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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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As usual we are following the same general format as our other issues. But bearing in mind that we have no difficulty at all in filling a complete book with data and discussion on just one component in the hi-fi chain, the approach this time naturally had to be somewhat different. Even though we are reviewing rather fewer systems than we did say, amplifiers, it is in the nature of the beast that we have to deal with at least twice as many components as usual, so the coverage necessarily has to be more superficial.

This edition is not therefore intended to replace the others, rather to supplement them and provide sensible advice for the person who does not wish to become over-involved in the technicalities and subtleties of putting together a system from individual hi-fi components. This does not mean that we have tried to eliminate all technical talk from the text, in fact quite the contrary. If we are to make value judgements about technical products, then we believe it is necessary to provide the information which has led to those judgements and the rationale behind them, so that the reader at least has the opportunity to form his own opinions rather than being treated as a simpleton.

The key to interpretation lies in the *Consumer Introduction* and *Technical Introduction.* The former is a rather abbreviated attempt to introduce the whole subject of hi-fi, with some discussion of the tasks and difficulties faced by the different components and of the means used to assess their success in dealing with them, plus some general if superficial advice on avoiding pitfalls and achieving a good result. The *Technical Introduction* deals with the measurements undertaken, explaining the purpose behind them and the techniques used. At the end of this introduction there is a section which explains the graphs used to help present the review data efficiently, and a *Key to Facilities* which enables the reader to interpret the notation used in the data section of the reviews to summarise the facilities provided with each system.

The *Reviews* themselves occupy four pages each (apart from the handful of reprints from *Music Centres*). The text contains a short introduction (by the editor) summarising the position of the reviewed system *vis à vis* other combinations offered by the manufacturer. The authors then describe and criticise where appropriate each of the components (tested where possible as an integral part of the system), discuss the results of the listening tests and summarise the unit as a whole. There is a tabulated list of data upon which much of the review has been based, plus a series of graphs representing aspects of performance that are considered significant.

The *Conclusions* discuss in general terms the findings of the book, attempting to bring a sense of perspective to the project and point out any major patterns and trends, while the *Best Buys and Recommendations* summarises our examination of the different systems' performance in respect of their typical prices and the group as a whole, picking out the examples which we believe offer superior value or value for money.

The *Overall Comparison Chart* is a further method used to summarise the test results, though its shorthand nature must inevitably leave stones unturned; readers are strongly urged to refer back to the reviews themselves after consulting this section. Value judgements made in the chart are approximately based on a five-point scale centred on the average for the group as a whole, a technique that avoids the need to use emotionally loaded absolutes such as 'good' or 'poor'.

The next section is a comprehensive examination of the hi-fi *Accessory* market. A systems book seems an appropriate place for *Choice* to publish its first probe into an area of hi-fi for which phrases to do with fools and their money might have been expressly coined.

Finally we have tried to combat the jargon used elsewhere in the book by means of a *Glossary* which we hope will bridge the occasional cognitive gap for the less technically minded.

Editorial Introduction

It is now some two years since the publication of our successful *Music Centres* edition, the sales pattern showing that this was eagerly received by the first-time buyer. Unhappily most of the models we tested then have now been replaced, due to the frequently absurd policies of rapid planned obsolescence adopted by most manufacturers, so this book is virtually all new, though we have reprinted a handful of the centres that continue to be available.

The overall conclusions of the last volume were that the music centres generally were rather inferior to similarly priced 'separates' systems, and that those centres which were supplied with loudspeakers would probably have been better off without them! In the intervening period manufacturers have responded by producing a new format for packaging complete hi-fi systems, known variously as racked systems, component systems, etc, in which a (hopefully) matched set of separate components have been made into an overall package with furniture; additionally the speaker option is more frequently available. So this time around we have concentrated heavily on the racking type systems, though we have included a few music centres by way of contrast. In fact, while the book focuses primarily upon the racks, we have tried to choose examples that show the range of choice available in the marketplace, and have deliberately included examples of a micro-system, a music centre with full remote control, and a predominantly 'home-grown' separates system which is typical of those available from the better specialist dealer. When one considers the vast number of components available on the market, it is clearly impossible to cover more than a few combinations, so the intention has therefore been to try and provide a representative selection of the different approaches.

To accommodate the music centres in two-page reviews last time undoubtedly meant dealing with them in a rather cursory manner, so we decided to reduce the total number of systems somewhat but extend the format and carry out rather more comprehensive testing – as befits the higher standard of performance attained by these more sophisticated components. At the same time it is only fair to point out that the reviews are not as detailed or thorough on the individual items as our companion publications devoted to one particular field; the intention is primarily to review the systems rather than the constituent components, though it is not always easy to separate one from the other!

While we still consider that careful selection and matching of individual components with the assistance of our other volumes and/or a good specialist retailer is probably the best way to achieve satisfaction in audio purchasing, we nevertheless appreciate that many would-be purchasers are unwilling to become involved to this extent, and prefer to choose a fixed package with homogenised performance and styling; we hope that this volume will assist them in finding one which meets their requirements without excessive compromise in performance. Our companion volume *Loudspeakers,* published two months before this issue, provides ample data to assist the purchaser to complete his system where these are not included (or perhaps where they are!), while *Cartridges and Headphones* may also prove a useful adjunct, particularly where the fitted pickup cartridge leaves something to be desired (all too common unfortunately).

For the first time we have also included a quite comprehensive examination of the accessory market, which is so very active in the hi-fi field. Author Clement Brown is new to *Choice*, but has had a long and distinguished career in hi-fi journalism, recently paying much attention to this aspect of hi-fi. His long experience and occasionally jaundiced eye should prevent the novice from being caught too easily! It could be argued that too great an emphasis is placed on disc reproduction accessories, but this merely reflects their domination of the accessory market as a whole.

I will conclude by repeating once again that this is a guide, not an instruction manual in buying hi-fi. Facts are inalterable (though their interpretation may be disputed), but some of our judgements must be based on opinions upon which even we ourselves can disagree! The purchaser has one duty only, and that is to satisfy himself that the system sounds good, looks good and satisfies his requirements. The omission of a 'recommended' flag, or lack of a review at all, is no condemnation: use our advice to help you make up your own mind, not to make it up for you, and try to find the energy to get out and use your own ears!

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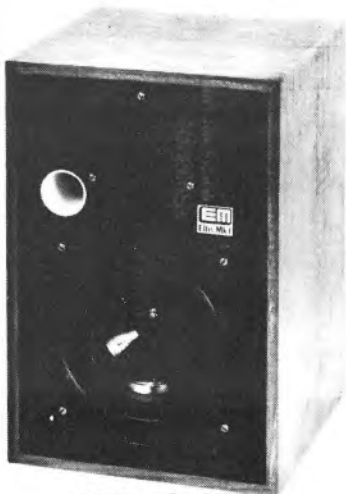

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The consumer introduction is specifically designed to assist the novice with no experience in audio matters. Our other publications which concentrate on one particular type of product enable us to go quite deeply into a topic without becoming too technical. Dealing with complete systems we will naturally have to be more superficial, avoiding discussions of principles in favour of more immediately practical information. We will start by discussing what a hi-fi system consists of, then examining the variations in the fragmented marketplace. Each component will be examined in turn, with information of a practical nature to help get the best out of the components and understand the reviews. Finally there will be some advice on actually purchasing and setting up a system in the home.

Stereo and hi-fi

In common parlance these words appear synonymous, but in fact their meanings are quite different. Stereo, taken from the Greek word meaning solid, is concerned with a mechanism used to transmit sound 'in the solid', so that the listener can perceive a sound stage. Much in the same way that a child's stereo viewer can give the illusion of depth when a slightly different image is presented to each eye, so the ear can perceive spatial relationships when each ear is fed subtly different information. To achieve stereo reproduction one merely feeds two slightly different channels of information into each ear (there are actually many other complications, but I don't intend to fill the book with discussions on the hearing mechanism). In practice this is accomplished by means of two loudspeakers or a stereo headphone set, fed from two channels (*ie* stereo) sources, such as discs, Musicassettes or FM radio, *via* a stereo amplifier (two amps combined in one box usually).

Hi-fi is of course short for high fidelity, and refers to recreating the original sound as faithfully as possible. It is therefore possible to have a mono (one channel) system which is of hi-fi quality, although it would be difficult to buy one nowadays, but it is easy to find plenty of stereo systems which are very far from hi-fi. Our priorities are basically towards hi-fi, stereo being an extra dimension to the achievable fidelity but not the be-all and end-all.

Indeed hi-fi developed long before stereo, and merely prospered from its introduction. It also succeeded in weathering the abortive efforts to foist quadrophony upon an unwilling public. An extension beyond stereo of some sort appears likely to happen eventually, but it is to be hoped it will be based on sounder premises and accompanied by the engineering necessary to accomplish it satisfactorily next time.

Even the term fidelity is open to a variety of interpretations, some of which cannot be approached in engineering terms without compromising others. To avoid this becoming a treatise, I will merely point out that commentators tend to place their own weighting on the importance of different aspects of hi-fi reproduction, and this perception will be based on attitudes, knowledge and experience. All will therefore have different perceptions, so quite justifiable differences of opinion may arise. There are occasions where I disagree with the other authors, and there are doubtless some where they disagree with each other and me. The hardest thing for the novice to accomplish is to discover where his own preferences lie, and this is why we constantly encourage readers to go out and seek demonstrations to try and establish their own standards (and hear some real music!) This enables the findings of a project such as this to become considerably more useful.

The stereo system

A stereo system consists of a number of components, including up to three programme sources (disc, cassette and radio) plus a stereo amplifier and a pair of loudspeakers. The amplifier and speakers will be used all the time, so weaknesses here may dominate the system. But at the same time the system can only be as good as the quality of the programme source being used, and most of these reveal inadequacies also.

One advantage of buying a complete system from a manufacturer, such as the majority of those tested in this book, is that the performance of the various components is likely to be balanced, with the constituents compatible with one another at least stylistically if not always technically. To get good value for money it is important that the balance of components in the system should match the requirements of the user. The ability to tinker with this balance is one important advantage the rack type system has over the music centre. To fill a large room with high levels of sound, it would be a simple matter to choose more powerful amplifier or more sensitive speakers than usually provided, for example.

Consumer introduction

The system marketplace

The packaging of separate components into balanced systems with cosmetically appropriate furniture is a relatively new development in hi-fi marketing. When hi-fi was a pursuit for the enthusiastic minority, most *afficionados* treated it as something of a hobby and were fairly well informed, often to the extent of making their own components; in these far off days the mass market was in radiograms and stereograms, whereas the enthusiast would pick components carefully from the limited range available from highly specialised manufacturers. Therefore a disc playing unit might consist of turntable, arm and cartridge from three different manufacturers, the amplifier might be split into a stereo pre-amp and two mono power amps, etc. This is still very much the route followed by today's audiophile, and has continued to influence, albeit slowly, the mood and fashion of the mass market.

The first significant development to replace the stereogram was the music centre, and this still has a number of advantages and remains very popular at the more inexpensive end of the market. These include compactness (sometimes) and economies gained from the integrated cabinetwork, ergonomics and (perhaps) power supplies, plus potential benefits in manufactured system optimisation. Disadvantages however include the inflexibility of the total system to individual needs, the need to have the whole machine removed if one item needs servicing, and the difficulty of upgrading any particular component if desired. Nevertheless the better music centres remain an elegant and uncomplicated approach to audio, permitting such sophistication as full remote control, which would be rather more difficult to incorporate in a separates system. Furthermore the ergonomics of operating a one-level 'horizontal' music centre and of keeping the system clean under all-embracing dust covers are clearly superior to the vertical rack with all its knobs proudly displayed and the tuner at floor level!

The latest development which is fast ousting music centres, at least at the top end of their market, is the rack-type housing (or horizontal cabinet housing) of matched components. These permit considerably greater flexibility for future change than the music centre, but perhaps at some ergonomic cost. Some opportunist manufacturers, interpreting the change as merely a styling fad, one assumes, have combined the worst of both worlds in 'vertical music centres', which look like floor standing racks. To what extent rack systems are merely a pseudo-technological styling fad rather than a serious attempt to provide market flexibility with integrated styling, the market will have to decide for itself.

A further 'new' development has been the arrival of a number of 'mini' and 'micro' systems which would appear to offer good ergonomics as well as flexibility, because they are really intended for shelf mounting and the controls are at a sensible level for operation. It is early days yet, and system size is still largely limited by the size of the record deck needed to accommodate the LP disc. It is an interesting observation that compactness has often been a feature of specialist British electronics over the years, notable examples being from Quad, Sinclair, Cambridge, Armstrong and Meridian, the latter surely the ultimate micro system.

Despite some apparent increase in flexibility with component systems, in reality the purchaser is likely to be almost compelled to stick with the products of a single manufacturer, not only on styling grounds, but because very few manufacturers are adhering to the internationally recommended 19in width specified for professional racking components (which were undoubtedly the styling inspiration in the first place). Clearly the *raison d'être* for their development has been to increase the domestic acceptability of hi-fi equipment by presenting unified styling and concealing wiring, etc. The experience of the series of *Hi-Fi Choice* books does suggest that the best value for money and ultimate satisfaction is still to be obtained by examining the individual components available in the separates field in relation to one's own needs. The catch is that until one has acquired a certain experience, it is a little difficult to establish precisely what those needs are!

Loudspeakers

Because they are the final link in the chain and are common to all the signal sources, the loudspeakers will impose their character on the whole system. Most commentators would argue that the loudspeaker is by far the weakest link in the hi-fi chain, and current measurement techniques back this up. Moreover differences between designs are often quite gross, being readily and reliably identifiable. While I agree that differences between speakers are quantatively grosser than between other types of component, I have personally found that they

are often less important qualitatively for me; the buyer should encourage his dealer to help him decide for himself.

In the last book it was fairly clear that when speakers were supplied with a system, they frequently let down the performance of the rest (cartridges were also offenders on occasion). Although fewer systems were automatically supplied with speakers this time around, once again many that were supplied were frankly of a low standard. It is our opinion that speakers are almost invariably better selected separately. It is not unfortunately possible to incorporate extensive purchasing advice on speakers in this already crowded book; our companion volume *Loudspeakers* has just been published, with the reviews of some sixty-five models, distilled from an even larger group.

One of the reasons why speakers sound quite different from one another is because none exhibit anywhere near a 'flat' frequency response. Why does this matter? The ear responds to a range of frequencies from the lowest notes of deep bass to the high harmonics of the extreme treble. The frequency of a sound is a measure of its pitch. Any single musical note consists of a range of different frequencies, the fundamental and its associated harmonics, the proportions of which determine the *timbre* of an instrument; the difference between say a trumpet and a clarinet playing the same note lies in the differences in the harmonic structures overlaying the fundamentals from each. The frequency response – or more strictly the frequency/amplitude response – determines whether sounds at all frequencies will be reproduced with the same relative loudness, or whether sounds at certain pitches will be exaggerated or suppressed. If the response is not flat, some change in instrument *timbre* will result, and likewise when a number of instruments are playing together, a poor response may exaggerate some at the expense of others.

Preserving a flat(ish) frequency response throughout the chain is one of the most important hi-fi criteria, and so it has been dealt with at length; a number of the graphs published with the reviews delineate a frequency response measurement. I have discussed it here under *Loudspeakers,* as these show the greatest failings and are also the first components to be examined.

Another measurement of great significance is sensitivity. This indicates how loud the output will be for a given amplifier voltage input; if one wishes to increase the maximum sound output from a system it is almost invariably cheaper to use loudspeakers with greater sensitivity than a more powerful amplifier. (Sensitivity can be increased at the expense of reducing another loudspeaker characteristic, the impedance, but to do so may give problems for the amplifier, so sensitivity is only really meaningful when comparing designs of roughly similar impedance characteristics.)

The tricky thing about loudspeakers is that one can often only optimise one aspect of the performance at the expense of others. To get a well extended frequency response at the bass end usually requires a largish box; to achieve this with a smaller box requires sacrificing sensitivity and power handling. Extra sensitivity in the important midband may be obtained at the expense of compromising the frequency response. Experience has also shown that a narrow enclosure with the drive units mounted vertically tends to give superior stereo imagery when the speakers are stand-mounted clear of walls, but such an arrangement may not prove domestically acceptable, and larger designs may be at a disadvantage in this respect.

One thing is certain: visual evidence of technical 'sophistication' is no guarantee of good loudspeaker performance. Indeed the elaborate-looking design often (though not always) fails to live up to expectations. Furthermore, the number of drive units in an enclosure is no reliable indication of performance either. The proof of the speaker remains in the listening, though even here there is the further complication of the loudspeaker's interaction with the listening room.

The fact that every room is different means that the performance of a loudspeaker can never be accurately predicted, so trial (and error?) still has a part to play, and there is no substitute for finding a dealer who will give home demonstrations or permit a customer to exchange an unsuitable (undamaged) model after a few days. Now while the overall character of the room will affect the total sound, the effects of the immediate environment around the speaker are much more pronounced. To obtain the best stereo and lowest coloration it is best to keep the speakers at least a yard from side and rear walls and a foot off the floor on open stands; they should be placed more or less symmetrically with respect to the room boundaries, should be equidistant from the listening area and a similar (or smaller) distance apart, with no great lumps of furniture in between.

Such an ideal is not always domestically acceptable, so although it requires some compromise in sound quality, many users have to be content with a rearward wall, floor or bookshelf location. Under these conditions the flat free-field type design will tend to sound boomy, so some speakers are designed with a reduced level bass response to permit such a location (there is no compensation for the added coloration). Close proximity to each of the three room boundaries (floor, side wall, rear wall) will increase the perceived bass, so getting near all three will probably sound intolerable. Although it involves some compromise, it is possible to make quite significant changes to the overall sound balance by moving the speakers around slightly.

In practice there are likely to be a limited number of locations where speakers can be accommodated, as well as a maximum acceptable size of box; a little effort in choosing the most appropriate design to suit the conditions prevailing is likely to pay big dividends. As well as the room, the type of music and desired loudness levels plus amplifier power characteristics should all be taken into account.

The amplifier

However one looks at things, the amplifier remains the heart of the hi-fi system, accepting the signals from the different sources, processing them as necessary, and then driving the loudspeakers with the amplified version. Amplifiers also happen to be the most controversial component in hi-fi at the present time, with strong disagreement between enthusiasts and designers concerning their contribution to sound quality. (I myself, for example, believe that amplifiers do play an important role, whereas the main authors of this book, Messrs Moir and Stevens, consider that the better models have a performance so superior to other system components that they all sound the same on current programme sources.)

It is certainly true that amplifiers measure extremely well on all normal parameters, and for many people a choice is made on the basis of power, facilities and styling. Nevertheless there are many who still claim amplifier 'sound' is important, so the only rational advice is to suggest that the purchaser seeks demonstrations for himself.

