to hits point, however, was described as clean, deep and even in character, if not very loud. Colorations included comments of 'boxy', 'treble bright' and 'breathy treble', with slight 'metallic' and 'presence dull' effects.

The stereo imaging was fairly good, but it lacked some depth, and on occasion it was felt to be 'hazy'. During these sessions the colorations were heard more keenly, giving rise to comments of 'middy', 'boxy', slight

RECOMMENDED

'fizz', 'nasal' and 'boomy' effects, with a thickening of the sound at certain frequencies. Detail however was good.

T.F. Comment

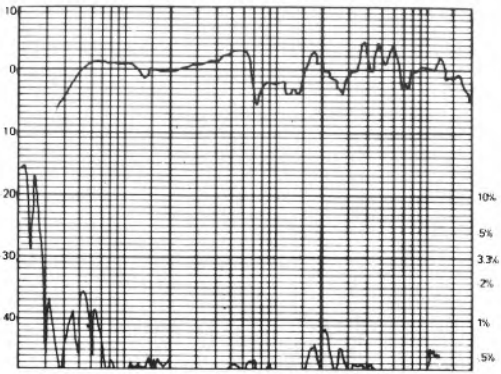
This system worked well in all respects, with somewhat limited bass power-handling and a slightly 'pinched' sound on human voice; nevertheless well liked.

Summary

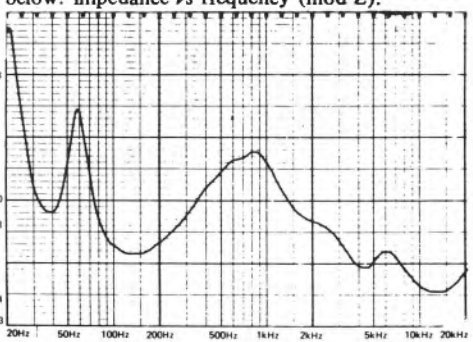
This inexpensive loudpeaker has some strong points, notably an extended bass response, marginally above average sensitivity with a pretty uniform frequency balance and fairly low coloration, while its loading requirements mean that a 4 ohm type amplifier is to be preferred to provide a good match. Considering its price and all that it offers, it is certainly worthy of a recommendation.

Size	57.8(22.8) H; 34(13.4) W; 27.8(11) D; cm(inches)
Weight	14.1(31) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	65Hz to 17kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	acc.
Forward response uniformity	good
Typical price per pair inc. VAT	£135

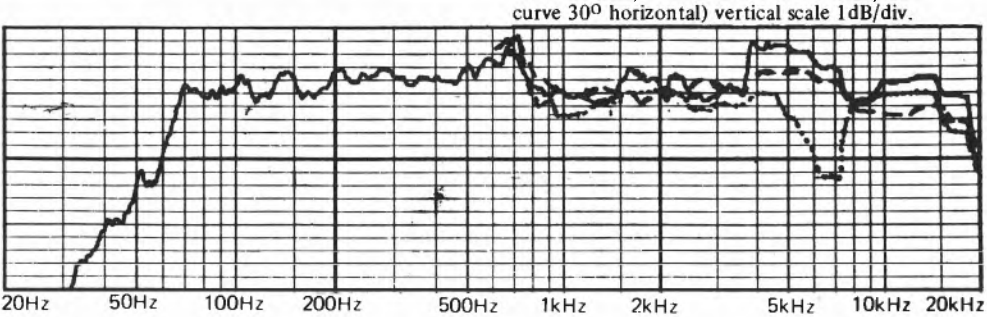
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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

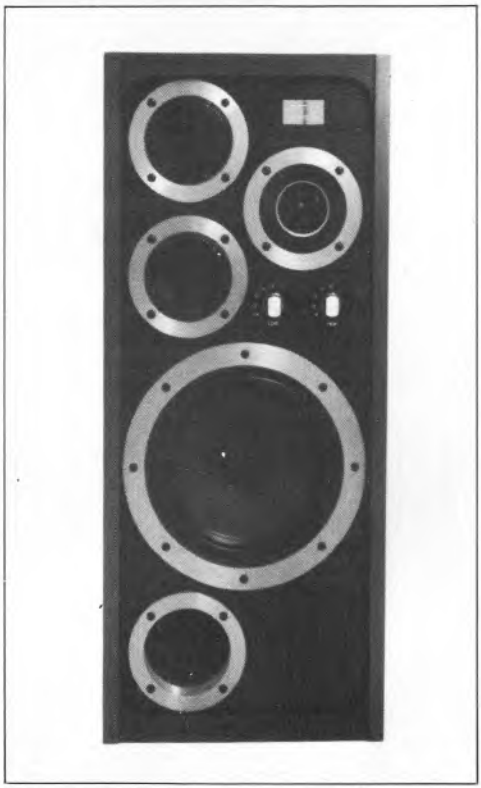


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Wharfedale E70

Rank Hi-Fi, PO Box 70, Great West Road, Brentford, Middx. TW8 9HR. 01-568 9222.



This relatively expensive loudspeaker sets out to offer a high sensitivity, and consequently it will achieve good sound levels with a comparatively modest amplifier input; in fact the comparator table shows its sensitivity to be the highest of the entire group. A relatively tall enclosure, a floor position is indicated although mounting on a small stand did offer a slight subjective improvement in the upper bass range.

Technical details

An unusual design, the enclosure is reflex loaded by a large vent with a short duct. A 250mm pulp-cone driver covers bass to low-mid frequencies, the crossover to a pair of 100mm mid units occuring at 800Hz. A horn-loaded 25mm hard-dome tweeter operates above 7kHz, this laterally mounted with respect to the mid units. A good quality if simple 6-element crossover is employed, with a further 13 elements used for the versatile 'contour' frequency balance controls.

Lab results

A good pair match was shown by the *E70s* except in the 2-7kHz range, where up to 4dB mismatch occurred. This was partially due to the inherent character of the speaker itself, ie its variability of output with axis. A very high 94dB sensitivity was recorded — right on spec — with a correspondingly restricted low frequency range, the —6dB LF point occuring at 56Hz. Low reactive elements were present in the impedance and a typical value of 10 ohms was recorded, with a minimum fractionally below 7 at 150Hz. The speaker was thus easy to drive.

Third harmonic distortion was quite good in the mid range, at 0,6% from 200Hz-3kHz, but quickly rose to 4% at 150Hz. It improved at lower frequencies, measuring 1.5% at 50Hz, before rising rapidly again to 10% at 40Hz; a low filter is thus to be recommended. In fact, considering the very low power input required to produce the test level, the distortion does seem a little on the high side.

On sine wave at 1 metre mike spacing, an even rising response trend was apparent with a total lift of 8dB from 60Hz-2kHz, suggesting that the speaker might balance better when backed against a wall. Irregularities were present in the crossover region, and on this near ideal axis, the HF fell away above 15kHz. At 2 metres the outputs were better integrated, illustrating a generally smooth if unbalanced character. The 30° off-axis traces were weak, demonstrating marked asymetry between left and right directed axes, the significance of which was realised when the results of the listening tests were analysed.

Sound quality

With the controls set to 'zero' for all our tests, the *E70s* developed maximum efficiency, but upon experimenting we found they actually sounded better on the 'minus 2' settings, this agreeing with Wharfedale's curves printed on the loudspeaker rear panel.

Taken overall, this speaker scores about average on sound quality. In mono and compared with live sounds, it did fairly well, producing a surprisingly limited (in view of the high sensitivity) but still loud 103dBA maximum. Problems were apparent in the

bass — the electric guitar sound was 'altered' and it would not attain high volumes. Coloration comments included 'hard', 'steely', 'fizz', 'bright', 'LF distortion', 'HF ringing', poor driver integration and 'hollow' effects.

On the stereo tests the situation was much the same, with comments of 'metallic', 'sibilant', 'thin', 'HF directional', 'tizz' and 'honky', effects together with lack of extreme treble. It did produce a satisfying degree of musical detail, but stereo image problems were evident.

T.F. Comment

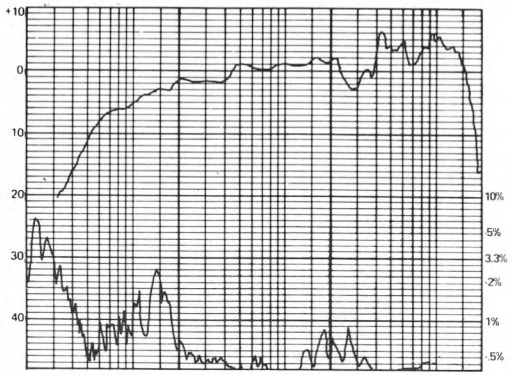
I found this system below average overall, mainly because of a serious dispersion problem; stereo image change dramatically with head movements, as did the treble balance. An overall treble boost was apparent, giving a feeling of loudness, but not without some discomfort.

Summary

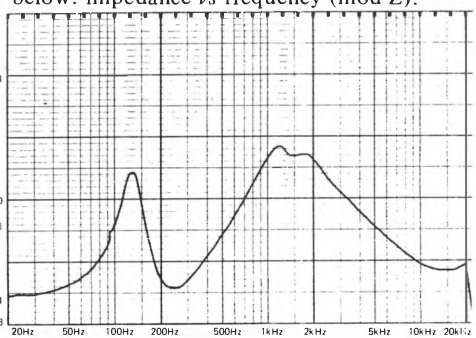
While it could not be driven particularly hard, the *E70* produced quite high levels on modest inputs; for example, a 100 watt peak produced 103dBA from a pair at 2 metres. The stereo image problem is undoubtedly its main weakness, and could be improved by the simple expedient of providing mirror pairs.

Size	81.5(32) H; 34.2(13.5) W; 36(14) D; cm(inches)
Weight	32(70) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 75W
Recommended placement	floor
Frequency response within ±3dB (2m)	150Hz to 15kHz
Low frequency rolloff (—6dB) at (1m)	56Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	94dB at 1m
Approximate maximum xound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	acceptable
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	average
Typical price per pair inc. VAT	£345

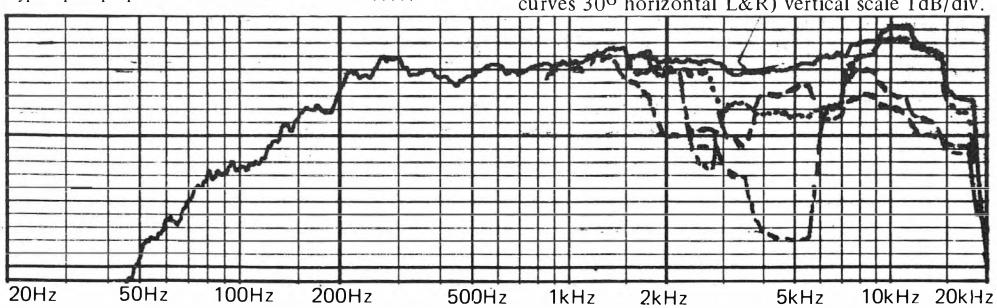
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



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



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



RECOMMENDED

Yamaha NS 1000M

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

Reviewed in the previous issue of *Loudspeakers*, the *NS1000M* was included in this report partly to provide an element of continuity and partly to permit a comparison to be made between two test and listening programmes.

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 bass lift may 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 did its 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.

RECOMMENDED

Scoring 'above average' on the stereo sessions, this Yamaha exhibited fine imaging and excellent rendition of musical detail. Some panellists 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.

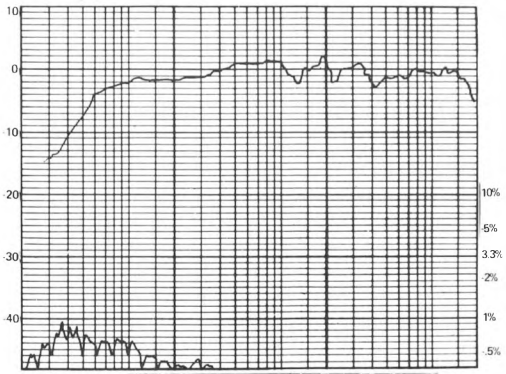
T.F. Comment

I found the *NS 1000s* above average in all respects, with slight hardness and brittleness, particularly noticeable at higher volumes. A good system at a high price.