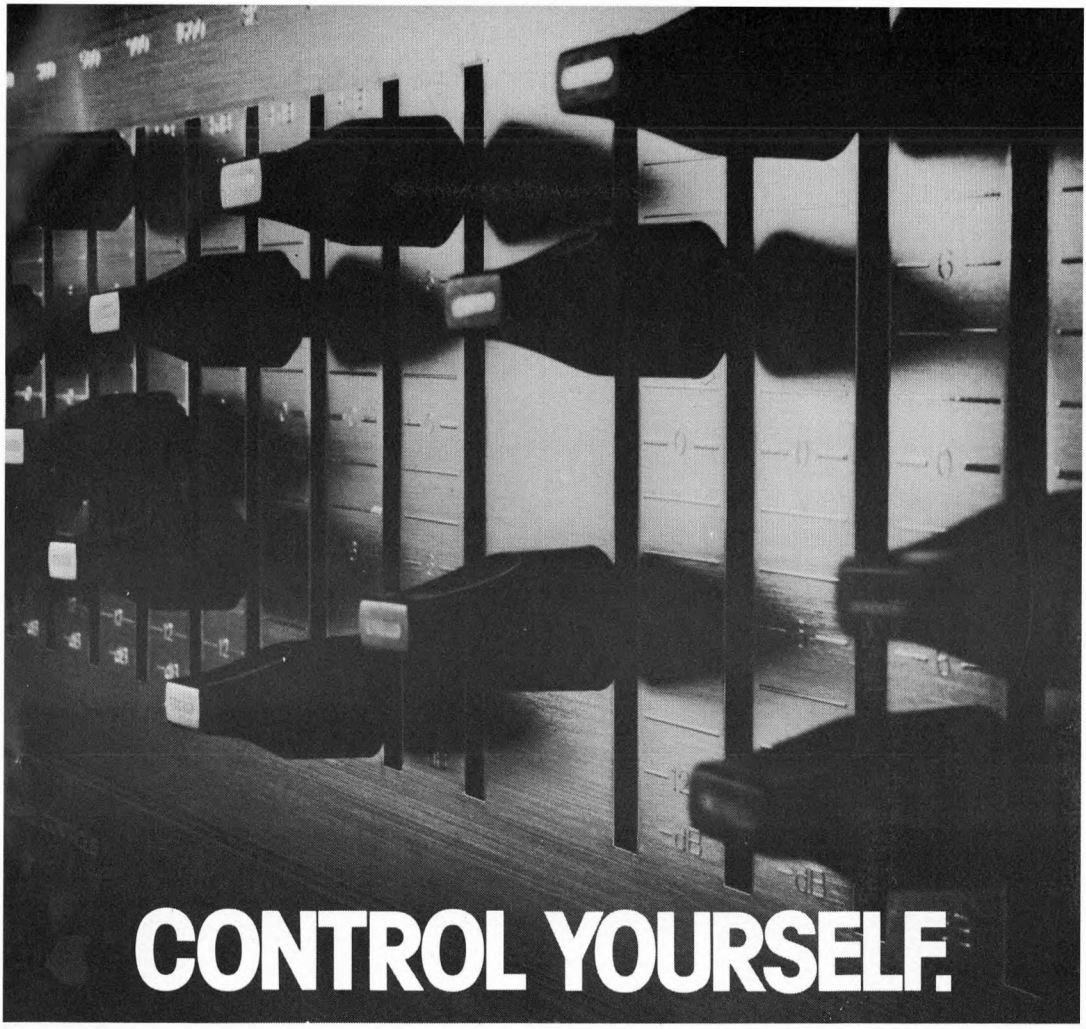
We have carried out measurements on the amplifiers, with their speakers connected if provided. As amplifiers do in fact perform better on practically every count than either their sources or the loudspeakers, measurements may give little indication of the differences between them. Nevertheless it is still necessary to do the tests to check for the occasional weak spot that may be discovered.

One measurement undertaken is the signal-to-noise ratio, which is also carried out on cassette decks and tuners. All electronic devices produce some noise, and it is important that this should not intrude on the wanted signal. The amount of noise is measured at different settings of the volume control to ensure that it is unlikely to mask the softest signals that are to be amplified. In point of fact ordinary electronic 'thermal' noise, as it is called, is unlikely to present any problem in amplifiers at least; other forms of noise, such as hum or turntable rumble, are much more upsetting to the ear, and these are examined more closely.

Other amplifier measurements that can give useful results include distortion measurements, with the intermodulation form being more serious than the harmonic. An unusual test that gives some useful information about the quality of the amplifier's power supply (a vital part of the power amplifier) is the hum modulation figure. A figure greater than a few dB could indicate that the amplifier may sound untidy when driving hard, and there could be possible problems driving the bass resonance of a loudspeaker.

The power performance of the amplifier is important, though perhaps the absolute power is accorded too great a significance. When one looks at typical amplifier powers, they usually lie between 20 and 100 watts; to exceed this power it is normally necessary to spend more than £400. To achieve double the perceived loudness, it is necessary to use ten times the amplifier power, so the difference between the 20 watt and 100 watt designs is surprisingly small when translated into loudness at the loudspeakers (in point of fact 7dB). This difference can be found in the sensitivity ratings of loudspeakers of a similar quality at a similar sort of price, so clearly the 'bigger amplifier' route is an expensive one.

Most commercial loudspeakers present a nominal load of 8 ohms for the amplifier to drive, so amplifiers tend to be designed to produce maximum power into this or a slightly lower figure. However some speakers offer a lower load, and sometimes two sets of speakers are operated together so that the load is again reduced. If the



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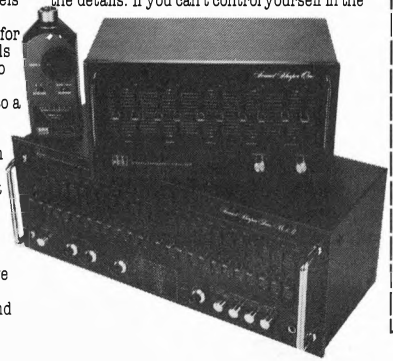

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amplifier is behaving as an ideal 'voltage source', halving the speaker impedance should double the power output. However to design an amplifier to approach this ideal is expensive, and usually means some sacrifice of the 8 ohm power capability which many designers deem as unacceptable. Others say the effects of the speaker load is more complex than traditional measurement implies, and therefore that an attempt to approach the ideal is necessary. Whatever the truth of the matter, a substantial gain in power into 4 ohms over power into 8 ohms is a comforting margin for coping with tricky speaker loads.

A further aspect of amplifier performance of interest is the frequency bandwidth, which effectively shows the highest and lowest frequencies the amplifier can work at. There is currently a considerable fashion for high-speed and DC amplifiers, *ie* ones that go from very low infrasonic to very high ultrasonic frequencies. But British designers and commentators almost universally condemn this practice, because the frequencies themselves are inaudible, and the effect of amplifying them is merely to risk amplifying distortions, wasting power, and risking further distortions, according to the old adage 'the wider you open the window the more the muck flies in'.

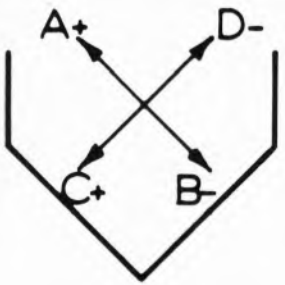
The final point to discuss is the amplifier's facilities. The spread of options is amazing, with oddly enough the cheaper amps normally providing the most features! The logic (?) behind this in the mass market seems to be that if there is a facility to provide, then it should be provided or a sale may be lost. In contrast the enthusiast-oriented models at higher prices adopt a 'purist' approach, claiming to avoid distortions in the signal path by leaving out less necessary features (my personal amplification, housed in six cases and listed at around £3000 – a testament to the importance I myself place on amplifier sound quality – has only three knobs and five switches *in toto*).

The answer must again be that the buyer has a choice, but whether the inexperienced can predict what facilities he will find useful is a moot point. My personal feeling is that it is a mistake to be too greatly influenced by facilities offered.

The record deck

The disc remains the prime hi-fi source, particularly amongst the more dedicated enthusiasts, because at the present time its potential for consistently high sound quality and flexibility of programme choice remains superior to the other sources. The deck may be considered as three separate components, the turntable, the arm and the cartridge, though in the context of this book the first two are invariably integrated. The job of the turntable/arm is to permit the cartridge to trace the signal modulations contained within the groove, without allowing it to be shaken around to such an extent that the information contained therein is 'blurred'.

THE STEREO DISC



The above diagram represents either cutter or stylus. The lines A(+)–B(–) and C(+)–D(–) show the directions of vibration corresponding to the signals of each channel. A side-to-side vibration will cut or read two signals of the same size and phase (ie both moving +to–to+ together) in each channel, giving a central mono signal. A vertical cut would give equal size signals exactly out of phase, and if mixed together they should cancel

The cartridge itself consists of a small piece of shaped diamond which is attached to a short (usually aluminium) cantilever, which in turn is connected to a very small electrical generator. The diamond rests in and is moved about by the groove, and this motion is transmitted to the generator, producing electrical signals which should correspond to the stylus movement, hence the groove modulations (and hence the music). The stylus movement required to produce a signal is microscopically small, and moreover the stylus has to generate two distinct signals to provide stereo *(see Fig 1)*. When one considers that the cartridge is fixed to the end of a 9in arm, on a turntable which is being spun at 33rpm, sitting in a room with air vibrations from the speakers and also structural

vibrations, it is really quite surprising to realise that the cartridge can resolve signals which may be represented by movements as small as a millionth of an inch.

In order to traverse the record and cope with warps, etc, the cartridge must guide the arm as well as being supported by it; this in turn means that the stylus/cantilever must act as a spring of the correct stiffness to accomplish this. If the spring is made too stiff, it becomes difficult for the stylus to follow the convolutions within the record groove – too flexible and the system is easily upset by warps. Without getting even deeper into technicalities, it is sufficient to say that to avoid warp trouble it is desirable to keep the cartridge/arm resonance as small as possible and in the area 10–15Hz. This requires either a fairly stiff cartridge compliance, with risk of tracking problems, or a very light arm, with possible problems of lack of rigidity. Finding the happy medium seems to present manufacturers with considerable practical problems in many cases. However, because this is an area of inevitable compromise, the final judgement of a particular arm/cartridge combination must depend on listening tests, and its suitability may in fact also depend on such things as the type of music preferred. (It is probably relevant to point out that classical, and most particularly opera and choral music tends to require greater trackability than, for example, rock music.)

A further cartridge (strictly stylus/vinyl) resonance exists at the extreme top end of the frequency range, and the control and placing of this resonance is really what distinguishes the cheap from the expensive cartridge, and may well have an important bearing on whether a system tends to exaggerate or minimise surface noise. The frequency response graphs show how well this has been achieved, and also reveal any other shortcomings (frequently a lower treble suckout) which will affect the overall tonal balance. The crosstalk plot on the same graph is in many ways a fine indication of the precision with which the cartridge output reflects the stylus/groove relationship; the absolute distance between the frequency response and the crosstalk curve is important and should be as large as possible, and the curve should be as free as possible from irregularities, which are often an indication of arm resonances that may adversely affect sound quality.

The turntable itself may also strongly affect sound quality; some of the causes are susceptible to analysis, though some remain poorly researched, so once again the listening test is important. Traditional measurements such as rumble and wow and flutter help indicate the mechanical quietness and unobtrusiveness of the motor and drive system, but their practical significance can often be called into question. For example, the steady tone disc used for wow and flutter tests means that the stylus exerts a constant drag on the disc/platter/motor, rather than the variable load represented by music signal.

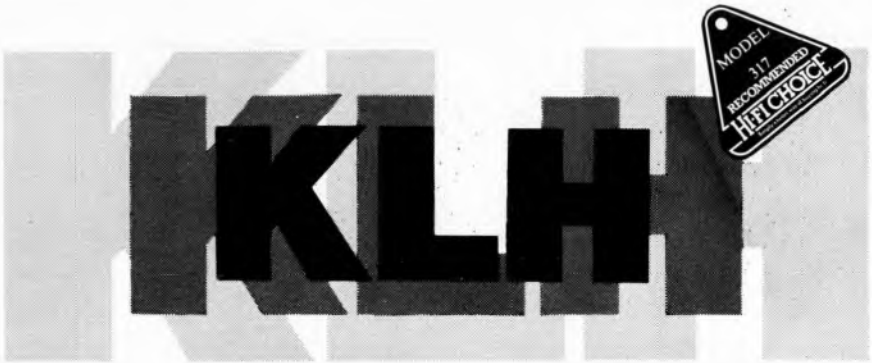
More recently investigators have been examining closely the susceptibility of the turntable system to outside interference, notably the sensitivity of the system to vibration from the structure on which it is standing and its sensitivity to vibration transmitted *via* the air, *ie* from the loudspeakers.

Final considerations for the purchaser must be styling and ergonomics, both of which are largely personal matters. There is a wide range of choice available, offering everything from the simplicity of manual operation, *via* various semi-auto and fully automatic operations to full remote control and cycle repeat memories.

The tuner

The second signal source must be the radio tuner, and for hi-fi purposes only the FM (VHF) system is appropriate. In fact AM is theoretically capable of similar quality, but it is prevented from achieving this due to interstation interference, and the additional problem that most normal electrical interferences affect AM more strongly than FM. However when selecting a radio tuner, it is worth considering local conditions and personal requirements: an embarrassed retailer once admitted he had sent an FM-only tuner to New Zealand, finding out later that there is no FM broadcasting there! In the UK, for example, it is practically impossible to receive Radio 4 on FM during the day due to shared transmission with educational broadcasting; moreover, to receive Radio 4 it is necessary to have a tuner that not only receives AM medium wave transmissions, but extends its coverage to the long wave band too – many users no doubt just give up and revert to the 'tranny', myself included.

There is no doubt that for many people the radio represents the favourite programme source, citing as examples the excellent standards achieved by the best live BBC transmissions. For others the



MUSIC LOVERS
agree that the loud-speaker is probably the most important item in any hi-fi system.

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BBC merely succeeds in producing worthwhile fare in the culturally elitist world of classical music; while most light, pop and rock music is from largely indifferent quality disc sources. For the majority of people reality will lie somewhere in between, with the value of continuous background type programming offset against the lack of freedom of choice, etc. It remains a sad but obvious fact that BBC radio in the UK is severely undercapitalised, while the commercial stations that do exist have scarcely shown themselves capable of competing with the high technical standards of the Beeb.

One of the difficulties in assessing tuners is that the most important aspects of their performance are governed by local environmental conditions; every user has a slightly different FM reception environment and likewise different expectations (some are determined to pick up Australia one of these days, while others are perfectly happy to stay tuned to a couple of local stations). For those living in fairly remote rural areas, the ability to receive distant stations will assume greater importance than for the city dweller for whom freedom from interstation effects and local electrical interference will become more prominent.

Without getting involved in explanations of the principles of operation of FM radio, it is still possible to determine the important things the tuner needs to do. First and foremost the frequency response should be flat up to 15/16kHz above which the stereo pilot tone frequencies (19 and 38kHz, above normal audibility) should be suppressed. While a tuner does benefit up to a point from high sensitivity, the specification figure usually represents an unacceptably noisy signal, so a more worthwhile parameter is the signal required for 50dB signal-to-noise, stereo. Other basic measurements include the crosstalk (*ie* interference from one channel to the other) and the distortion generated in the system.

Many other tuner measurements are described in greater detail in the *Technical Introduction,* and relate to the ability of the tuner to discriminate the wanted station from various possible sources of interference: AM signals, stations broadcasting on the same or multiples of the same frequency, etc. It is important that the tuning indicators are accurately aligned; if this is not the case the user is unlikely to obtain the full performance capability.

Probably the one major snag with FM radio is the need to provide (comparatively) sophisticated aerial arrangements. While the AM transistor

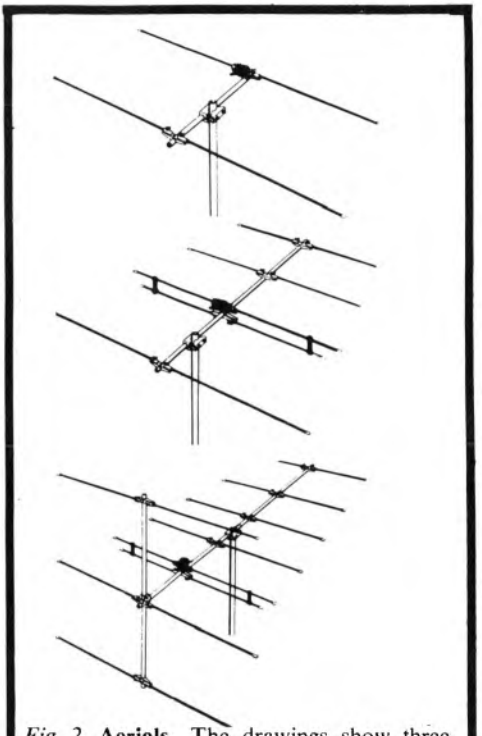
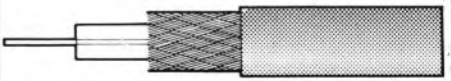


Fig 2 **Aerials** The drawings show three aerial types for outdoor installation, in order of increasing gain or sensitivity (usually good) and directivity (sometimes inconvenient). These are usually fitted with 75ohm co-axial cables/plugs similar to a domestic TV installation, though simple indoor ribbon aerials may use a 300ohm connector of a different type.



75ohm co-axial

300ohm ribbon

radio works adequately from an internal aerial, any FM reception needs at least a 4ft metal rod, or better still a number of these arranged into an array *(see Fig 2)*. The greater the number of elements, the more powerful will be the received signals (and as a consequence more distant or weaker signals will be received strongly enough to be of use). However there are a number of conflicting conditions at work: the more elements there are, the narrower the angle from which the signals will be received, so to use such an aerial it is advisable to fit a remote-controlled rotator: the erection of such a system begins to get expensive. Simpler aerials avoid the need for such complications but at the expense of signal strength. It is still worth getting as much aerial height as possible, both because FM radio waves travel in straight lines from transmitter to receiver, being interrupted by anything in the path, but also to avoid electrical interference from traffic at street level. Although convenient, a loft aerial sacrifices height and signal strength to a proper outside installation. An inadequate aerial arrangement is usually obvious made by a high background noise, particularly on stereo signals.

The cassette deck

Final signal source is the cassette deck. While pre-recorded Musicassettes are usually issued alongside discs, there is no doubt that their quality is rather inferior due to the difficulties of mass duplication. It is clear that the majority of users make their recordings from the radio or from discs irrespective of the copyright position, but honesty and legality are quite cheap: a licence costs £1.50 plus VAT from MCPS, Elgar House, 380 Streatham High Road, London, SW16.

It is of course inevitable that any tape recording will lose some fidelity when compared with the original, because the particular distortions of the tape recording process will be imposed upon the distortions in the original; for this reason the cassette medium is still scorned by many enthusiasts. However its convenience is undeniable, and for many it performs a valuable function recording radio broadcasts, preparing party or background music or cassettes for replay in the car.

The most important criterion for the tape deck is, as usual, its frequency response. We have assumed that the entire cycle from record through to replay is desired, and that the Dolby noise reduction system usually fitted to cassette decks with any pretensions to quality is switched on. Manufacturer recommended tape types are used, but if these have given disappointing results we have selected alternatives.

Of similar importance is the signal-to-noise ratio, and this needs to be taken in conjunction with the distortion, as it is possible to increase one at the expense of the other. Because the dynamic range of the cassette medium is marginal, it is important that the Dolby system electronics are working correctly. Various other measurements are used to check the electronic and mechanical alignment of the machine, the latter by checking azimuth of the playback head, phase jitter and wow and flutter. A more thorough treatment of these parameters is given in the *Technical Introduction.*

Perhaps more than any other component, the cassette has been the recipient of a large number of ingenious built-in features, most of which one can live without but which nevertheless can prove useful. The really useful 'extras' such as separate record/replay heads, which enable one to directly compare the recording with the original whilst actually making the recording, or microprocessor-controlled tape/machine alignment facilities are only to be found on the most expensive machines. For the normal domestic user, a no-frills machine with good mechanical performance and stability plus accurate electronic alignment is really all that is necessary, and although it is helpful to have sophisticated metering, it is not difficult to get the best from simple cheap meters after a little experience.

The most important element in getting good results from a cassette machine is usually in choosing the correct tape to match the machine. And this does not necessarily mean the most expensive tape. Apart perhaps from the horrendously expensive metal tapes that are just appearing on the market, there is little doubt that a good quality Ferric tape is nearly always adequate for the task, and excessive expenditure on exotic tapes – or indeed the machinery for operating them – is very difficult to justify. It is worth some time and trouble to investigate a number of tape types on a particular machine to find the most acceptable cost/performance compromise. Further details on tape types and machine compatibility will be found in our companion volume *Cassette Decks and Tapes.*

Choosing and using the stereo system

It is less than twenty years ago that the hi-fi buyer

would be ferreting about the back streets amongst the radio shops and government surplus stores. Nowadays stereo and hi-fi equipment can be purchased from all sorts of places: the independent specialist, a specialist who is linked into a loose association to increase buying power, national chains which have either grown out of the hi-fi business (*eg* Hardmans, Tandy) or the electrical business (*eg* Currys) or neither (*eg* Boots, Woolworths, department stores), discount warehouses – the list is endless. Some specialists have even started avoiding shop premises altogether, operating a sort of consultancy service, based on appointments in deliberately domestic surroundings.

The important thing the customer should remember is that his satisfaction with a hi-fi purchase may well be dependent on the quality of the dealer who sold it. While this magazine can proffer advice that may be useful in all sorts of ways, it does not install the cartridge in the arm, send back a substandard sample, line up a tape deck to a tape type, install equipment in the home, or repair things if they go wrong. It is clear that a prime requirement for getting satisfaction from a stereo system is to find a good dealer.

This is of course easier said than done. To start with the prospective customer should have some idea of his own mind: why he wants to buy hi-fi; what he expects the hi-fi to do; what sort of money he plans to spend; what sort of music he likes; what domestic constraints will influence his choice. A good salesman should at least try to elicit these facts if he is really to be of assistance to the customer, rather than merely relieving him of his money in the shortest possible time.