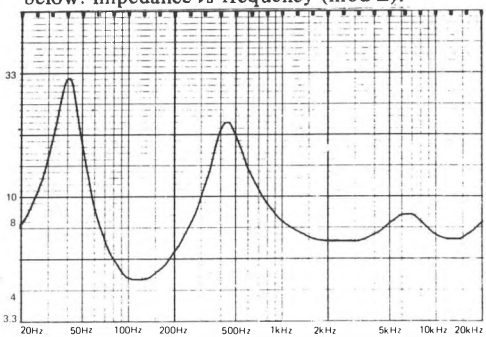
Summary

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 exite 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.

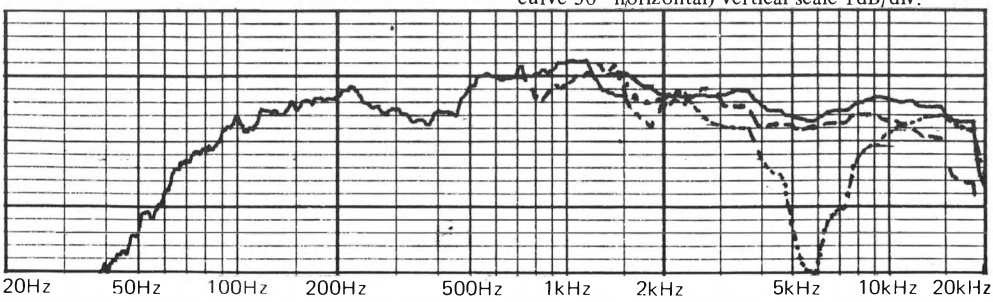


below: impedance *vs* frequency (mod Z).



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	£700

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



studio monitor loudspeakers by spendor

BCI A standard monitor loudspeaker in sound broadcasting studios throughout the U.K.; also used in recording studios where the requirement is for accurate reproduction rather than an "impressive" sound. The BCI is a three-unit bass reflex design using a Spendor 200mm cone driver for bass/midrange. Power handling is 55W.

SAI Specifically designed for small control rooms, the SAI "mini monitor' uses a Spendor 150mm bass/midrange unit with Son Audax tweeter in an infinite baffle enclosure handling 40W.

BCIII Spendor 300mm and 200mm cone drivers are used for bass and midrange in this four-unit bass reflex loudspeaker which can handle 70W programme.

Stands fitted with castors are available for both the BCI and BCIII loudspeakers.

Spendor Audio Systems Limited.
Station Road Industrial Estate, Hailsham, Sussex. Hailsham 843474.

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.

Stereo quality In addition to producing the individual reports, I set out to investigate certain aspects of sound quality that relate to speaker performance. Stereo imaging was one particular 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.

The results were in the main disappointing. A total of 12 models were auditioned which claimed some feature or features along special 'phase' lines, these including models from Technics, Bang and Olufsen, KEF, Bowers & Wilkins, Dahlquist, Nightingale, Keesonic, Leak, Revox, Sony and Tangent. One model, the KEF *105*, proved capable of precise spatial location with satisfying depth perception and ambience, but whether this was particularly due to its time delay compensation is impossible to say, since almost the same high quality of imaging was attained by another model, namely the Spendor *BC1*, which incorporates no special 'phase' or 'time compensated' features. The factors common to these two designs were in fact classical 'prime' performance aspects namely low colorations; excellent driver integration both in relative phase and amplitude terms; fine lateral directivity symmetry; low distortion; adequately wide bandwidth and a uniform frequency response naturally balanced. Many other conventional systems in the group which possessed a sufficiently good performance on the afore-mentioned parameters were also found to produce very good stereo image quality.

In conspicious contrast, the majority of the 'special' speakers under discussion were actually ranked below average in terms of their stereo image. A careful analysis of their remaining parameters revealed distinct shortcomings in either or both areas of frequency response balance and eveness, together with significant levels of perceived coloration. Discussion with the panel and other audio experts led to the conclusion that if 'phase' or 'time delay' aspects of speaker engineering were to have any chance of producing audible improvement, then the speaker to which the techniques were applied must already meet or exceed established high standards of sound reproduction, something which the majority would appear to fail to do.

The consensus of opinion was that whenever errors in frequency balance and/or coloration were present to any degree, the masking and distortion of the subtle clues

The NEW Celestion Ditton 121

A big advance in small speaker technology

For the first time in a budget loudspeaker ou can enjoy a sound quality that results from ıe sophisticated engineering normally applied ılly to far larger and costlier systems. naginative use of recently developed structural ıam materials plus Celestion's tried and :oven acoustic expertise combine to produce a udspeaker that is exceptional for its modest mensions.

Put advanced loudspeaker technology on our bookshelf with the new Celestion Ditton 121.

Overall Dimensions H395 mm, W265 mm, 226.5 mm.
Internal Volume 18 litres.
Weight Packed 13.5 kg per pair. Unpacked 6 kg each.
Overall Frequency Response 60 Hz to 18 kHz (±6 dB).
Impedance 8 ohm (nominal).
System Resonance 75 Hz.
System Q 1.2.
Sensitivity 2.5 watts pink noise input produces 90 dB SPL at 1 metre in anechoic conditions.
Crossover Frequency 4 kHz.
Power Handling 1. Maximum rated power 40 watts programme (without clipping).
2. Continuous Sine Wave voltage rating 9.0 V 20 Hz – 4 kHz, 4.5 V 4 kHz – 20 kHz.
Amplifier Requirements 10 – 40 watts.
Finish Teak, Walnut, Black.

celestion international

Please send me full details of the new Ditton 121.
Rola Celestion Limited, Ditton Works, Foxhall Road, Ipswich, Suffolk IP3 8JP, England.
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which allow subjective perception of the stereo illusion were so great that the effect was greatly reduced; for example, a poor frequency balance can be shown to ruin imaging in the following manner. 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 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 poor locational information. (This excepting one or two systems with carefully optimised mirror image driver arrays, such as the IMF *TLS80* which did attain satisfactory image presentations.)

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. (The JBL *L212* was an exception due to its use of unusually wideband drivers, which helped to control the usual irregularities.)

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-

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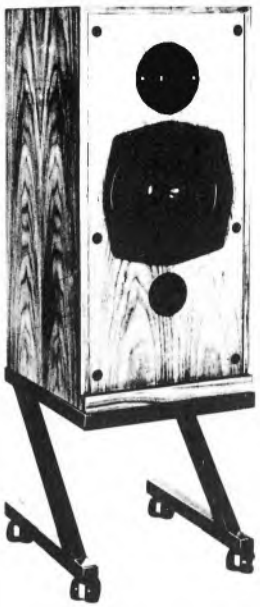

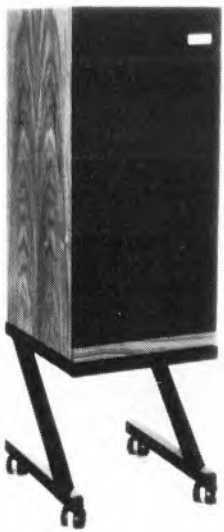

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centre seat results in an imbalance of the sound mix from the two speakers, thereby degrading the stereo image quality. At higher frequencies diffraction theory informs us that the edge of the grille and cabinet act as secondary sound sources thus 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 $\pm 10^{\circ}$ vertical and $\pm 30^{\circ}$ 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 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!

As far as Japanese designs are concerned, the seeds of an overall improvement were shown in the last issue, where 3 models were recommended. This trend has continued in this revised report, with 5 designs accorded recommendation, namely models from Sansui, Sanyo, Sony, Toshiba and Yamaha. However it must be said that of these five only the Yamaha is wholly Japanese in origin, the remainder being built with either UK or European component or design involvement.

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.

While on the subject of power handling, it was a great surprise to find that so many models developed buzzes and rattles at quite moderate levels of pure bass input. These were not just the expected 'chuffing' from reflex ports etc near overload, but were attributable to sloppy workmanship. They included poor fixing of drivers to front baffles (inadequate screws, omission of a sealing gasket on either the driver frame or removeable panels), loose or inadequately fixed crossover assemblies and vibrating internal wiring, and, finally, a significant number of rear terminal panels were noisy, either as a result of poor sealing or bad attachment. There is no excuse for any of these faults.

Subwoofers

A total of three subwoofers have been evaluated int his and the previous edition of *Choice: Loudspeakers**, and some worthwhile overall findings have emerged from our tests.

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.

By the standards established for *Hi-Fi Choice*, the general claim that subwoofers may be located anywhere in the room was not verifed. Even with the crossover points as low as 50Hz it was found all to easy to become aware of the location of the subwoofer system, and in the end we were driven to place them virtually inbetween the main stereo pair, if distortion was 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 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 two systems reviewed in this issue; while in no way seeking to imply that they represent bad value, I personally am not 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

**Cf these, the original JR system has since been discontinued.*

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 anything other than small stereo speakers.

At the end of the project we are left mildly surprised that arguably the best mid-price loudspeaker is the Spendor *BC1* — which is in its eleventh year of production! As with all products, some weaknesses were present, and unfortunate combinations of environment, placement, and ancillary equipment can all apparently worsen its subjective quality. Nevertheless, careful analysis of the listening data shows that under the controlled conditions of this test programme, its prime position at the £300.00 price level is unassailable. I feel this must reflect production care and quality control, as well as the accuracy of the original design. A fact which may surprise some readers who follow progress in new products is that the design of Celestion *HF1300* tweeter used in the *BC1* and which the panel rated highly terms of musical quality, is in fact more than twice as old as the speaker system itself!

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 incompetance or, worse still, inaccuracy.

Other recent reviews

The following models have recently been reviewed by Martin Colloms under similar conditions to those used in this book.

Hi-Fi for Pleasure May 1979
Audiomaster MLS2, Castle Kendal II, Goodmans Achromat Beta, Marantz HD440,*, Monitor Audio MA6*, Philips RH487, Tangent TM3, Tannoy T165, Visonik David 6000 + Sub2 subwoofer.

Hi-Fi News & Record Review June 1979
(presumably to be reprinted in 1980 Audio Annual.)
Allison 4, Cerwin Vega R12 (+DB10), ITT 8073, B&W DM2 II*, Audiomaster MLS4, Goodmans Sigma, Tannoy T125, Wharfedale Teesdale SP2*, Sony G1*, Lentek S4*, NAD 8080, Radford T90, KEF Concord III.

* *Reviewed and printed in Choice.*

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As in the previous edition we have omitted a 'Best Buy' classification on the grounds that such narrow distinction is inappropriate to loudspeaker evaluation. Instead we have selected models we feel worthy of recommendation, but clearly the prospective purchaser should still audition any speaker that interests him, to make sure that he agrees with our assessment of its relative faults and virtues. This is particularly relevant in view of the strong effect that is brought to bear upon subjective performance by room acoustics and speaker positioning, as well as programme type, quality, and ancillary equipment.

All those speakers which offered genuinely good sound quality and competant all round performance are recommended, virtually irrespective of price. Those which additionally offer value for money and in some cases compact dimensions are also singled out for mention (for many users small size is a more important consideration than hi-fi reviewers would like to believe!)

Exceptional performance

Those models which clearly demonstrated an exceptional performance included the **KEF R105 11** (£750), possessing excellent stereo and high power handling, together with excellent consistency and good bass extension. The **Spendor BC1** (£300 + stands) continues to stand out, with certain areas of its performance as yet unrivalled, notably midrange accuracy and spectral balance. The stereo presentation is also exceptional especially for a centrally placed listener. While much less expensive, the **Castle Conway II** (£240 + stands) romped home on virtually all counts and is recommended without hesitation. The **Sanyo Hi Fi One** (£95) qualifies on the grounds of excellent value for money and the surprising **KLH 317** (£160) on the basis of a fine performance versus price, together with a remarkable maximum sound level and usefully high sensitivity — perhaps this is the rock music award!

Recommendations
Above £600.00 per pair

Acoustic Research AR90 (£725)
A large floor-standing model, the *AR90* possesses a smooth sound with good stereo and a firm, powerful, extended bass. It does however present a difficult amplifier load.

KEF R105 II (£750)
See 'Exceptional performance' above.

Yamaha NS 1000 M (£720)
A compact high sensitivity design attaining high loudness levels, although now rather costly.

£400.00-£600.00 per pair

Mordaunt Short Signifer (£475 + stands)
This model is undoubtedly the Company's finest product to date, showing itself to be a well designed model of good all round performance.