A good salesman moreover should be able to demonstrate the differences between components, justifying the differences in asking price. If one merely wishes to buy equipment on its styling, then every metropolis has its hi-fi district, where acres of gleaming satin-chrome and similar fashion accessories will be displayed. If the object is to obtain the best possible music reproduction in the home, then it perhaps makes sense to judge a shop on the quality of musical reproduction heard therein. If a shop (department store or whatever) can make music sound enjoyable, and moreover justify the difference in price between the cheapest and the most expensive systems on display to the satisfaction of the customer's (or his wife's) ears, then this is a pretty good start.

Having found a good dealer, it remains for you and he to establish first of all your requirements, and then the system that suits you best. By the same token it is sensible for the customer to use the dealer's expertise; while we do our best to advise in this publication, it is one-way communication and not a dialogue, so although the mail order customer needs to have made his mind up in advance, the shop customer should take advantage of the retailer's experience.

Domestic considerations are usually as important as sound quality, so it is worth bearing a few points in mind. It is better to use bookshelf speakers on shelves than hide a floor-standing monster behind the sofa. Trolley stands enable speakers to be kept discreetly back against walls, and pulled out for listening. If there are young and inquisitive fingers about, the floor-standing rack is unlikely to be suitable, and highish shelves are probably the only way (the final solution being perhaps a remote-controlled music centre!) Many turntables offer poor resistance to vibration and may benefit from a wall-mounted shelf well away from the speakers. A lot depends on personal circumstances, and it is only sensible to take these into account; to borrow a critique of the fashion industry, 'any fool can be uncomfortable.'

It is beyond the scope of this publication to go into detail on installing and setting up a system – if it is indeed possible to write a useful manual when so much is in the province of experience. While it may be possible to save money by buying sealed cardboard boxes and doing one's own setting-up, I doubt if the saving is worthwhile; Bill Stevens' comments on rack assembly and set-up were not always suitable for publication, so I shudder to consider how the novice might have fared.

Finally it is worth summarising a few pointers that have been mentioned elsewhere but do help a system to give of its best. Speakers should be chosen so that the listener may sit an equal distance from both, and they should be a similar or slightly shorter distance apart. One should always experiment with speaker positioning, small changes may give big improvements; it is often worth trying a design turned upside down – some sound better this way, often depending on your and their relative heights.

Record players should not jump grooves when the cat sneezes; if they do, then they need moving or changing. 'Solid' type turntables in particular can give different results in different locations; it might be useful to tape the sound of a repeated

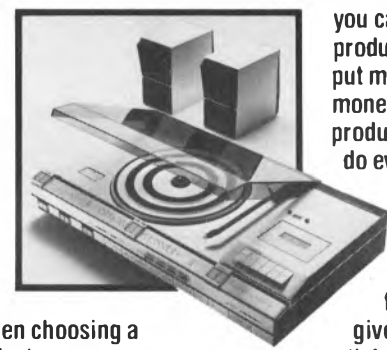
passage with the speakers switched alternately on and off and in different parts of the room – the tape recorder should be able to discriminate the extra colorations produced by the turntable in the changing sound field, and help find the best location.

Every tuner benefits from at least a half-decent outdoor aerial. If you can't receive the stations you want in stereo without a lot of background noise, then you need a better aerial. A really good aerial system is not terribly expensive, and can make the cheapest tuner better than the most expensive one operating off an inadequate indoor type. The services of an experienced local specialist is invaluable.

A cassette deck only works well with tapes for which it has been set-up. Some dealers will have the facility to set the machine up for any tape type, but it is more likely that you will have to discover for yourself which brands are the most suitable. It is easy to check this by starting with a range of tapes and recording a short extract on each, then comparing each with the original by starting the two simultaneously and switching from one to the other. The correct tape is the one which sounds most like the original, not the one that sounds nicest; there is no way a recording can sound better than the original – if it does, something is wrong with the original.

Regular maintenance care is covered in greater detail in the accessory section of this book.

If you can buy a music system for £200 why pay more?



Modern hi-fi equipment is extremely complex, but you don't need a science degree to evaluate what you are buying. There are just two things you should know, and they are easy to remember.

The first is V.A.T. – no, not the tax, but Value Added Technology. It's something you ought to look out for when choosing a hi-fi system. Has the manufacturer shown any ingenuity by using quite common components in an uncommon way? Will you get extra pleasure from using and owning this product instead of another because it's easier to operate and easier to live with? You won't get much Value Added Technology for £200!

The second is R.S.V.P., and this is as much a matter of where you buy the equipment as what you buy. R.S.V.P. stands for Reliability, Service, Versatility and Performance, and these are qualities you can find only in products and shops that put music before money. Does the product (and the dealer) do everything you expect of it, and do it well? Will your hi-fi system (and the shop that sold it to you) give you long-term satisfaction? You won't get much R.S.V.P. for £200 either!

Bang & Olufsen offers you the sensible alternative – a wide choice of matched systems backed by solid guarantees of quality and service through appointed specialist dealers. Of course a Bang & Olufsen system costs considerably more than £200, but most Bang & Olufsen dealers offer personal credit facilities that make it easy to afford.

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All this big, beautiful sound could be yours for a pretty small price. Making our big match a real winner, we think you'll agree.

SANYO
Technology at your fingertips

This introduction explains the purpose of the various technical measurements and discusses the test techniques used. It will obviously be advantageous for the uninitiated to read the consumer introduction before attempting to cope with this section. Several of the test techniques are common to the record player, cassette and radio section of a system, so these fundamental techniques are described in the first few pages.

It is impossible to express the performance of technical equipment such as a music system without making measurements which require a considerable collection of test equipment. The absence of any measured data in an equipment review is often excused by the shallow argument that we do not listen with instruments but with ears, a point that is true but irrelevant. Both objective (instrumental) and subjective (listening) tests must be used to obtain an accurate and balanced assessment of the performance of any sound reproducing equipment.

Setting standards

Because there are usually many methods of measuring any aspect of the performance of a music system, it is essential that all the measurement techniques and the methods of expressing the result should comply with one or other of the various international Standards. After considering all the various Standards that cover the audio and radio field, it was decided that the tests should comply with those specified by the American Institute of High Fidelity Equipment Manufacturers, where these are applicable, as these are the most recent and about the most comprehensive Standards currently available. (The IEEE/IHF Standard covering tuner testing was revised and re-issued in 1975, and the equivalent standard for amplifier tests re-issued in 1978, so both standards represent recent thinking on the question of test techniques.)

In general there are no significant differences in the measurement techniques specified by the various national Standards, but they do not all use the same reference values for such parameters as signal-to-noise ratio, modulation depth, etc. One Standard may adopt a modulation depth of a 100% as a reference while another adopts 30%, for example, and the resultant signal-to-noise ratios measured on the same receiver by the two methods then differs by about 10dB. The use of differing instruments for measuring the amplitude of the noise may result in a further difference of up to 12dB in the signal-to-noise ratio, even though both instruments are accurate and comply with some current standard. It is therefore important that the same reference quantities and the same test techniques be used throughout the series of tests. Care must be exercised in comparing the quoted data with that measured by other Standards, or by non-standard or non-specified techniques, usually adopted because they make the performance appear to be a great deal better than is justified.

For this issue of Music Systems we have opted to measure electrical circuit noise levels using the CCIR/ARM Standard. This Standard adopts the frequency weighting network specified in CCIR/468-1 and 2, but employs a mean reading meter rather than a peak or quasi-peak meter, and adopts a frequency of 2kHz as a reference frequency rather than the usual reference frequency of 1kHz. A discussion of the many methods of measuring signal-to-noise ratio and a comparison of the results obtained in typical situations when using the many available techniques is given in a contribution to the *Wireless World* June 1978. When acoustic noise is discussed the levels are expressed in dBA to BS 4197 and IEC 179.

On all aspects of electrical safety, British Standard 415 and its subsequent amendments have been followed.

AMPLIFIERS AND LOUDSPEAKERS

As the amplifier and loudspeakers are common to all the signal sources, they set limits to the quality of the acoustic performance that can be achieved from many of the available programme sources, so the first series of tests were aimed at assessing the performance of these common features. Where loudspeakers are supplied with the music system, the amplifier and loudspeakers have been tested together as one unit. If the loudspeakers limit the performance of the system this is noted.

Several systems did not include loudspeakers in the quoted price, leaving the purchaser to choose speakers that pleased him and suited his budget. We had then to select speakers to allow us to carry out the listening tests, but this poses a problem in deciding just how much of the total budget can be devoted to buying loudspeakers. Where loudspeakers were not supplied with the system we have used either a pair of Mordaunt-Short *Signifers* costing around £480 per pair or, for the

cheaper music systems, a pair of Mordaunt-Short *Pageant IIs* at £180 per pair, the more expensive units being used with the more expensive systems. The frequency response charts for these two loudspeaker systems are shown in *Fig. 1*.

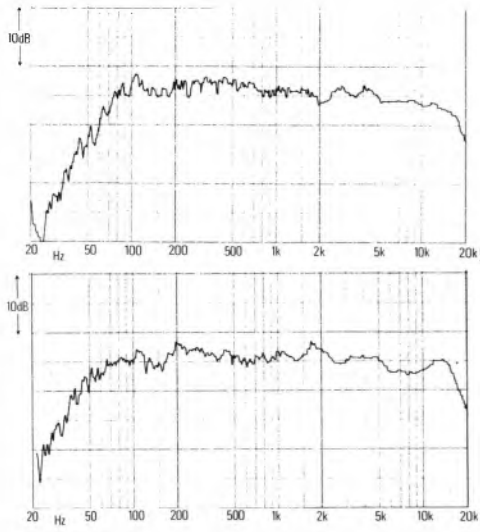

Fig 1 Frequency responses of Mordaunt Short *Pageant II* (above) and *Signifer* loudspeakers. Current production *Pageants* are rather different to those used in these assessments.

Frequency Response

The measurement of the frequency response of an amplifier, or an amplifier and speaker system, is one of the simpler problems in measurement technology. In our laboratory it is automated, the frequency control dial of the Bruel and Kjaer *Type 1014* signal generator being mechanically coupled to a Bruel and Kjaer *2305* chart recorder. This sweeps the test frequency through the range from 20Hz to 20kHz, while the output of the amplifier or the measuring microphone is used to deflect the pen of the recorder to produce the charts shown in the reviews.

Most of the current generation of amplifiers have a frequency response that is flat within ±2dB over the audio frequency range, 20Hz and 20kHz, with any tone controls set to their mid position. This order of performance is much better than is really justifiable, but it is a performance that is relatively easy for the amplifier designer to achieve. It is virtually impossible for the loudspeaker designer to match the performance of a good amplifier, the frequency response and amplitude distortions being at least ten times worse than the equivalent performance of an amplifier.

The effect of the tone controls on the frequency response is charted by the same equipment, both bass and treble controls being set first to their 'maximum' positions and then to their 'minimum' positions to produce the two 'limit' curves on the same chart, on the assumption that any frequency response within these limits can be achieved by appropriate setting of the two controls. A range of adjustment of ±10dB at frequencies of 100Hz and 10kHz is generally more than adequate to compensate for any likely deficiencies in other parts of the replay system.

Where loudspeakers are included with the music system, the combined response of the amplifier and loudspeaker has been measured and the response chart included in the discussion of each system. In practice, the amplifier section of a music system has a response that is much smoother than that of any loudspeaker, the amplifier response falling away only slowly at both low and high frequencies, so the curve illustrating the combined performance is substantially that of the loudspeaker alone. All the "wiggles" are due to the loudspeaker.

The responses were measured with the loudspeaker mounted at a height of approximately 2.5 metres above the ground, with the Bruel and Kjaer 12mm microphone at a distance of 1 metre from the speaker and on the axis of the tweeter. The measurements are carried out in the open air under free field conditions, investigation having shown that the measured frequency response is substantially independent of the location of the test equipment in the two-acre open area used for these measurements. The loudspeaker was excited by pink noise and a B&K tracking unit swept a one-third octave filter through the band, the output being charted by the B&K *2305* Level Recorder.

Signal-to-noise ratio

The upper limit to the loudness that is subjectively acceptable in the listener's lounge is usually set by the harmonic and intermodulation distortions in the reproducer system, while the lower limit is set by the "noise" that is always present in the signal from tapes, records or radio, or even road traffic. The reproduction becomes subjectively unaccept-

able when these incidental noises have about the same loudness as the quiet sections of the programme signal, indeed the sound quality is generally unacceptable when the programme signal in the quieter passages is about 10dB higher than the noise. Though the noise so far discussed is introduced in the recording and reproducing systems, background noise in the domestic listening room may also set a lower limit to the usable sound level. A user will generally adjust the volume control to make the quiet sections of the programme a little louder than the total acoustic noise present in the room, unless this brings the passages that have the maximum loudness to an unendurable level.

Subject to a maximum loudness limit of about 90dBA, it is desirable that the ratio of the maximum signal to the residual noise be not less than about 50dBA, and preferably 60dBA (which is more easily attained if you live in a quiet residential area where the level of the acoustic noise in the lounge may not exceed 30dBA).

Now there are several ways of specifying the signal-to-noise ratio of an amplifier. It is usual to take the maximum output power of the amplifier as determining the upper limit of the signal power available, and to compare this with the level of the noise, weighted in accordance with some Standard, to bring the objective measurements of the noise into agreement with the subjective opinion of a panel of listeners on the degree of annoyance caused by the noise. It has been noted earlier in the discussion that the CCIR/ARM Standard has been employed for all the electrical noise measurements quoted in this issue.

This basic process of specifying the signal-to-noise ratio of a system would appear acceptable, but it is subject to some reasonable criticism. A 20 watt amplifier will produce loudness levels in a typical lounge of around 90–95dBA, about the maximum that anyone is likely to tolerate in a domestic environment. Changing to a 100 watt amplifier will increase the maximum possible level by 7dB, but it will not greatly change the maximum power actually used, merely because the 20 watt amplifier will provide all the power required.

If the signal-to-noise ratio is calculated from the maximum amplifier output and the weighted background noise, an increase in the power output of the amplifier system will increase the "quotable" signal-to-noise ratio, though it may well decrease the "achieved" signal-to-noise ratio. Any increase in the amplifier power output may result in some small increase in the electrical noise power output of the power amplifier, and as this noise is constant irrespective of the volume control setting, the achieved signal-to-noise ratio decreases as the volume is reduced.

Amplifier power output

There are almost as many methods of measuring the power output of an amplifier as there are methods of expressing the result, and all the usual methods of measurement have some technical justification. In the present instance, the power output values quoted are those calculated from the readings of a true RMS-reading voltmeter connected across a load resistance equal in value to the quoted impedance of the loudspeakers specified, the measurement being made at a signal frequency of 1kHz. The readings are taken when waveform clipping is just visible on an oscilloscope. This "just clipping" point generally corresponds to a harmonic distortion content of about 2%–3%, but the distortion increases so rapidly at the onset of clipping that any quotation of the percentage of distortion at this clipping point is almost meaningless. This is particularly true in the case of transistor amplifiers employing considerable amounts of negative feedback.

When distortion values are quoted the test signals were provided by two very low distortion signal generators providing signals of 4 and 5kHz and 10 and 11kHz, all the distortion components being displayed on a Hewlett-Packard Type 3580 real time analyser. The tests were carried out at half the rated power.

Hum modulation

When the amplifier is operating at full power output, the average HT voltage has its minimum value because the current drain is at its maximum. The mean HT voltage then has a large ripple component superimposed on the DC voltage causing the HT to vary over a significant voltage range at the supply frequency. The output power available will then be appreciably higher at test frequencies of 50, 100 and 150Hz than it is at other frequencies. The figure quoted in the performance table is this increase in power expressed in dB. Small increases indicate a good performance.

Dynamic headroom

Any amplifier without an electronically regulated

power supply will provide increased power output if the signal duration is short. The dynamic headroom value quoted in the table is the power increase expressed in dB that is available when the signal is a pulse of tone 20ms long.

Crosstalk
Ideally there should be no leakage of signal from either channel into the other channel, for this reduces the width of the stereo stage and at worst results in a monophonic performance. It is relatively easy to minimise the leakage in an amplifier, but much more difficult to achieve the desired performance in a pick-up or tape machine. (Crosstalk figures of 40dB are easily achieved in an amplifier.) The crosstalk is usually a function of frequency, but brevity restricts the quotation to the value measured at frequencies of +10kHz. The quoted figure is the ratio in dB of the signal applied to either channel, to the leakage signal in the opposite channel. Any value in excess of 20dB is acceptable.

Channel balance
With equal input signals to both channels the output voltage to the speaker terminals should remain in balance. This measurement indicates the degree of unbalance in dB at a frequency of 1kHz.

Ambient output voltage
Every amplifier has a minimum value of noise output voltage, generally that present when the volume control is down to zero but in some instances the minimum occurs at some other setting of the control.

The ambient output voltage is the maximum value of noise voltage across the loudspeaker line measured at whatever setting of the volume control gives this maximum voltage.

RECORD PLAYER SECTION

The problems discussed in the amplifier section have superimposed on them the problems of the record player section when this is being used. The distortions that beset the user of records have been dealt with in detail in a previous Hi-Fi Choice *Turntables and Tonearms,* so this limits the need to discuss the problems in great depth.

Frequency response
As the acoustically significant signal is that fed to the loudspeakers from the main amplifier output, the frequency response of the pick-up chain has been measured at the loudspeaker terminals. The resultant curve includes any irregularities that are present in the pre-amplifier, though these are rarely significant. This was one of the automated measurements included in the test programme, a standard Bruel and Kjaer constant frequency record *QR 2009* being played and the main amplifier output fed to a Bruel and Kjaer *2307* level recorder to produce a chart showing the frequency response over the range from 20Hz to 20kHz. Frequency response, channel balance and crosstalk separation were all obtained from two runs in which the output voltage in both channels was measured first with the left channel only modulated and then with the right channel only modulated. The charts printed in the reviews can be directly compared with the similar charts published in *Cartridges and Headphones.* In many instances the rumble level is sufficiently high to make measurements of crosstalk impossible below 100Hz.

Signal-to-noise ratio
The signal taken as a reference in this instance is that provided by a record modulated at 1cm/sec at 1kHz, while the noise is that due to the induction into the pick-up and from all other sources when the pick-up is supported just clear of the record surface with the motor running.

Wow and flutter
This is the description of the pitch variation effect introduced by every mechanical link in the reproducer chain. The extent of these frequency modulation effects were measured using a Bang and Olufsen *WM1* wow and flutter meter and a standard 3kHz recording of known low flutter content (Type *2010,* Bruel and Kjaer) or a special direct cut record if the deck had a specially good performance. This technique and the measuring equipment complies with the requirements of DIN 45,507. Values below .1% are good, below .05% they are excellent.

Arm/cartridge resonance
A mass supported at the end of an arm will display an obvious mechanical resonance at a frequency determined by the effective arm mass and the vertical compliance of the stylus assembly. This can result in a significant deterioration in sound

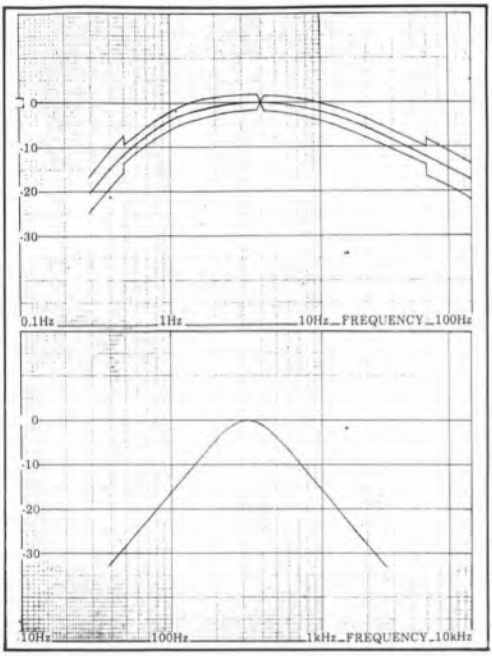

Fig 2 Weighting curves for wow and flutter (above) and rumble (below) measurements.

quality for the resonance is excited by surface irregularities in the record (warps) and it can be shown that this increases the instantaneous wow and produces scrubbing of the stylus across the record groove.

The resonance cannot be avoided but it can ideally be designed to fall into the frequency band between about 10 and 15Hz, and by the provision of appropriate damping the amplitude of the resonance can be limited. Two parameters are quoted in the performance table; the subsonic frequency at which the resonance occurred and the relative amplitude of the resonance in dB. Low values of the resonant gain are advantageous.

Rumble

The relevant DIN standard specifies two weighting curves listed as Type A and Type B weightings. The Type A weighting includes all disturbance frequencies below 300Hz and the Type B weighting all disturbances having frequencies centred on 300Hz. The weighting curves are illustrated in *Fig 2*, and the Type 'B' weighting was used for all the measurements quoted so that the measurement was not unduly affected by the cartridge/arm LF resonance.

Trackability distortion

The stylus load setting has been checked using a precision Correx gauge. Broadly speaking, the stylus loading should not exceed 3 grams, and can be as low as 1.5 grams with advantage. It is doubtful whether there are any advantages in the use of ultra-low stylus loadings below 1 gram.

If the compliance of the stylus suspension and the stylus load are not appropriately co-ordinated, the stylus will not stay in the record groove during heavy modulations, but the signal waveform will be greatly distorted at velocities below that at which the stylus actually jumps out of the groove. The increase in distortion with increase in recording velocity has been assessed using the pulsed 10.8kHz bands on the Shure tracking record *TTR 103*. The stylus loading that ensured adequate tracking at recording velocities of 31cm/sec is indicated in the review table. There is some disagreement among pundits about the velocity up to which perfect tracking should be secured, largely due to the wide variation in the depth to which commercial records are modulated during recording. The industry agreed upper limit is 25cm/sec, but there appear to be many recordings in circulation in which this limit is greatly exceeded. It should be emphasised that our trackability distortion values are not the usual harmonic distortion figures. They can only be compared with each other and with any other test data taken using the Shure test record *TTR 103*.

Acoustically induced breakthrough

This is an indication of the sensitivity of the record deck to noise generated by sounds from the loudspeaker. The measuring technique consists of applying a swept frequency voltage to a loudspeaker and using the Bruel and Kjaer tracking filter to record the voltage generated by the pick-up resting on a stationary turntable. The technique is described in a contribution by Messrs Moir and Stevens to *Wireless World* dated May 1979. The data is necessarily presented as a curve.

Vibration induced breakthrough

This is an indication of the sensitivity of the record player to vibration originating in the table on which

Denon hardware.

When most hi-fi enthusiasts think of their ideal system, various names spring to mind for the individual components.

Because most of today's hi-fi manufacturers are best known for technical excellence in one or, maybe two categories, be it cassette decks, tuners, amplifiers, record decks, etc.

But we at Denon built our reputation on developing and manufacturing an entire music system for both the professional broadcasting industry and the hi-fi enthusiast.

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Each of our hi-fi components has 70 years of experience in audio technology built in.

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They sport many of the advanced features found on items costing much more. Starting at the top is the new SL51 DFF direct drive turntable with variable pitch controls on both 45 RPM and 33 RPM.

Next is the new Denon RN 126 D stereo cassette deck. It has two banks of fluorescent indicators, the most accurate form of record level metering available today.

Below that is the new ST 3380 stereo tuner which has both the traditional tuning scale plus a digital wavelength display as well as fluorescent signal strength metering.

Finally the new SA 3380 stereo amplifier.

Along with fluorescent peak metering it has facilities for two sets of speakers and two tape decks. There's even a feature for MIC mixing from source and between the two tape decks.

The new range is built to the same ultra high standards as our professional hi-fi equipment. (Which is shown below each of the photographs on the left.)

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On the right, our new range of DX cassettes. The Denon double coating process reduces distortion and widens the dynamic range, especially in the upper frequencies.

Phase differential has been thoroughly suppressed by improved tape transport.

And new standards in machining have improved the cassette shell to exceed that of the IEC standards.

As well as our new blank cassettes there is a selection of our award winning PCM recordings.

They extend from selected classical to selected jazz works, constantly being added to as new music is recorded.

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the player stands. It is assessed by standing the equipment on a vibrating table and plotting the output voltage/frequency relation when the vibrator excitation is swept through the audio frequency range. The data is necessarily in the form of a curve. The technique is described in the contribution to *Wireless World* dated May 1979.

RADIO SECTION

Least usable sensitivity

Receivers can be built with any desired degree of sensitivity, but sensitivity alone is a misleading indication of the receiver's capacity to pick up distant stations with good quality. The 'least usable sensitivity' is the signal from the aerial that will, broadly speaking, ensure that the inevitable noise plus signal distortion is at least 30dB lower than the signal. This is inadequate to ensure that the signal-to-noise ratio will satisfy the hi-fi enthusiast but it establishes an agreed level of signal-to-noise that is probably just acceptable to the least critical listener when playing pop music.

The least usable sensitivity was measured using a 100% (1kHz) frequency modulated carrier signal provided by a Marconi *2008* or Marconi *2016* signal generator fed directly into the aerial terminals of the receiver section and reduced in level until the distortion and/or noise as measured at the loudspeaker terminals through a 1kHz null filter was just 30dB below the 100% modulated signal level. In accordance with the requirements of the IHF Standard no weighting was applied when measuring the noise level.

50dB signal-to-noise ratio

Much more important than achieving a low value for the least usable sensitivity is this parameter, which is the aerial signal required to achieve a signal-to-noise ratio of 50dB when receiving a stereo signal.

Signal-to-noise for 1mV input

An alternative method of indicating the performance is to quote the signal-to-noise achieved for a relatively strong signal of 1mV. Different receivers approach the point at which they reach their maximum S/N in different ways. A good receiver will achieve its maximum S/N at a low value of input voltage and the S/N value will stay around the maximum over a wide input voltage range above this limit value. At the other end of the performance scale a receiver may have a high maximum value of S/N but the S/N ratio will fall away from its maximum value very rapidly as the signal level is reduced. When the performance is subjectively judged the user will prefer the receiver having the maximum S/N that is independent of signal over a wide range of input signal level. To indicate the range of input signal inputs over which the S/N is within 3dB of its maximum value, we have quoted the minimum signal for maximum S/N.

Distortion

Like every other part of the system, receivers introduce harmonic and amplitude distortion and these add to the overall distortion. The distortion introduced by the receiver circuits is mainly due to bandwidth limitations in the IF section and to non-linearities in the detector, the distortion increasing with the extension of modulation depth. The distortion was measured by applying a 97mHz FM signal to the receiver aerial terminals, the signal being modulated to a depth of 100% by a 1kHz tone. The overall distortion at the speaker terminals was then measured using a Hewlett Packard *HP 3680* Spectrum Analyser. A value of 0.7% was average, 0.4% very good and anything above 1.2% might be criticised.

AM rejection

The AM rejection is an important parameter, for the basic advantage of any FM system is the high S/N ratio that can be achieved. One of several reasons for the high achievable S/N ratio is a tuner's ability to ignore the many types of interfering signal that are amplitude modulated. Any receiver having a low value of AM rejection is likely to suffer from interference from AM stations and mains-borne from domestic electrical equipment. The degree to which interference is actually encountered in any location depends upon the amount of electrical equipment and the strength of any AM transmissions in the vicinity of the receiver, so it is not possible to specify a unique minimum value but a good average minimum value is around 60dB.

AM rejection was measured by applying a 100uV 100% frequency modulated signal to the aerial terminals and noting the output level with the gain of the amplifier set to produce 1W RMS into an 8 ohm dummy load. Without altering any of the controls the carrier was then amplitude modulated to a depth of 30% and the change in receiver output

noted. The AM rejection ratio is expressed as the ratio of decibels of the output when the carrier is FM modulated to the output with amplitude modulation, and the higher value the better.

Stereo crosstalk
This has the meaning discussed in the amplifier section. The decoding circuits in a receiver can reduce the channel separation by introducing crosstalk between the right and left channel and so degrade the stereo performance. The figure quoted for separation in this section is an indication of the overall performance of the receiver/amplifier system. The amount of crosstalk was assessed by separately modulating the left and right channels of the stereo signal generator and measuring the leakage signal present in the opposite channel.

Image rejection
The circuit design and layout of the first few stages of the receiver are always intended to eliminate any station that happens to be working on a frequency twice the IF frequency away from the wanted station of the pair, and the 'image rejection' indicates how effectively the receiver attenuates this image signal. A good average for the Image Rejection ratio is 62dB.

The image rejection was measured by applying a 100% frequency modulated carrier signal to the aerial socket and tuning the generator to the image frequency. The signal level at the image frequency was increased in level until a 30dB S/N+distortion was obtained at the frequency to which the receiver was tuned, the quoted image rejection being the ratio in decibels of the signal at the frequency to which the receiver was tuned to the signal at the image frequency. Again the higher the value the better.

IF rejection
All current tuner designs are superheterodyne units that could be very susceptible to interference from radio stations working on the receiver's intermediate frequency, usually around 11mHz. Designers take precautions to minimise the sensitivity of their receiver to transmissions in this frequency region, the effectiveness of the design being indicated by the IF rejection. A value of 60dB is typical of the performance of the receivers fitted to the music systems. IF rejection was measured by applying a 100% (1kHz) frequency modulated 95mHz signal to the aerial and tuning the generator to the receiver's intermediate frequency (usually 10.7mHz). The signal at the intermediate frequency was increased in level until a 30dB signal-to-noise ratio was obtained on the programme to which the receiver was tuned, the quoted IF rejection being the ratio in decibels of the signal at the tuned frequency to the signal at the IF frequency. Once again high values are desirable.

Adjacent channel selectivity
All radio receivers are designed to receive a wanted station without interference from stations working on frequencies 200kHz away from each other in 'adjacent channels'. The figure in dB quoted for the adjacent channel selectivity is the amount by which the strength of the unwanted adjacent channel can exceed the strength of the wanted station and still produce a signal-to-noise ratio in the wanted station of 30dB. A good average of adjacent channel selectivity is 4dB, with again high values better.

Adjacent channel selectivity was measured by applying a wanted signal at a level of 100uV (unmodulated) to the aerial terminals and tuning the receiver accurately to this signal. A second generator was then connected (via suitable isolating circuitry) to the receiver and varied in frequency by ±200Hz, one standard channel separation (200kHz) with respect to the wanted signal frequency. The unwanted signal modulated to a depth of 100% by a 1kHz signal was gradually increased in level until the level of the 1kHz breakthrough into the wanted channel was only 30dB below the output obtained with 100% modulation in the wanted channel. Adjacent channel selectivity is quoted as the ratio in decibels of the unwanted RF signal to the wanted RF signal.

Alternate channel selectivity
Though any interference experienced from another FM station is usually due to the station working on the frequency of the adjacent channel 200kHz away, there are situations where interference is experienced from a station 400kHz away from the wanted station. The ability of the receiver to reject interference from this alternate channel is measured and expressed in exactly the same manner as for the adjacent channel. A typical value for receivers in the present group is 50/55dB, and again high values are desirable.

RF intermodulation
Birdie whistles and similar noises can be produced by the simultaneous presence of several radio signals at the mixer input or by overloading of the early RF stages by strong signals, a problem that becomes more troublesome as the receiver sensitivity is increased. To assess this trouble two equal amplitude signals having frequencies 1mHz apart were applied and the degree of the intermodulation distortion measured. High figures indicate good performance in respect of RFIM.

Capture ratio
It is a considerable advantage of an FM system that the presence of a wanted station can prevent, or at least greatly reduce the signal from an unwanted signal on the same, or a closely adjacent frequency. In a good receiver a wanted station will eliminate the signal from an unwanted station when it is only a few dB above it in radio signal strength. The input signal level difference at which an unwanted station is reduced in strength by 30dB is quoted as the 'Capture Ratio'.

Capture Ratio was measured by connecting two signal generators simultaneously to the receiver under test. With both generators on the same carrier frequency, one generator was set to provide a 100uV 100% frequency modulated signal whilst the signal from the second generator was gradually increased in level until the audio output had fallen by one dB. The level of the unwanted interfering signal was then increased until the audio output had fallen by 30dB. The capture ratio quoted in the reviews is the difference between the two values measured in decibels, divided by two. A good average value of Capture Ratio is 2dB. In this case the smaller the figure the better the performance.

Pilot carrier suppression
In good receivers special filters are used to eliminate the 38kHz and 19kHz stereo pilot tones and ensure an absence of 'birdie whistles' when the receiver output signal is being tape recorded. In a budget priced receiver it is more usual to rely on increasingly attenuating the audio frequency response above a frequency of about 10kHz.

The data table in the reviews notes the attenuation of the 19kHz tone that is achieved by the filters, all the receivers included in the present series of tests providing reasonably adequate attenuation of the 38kHz pilot.

When the attenuation of the 19kHz pilot tone falls below about 25dB, a receiver that proves acceptable with one cassette recorder may be unacceptable with another make of recorder. Some cassette recorders include a switch to change the bias frequency by a few kHz if 'birdie whistles' become obvious when recording from radio.

Frequency response
The requirements are the same as those discussed in the amplifier section and the test technique is basically the same. Instead of applying the variable frequency audio signal direct to the input terminals of the audio section, it is used to modulate (in stereo) a Marconi Type *2008, 2016* or Radiometer *SMG1* signal generator tuned to a frequency in the region of 100mHz. This RF signal is applied to the aerial terminals of the radio unit and the audio modulating frequency swept through the usual frequency range of 20Hz–20kHz. The output voltage at the speaker terminals is used to obtain a chart recording of the frequency response using a Bruel and Kjaer Type *2305* chart recorder exactly as discussed previously. The effects of channel unbalance in the receivers are exactly the same as discussed previously in connection with the amplifier section.

CASSETTE TAPE SECTION

Frequency response
As most users employ their machines for replaying tapes that they have recorded themselves it is the combined record/replay characteristic that is of major importance, and it is this overall curve that is illustrated in each review. To assess the overall performance, a sine wave signal from Bruel and Kjaer Type *1014* signal generator was swept through the signal frequency range from 20Hz to 20kHz, at constant level (−20dB ref Dolby level) and recorded on that tape. On replay, the tape and chart were synchronised to produce a pen chart showing the overall record/replay frequency response.

Azimuth alignment
The degree of misalignment of each head was checked by replaying a specially recorded 3kHz two-track cassette known to meet the azimuth standards and comparing the phase of the signals from the two tracks. Misalignment is a fault that is almost impossible for the average owner to correct, so all the performance data quoted was taken with the head alignment as received, but any serious

misalignment is noted in the discussion of each machine.

It should be noted that the amount of misalignment effects varies with the type of tape used, one cause of the differences in frequency response that appear when different tapes are used on the same machine.

Tape line-up
For the tape line-up tests a Dolby reference level tape (400Hz at 200nwb/m) was played in the cassette deck and the deflection on the VU meters noted. It is usual for the manufacturers to set the reference level at either 0dB for fast reading meters or more usually +3dB(VU) on the slower reading meters. Reference 400Hz tones at −6dB, 0dB and +3dB were recorded on the cassette deck and then replayed and the deflection on the meters again noted. Ideally the meters should read the Dolby reference tone and the recorded tones correctly but if they seriously under- or over-read it is an indication that the tape is being incorrectly modulated. If a tape is under-modulated the distortion levels will be generally better than average with tape noise levels higher than average, but if over-modulated the reverse will be true. It is important not to place too much importance on any small errors in the meter readings unless vindicated by notably higher or lower than average values of distortion or tape noise.

Signal-to-noise ratio
This has the same meaning and significance as before. The signal value is that recorded at the zero on the cassette recording level meter while the noise is that measured with a new unrecorded tape run through the machine. When Dolby noise reduction circuitry is included the figure quoted in the reviews is the signal-to-noise ratio with Dolby in action. (This usually improves the signal-to-noise ratio by 8–10dBA.)

Tape noise headroom
The residual noise in a tape reproducer is primarily due to two sources, tape noise due to irregularities in the tape coating and recording amplifier, plus noise from the electronics in the replay amplifier input circuit. If a tape recorder is to be able to take advantage of future developments in tapes, and these are taking place at a high rate, then the noise from the electronics should be small in comparison with the noise from the tape. As an indication of the margin we specify a quantity which we term the tape headroom, the ratio in dB of the noise with the tape running to the noise without the tape.

Wow and flutter
This is exactly the same as the problem encountered in the record player section. Measurements are made in exactly the same manner and have the same meaning, though because there should be no variable frictional drag on the system they are probably more useful.

Erase efficiency
The efficiency of the erase process is assessed by recording a 1kHz signal at full amplitude and then running the tape through the machine on its record settings, but without any applied signal. The ratio of recorded signal to the erased signal is then quoted as the erase deficiency. The figure should not be less than 64dB.

Phase jitter
Recorded signals that were in phase in the input to the recording circuits may continuously vary in phase in the output circuits, the jitter being a function of the mechanical irregularities in the tape running. This is indicated by measuring the variations in phase between the channel output signals when the input signals were recorded in phase at a frequency of 3kHz.

Signal level indicators
Some form of signal level indicator is always necessary to ensure that the tape is not magnetically overloaded by the maximum signals applied. The present tapes available cannot deal with the signal amplitude range that exists in real music if the absolute peak values are taken and it is considered necessary that the minimum signals should still be well above the level of tape and electronic noise, so some compression of the signal peaks is generally imperative. It is well established that peaks of short duration do not produce the same degree of distortion subjectively judged as do peaks of the same amplitude but of longer duration, and in consequence if a sacrifice must be made, the tape can be allowed to overload on peaks of short duration. This is most easily arranged by using a peak signal indicator that is slow in action by a standard amount and in consequence does not indicate the amplitude of short peaks, the reasoning behind the design of the VU meter, originally

JVC Hi-fi system G with full remote control

The beauty of this JVC system is not that all the components fit neatly into a smart console. It's not even that you can operate it from one handheld control.

It's in the individual units themselves.

This system is the culmination of half a century's technological innovation. And it shows in every component.

QL-A5R Quartz-locked direct drive turntable

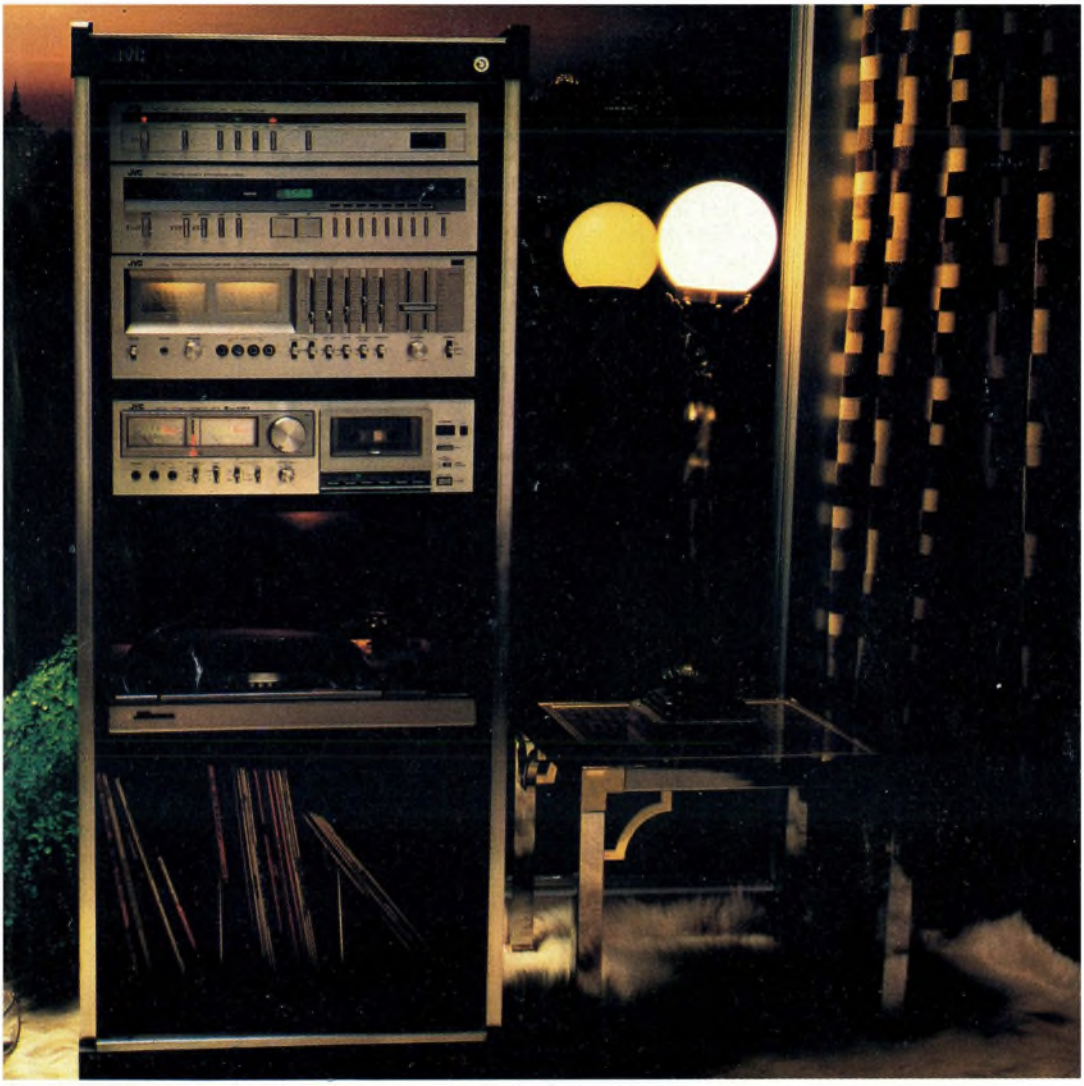
Inventing the Quartz locked turntable was just the beginning. With its extra Quartz servo system, the QL-A5R has wow and flutter of 0.025% (WRMS) and drift of 0.0001% per hour. It also has our own auto-return arm mechanism.