£250.000-£400.00 per pair

Celestion 551 (£330 + stands)
Well engineered with a good all round performance, particularly as regards stereo presentation as well as bass power and quality.

Harbeth HL1 II (£300 + stands)
The new version continues to be recommended albeit still with reservations regarding consistency. At its best it gives a relatively neutral and clear performance.

Mission 770 (£350 inc stands)
Slightly on the bright side, this model offers a firm, clear sound and a good all round performance, particularly in view of its modest size. The power handling is also good.

Rogers Export Monitor (£275 + stands)
With a slightly limited maximum output level, this established Rogers model still offers a good standard of performance and is well worth trying.

Spendor BC1 (£300 + stands)
Last but by no means least the BC1; see 'Exceptional performance' above.

£160.00-£250.00 per pair

Audiomaster MLS4 (£180 + stands)
At a modest price, this speaker offers much of the performance of the larger two-way stand mounted systems. The bass extension is good and the overall performance places it near the 'Exceptional performance' category.

Celef Monitor Improved (£180 + stands)
Worthy of its new title *Improved,* this compact design offers a very fair performance for the price.

Chartwell PM110 (£165+stands)
Generally liked by the panel, this trim compact design offers good clarity and a useful sensitivity for its size.
Lentek S4 (£220+stands)
Continuing to appear rather on the costly side, the *S4*'s neutral and well balanced performance together with its fine finish nonetheless merit recommendation.
LS3/5a (£175) **(Rogers/Chartwell)**
This finest of the ultra compact systems, the *LS3/5A* offers great detail and accuracy but has limited bass extension and power handling, proving quite insensitive although easy to drive.
Sansui ES207 (£160+stands)
Offering a well extended if slightly over-rich bass, apart from the lowish sensitivity all aspects are generally very good for the price.
Sony GI (£190+stands or shelf mounted)
In contrast to the *ES207,* the Sony is a punchy, clear system with firm bass, very high maximum sound level and fine sensitivity. Overall it is an impressive performer almost in the 'excellent' category.
Spendor SA1 (£190+stands if required)
A small insensitive system, possessing good bass for the size, moderate distortion and fine stereo. Generally good value.
Tangent RS2 (£+stands)
A typical low sensitivity system of pretty good quality at a fair price.
Toshiba SS100GB (£170+stands)
By virtue of good value engineering and a skillful balance, this pleasantly musical system has few vices and easily qualifies for recommendation.

£60.00-£160.00 per pair

Audiomaster MLS1 (£150)
While we were not quite so keen on the recent samples as we had been on those supplied some eighteen months ago, this model still qualifies for a recommendation.
B&W DM5 (£120)
A compact system of useful sensitivity and power handling suited to shelf mounting.
Castle Richmond II (£110)
An inexpensive system possessing good sensitivity and power handling as well as a fine overall performance.
Celestion Ditton 22 (£150+stands)
An inexpensive three way design of generally good performance and capable of high ultimate sound levels.
JR149 (£140)
A low sensitivity system of neutral balance, low coloration and fine stereo, possessing an unusual appearance.
KEF Celeste III (£103+stands)
A low cost stand-mounted system of reasonable sensitivity with a good performance for the price.
KEF Corelli (£145)
A well engineered all rounder with powerful clean bass, it needs a fair sized amplifier for the best results.
KLH 317 (£160)
While the engineering is unsophisticated the results are not — see 'Exceptional performance' above.
Marantz HD440 (£95)
Although not everyone's cup of tea, this model is very sensitive and will, when wall mounted, produce very high levels on rock program, considering its size and price. The sound quality is not bad either.
Ram Mini Bookshelf (£110)
Almost on a par with the *MLS1,* the *Mini* represents another inexpensive but good miniature.
Sanyo Hi Fi One (£95)
See 'Exceptional performance' above.
Wharfedale Teesdale SP2 (£135)
A respectable three-way system with extended bass and useful sensitivity.
Wharfedale Shelton P2 (£65)
An inexpensive and compact speaker offering a basic hi-fi performance as well as good value for money.

It was felt worthwhile to extend these conclusions to include some brief mention of certain good quality systems which were not covered by this report, but which have fared well in recent months in similar group tests I have conducted for other magazines. These are as follows:

Audiomaster MLS2 (£140)
A well balanced design of promising performance and good finish, retailing at a realistic price.
Audiomaster LS3/5a (£175)
Castle Acoustics Kendal II (£150)
This can in many ways be regarded as a more

advanced and larger *Richmond,* appearing to offer equally good value.

KEF Concord III (£175)
A very good performer, offering fine value for money.

Recommended speakers which have recently been deleted but which may still be available include the older version of the **Monitor Audio MA4 II** (the new version was deliberately ommitted from this report due to my design involvement); the **Bolivar 64** and **Bolivar 125;** and finally, the **Philips AH487.**