KD-A5 Metal tape stereo cassette deck

JVC are in at the start of 'Metal' tape, capable of a much wider dynamic range than standard cassettes. The deck's performance figures speak for themselves. Frequency response (at -20 VU) for Metal Tape without ANRS (Dolby) is 30-16000Hz (Typical). Wow and Flutter is 0.04% (WRMS) and signal to noise ratio 60dB (Metal tape).

JA-S44 DC Stereo integrated amplifier

Clean sound. That's the message of JVC's Direct current technique. The amp can handle low



frequency signals down to zero Hertz. Output is 48 watts RMS per channel. And there's a built-in SEA Stereo Graphic Equaliser with 5 tone-zones. So you can enjoy a total of 371,293 possible tonal combinations.

T-40P FM/AM Quartz synthesised tuner
Instant tuning, digital display and drift-free reception all in one tuner. You have quick random access up to 8 pre-set FM/AM stations. And it's Quartz-locked. Tune it and it stays tuned.

RM 505 Remote control unit
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It's all done by infra-red. Isn't that sky hi-fi?

JVC

ANOTHER STEP CLOSER TO REALITY

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developed for broadcast transmitters.

Its use was carried over into tape recording practice but it was soon found that the meter was just a bit too slow in action and that it resulted in audible distortion being present on peaks which were not indicated by the meter. The BBC developed a peak programme meter for the same applications but with a movement that was a little faster in action than the VU meter. This proved to be more suitable as an indicator of the peak signals when these were being magnetically recorded because the balance between meter speed and the consequent audio distortion was an improvement over that of the VU meter.

The use of a real peak indicator having a high speed of operation is clearly a luxury we cannot afford until such time as we have recording systems capable of a dynamic range in excess of perhaps 90dB. With this in mind we should be cautious in assuming that such peak indicators as LEDs or CRTs are desirable because of their fast response. Ensuring that overloads are completely absent only ensures that the signal/noise ratio is sub-optimum. Fast acting indicators such as LEDs can be slowed down by suitable circuitry and the combination of a meter, and a suitable circuit having the appropriate time constant is probably a good solution, but note the emphasis on 'a suitable time constant'.

Coupled volume controls

Many of the systems employ separate volume controls for the two channels though this makes it difficult to ensure a balanced fade when this is necessary. Separate volume controls have advantages in allowing a good left/right balance to be obtained so it is logical to combine the advantages of both arrangements and provide volume controls that can be turned individually when necessary but can be locked together by some simple friction device that allows them to be rotated together when the desired degree of balance or unbalance has been set in.

GENERAL

Listening tests

A pair of keen ears will reveal any deficiencies in sound quality more rapidly than an objective approach, and take every factor into account, so the objective tests were supported by carefully controlled listening tests using several experienced observers. First generation 15in/sec tapes and high quality discs were available, all covering the same selection of spoken and musical material. The signal on the tape was transferred from the tapes to cassettes using a Technics *9900* professional cassette deck allowing a direct comparison of the sound quality from two systems on playback, both reproducing the same programme. Generally the cassette being assessed was run a few seconds behind the reference cassette so any section of programme heard on one machine was repeated on the other to allow an immediate comparison of the sound quality of the two units.

When assessing the performance of the radio sections the same basic technique was used, the 15in/sec tape being used to stereo modulate a Radiometer *SMG1* signal generator to provide equal radio signals to both receivers. When BBC programmes of good quality were available, the two receivers were tuned to the same station and heard alternately.

The record sections presented some special problems insofar as it was not possible to compare the performance of the record/replay facilities against that of the radio and cassette sections using the same programme except when testing a few of the top quality units. The same programme was available in all three formats using records of the direct cut acetate type, usable without significant deterioration in sound quality for only 10 to 20 playings; in consequence, these special discs were used only for the final comparison on the top 10 units. All the preliminary comparisons were made using two copies of the same commercial record, carefully selected from current lists for their outstanding sound quality. In selecting all the material we had excellent co-operation from Decca, EMI, Enigma and Pye, all of them providing advice and selected recordings.

Final listening tests were carried out by a small panel following a preliminary ranking achieved during the earlier testing; final tests compared the performance of those systems ranked near the top in the preliminary check.

It is worth emphasising that the differences in sound quality between the 'recommended' units is not large, and is generally less than the difference between successive items in a broadcast programme. Thus the final choice between recommendations can often be made on such aspects as appearance, size, facilities provided, etc.

The sound quality of practically all the music centres was limited by the loudspeakers supplied

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with the centre, rather suggesting that there are advantages in choosing your own loudspeaker, though it should be emphasised that the speakers supplied were generally a great deal less costly than units typically available on the open market.

AM performance

No measurements were taken on the AM section of the tuners in view of the near impossibility of achieving a hi-fi performance from any station on the medium and long wave bands. In the area north-west of London there is not a single station free of whistles during the hours of darkness.

Some of the tuners included a ferrite rod aerial on a mounting that allowed the rod to be located in a position that achieved the maximum signal-to-noise ratio, a facility that was particularly valuable to those listeners who still have a lingering passion for the medium wave band.

Notes to accompany test charts

All the test charts cover a signal amplitude range of 50dB and were taken with a writing speed in excess of 63dB/sec and a paper speed of 3mm/sec.

Amplifier response and tone controls (top left)

The response with the tone controls in the neutral position was positioned halfway along the vertical axis with two additional curves showing the response with both tone controls in their minimum and maximum positions. Dashed curves at either extreme of the overall response indicate the performance of any switchable high or low frequency filters that may have been included.

Tuner response (centre left)

Single channel only modulation was used when taking the tuner response and a tracking filter was connected to the output from the system to ensure that the response was not impaired in any way by the sub-carrier tones. The dotted curves below the main response show the left-to-right and right-to-left crosstalk levels over the frequency range from 20Hz to 18kHz. Pre-emphasis of 50uS and a modulation level of 20% at 1kHz were set on the stereo generator when plotting the curves.

Tape record/replay response (bottom left)

The tape record/replay responses were taken at a level 20dB below Dolby level with the Dolby noise reduction circuitry in operation. The curves show both the left and right channel responses, the left channel being the upper curve. The curves are offset by some 10dB to allow them to be individually examined.

Cartridge response (top right)

Taken using the outer bands of the B&K test record type *QR 2009*. A tracking filter was included in the system to allow accurate crosstalk responses to be plotted even when high rumble levels were present. Both left and right channel response and crosstalk curves were taken but only one curve (usually the least impressive) is shown in the individual reviews. Crosstalk levels plotted below 100Hz should generally be ignored as they may have been affected by rumble.

Vibration breakthrough on record deck (centre right)

Taken with the same 1kHz 5cm/sec reference level at the topmost line of the chart as that used in the acoustic breakthrough tests. The deck was mounted on a vibrating platform (driven from a shaped white noise source) having a reasonable flat velocity spectrum characteristic up to 3kHz. Both left and right hand channel breakthroughs have been plotted on the same curve, so as with the acoustic breakthrough tests it is again more useful to examine the broad outline of the curves rather than differentiate between the two responses.

Acoustic breakthrough on record deck (bottom right)

This is taken with a sound pressure level of 90dB being maintained over the whole frequency range (*via* a feedback loop) at 100mm above the record deck spindle. All the curves are taken with the dust cover lowered and with a reference cartridge output level from a 1kHz 5cm/sec band being represented by the level at the top of the chart. Both left and right hand channel breakthroughs have been plotted on the same curve, so it is more useful to look at the broad outline of the curve rather than try to differentiate between the two curves.

Loudspeaker frequency response (extra curve where appropriate)

The loudspeaker was driven from a pink noise source with a B&K 1in microphone located on the axis of the loudspeaker at a position 1 metre from the front face (baffle). The output from the loudspeaker was analysed using a swept one-third octave tracking filter driven from a B&K *1014*

oscillator. Where possible all the responses were taken with the microphone located mid-way between the tweeter and woofer in a two-way design or between the tweeter and midrange unit in a three-way design.

FACILITIES KEY

A Stereo FM
B AM
C SW
D 240/300ohm aerial terminals
E 60/75ohm aerial terminals
F Preset tuning controls
G Separate AM tuning controls
H Tuning meter facility
I Stereo pilot light
J Muting (switchable)
K AFC switchable
L Local/distance switch
M Multiplex on/off switch
N Signal strength meter
O Quasi-stereo capability (*ie* reduced cross-talk for lower noise)
P Anti-whistle or whistle defeat facility
Q Reference tone for tape recording set-up
R Moving iron/magnet pickup
RC Moving coil pickup
S Ceramic/crystal pickup
T Tape head input
U Treble controls only
V Bass and treble controls
W Rumble filter/low frequency filter
X Scratch filter/high frequency filter
Y Loudness filter (switchable)
Z Tape record/replay external facility
ZA Pre amp/main amp insert points
AA Extension LS terminals (to run with or without mains LS)
AB Headphone socket
AC Auxiliary mains outlet
AE Mono/stereo switch
AF Simle ambiophony capability
AG Bass controls only
AH
AI Deck speed adjustment (fine)
AJ Automatic changer
AK Removable headshell/pickup plate
AL Cueing device
AM User tracking weight adjustment
AN Bias compensator (adjustable)
AO Automatic shut down (dream)
AP Auto repeat capability
AQ 33/45 rpm cueing sensor
AW Dolby noise reduction
AX Manually switchable Fe or Cr replay facility
AY Tape position indicator
AZ Pause control
BA VU metering – including LED equivalent
BB PPM metering
BC Automatic stop
BD Twin meters
BE Single meter
BF Dynamic noise limiter (DNL)
BG ANRS noise reduction
BH Super ANRS noise reduction
BI Auto CrO_2 replay facility
BJ Auto/manual recording level control option
BK Microphone (supplied)
BL Stereo microphone (supplied)
BM Microphone input
BN Bias adjustment separate from equalisation setting
BO Limiter (switchable)
BP Auto programme search facility
BQ Tape memory capability
BR Tape transfer capability (usually in the form of two tape inputs)
BS Peak level LED indicator

Acknowledgements

Acknowledgement is made to the following organisations for providing the high quality records and tapes used in the listening tests.
Decca Record Company Ltd.
EMI Records Ltd.
Enigma Records.
Pye Records Ltd.
Thanks are due to Bruel and Kjaer for the loan of a *2305* level recorder.

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Aiwa AF 5300

Aiwa Sales and Service (UK) Ltd., Cons. Inf. Dept., Aiwa Centre,
56–58 Brunswick Centre, Marchmont Street, London WC1. Tel: (01) 278 2081

Introduction

As their separates systems were not available in time for our deadlines, Aiwa are represented by one of their music centres; accorded two 'best buys' out of two submissions in the *Music Centre* edition, they clearly already have a strong reputation in this field. The *5300* is one of two models in the range, the other being the slightly more expensive *5600*, which offers more power in a slightly higher cabinet and is supplied without loudspeakers. Aiwa also offer a brace of 'cassette/tuner/amplifiers' (similar in content to the B&O *4000* reviewed in this book) which offer the sensible option of choosing one's own accompanying record player and loudspeakers.

There are also three rack systems in the range. Two are based on conventional separates housed in a floor-standing vertical glass-fronted rack with record storage. The third is one of the new micro-systems, with separate pre-amp, power amp, cassette deck and tuner but no record player (!), supplied without loudspeakers for a little over £400.

General description

This is an attractive looking low profile system with the cassette unit and record player protected by a hinged tinted perspex cover and the majority of the controls positioned along the slightly angled front panel. Though the cassette player is positioned below the cover the piano key tape transport controls are mounted on the front panel allowing some measure of tape control with the lid down. Pushbutton wire terminals and standard DIN sockets are provided for the connection of two sets of loudspeakers, and a 5-pin DIN socket is available for connecting an external tape recorder. The centre is finished in brushed aluminium with a grey coloured plastic top moulding and simulated wood side panels.

The four band tuning scale was well liked, especially the easy to read green legends and perspex tuning cursor, whilst the overall quality of construction was very high. Two unusual features of the centre are the provision of facilities for tape recording programmes from disc automatically and the permanent connection of the record level meters across the early stages of the amplifier, leaving them in operation on all the signal sources.

Amplifier

Power output is a useful 27.1 watts into 8 ohms rising to 32.6 watts when a 4 ohm load is connected. The hum modulation performance at near maximum power levels was quite reasonable and an average dynamic headroom of 0.9dB was available on pulse duration of less than 20mS. The bass, treble and balance controls situated on the front panel are of the slider type with centre detent positions, whilst the volume control is of a similar slider style, but with a slightly longer overall travel. Selection from the many signal sources is by pushbutton. A switchable loudness control and a stereo/mono are included. Switching is included at the left hand end of the centre to allow the selection of either of two sets of loudspeakers, whilst the normal type of stereo jack socket is available for the connection of headphones. The signal-to-noise ratio was about average at 89dB as were the IHF intermodulation distortion products, and the bandwidth of the amplifier was sensibly limited to between 10.8Hz and 36kHz. The overall frequency response of the amplifier was very smooth though the range of the tone controls was rather less than usual.

Tuner

The tuner section features six pre-set tuning controls, a multiplex on/off switch, muting and AFC switching and a nicely illuminated LED tuning indicator. Adjustment of the pre-sets is carried out using six tuning knobs hidden under a hinged lid adjacent to the record player, whilst the tuning indicator comprises three LEDs coloured red/green/red, the green LED lighting up when optimum tune has been achieved. The overall sensitivity of the tuner was generally above average with an average IHF least usable sensitivity of 2uV and a better-than-average 280uV being required for maximum signal/noise ratio. All the radio frequency rejection levels were good and the RF/IM level of 71dB was very acceptable. The overall frequency response of the tuner was generally smooth, though a gradual rise in output was evident from 100Hz up to 8kHz, the 8kHz level being some 2.5dB higher than the 100Hz level. Crosstalk performance was good, even at high modulation levels, whilst the overall performance in respect of audio frequency distortion and pilot carrier rejection was generally very good. The tuning scale was well liked giving comprehensive frequency information of the SW, MW, LW and FM bands, whilst the action of the tuning knob and clear perspex cursor was particularly smooth. An FM frequency meter is provided for use when setting up the presets. The tuner section had a better than average performance, though the frequency response measured on the FM band might be improved.

Cassette deck

The cassette deck is a top loading design with a damped access lid and separate left/right record level controls fitted to the top of the deck behind the housing. Above the record controls are two very small recording meters connected across an early stage of the amplifier to indicate the signal level of the source selected. The meters under-read by 5dB on a 64mS pulse and no peak reading LED facility is available, so some care is needed to attain good recording quality. The tape drive mechanics were very satisfactory with a wow and flutter level of 0.07% and L/R phase jitter of 16°.

The overall tape line up was below average using the TDK *SA* tape, but this was compensated to some extent by the error in the Dolby level line-up, the meters reading +4.5dB instead of +3dB. These conditions resulted in slightly higher than average distortion figures (at a meter reading of nominally +3dB) and correspondingly lower levels of tape noise. Tape erasure was a little lower than average at 65dB whilst the tape noise headroom with respect to replay noise was very good at 10.5dB. A tape selector is provided for simultaneously varying the bias and equalisation, whilst the piano type keys at the front of the centre provide convenient control of the tape transport system.

Record deck

The record deck is a two-speed belt drive design mounted on a sprung metal base plate with the base plate firmly connected to both the light alloy platter and the tonearm assembly. This construction results in somewhat lower than average levels of acoustic and vibrational breakthrough though a

prominent 230Hz resonance was quite noticeable on the acoustic breakthrough pen chart. The record deck was fitted with an Aiwa design of cartridge (Aiwa *MM-AN8743)* giving an average level of high frequency intermodulation distortion and an unusual frequency response, being some 3dB down at 44Hz and 8kHz and with a mild high frequency peak at 19kHz. The performance in respect of wow and flutter was above average and an average level of signal-to-noise ratio was recorded. The deck is fitted with the usual speed selector switch, anti-skating force adjustment, semi-automatic reject control and an SME type of detachable headshell. The rumble levels were slightly worse than average though the crosstalk performance of the pickup was fairly typical for a cartridge of this quality. There is provision for semi-automatically recording from disc to tape, the cassette deck being switched to run in the record mode in synchronisation with the turntable operation cycle.

Listening tests and overall appraisal

Loudspeakers were not provided with this centre, which is surprising as it is normally sold as a complete system with speakers. All the listening tests were carried out using the Mordaunt-Short *Pageant IIs*. The slight lack of extreme high and low frequency output from the cartridge resulted in a subjectively hard sound but with good overall image detail and a fine tracking performance. Rumble was just audible on quieter passages but generally the performance from disc was quite acceptable. Though the record/replay frequency response using the Maxell *UDXL1* tape was a little lumpy when measured, the subjective tests revealed a reasonably balanced sound very close to the original quality from radio or disc. Because of the tape line-up, meter ballistics and separate recording level controls some care was needed to achieve a good recording. The pre-set FM tuning arrangements were well liked as were the LED tuning indicators and tuning cursor.

Amplifier

Power Output 8ohms/4ohms	27.1/32.6 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/6dB/2dB
Dynamic Headroom	0.9dB
Signal/Noise ratio CCIR/ARM	89dB
Ambient output voltage CCIR/ARM weighted	0.44mV
Phono input impedance/capacitance (inc lead)	48kohm/110pf
Crosstalk 1kHz/10kHz	51dB/44dB
Gain tracking error, ¼/½/¾ setting	1.0dBL/0.3dBL/0dB
Balance	0.2dBL
3dB Bandwidth (at 1W RMS)	10.8Hz/36kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	64dB/69dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	66dB/67dB

Tuner

IHF least usable sensitivity	2uV
50dB quieting mono/stereo	3.3uV/36uV
Signal/Noise 1mV CCIR/ARM	70dB/66dB
Min signal for max S/N ratio mono/stereo	44uV/280uV
AM rejection	59dB
IF rejection	>80dB
Image rejection	62dB
Capture ratio	2.6dB
Adjacent/Alternate channel rejection	1dB/>60dB
RFIM	71dB
Distortion L/−R, L only	0.38%/0.62%
Crosstalk 1kHz/10kHz	38dB/33dB
19k/38k suppression	61dB/59dB

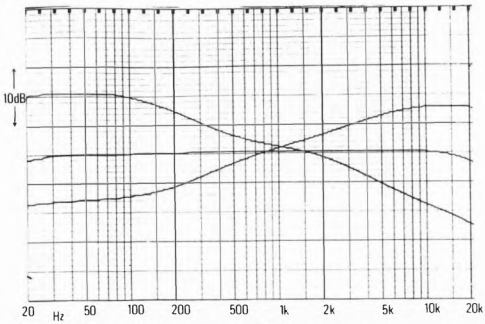
Tape

Tape used for tests	TDK SA C60
Replay azimuth alignment	19.3°
Wow and Flutter	0.09%
L/R Jitter at 3kHz	16
Dolbyref level readout on meters, 64mS under-read	+4.5dB/5dB
Distortion −6dB, 0dB, +3dB	0.23%/0.63%/1.6%
Line up on replay meters −6dB/0dB/+3dB	−3dB/+3dB/+5.5dB
Erasure efficiency (400Hz at Dolby level)	65dB
Signal/Noise biassed tape CCIR/ARM	50dB/60dB
Tape noise headroom wrt replay noise (no cass)	10.5dB

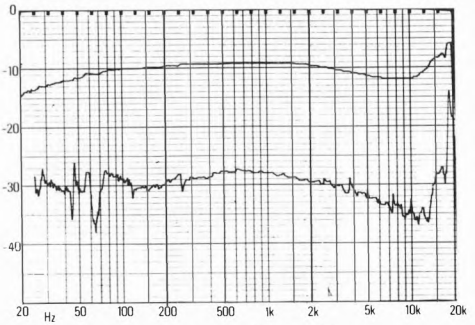
Disc

HF Intermodulation distortion (10.8kHz pulsed)	0.47%
Tracks 1k+1.5k 31.5cm/sec band at	1.7gms
Effective mass of pickup + arm	24.9gms
Subsonic resonance freq/dB gain	6.5Hz/approx 6dB
Estimated compliance	24cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	59dB
Wow and Flutter	0.075%
Rumble (DIN B)	60dB
Tracking weight error setting/actual	2.3gms/2.4gms
Pickup type	Aiwa MM (AN-8743)

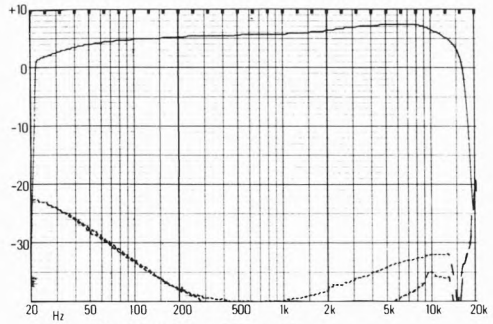
Available facilities	A. B. C. D. E. F. H. I. J. K. P. R. V. Y. Z. AA. AB. AE. AK. AL. AM. AN. AW. AX. AY. AZ. BA. BC. BD. BM
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw type
Ferrite rod aerial	no external aerial
Typical System price	£395



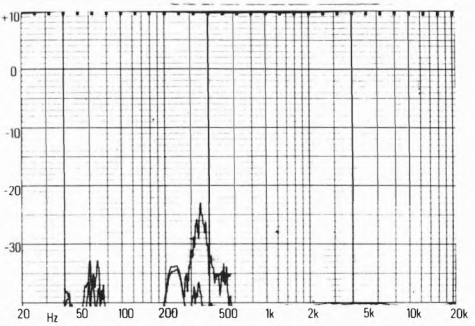
Amplifier response, tone and filter variations.



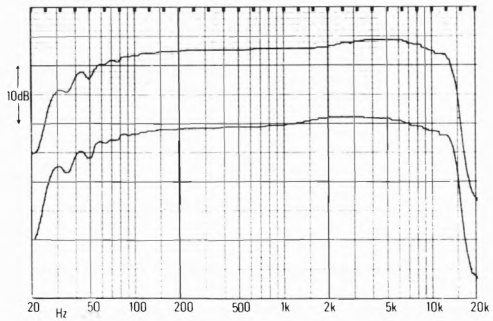
Pickup cartridge response and crosstalk.



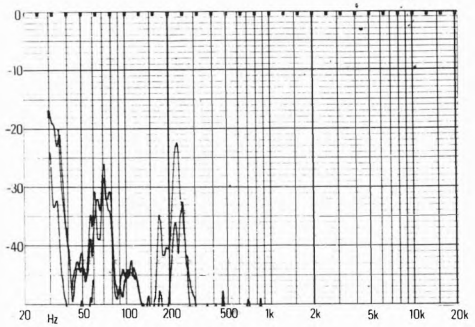
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

RECOMMENDED

Aurex system 15 Micro Series

Toshiba UK Ltd., Toshiba House, Frimley Road, Frimley, Camberley, Surrey GU16 5JJ. Tel: (0276) 62222

Introduction

Aurex is a new name to Britain, but in fact has been used for top-end Toshiba hi-fi products in Japan for a number of years. This marketing image split amongst the big electronics companies is becoming quite common, with Technics/Panasonic and Optonica/Sharp already established (Lo-D/Hitachi too one day?), because the manufacturers prefer not to confuse the image of prestige hi-fi with microwave ovens and TV sets.

The Aurex brand has really been making waves with the introduction of the first 'micro-system', featured here, followed more recently by two further systems with similar styling and 'camera' finish, with reduced specifications at a significantly lower price. They also have conventionally styled separates, including the interesting Toshiba *ADRES* noise reduction system and unusual electret cartridges.

General description

Representing the cream of Toshiba's new micro system offerings, the equipment features solenoid tape transport controls, digital electronic FM tuning in steps of 100kHz, automatic selection of bias and equalization for ferrichrome and chromium dioxide tape, and front panel switches to bypass tone controls and the early amplification stages. The tuner, amplifier and cassette deck are all solidly housed in 3mm thick metal aluminium cabinets, all the interconnections at the rear of the equipment being made exclusively with gold plated phono plugs and sockets. When the separate units are stacked as shown in the photograph, the interconnections line up in a logical sequence with, for example, the tape playback sockets on the pre-amplifier being positioned directly in line with the 'line out' sockets on the cassette deck. Grooves into the metal cabinets lock into specially shaped

RECOMMENDED

feet to ensure that the equipment is securely stacked. The overall quality of construction was considered excellent.

Amplifier *(SY C15 + SCM15)*
The amplifier combination provides an output of 48.6 watts into 8 ohms rising to 53.8 watts into 4 ohms, with the low distortion figures showing that the small size has not compromised the output power considerations. The balance control is of the rotary centre indent type while the large rotary volume control is fitted centrally on the pre-amplifier. The bass and treble controls are situated to the left of the volume control and though no centre indent position is featured a tone control bypass switch is available to ensure that the flattest response is obtained. A balanced transformerless switching circuit is provided on the main amplifier to allow both left and right power amplifiers to operate together as a single source providing twice the output power. Selection of either or both of two sets of loudspeakers can be made via the switches fitted on the power amplifier and a headphone socket is available adjacent to the power amplifier on/off switch. It is perhaps a pity that the headphone socket and power switch could not be fitted to the pre-amplifier to allow the main amplifier to be separated from the remainder of the equipment.

The overall performance of the amplifier was generally excellent, though a bandwidth extending from 3Hz to 170kHz is a little extreme. One unusual feature is the equalizer direct switch which allows the first stage of the pre-amplifier as well as the tone control circuitry to be completely bypassed with an overall loss in gain of around 17dB. If sufficient signal is available to overcome this loss in output, it is claimed that greater fidelity is achieved. In practice however the switch is more useful as a partial mute to reduce the output level by a known amount, when for example the telephone requires attention.

Tuner *(ST-F15)*
The *ST-F15* digital synthesizer tuner is really the centre point of the system featuring ten pre-programmable channels, manual or automatic tuning capability, fine tuning in steps of 100kHz and a digital frequency readout. Signal strength LEDs, a stereo pilot light and channel identification numbers are also featured on the display. Manual tuning is carried out via two 'up' and 'down' push-buttons, the frequency being moved by 0.1MHz each time either of these buttons is pressed. If the finger is kept on the push-button rapid movement through the frequency band is possible. The tuner may also be swept automatically through the band until a signal of sufficient strength is found, or alternatively the frequency of a desired station may be keyed in via the numbered channel pre-sets. The station frequencies remembered by the circuitry in the tuner are maintained for between 1–2 days if the equipment is not used, a period that is felt to be too short for many domestic users who may not use the tuner for a number of days. A UHF screw type 75 ohm aerial socket is available at the rear of the tuner to ensure that the tuner receives the highest possible signal, though it is worthy of note that an adaptor is supplied to allow the normal coaxial plug to be employed.

The technical performance was particularly good with an IHF least usable sensitivity of 1.6uV with 300uV needed for optimum stereo reception. AM rejection was outstandingly good, and audio distortion particularly low, a figure of 0.2% being achieved for 100% L=−R modulation falling slightly to 0.14% when single channel modulation is applied. Some asymmetry was noted in the crosstalk curves, and the frequency response, though smooth, did tend to drop off slightly at low frequencies, the output at 30Hz being 3dB below that achieved at 1kHz. Pilot carrier suppression was below average, the 19kHz and 38kHz suppression levels being 46dB and 26dB respectively. These suppression levels may prove inadequate when some cassette units are used. In summary then a fine tuner with many outstanding technical features that complement perfectly the performance achieved by the amplifier.

Cassette deck *(PC-D15)*
The *PC-D15* cassette deck is a manually operated front loading design featuring solenoid-operated tape transport controls, laterally positioned bar-graph meters using LED indicators, concentric friction-locked recorded level controls and automatic selection between chrome and ferric oxide or ferric chrome tapes. A memory facility is included as is an auto play switch which allows the tape to be rewound and then automatically set to the playback mode, starting either from the beginning of the tape or a position stored in the memory counter. Azimuth alignment error on arrival was a little below average at 57° though wow and flutter

was commendably low at 0.09% with inter-channel tape jitter being an average 23°. Absolute record/replay line up was approximately 1dB high resulting in average levels of distortion and typical signal-to-noise ratios.

The record/replay response achieved using Maxell *UDXL1* tape was near perfect, the response being absolutely flat from around 50Hz to 13kHz. Similar results were achieved using TDK *SA* tape, though a slight rise in output of just over 1dB was notable between 2kHz and 9kHz. These results do tend to indicate that the bias and equalization levels have been optimised, and indeed a useful chart is included with the instructions showing which setting gives the best results for a number of well known tapes. The tape transport controls can be switched from fast forward to fast rewind directly without the need to touch the stop control between operations. The usual safety lock is incorporated to ensure that the deck is only switched to the record mode when both the record and play buttons are depressed. A plastic preformed cover is included with the deck and slips into the tape housing when the deck is not in use, offering useful protection for the tape heads and capstan drive.

Listening tests and overall appraisal

This Aurex system is clearly a major step into the world of miniature audio technology, though at £950 it may not be considered good value for money. Cheaper versions of the system will soon be available with mechanical tape transport controls and a manually operated tuner, and it is expected that the technical performance of these systems will not be compromised by their budget price. The controls on the Aurex system were rather tiny, especially the push-button tuner, so some dexterity is needed.

The record level LEDs were found to be a little dim under daylight conditions and reflections from the transparent screen over the meters could be a problem if the equipment is positioned near windows or lights. The tuner performance was well above average with low levels of crosstalk, a smooth frequency response and a firm stereo image. The audio distortion at high modulation levels was minimal and radio interference problems were negligible though a faint very high frequency whistle (19kHz pilot carrier tone) was audible to young ears at low modulation levels. The subjectively judged quality was also very good, with a particularly smooth response when using the Maxell *UDXL1* tape. The ballistic response of the meters was just a little slow, the meters effectively starting to under-read with a 20mS long pulse, though no under-read was apparent at 64mS. The auto play after re-wind feature was well liked as were all the recording and tape controls, giving an impression of precision not usually found on many of the larger cassette decks. As mentioned earlier the price prohibits the system from being awarded a 'best buy' tag but it can clearly be strongly recommended to those having an oil well in the garden.

Aurex system 15 Micro Series

RECOMMENDED

Amplifier (SYC15 +SCM15)

Power Output 8ohms/4ohms	48.6/53.8 watts
Hum modulation 50Hz/100Hz/150Hz	0dB/5dB/3dB
Dynamic Headroom	0.8dB
Signal/Noise ratio CCIR/ARM	88dB
Ambient output voltage CCIR/ARM weighted	1.3mV
Phono input impedance/capacitance (inc lead)	47k/269pf
Crosstalk 1kHz/10kHz	49dB/48dB
Gain tracking error, ¼/½/¾ setting	0.3dBR/0dB/0dB
Balance	0dB
3dB Bandwidth (at 1W RMS)	3Hz/170kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	>78dB/>78dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	>78dB/>78dB

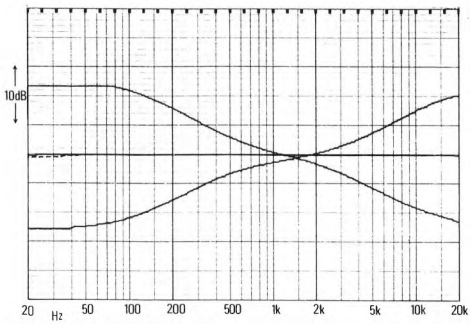
Tuner (ST-F15)

IHF least usable sensitivity	1.6uV
50dB quieting mono/stereo	6.3uV/45uV
Signal/Noise 1mV CCIR/ARM	69.5dB/66dB
Min signal for max S/N ratio mono/stereo	44uV/330uV
AM rejection	66dB
IF rejection	>80dB
Image rejection	76dB
Capture ratio	approx 2dB
Adjacent/Alternate channel rejection	3dB/58dB
RFIM	74dB
Distortion L/−R, L only	0.2%/0.14%
Crosstalk 1kHz/10kHz	36dB/33dB
19k/38k suppression	46dB/26dB

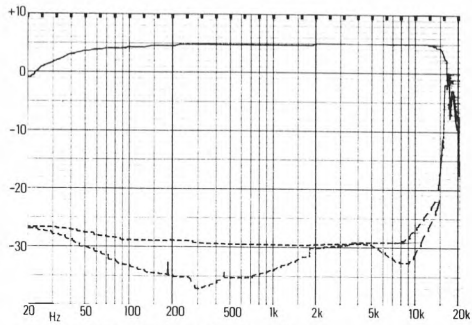
Tape (PCD15)

Tape used for tests	Maxell UDXL1 C60
Replay azimuth alignment	57°
Wow and Flutter	0.09%
L/R Jitter at 3kHz	23°
Dolby ref. level readout on meters, 64mS under-read	+3dB/0dB
Distortion −6dB, 0dB, +3dB	0.32%/0.5%/0.8%
Line up on replay meters −6dB/0dB/+3dB	approx −4dB/+1dB/+3dB
Erasure efficiency (400Hz at Dolby level)	69dB
Signal/Noise biassed tape CCIR/ARM	48.5dB/58dB
Tape noise headroom wrt replay noise (no cass)	7dB

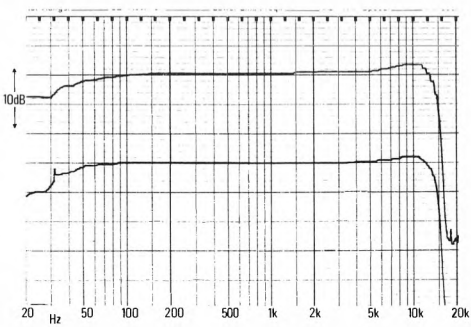
Available facilities	A, B, E, F, I, M, N, V, W, Z, ZA, AA, AB, AE, AW, AX, AY, AZ, BB, BC, BD, BI, BM, BQ
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	no user adjustment
Ferrite rod aerial	no AM
Typical System price	£900 plus extras



Amplifier response, tone and filter variations.



Tuner FM response and crosstalk.

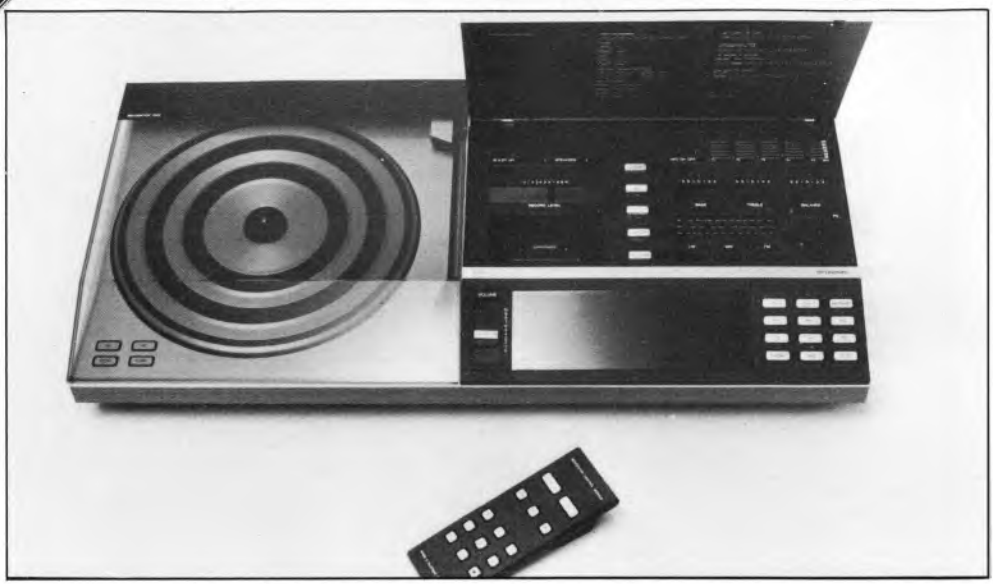


Cassette response L&R, Dolby in (−20dB ref Dolby).

RECOMMENDED

Bang & Olufsen 7000

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



Introduction

The B&O *7000* is one of the tips of the remote-controlled iceberg. With the advent of micro-processor technology this facility is becoming increasingly available and looks set to become as much a part of the system scene as it has the television market. Such a mode of operation will presumably be restricted to complete systems, though this could include rack type separates from a single manufacturer as well as music centres. Other remote operated equipment from B&O includes two record decks, one with a conventional pivoted pickup arm and one with a parallel-tracking arm, plus a remote tuner amplifier. Other manufacturers, notably Sony, are also producing models with this sort of control capability.

General description

This is a centre of outstanding styling, featuring a comprehensive infra-red remote control module that virtually eliminates the need to even approach the centre except to place records and cassettes in their appropriate positions. The hand held remote control module allows selection of any of the signal sources including five pre-select positions and enables recordings to be made from disc or radio virtually automatically; fast forward and rewind of the cassette tape is also available using the remote module. The centre is fitted with a digital tape counter which may also be used as a clock, and the whole system may be programmed either to switch on and play any of the sources, record a radio programme or switch off the centre at a pre-selected time in any 24-hour period. The control features provided by the system are so numerous that it is impossible to give details of them all in a review of this length. Overall it must represent a significant advance in automated control and monitoring of high quality audio signals, and is a model of good styling and design.

A hinged brushed aluminium top panel covers the many programming controls and also gives access to the cassette deck. The record player is fitted with a tinted hinged perspex cover and features fully automatic control of the tonearm, no manual adjustment of the tonearm being needed unless the cartridge is required to play a particular track on a disc. Loudspeaker and aerial connections are easily made via a hinged panel at the rear edge of the centre, and connections for a second tape recorder, microphone and headphones are discretely positioned along the lower front edge of the centre.

Amplifier

Slider type bass, treble and balance controls are

RECOMMENDED

neatly positioned below the hinged metal lid, the main volume control being positioned on the angled front panel to the left of the clock/counter display. No centre detent positions were provided on the balance or tone controls, though it was noted that a very flat response was obtained with them in their neutral position: there was a range in excess of ±10dB available at 100Hz and 10kHz. The frequency response was sensibly limited from 6.2Hz to 48kHz with the IHF distortion products at half power levels being reasonably low. A power output of 39.2 watts was measured into 8 ohms rising to 51 watts when a 4 ohm load was used, the hum modulation performance at maximum power being significantly better than average.

The signal-to-noise ratio at 77dB CCIR/ARM weighted was worse than average, though certainly more than adequate for the reproduction of the sound sources provided in the centre. Crosstalk was very good at 46dB and the gain tracking errors were minimal. Facilities for the connection of two pairs of loudspeakers are provided, either or both pairs being selected *via* pushbuttons situated under the hinged cover.

Tuner

The IHF least usable sensitivity level of 1.2uV was one of the best figures measured in this survey, with some 330uV being needed to achieve the maximum signal-to-noise ratio. All the radio frequency rejections were good, especially the intermediate frequency rejection at 80dB though the alternate channel rejections was perhaps a little worse than average at 45dB. The maximum signal-to-noise ratio on stereo reception was a very respectable 69dB with the overall frequency response being particularly smooth up to 14.5kHz. Pre-selection of five FM stations can be made *via* small knurled tuning wheels fitted below the top plate, and a switchable AFC facility is also provided. No signal strength or stereo pilot light indicators are provided, though a tuning indicator in the form of two adjacent LEDs is located above the main tuning knob, the optimum tuning point being indicated when the two lights are equally bright. Performance in respect of capture ratio, the 19kHz pilot carrier suppression and radio frequency intermodulation distortion were all well above average, but it was noted that the 38kHz carrier suppression was below average at 43dB. Audio distortion was well below average both on the L=−R fully modulated carrier and single-channel-only modulation. Sockets for AM, 75 ohm FM and 300 ohm FM aerials are provided on the rear panel and facilities are available on the tuner for the reception of LW and MW transmissions.