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Overall Comparison Chart

	Height		Width		Depth		Weight		Response controls	Recom. max. amp power per channel (watts)	Recom. min. amp power per channel (watts)	Max sound level in room at 2m (dBA pair)	Lab sensitivity at 1m (dB lin) 2.83V input	Low frequency rolloff at 6dB down
	cm	ins	cm	ins	cm	ins	kg	lbs						
Acoustic Research AR90	108	42.5	37	14.5	38	15	37	82	2	300	30	103	90	30
Audiomaster MLS1	37.2	14.5	23	9	19.2	7.5	15.3	11.7	—	50	36	100	84	57
Audiomaster MLS4	62.5	24	27.5	11	31	12	14	30	—	150	30	101	85	37
Audiopro Subwoofer	37	15	46	18	45	17	28	62	3	incl.	—*	99*	—*	18
B & W DM2 II	71	28	27	11	34	13	22	48	—	200	25	99	86	45
B & W DM5	45.5	18	22.7	9	24	9.5	9.5	21	—	100	20	102	87	54
Castle Conway	63.5	25	34.5	11	35.5	12	18.5	41	—	200	25	103	86.5	38
Castle Richmond II	41.5	16.5	23	9	25	10	8.5	18.7	—	50	10	104	90	48
Celef Monitor	52	20	24.5	9.6	28	10			—	200	15	98	88	50
Celestion 15	56	22	25	10	24	9.5	8.2	18	—	100	15	105	88	48
Celestion 22	51	20	33	13	27	10.5	12.4	27.3	—	150	15	105	89	50
Celestion 551	72	28	40	15.5	32	12.5	25	55	2	200	25	103	86.5	38
Celestion 662	111.5	44	40	16	32	12.5	34	75	—	300	15	104	88	35
Chartwell PM110	46	18	23	9	21	8	7.5	16.5	—	150	25	102	86	55
Chartwell PM210	66	26	34.3	13.5	28.6	11.3	17	37.4	—	200	20	102	87	40
Dahlquist DQ10	80	31.5	77.5	30.5	22.9	9	27.3	60	1	250	50	103	85	40
Eagle 7800	62	24.4	33	13	30.5	12			1	50	10	98	89	40
Goodmans Kappa	54	21	27	11	27	11			—	100	30	97	85	45
Harbeth HLI II	63.5	25	32.5	13	30.5	12	13.5	30	—	100	20	102	87	44
IMF TLS80 II	98	38.5	46	18	41	16	37	81	1	250	30	105	86.5	25
Infinity Qe	46	18	30.5	12	25	10			—	100	20	104	89.5	52
ITT 8072	47	18.5	30	12	26.8	10.5			2	100	25	96	86	50
JBL L19	53.3	21	33	13	25.4	10	13	29	1	100	10	106	89	50
JBL L110	59.5	23	36	14	29	11.5	18	40	2	250	20	104	87	38
JR 149	37	14.5	23	9	23	9	5.5	12	—	50	30	96	83	45
JR 150	54.5	21.5	28	11	28	11	11	24	—	150	25	98	86	60
JR Subwoofer	47	18.5	50	21	50	21	18	39	3	incl	—*	103*	—*	30
JVC Zero 5	65.5	26	37	15	33.5	13			—	250	10	107	93	45
KEF Celeste	50.5	20	26.5	10.5	23	9			—	200	20	100	87	55
KEF Corelli	47	18.5	28	11	22	8.7	9	20	—	100	30	98	85	50
KEF R101	34.5	13.5	18	7	19	7.5	5.6	12	—	100*	50	96	81	60
KEF R105 II	100.5	39.5	41.5	16	42.5	17	28	61	—*	300	25	103	84.5	32
KLH 317	58.5	23	30.5	12	25	10	13.2	29	—	100	10	104	89	55
Lentek S4	49.5	19.5	25	9.7	25.5	10	11.7	25.7	—	100	30	99	84.5	47
Marantz HD 440	49	19	28	11	23	9			—	100	10	107	93	80
Mission 770	59	23	30	12	30.7	12	12.7	28	—	150	25	100	86	42
Monitor Audio MA6	58	23	30	12	28.5	11	13	28	—	150	20	96	86	46
Monitor Audio Mini Monitor	38	15	23	9	19	7.5			—	60	45	99	81.5	50
Mordaunt-Short Pageant II	53.3	21	33	13	23	9	9.6	21	2	50	15	98	88	50
Mordaunt-Short Signifer	81	32	38.5	15	33	13			1	250	25	105	86	33
Philips 587	48.7	19	30	12	23.7	9			4	incl.	—*	100	—*	43
Pioneer HPM 100	67	26.3	39	15.3	39.3	15.5	26.7	59	2	100	10	101	92	38
Pye 5777	67	26.3	30	12	30	12			—	100	25	101	87	45
Ram 150 II	58.4	23	29.2	11.5	25.4	10	13.3	29	—	150	20	103	87	44
Ram Mini	41	16	25.4	10	23	9	5.3	11.7	—	50	30	98	84	56
Revox BX350	52	20.5	35	13.8	29.5	11.6	14	30.8	1	50	15	101	92	38
Rogers LS3/5a	30	12	18.5	7.5	16	6.5	5.5	11.5	—	50	30	93	82.5	56
Rogers Export Monitor	63.5	25	30.5	12	30.5	12	14	31	—	100	25	98	86	43
Sansui ES207	59.3	23.3	28.2	11.1	28.1	11	13.2	33.5	1	100	30	102	86	40
Sansui J11	29.5	11.5	12.5	5	13	5			—	60	30	100	86	80
Sanyo Hi Fi One	45.5	18	27.5	10.8	17.8	7	7.5	16.5	—	100	30	103	86	50
Sony G1	59.5	23	33.4	13	30	12	13	29	—	100	10	105	89	55
Sony G5	72	28.4	41.5	16.4	35	13.6	26	58	2	100	10	108	93	60
Spendor BC1	63.5	25	29.8	11.7	30.5	12	14	30.8	—	150	30	101	86	44
Spendor SA1	30.4	12	22.5	8.9	21.6	8.5	7.2	15.8	—	75	30	98	82	53
Studiocraft 330 II	53.3	21	34.4	13.5	22.9	9	15.5	34	—	50	10	101	92	55
Swallow CM70 II	36	14	24	9.5	24	9.5			—	150	35	103	84	55
Tangent RS2	37	14.6	25.5	10	28.5	11.2	4	8.8	—	100	30	104	83	45
Toshiba SB100 GB	63.5	25	34	13.4	29	11.4	15.7	34.5	—	150	25	100	87	50
Videotone GB2	26	10	15	6	22	8.7			—	75	45	93	82	55
Visonik David 502	17	6.7	10.3	4	10.7	4.2	2.5	5.5	—	100	30	98	83	95
Wharfedale Shelton	41	16	24.5	10	24	9.5			—	50	25	96	86	55
Wharfedale Teesdale SP2	57.8	22.8	34	13.4	27.8	11	14.1	31	—	100	15	101	88	40
Wharfedale E70	81.5	32	34.2	13.5	36	14	32	70	2	75	10	103	94	56
Yamaha NS1000 M	67.5	26.5	37.5	14.7	32.6	12.8	31	68.2	2	200	20	107	90	50

Overall frequency response	Dispersion	Coloration	Amplifier loading	3rd harmonic distortion	Overall subjective quality	Stereo image quality	Truth to life	Typical price per pair inc VAT	
good*	good	good	poor	v. good	good	v. good	average	£ 725	Acoustic Research AR90
v. good	v. good	good	v. good	v. good	good	v. good	average	£ 105	Audiomaster MLS1
good	v. good	good	average	v. good	v. good	good	good	£ 180	Audiomaster MLS 4
v. good	—*	v. good	—*	v. good	v. good	—*	—*	£ 460 each	Audiopro Subwoofer
good	v. good	average	average	good	average	good	acceptable	£ 300	B & W DM2 II
good	v. good	acceptable	poor	good	average	good	good	£ 120	B & W DM5
v. good	excellent	v. good	average	v. good	v. good	v. good	v. good	£ 240	Castle Conway II
v. good	v. good	average	average	v. good	good	good	average	£ 110	Castle Richmond II
average	v. good	average	good	v. good	average*	average	acceptable	£ 180	Celef Monitor
good	good	acceptable	good	v. good	average	good	acceptable	£ 105	Celestion 15 XR
good	good	average	poor	good	good	good	average	£ 150	Celestion 22
good	good	good	good	v. good	good	good	average	£ 330	Celestion 551
good	good	average	v. good	excellent	good	good	average	£ 490	Celestion 662
good	v. good	good	average	good	good	v. good	average	£ 165	Chartwell PM110
v. good	v. good	average	acceptable	good	average	good	average	£ 295	Chartwell PM210
average	poor	average	acceptable	excellent	average	good	average	£ 650	Dahlquist DQ10
good	good	average	average	v. good	average	average	good	£ 240	Eagle 7800
average	good	average	acceptable	good	average	average	average	£ 200	Goodmans Kappa
good	excellent	good	good	v. good	good*	good*	v. good	£ 300	Harbeth HL1 II
good	good	average	acceptable	v. good	good	average	good	£ 700	IMF TLS 80 II
average	average	acceptable	poor	acceptable*	average	average	average	£ 140	Infinity Qe
acceptable	acceptable	acceptable	good	acceptable*	acceptable	acceptable	acceptable	£ 160	ITT 8072
average	good	average	average	v. good	average	good	average	£ 240	JBL L19
average*	v. good	average	good	v. good	good	good	good	£ 620	JBL L110
v. good	v. good	good	good	v. good	good	v. good	average	£ 140	JR 149
good	good	average	average	v. good	average	good	average	£ 225	JR 150
good	—*	good	—*	v. good	good	—*	—*	£ 260 each	JR Subwoofer
poor	good	poor	average	excellent	poor	acceptable	poor	£ 400	JVC Zero 5
v. good	v. good	average	good	v. good	average	good	average	£ 103	KEF Celeste
v. good	v. good	good	average	v. good	good	v. good	acceptable	£ 145	KEF Corelli
good	excellent	average	v. good	v. good	average	v. good	average	£ 180	KEF R101
excellent	excellent	v. good	v. good	v. good	excellent	excellent	v. good	£ 750	KEF R105 II
average	good	good	v. good	v. good	good	good	v. good	£ 160	KLH 317
v. good	v. good	good	good	excellent	good	v. good	average	£ 220	Lentek S4
average	acceptable	acceptable	acceptable	good	acceptable	acceptable	average	£ 95	Marantz HD 440
v. good	v. good	v. good	v. good	good*	v. good	v. good	average	£350	Mission 770
good	v. good	average	good	good	good	good	acceptable	£ 160	Monitor Audio MA6
average	average	average	v. good	good	average	good	average	£ 100	Monitor Audio Mini Monitor
v. good	v. good	acceptable	good	good	average	good	acceptable	£ 160	Mordaunt-Short Pageant II
v. good	v. good	v. good	average*	v. good	v. good	v. good	v. good	£ 475	Mordaunt-Short Signifer
v. good	v. good	average	—*	excellent	acceptable	good	average	£ 420	Philips 587
good	acceptable	average	acceptable	v. good	good	acceptable	average	£ 400	Pioneer HPM 100
average	average	acceptable	poor	v. good	poor	average	poor	£ 200	Pye 5777
average	v. good	average	average	good	average	good	good	£ 270	Ram 150 II
good	v. good	good	good	good	v. good	good	good	£ 110	Ram Mini
good	average	average	poor	excellent	average	average	good	£ 350	Revox BX 350
good	v. good	good	v. good	v. good	good	v. good	v. good	£ 175	Rogers LS3/5a
acceptable	v. good	good	acceptable	v. good	good	v. good	v. good	£ 275	Rogert Export Monitor
average	v. good	good	v. good	v. good	v. good	v. good	v. good	£ 160	Sansui ES207
acceptable	excellent	acceptable	poor	good	acceptable	good	good	£ 105	Sansui J11
v. good	v. good	good	v. good	v. good	v. good	v. good	v. good	£ 95	Sanyo Hi Fi One
good	good	good	average	excellent	v. good	v. good	v. good	£ 190	Sony G1
v. good	acceptable	average	average	excellent	average	poor	good	£ 440	Sony G5
v. good	v. good	v. good	good	escellent	excellent	excellent	v. good	£ 300	Spendor BC1
v. good	excellent	good	v. good	excellent	good	v. good	good	£ 190	Spendor SA1
good	poor	acceptable	good	good	acceptable	acceptable	average	£ 160	Studiocraft 330 II
average	good	average	good	good	average	average	average	£ 170	Swallow CM70 II
average	excellent	good	good	v. good	good	good	average	£ 160	Tangent RS2
good	good	average	poor	good	good	good	acceptable	£ 170	Toshiba SB100 GB
acceptable	good	acceptable	v. good	good	poor	average	poor	£ 70	Videotone GB3
average	excellent	acceptable	acceptable	good	acceptable	v. good	acceptable	£ 100	Visonik David 502
poor	acceptable	acceptable	poor	acceptable	average	good	poor	£ 65	Wharfedale Shelton
good	good	good	acceptable	v. good	good	good	good	£ 135	Wharfedale Teesdale SP2
acceptable	average	average	v. good	acceptable	average	poor	average	£ 330	Wharfedale E70
good	v. good	good	average	escellent	v. good	v. good	v. good	£ 720	Yamaha NS1000 M

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Active: Speaker systems which contain no crossovers and where the drive units are connected directly to power amplifiers.

ABR: Auxiliary bass radiator, a reflex type bass-loading system, which uses a speaker-like 'cone' without motor instead of a port.