Cassette deck

Best results on the cassette deck were achieved using BASF CrO_2 C60 tape, the record replay response being generally smooth up to 5kHz but rising by 2–3dB at 15kHz. The VU indicator lights situated at the left of the electronic tape counter comprise five LEDs giving mono only information on the level of modulation applied to the tape. Tape line-up cannot be commented on as no replay signal from the tape is indicated on the LEDs, though it is worth noting that average levels of distortion and tape noise were achieved.

Tape mechanics were particularly good: wow, flutter and L/R tape phase jitter were particularly low, while the tape noise headroom with respect to replay noise were good. A very convenient counter address memory is provided to locate any wanted section on the tape. This winds the tape backwards or forwards to any pre-selected point on the tape. Pushbutton 'pause' and 'repent' facilities are available on both the centre and the hand held remote control module. The repent feature is particularly useful, for if the operator finds that he does not wish to continue to record the programme he has begun – the selection being recorded is not required – the fast rewind button will stop the recording and the tape will then automatically rewind to the start of the unrequired section ready to re-commence recording. This facility is particularly helpful when recording programme from the tuner.

Record deck

In true B&O tradition the pickup and platter are both mounted on a well sprung subchassis providing very effective protection against acoustic or vibrational breakthrough. A B&O *MMC20E* cartridge is employed, the frequency response being very similar to that measured on the *2200* deck in the preceding review. The overall performance of the pickup was very good, with low levels of HF intermodulation distortion, notably good crosstalk and tracking results. Wow and flutter was a little higher than average at 0.11% with a reasonable signal-to-noise ratio of 61dB and an outstandingly low rumble level of −69dB. The effective mass of the pickup and arm was very low (less than

RECOMMENDED

Bang & Olufsen 7000

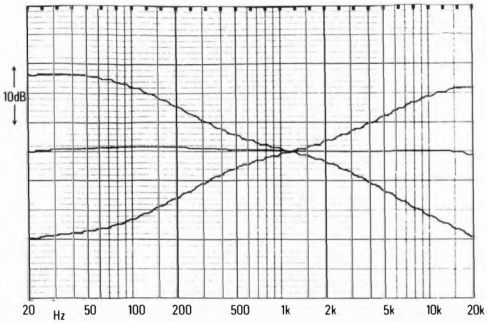
7gms) resulting in an optimum subsonic resonance of around 15Hz with an amplification of less than 1dB. The automatic operation of the deck was well liked, though patience is needed if the operator is familiar with the instant accessibility provided by manual decks. Pushing the 'phono' pushbutton on the centre or the remote unit automatically senses the size and speed appropriate to the record (with manual override for 'specials') and sets down the pickup on the outer track of the record accordingly. If the phono pushbutton is again pressed the record pauses and the pickup is automatically lifted from the record. To continue playing the phono pushbutton has to be pushed again. This gives some idea of the multi-operational switching capability of many of the pushbuttons on the remote unit and the main centre.

Listening tests and overall appraisal

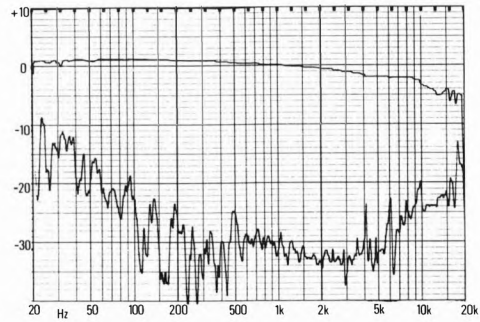
When using the Mordaunt-Short *Pageant II* loudspeakers the sound quality from disc was very acceptable with subjectively low levels of wow and flutter and rumble, good overall stereo separation and no objectionable tracking problems. The high frequency roll-off limits the top response when replaying discs, though it does have the effect of reducing the surface noise from the records. External excitation either by the loudspeaker or by vibration was absolutely minimal. Sound quality when using the record/replay facilities was generally very good when using the BASF CrO_2 C60 tape. Replay only sound quality was excellent and only limited by the quality of the pre-recorded cassette. FM quality was very good, with low levels of distortion, an excellent overall frequency response and outstanding stereo separation. Tuning was easily carried out using either the large flush-fitting tuning knob (with finger indent) or the pre-set knurled wheel type tuning controls, although the absence of any stereo pilot light might be criticised. The infra-red control module was found to be very easy to use after a little practice, and the room location of the handset was not critical in any way. Although initially the centre may appear to be complicated to operate, it proves in practice to be remarkably simple, and at £725 it offers facilities virtually unobtainable anywhere else, together with excellent performance, and hence may be strongly recommended.

Amplifier	
Power Output 8ohms/4ohms	39.2/51 watts
Hum modulation 50Hz/100Hz/150Hz	1dB/1dB/6dB
Dynamic Headroom	0.6dB
Signal/Noise ratio CCIR/ARM	77dB
Ambient output voltage CCIR/ARM weighted	2.5mV
Phono input impedance/capacitance (inc lead)	N/A
Crosstalk 1kHz/10kHz	46dB/46dB
Gain tracking error, ¼/½/¾ setting	0dB/0.3dBR/0.5dBR
Balance	0.5dBR
3dB Bandwidth (at 1W RMS)	6.2Hz/48kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	62dB/75dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	62dB/73dB
Tuner	
IHF least usable sensitivity	1.2uV
50dB quieting mono/stereo	2.2uV/44uV
Signal/Noise 1mV CCIR/ARM	73dB/69dB
Min signal for max S/N ratio mono/stereo	43uV/330uV
AM rejection	60dB
IF rejection	>80dB
Image rejection	72dB
Capture ratio	1.7dB
Adjacent/Alternate channel rejection	2dB/45dB
RFIM	76dB
Distortion L/−R, L only	0.32%/0.15%
Crosstalk 1kHz/10kHz	47dB/37dB
19k/38k suppression	62dB/43dB
Tape	
Tape used for tests	BASF CrO_2(C60)
Replay azimuth alignment	6°
Wow and Flutter	0.07%
L/R Jitter at 3kHz	21°
Dolby ref. level readout on meters, 64mS under-read	—/0dB
Distortion −6dB, 0dB, +3dB	0.62%/2.4%/4.2%
Line up on replay meters −6dB/0dB/+3dB	no replay on meters
Erasure efficiency (400Hz at Dolby level)	69dB
Signal/Noise biassed tape CCIR/ARM	51dB/61dB
Tape noise headroom wrt replay noise (no cass)	7dB
Disc	
HF Intermodulation distortion (10.8kHz pulsed)	0.4%
Tracks 1k+1.5k 31.5cm/sec band at	1.2gms
Effective mass of pickup + arm	approx 6.3gms
Subsonic resonance freq/dB gain	approx 15Hz/<1dB
Estimated compliance	18cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	61dB
Wow and Flutter	0.11%
Rumble (DIN B)	69dB
Tracking weight error setting/actual	1.5gms/1.5gms
Pickup type	B&O MMC 20E
Available facilities	A, B, D, E, F, H, K, R, V, Y, AA, AB, AK, AL, AM, AQ, AW, AY, AZ, BB, BC, BE, BI, BQ, BR, BS
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	not easily accessible
Ferrite rod aerial	no external ferrite aerial
Typical System price	£725

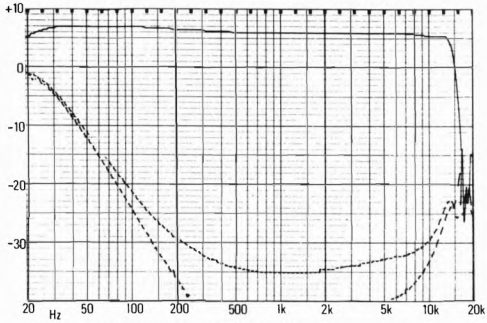
Bang & Olufsen 7000



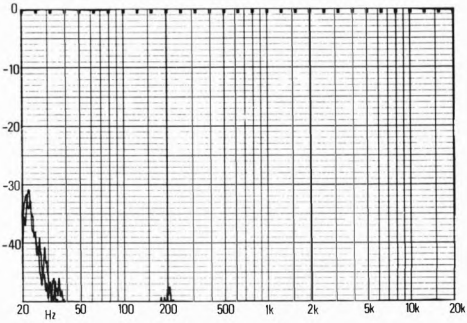
Amplifier response, tone and filter variations.



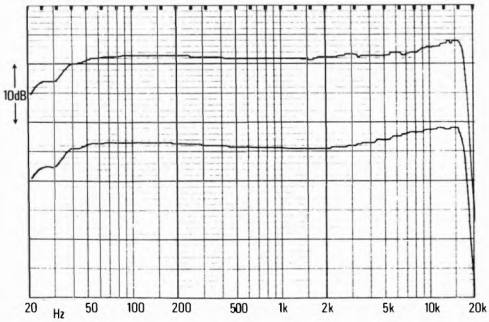
Pickup cartridge response and crosstalk.



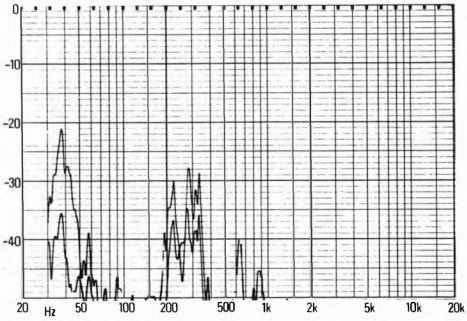
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



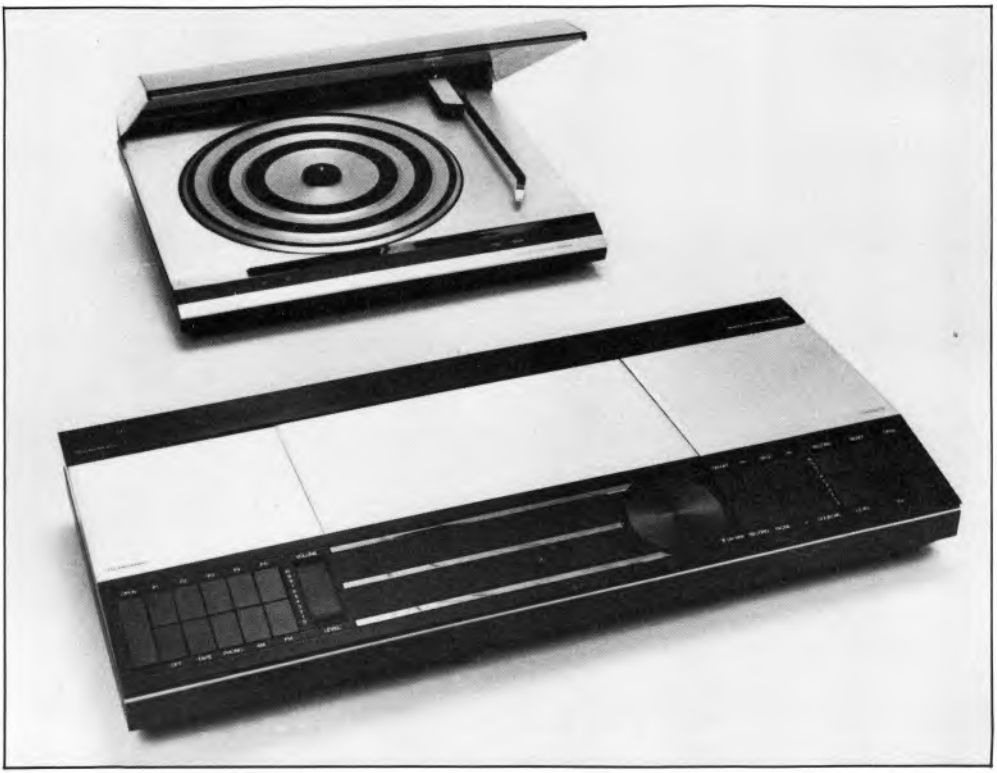
Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

Bang & Olufsen 4000/2200

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



Introduction

Distinctive ambassadors of Scandinavian 'style', B&O were one of the pioneers of the long low look, so it is not surprising that there are no vertical racks amongst their range. Instead B&O stick firmly to receivers, cassette decks, turntables and combinations of these to drive their loudspeakers. Leaving aside the new remote controlled systems that are dealt with in the introduction to the *7000* music centre, there remain a number of conventionally controlled compacts, notably the high specification *4000* tested here with a 'matching' turntable unit and the *4600* centre which is reprinted from the *Music Centre* book. The other compacts include systems which omit either disc or cassette sources, available with different power outputs.

General description

This B&O system comprises a *4000* centre housing the main amplifier, tuner and the cassette deck with a separate *2200 Beogram* record deck. The outstanding styling is typically B&O! The slim lines of the *4000* centre cleverly conceal an array of controls that once adjusted can be forgotten. A hinged plate at the left hand end covers the input connections (DIN sockets throughout), the tone controls, the FM preset adjustments and secondary switches, whilst a similar plate at the right hand end conceals the cassette tape mechanism. Controls situated along the slightly tilted front facia include press keys that control the tape motion via solenoids, the record level control mode switching, the volume control and the tuning knob and scale.

Tuning is carried out using a large rotary plate mounted flush with the front facia, as well as via five preset switches, and when in the AM mode switching from LW to MW can be quickly carried out simply by pushing the circular tuning plate. The record deck is as distinctive in styling as the *4000*

centre, the tonearm and platter being mounted on a floating subchassis, with the operational controls situated along the slightly angled front facia.

Amplifier
The amplifier controls are kept to a reasonable minimum and include the normal selector switches, tone and balance controls, a mono/stereo switch and a volume control. All these adjustable controls have a linear rather than a rotary motion, though there is no centre detent on the tone or balance controls. In fact when the tone controls are set to their nominal centre position the resulting frequency response is quite flat, the ranges of tone control offered at 100Hz and 10kHz being around ±10dB.

Power output measured into 8 ohms was found to be 33.5 watts, rising to 43.8 watts into 4 ohms. The hum modulation performance was reasonable, though it was noted that the output at 50Hz rose by some 9dB when maximum power was being dissipated. Few faults could be found in the amplifier section. The low power bandwidth was approximately 11Hz to 36kHz.

Tuner
As mentioned above, tuning is carried out *via* the flush mounted tuning knob and five chosen stations can be preset and instantly reached by selector buttons mounted on the front facia. The actual tuning controls for the preset stations are concealed under the left hand access plate and are mounted in a small horizontal panel which, when pressed, rises to reveal the five tuning knobs. Adjustment of the tuning knobs was found to be a little touchy and difficult, though once set the tuning appeared to be quite stable. Fine tuning is assisted by two red lights situated either side of the tuning knob, equal illumination of the lights indicating an accurately tuned station. The technical performance of the tuner section was quite outstanding, the RF sensitivities being above average whilst the signal-to-noise ratios measured with a signal strength of 1mV were about the best measured during this survey.

All the RF rejections were very good as was the radio frequency intermodulation distortion. The overall response of the system was remarkably flat (see attached response curves) with the FM response extending well up to 15kHz and then dropping away steeply. Crosstalk was never less than 33dB though it was noted that the crosstalk was asymmetric. In virtually all respects the tuner section performed exceptionally well and proved a fine complement to the amplifier.

Cassette deck
Recording level is adjusted using one linear level control matching the linear motion volume control. A vertical row of green LED's indicate signal strength with one red LED to indicate an overload situation. Because such indicators are not subject to any mechanical limitation the effective underread on a 64mS long pulse was negligible, though one criticism of this system was that not enough LED's are included (four green, one red), thus each LED has to indicate a signal range of some 5dB, making optimum recording levels a little difficult to achieve. Azimuth alignment was only fair at 60° whilst the measured wow and flutter was poorer than average at 0.17%. The mechanical problems were confirmed by the interchannel phase jitter of 32°, significantly higher than average. Erasure was more than adequate and signal-to-noise ratios were good, with the electronically generated noise some 12dB below tape noise. In all, the performance of the cassette deck was disappointing when compared with the outstanding technical performance of the tuner, amplifier and record deck.

Record deck *(2200)*
As hinted above, the record deck really is very good, many of the technical results being some of the best measured in this survey. The effective mass of the arm (including the cartridge) was measured at an astonishingly low 6.3gms, resulting in a subsonic resonant frequency of 14.5Hz – absolutely optimum. The B&O *MMC 20E* cartridge was found to track the 31.5cm/sec band at 1.4gms, exactly 0.1gm below the recommended tracking force. HF intermodulation distortion from the pickup was low, whilst the wow and flutter level of 0.06% and the rumble level of −68dB were very commendable. Pickup response was not quite so outstanding though there were no really serious problems, the response at 10kHz being some 2dB down with respect to the 1kHz response.

As would be expected from the isolated subchassis construction, the acoustic and vibrational breakthrough were both very good, though a marked peak in the acoustic breakthrough response did occur at 270Hz. Operationally the deck was a little unusual, patience being needed whilst the

automatic mechanism went through its operational modes if it was desired to skip a track or quickly change a record. Such automatic features do have their uses however, as it is highly unlikely that a record could be accidentally damaged. The strong features of the deck are its isolation from external excitation and the well designed tonearm, though this is unsuitable for cartridges other than the B&O types (a limitation accepted in the interests of attaining the very low effective mass).

Listening tests and overall appraisal

One pleasant aspect of the B&O record deck is that the main controls can all be operated with the lid down. The overall sound quality from records was very good with extremely low coloration from acoustic or vibrational breakthrough. The only minor criticism is (as would be expected from the response curves) a slight lack of top response, which interestingly enough has the pleasant side-effect of subjectively reducing the surface noise of discs.

The replay response of the cassette deck was classed as above average with little loss of high frequency detail, though the stereo image position did tend to become a little vague towards the end of the test tapes (inter-channel jitter often increases towards the end of a tape). The record/replay quality using Maxell *UDXL1* tape was again considered to be above average, though the higher than average wow and flutter was subjectively noticeable but not obviously bad. Sound quality from the tuner was excellent and gave a first class performance even with weak stereo signals.

Taken as a whole the performance of the system was very good indeed, and ranks both objectively and subjectively as one of the best systems tested in this group. However the problems with the cassette deck really prohibit any strong recommendations being made, though if you are not too critical of the cassette sound quality this system really does offer everything, including the styling for which B&O have justly become famous.