Amplitude: Size or magnitude, hence the amplitude/frequency response, known normally simply as the frequency response, which describes the relative loudness of the system at different frequencies with a constant input voltage.

Axis: The axis of a drive unit is the direction of movement of the voice-coil. The fundamental measuring axis used for our measurements is midway between midrange and tweeter axes.

Anechoic: Without echo, a special room or 'chamber' with thick sound absorbing materials on all surfaces to prevent reflections.

Bextrene: A plastics material frequently used for bass and midrange cone materials.

Balance: The overall frequency response balance of a system.

Bituminous damping: A cabinet damping technique whereby heavy impregnated felt pads are attached to the internal cabinet surfaces.

Bass: The low frequency (LF) section of the audio range.

Coloration: A rather vague term which refers to localised and aurally-perceived distortions in loudspeakers (see Consumer Introduction).

Crossover: An electrical circuit which uses combinations of inductors, capacitors and resistors to divide the signal from the power amp into the required frequency bands and with any necessary equalisation for feeding to the individual drive-units of the speaker system.

drive unit (driver): The term used to distinguish the loudspeaker unit itself, be it bass, midrange, treble or full-range in application, from the complete loudspeaker system which combines drive units, cabinet and crossover into a total design.

Doping: A technique involving the application of a liquid damping material to a driver cone in order to assist in controlling resonances.

dB (decibel): A unit of relative loudness, when referred to the complete audio range, the spectrum may be weighted (eg dBA, dB lin.)

Dispersion (diffraction): Describes the geometric pattern of the sound radiation from a speaker, which invariably varies with frequency.

Element: A component of the crossover which contributes towards controlling the system frequency response.

Efficiency: The amount of acoustic power delivered for a given electrical input power.

Ferro-fluid: A magnetic fluid which is introduced into the voice-coil gap to provide damping and/or improved cooling.

Hz (Hertz): 1 Hz = 1 cycle per second, and is a measure of frequency which corresponds to musical pitch (the higher the frequency the higher the pitch.)

HF: High frequencies.

Impedance: The electrical load presented to the amplifier by the loudspeaker. Measured in ohms for convenience, the modulus varies with frequency and is a combination of resistive and reactive components.

Integration: Used to describe the success with which the output from two drive units combine to give smooth output through the crossover region.

LF: Low frequencies.

Midrange: The central part of the frequency range, to which the ear is most sensitive.

Passive: The most common type of system, where drivers and crossover are driven from a single power amplifier.

Port: An opening in a cabinet which is tuned to characteristics of the bass driver and the enclosure volume to provide reflex type bass-loading.

Reflex: A system of bass loading (using port or ABR) which offers improved efficiency and bass power handling at the expense of subsonic control compared to a sealed box.

Sealed-box: Also known as 'infinite baffle' loading, this is probably the most popular form of bass-loading technique.

Sensitivity: The volume of sound output for a specific electrical voltage input.

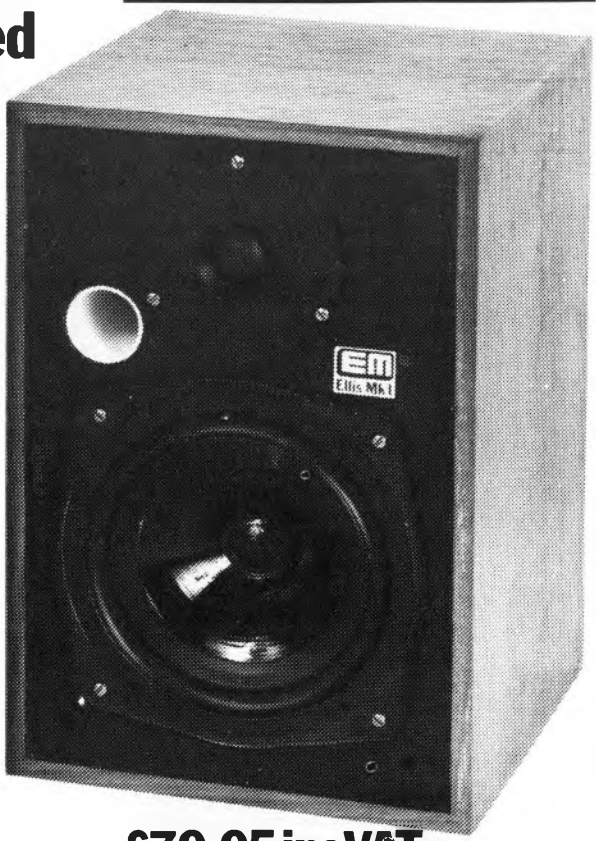
Transmission line: Complex in construction and hence fairly uncommon, this bass-loading technique has much in common with reflexing.

Tweeter: A small drive unit designed to operate over the high frequency range.

Woofer: A drive unit that operates over the bass portion of the audio range.

At last! A high quality low cost tuned speaker from Ellis Marketing

The EM Ellis Mk 1



Rather than bore you with reams of hard-sell spiel about how wonderful these speakers are, simply read through the specification. Glance through the review. And come and listen.

SPECIFICATION

Dimensions	12¼h, 8½w, 9d (mm) 311h, 216w, 228d
Weight (each unpacked)	12½lbs 5.67kg
Weight (pair, packed)	25¾lbs 11.68kg
Material	High density particle board
Finish	Teak veneer
Cover material	Acoustically transparent cloth
Nominal impedance	8 ohms
Amplifier requirements	10-50 watts
Crossover frequency	2.5kHz (approx)
Frequency response	50Hz - 20kHz
Efficiency	1 watt produces 83db at 1 metre
Connectors	Colour coded single pin, screw type
Guarantee	Five years parts and labour
Manufacturer	Ellis Marketing

£79.95 inc VAT

Popular HiFi, March 1979:

After listening to a few records I was really surprised; the sound was clean and quite open with a really sweet midrange performance. Voices, both male and female, sounded genuine and free from obvious constriction. The treble end too was really very good... they really sounded sweet. Once I accepted the lack of low bass I enjoyed them a lot. They took the power from the TVA power amplifier well and sounded very lively indeed on rock music. They cost £79.95 inc. from Ellis Marketing and if you are looking for a speaker in this price range, give them a listen.

Chris Thomas

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