Amplifier

Power Output 8ohms/4ohms	33.5/43.3 watts
Hum modulation 50Hz/100Hz/150Hz	90dB/0dB/71dB
Dynamic Headroom	0.4dB
Signal/Noise ratio CCIR/ARM	91dB
Ambient output voltage CCIR/ARM weighted	0.5mV
Phono input impedance/capacitance (inc lead)	
Crosstalk 1kHz/10kHz	43dB/43dB
Gain tracking error, ¼/½/¾ setting	+0.7dBL/+0.6dBL/+1.2dBL
Balance	0dB
3dB Bandwidth (at 1W RMS)	11Hz/36kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	72dB/76dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	69dB/77dB

Tuner

IHF least usable sensitivity	1.2uV
50dB quieting mono/stereo	1.8uV/28uV
Signal/Noise 1mV CCIR/ARM	77dB/71dB
Min signal for max S/N ratio mono/stereo	50uV/310uV
AM rejection	65dB
IF rejection	>80dB
Image rejection	>82dB
Capture ratio	2dB
Adjacent/Alternate channel rejection	2dB/+60dB/52dB(−400kHz)
RFIM	82dB
Distortion L/−R, L only	0.38%/0.63%
Crosstalk 1kHz/10kHz	46dB/40dB
19k/38k suppression	70dB/83dB

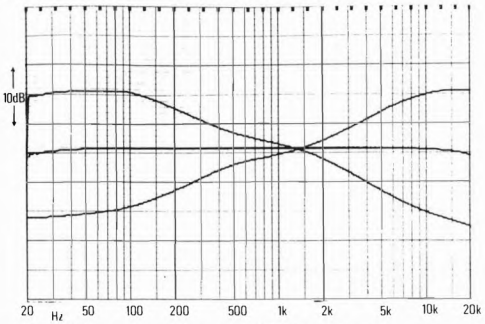
Tape

Tape used for tests	Maxell UDXLI
Replay azimuth alignment	60'
Wow and Flutter	0.17%
L/R Jitter at 3kHz	32°
Dolby ref. level readout on meters. 64mS under-read	(no red light)/0dB (see text)
Distortion −6dB, 0dB, +3dB	0.4%/0.7%/1.6%
Line up on replay meters −6dB/0dB/+3dB	good (see text)
Erasure efficiency (400Hz at Dolby level)	69dB
Signal/Noise biassed tape CCIR/ARM	49.5dB/59.5dB
Tape noise headroom wrt replay noise (no cass)	12dB

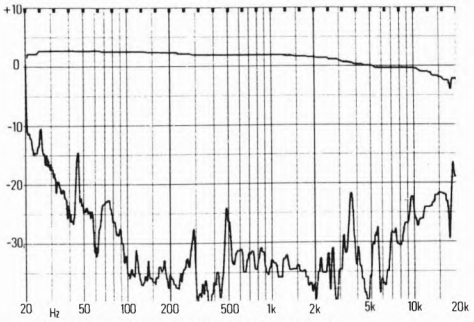
Disc (2200)

HF Intermodulation distortion (10.8kHz pulsed)	0.3%
Tracks 1k+1.5k 31.5cm/sec band at	1.4gms
Effective mass of pickup + arm	approx 6.3gms
Subsonic resonance freq/dB gain	approx 14.5Hz/1dB
Estimated compliance	19cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	61dB
Wow and Flutter	0.06%
Rumble (DIN B)	68dB
Tracking weight error setting/actual	1.5gms/1.5gms
Pickup type	B&O MMC 20E

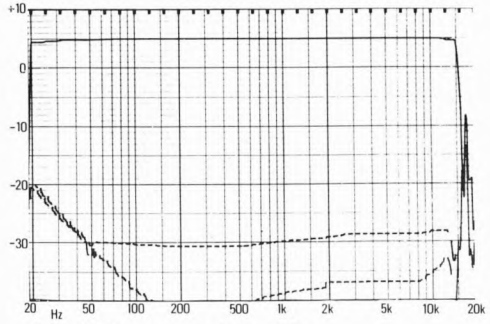
Available facilities	A. B. D. E. F. H. I. K. M. R. V. Z. AA. AB. AE. AI. AK. AL. AM. AQ. AW. AY. AZ. BB. BC. BE. BI. BM. BS
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	no adjustment unless dismantled
Ferrite rod aerial	no external aerial
Typical System price	£700



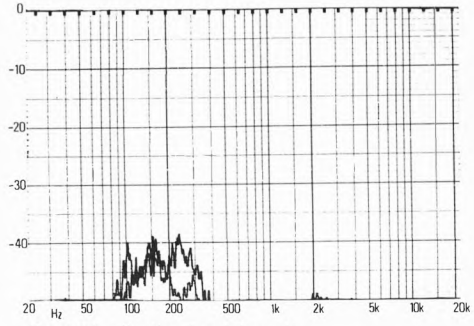
Amplifier response, tone and filter variations.



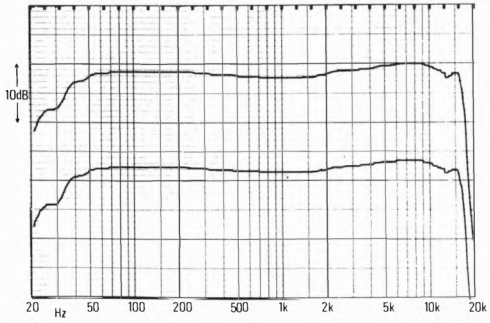
Pickup cartridge response and crosstalk.



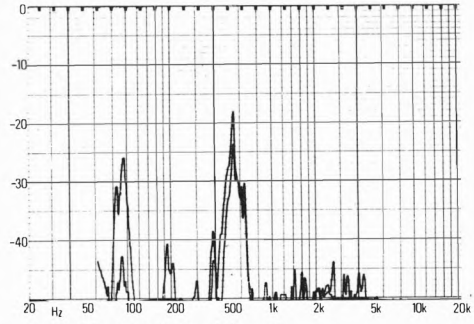
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

BEST BUY

Beocenter 4600

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

This is a system in the style that characterises the current range of B & O equipment, long and of low profile with slide rule cursor type controls. The general finish was in brushed aluminium though the brightness of the top was tempered by a smokey coloured hinged Perspex cover over the record facilities, only the cassette unit being outside the cover. It was liked by all the assessors. The long clearly marked turning scale is set along the sloping top edge of the unit where it is easy to read either standing or sitting in front of the system. All the push button controls are set along the vertical section of the front edge immediately underneath the tuning scale and in consequence the legends are less easily read.

The record player is a 2 speed belt driven automatic mounted in a very flexible supported plinth without any user adjustments for stylus load or anti-skating and using a remarkable slim and lightweight arm and cartridge. The single multi-purpose control switch is mounted as it should be on the fixed section of the deck and not on the flexible plinth. The measured frequency response is remarkably flat down to 20Hz but trails off smoothly above 1kHz being about 4dB down at 10kHz. Separation is very good all the way up to 10kHz and is still around 15dB at 15kHz. Rumble, signal to noise, balance, wow and flutter are all very good and the tracking distortion is in the 'good' class. Sound quality was well liked by all the assessors, though the fall away in the 10kHz region was noticeable.

Performance of the cassette section was comparable with that of the record player, the wow and flutter being very low, the distortion low, the signal to noise high and the erase efficiency very good. Using the recommended chrome tape the frequency response was within ±2dB between 40Hz and 14kHz. Sound quality was well above average, the reproduction being smooth and with obviously low distortion, the stereo image was well defined and tape hiss with Dolby in use was remarkably low.

This was a system in which the performance of all the individual units were well balanced, the radio receiver performance being well up to the high standard set by the cassette and record player. The frequency response was almost ruler straight from 30Hz to 15kHz with a remarkably high level of attenuation at 19kHz, distortion was low, separation good, and image rejection, AM rejection, IF rejection and Adjacent Channel rejection very good. Sound quality when used with the Celef speakers was praised by all the assessors. The bass being clean and extended and all the stereo image well formed.

There was a minor point of criticism of the safety aspect, the leads to the mains switch were not anchored against failure of the soldering.

In summary, a system that was well liked by all the assessors and one that can be recommended. Used with a pair of speakers such as the Celefs it was capable of a very satisfying performance.

Beocenter 4600

BEST BUY

Amplifier Section

Power output into 8 ohms	20W
Power output into 4 ohms	27.4W
Distortion at low power output 1W	0.028% v. good
Amplifier noise	v. good
Signal to noise ratio for tape output	81dBA good
Input voltage for full modulation Tape	570mV
Input voltage for full modulation Aux	—
Input voltage for full modulation Mike	90μV
Tape output	49mV
Stereo crosstalk	43dB average
Channel balance	good

Record Player Section

Frequency response	good
Trackability	average
Signal to noise ratio	65dBA good
Channel balance	good
Wow and flutter at 33⅓ rpm	0.1% good
Rumble	63dB v. good

Tuner Section

Least usable sensitivity	1.2μV good
Input for 50dB signal/noise	31μV v. good
Signal/noise for 1mV input	71dBA v. good
Distortion	0.7% good
AM rejection	64dB good
Stereo crosstalk	v. good
Image rejection	72dB v. good
IF rejection	81dB good
Adjacent channel selectivity	+4dB good
Capture ratio	good
19kHz suppression	71dB v. good
Muting level	3μV
Frequency response	v. good

Tape Section

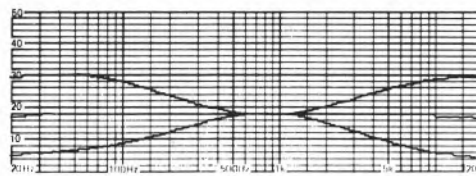
Record/replay frequency response	v. good
Azimuth alignment	good
Signal to noise ratio	59dBA average
Distortion output	good
Wow and flutter	0.12% good
Erase efficiency	50dBA fair

Loudspeakers (where provided)

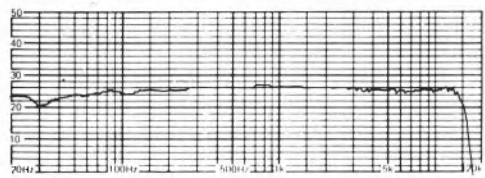
Frequency response of amplifier and speaker	—
Distortion	—
Sensitivity	—
Length of loudspeaker lead	—

General Data

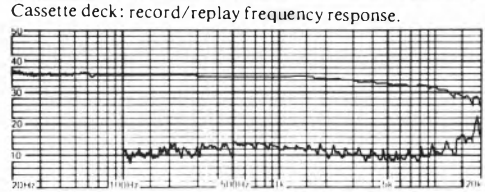
Compliance with British safety standards	5b
Available facilities	see Introductory Chart
Overall finish and engineering	excellent
Overall sound quality	v. good
Typical selling price inc. speakers and VAT	—
Typical selling price ex. speakers and inc. VAT	£450



Frequency response of amplifier and tone control response.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Boots/Sansui system

Audio Merchandise Dept., The Boots Company Ltd., Trent House, 69–79 Fulham High Street, London SW6 3QJ

Introduction

It may perhaps seem a little odd to include a system marketed exclusively by a national chain better known for its toiletries, but there are aspects behind Boots' marketing policy that provide adequate justification, not the least an unsolicited manufacturer's comment that they had never encountered such stringent pre-acceptance testing by a customer. It is also a highly significant fact that 'serious' hi-fi is now being handled by multiples such as this, albeit in a limited number of the bigger outlets, as this is bound to be the prime means of increasing the market penetration of hi-fi amongst those who are unlikely ever to enter a specialist shop. If a chain such as Boots can accomplish such an operation without losing the integrity of the product, this will be real progress.

The Boots philosophy is to concentrate on a limited number of complete systems each of which fits a convenient marketing niche. These currently include a Thorn manufactured 'casseiver' system, the tested Sansui and two Trio-based systems; there are plans to produce an own-branded system early in the new year ('80), based on Dual and Aiwa components.

General description

This system, to be marketed exclusively through Boots audio departments from October comprises three Sansui units (receiver, record deck fitted with an Ortofon *FF15E Mk II* cartridge and cassette deck), and a specially designed two-way loudspeaker system. The equipment is not housed in a separate rack in the normal way, the receiver and cassette deck being joined by common side panels and having the record deck as a separate unit that can be located by the side or directly on top of the receiver. No record storage space is available of course, though this may well meet the requirements of the user wishing to have the advantages of a rack system but unable to find the required floor space.

Interconnections at the rear of the equipment are of the phono type, though a 5-pin DIN socket is included on the cassette deck. The input and loudspeaker connections on the rear of the receiver are particularly well positioned on a horizontal ledge along the lower rear of the receiver. The equipment is finished in smoke tinted brushed aluminium and both the quality of construction and the visual matching between the units was excellent. Control layout was ergonomically designed.

Receiver *(G401)*

All the usual features are available on the receiver including switching to allow either or both of two sets of loudspeakers to be driven at any one time, a switchable loudness filter, a stereo/mono switch and microphone mixing facilities to allow a mono microphone signal to be mixed with any source selected.

Power output from the amplifier section was a very acceptable 51.7 watts into an 8 ohm load rising to 58.2 watts when a 4 ohm load is used. The IHF intermodulation distortion products are at a commendably low level. Hum modulation effects were reasonable and a dynamic headroom of 1dB was available when driving loads of 8 ohm impedance. Rotary position detent bass and treble

controls are included with a centre detent balance control and a large click-stop volume control. The overall frequency response was very smooth and unnecessarily extended way up to 110kHz, while the tone controls had a range of around ±10dB at 90Hz and 10kHz. Gain tracking error was low over the majority of the volume control range, though at low settings some channel inbalance was noted. The phono input impedance was fairly optimised at 51kohm and the input capacitance was a sensible 186pf, making it suitable for use with many other designs as well as the Ortofon *FF15E* cartridge supplied (though the added capacitance of Ortofon's *CAP210* should theoretically offer a slight improvement with the *FF15E*).

The tuner section was found to be particularly sensitive, the IHF least usable sensitivity level being a very low 1.5uV with 390uV being required to achieve the maximum signal-to-noise ratio. The latter were above average in both the mono and stereo mode as were the majority of radio frequency rejections, though the image rejection was rather lower than average and there was some asymmetry present in the alternate channel rejection figures. Capture ratio was particularly good as was the radio frequency intermodulation distortion products and the audio distortion levels were particularly low, both with two channel and single channel modulation.

The large tuning knob is fitted to the right of the volume control whilst signal strength and centre-tune meters are included. An FM muting switch and multiplex on/off switch have been fitted. The overall frequency response on FM was very smooth and extended well up to 15kHz whilst the crosstalk levels were above average, especially at low modulation levels. In summary the performance of both tuner and amplifier sections was very good indeed and well justify recommendation.

Cassette deck *(SC 1120)*

This front loading cassette deck (the same as the *1110* in Sansui's own system in all but cosmetics) features many of the design highlights found on more expensive Sansui decks including in particular the 'direct-o-matic' cassette loading system, the large perspex detachable cover that fits over the cassette housing and a tape lead-in pushbutton. When the tape lead-in switch is pressed directly before the fast forward pushbutton is depressed, the tape will start winding forward but will stop within a few seconds, making it ideal for jumping over the leader tape section of the cassette. Concentric friction-locked record level controls are provided making smooth stereo fades particularly easy. The tape selector switch simultaneously varies the level of bias and type of equalisation depending on whether LH, FeCr, or CrO_2 tape is selected.

Azimuth alignment had a reasonable error of 39°. Wow and flutter was just a little higher than average at 0.12% with L/R channel jitter being a better than average value 17°. Overall tape line-up was reasonable though the Dolby level was set 1dB too high on the record meters resulting in slightly lower than average signal-to-noise ratios. It is suspected that the signal-to-noise ratios were affected to some degree by electrical noise picked up on the replay head, the tape noise headroom with respect to replay noise being of the order of 4dB. Overall record/replay response using Maxell *UDXL1* tape was good, though an increase in output of 2dB was measured between 2.5kHz and 14kHz.

Record deck *(SRB200S)*

This is a two-speed belt drive design fitted with an Ortofon *FF15E Mk II* pickup and featuring an auto cut mechanism, a cueing lever, adjustable counterweight and a detachable SME type headshell. The tonearm, platter and plinth base are firmly connected together resulting in higher than average levels of acoustic breakthrough. The rubber feet did not appear to be very effective in reducing any external vibration.

The tracking performance was inferior due to the absence of any anti-skating (bias) compensation, the Ortofon *FF15E* pickup being unable to track the 31.5cm/sec band at 1gm over its recommended tracking weight. The overall frequency response and crosstalk levels were satisfactory with just a slight rise in output above 14kHz.

Whilst the overall frequency response, crosstalk, rumble and signal-to-noise ratio may all be classed as good, the performances of the record deck in respect to trackability, wow and flutter and acoustic breakthrough were rather below average which precludes it from recommendation.

Listening tests and overall appraisal

The two way loudspeakers supplied with the system were reasonably well liked; they did tend to have a boxy quality about them with a response that fell away slowly, though the overall response was within ±5dB between 55Hz to 15kHz and the

power handling capability in relation to the receiver's output power was well optimised. Sound quality from the tuner was very good, the smooth frequency response, low distortion and high sensitivity all combining to produce a fine overall result. Sound quality from tape was above average though the slightly higher than average noise levels were distracting. The overall record/replay response was well extended with just a little too much high frequency emphasis, but the quality when playing pre-recorded cassettes was generally above average. The smooth response from disc was well liked though the increase in output above 10kHz was noticeable. The Ortofon pickup provided a good stereo image and average tracking performance, but the higher than normal wow and flutter levels and the acoustic breakthrough effects rather distracted from what would otherwise have been a fine technical performance. In summary, a well designed system that deserves a moderate recommendation, the strong recommendation being withheld due to the lower than average performance of the record deck.

**Boots have informed us that the* SRB 200 *record deck, which replaced the now obsolete* SR 232, *will in turn be replaced by the* SR 222 II *from Dec. 1 '79. On the basis of our findings in this and our other books, such a combination would merit a Best Buy rating.*

Amplifier (G401 Receiver)

Power Output 8ohms/4ohms	51.7/58.2 watts
Hum modulation 50Hz/100Hz/150Hz	6dB/3dB/4dB
Dynamic Headroom	1dB
Signal/Noise ratio CCIR/ARM	91dB
Ambient output voltage CCIR/ARM weighted	0.6mV
Phono input impedance/capacitance (inc lead)	51k/186pf
Crosstalk 1kHz/10kHz	48dB/44dB
Gain tracking error, ¼/½/¾ setting	1.0dBR/0.2dBR/0.2dBL
Balance	0dB
3dB Bandwidth (at 1W RMS)	5Hz/110kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	69dB/70dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	69dB/69dB

Tuner (As above)

IHF least usable sensitivity	1.5uV
50dB quieting mono/stereo	2.7uV/38uV
Signal/Noise 1mV CCIR/ARM	70dB/67dB
Min signal for max S/N ratio mono/stereo	35uV/390uV
AM rejection	62dB
IF rejection	78dB
Image rejection	51dB
Capture ratio	1.2dB
Adjacent/Alternate channel rejection	0dB/41dB(+400k)/>60dB(−400k)
RFIM	74dB
Distortion L/−R, L only	0.26%/0.3%
Crosstalk 1kHz/10kHz	34dB/32dB
19k/38k suppression	63dB/38dB

Tape (SC 1120)

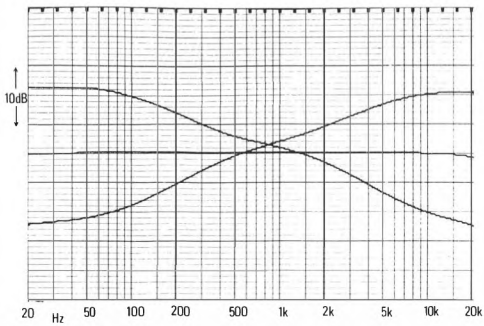
Tape used for tests	Maxell UDXLI (C90)
Replay azimuth alignment	38.5°
Wow and Flutter	0.12%
L/R Jitter at 3kHz	17°
Dolby ref. level readout on meters, 64mS under-read	+4dB/6.2dB
Distortion −6dB, 0dB, +3dB	0.25%/0.45%/0.6%
Line up on replay meters −6dB/0dB/+3dB	−4dB/+1.5dB/+4.5dB
Erasure efficiency (400Hz at Dolby level)	67.5dB
Signal/Noise biassed tape CCIR/ARM	46.5dB/56dB
Tape noise headroom wrt replay noise (no cass)	4dB

Disc (SR B200S)*

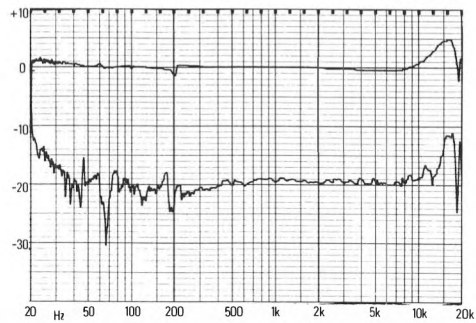
HF Intermodulation distortion (10.8kHz pulsed)	0.33%
Tracks 1k+1.5k 31.5cm/sec band at	>3gms
Effective mass of pickup + arm	21.3gms
Subsonic resonance freq/dB gain	8.1Hz/7dB
Estimated compliance	18.2cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	62dB
Wow and Flutter	0.17%
Rumble (DIN B)	63.5dB
Tracking weight error setting/actual	2gms/1.94gms
Pickup type	Ortofon FF15E Mk II

Available facilities	A, B, D, E, H, I, J, M, N, R, V, Y, Z, AA, AB, AE, AK, AL, AM, AW, AX, AY, AZ, BA, BC, BD, BM
Loudspeaker sensitivity (2.828V pink noise)	88dB
Length of loudspeaker lead	no leads supplied
Azimuth adjustment	usual screw type
Ferrite rod aerial	no external aerial
Typical System price	£360 w/o speakers; X202 speakers £150 perpr

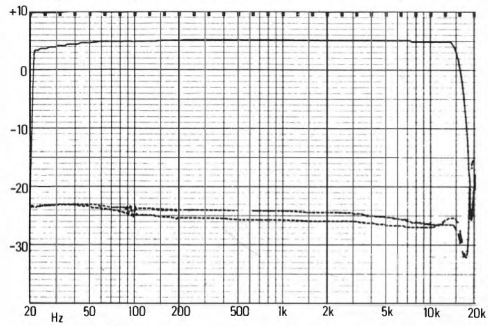
**note projected turntable change, see text*



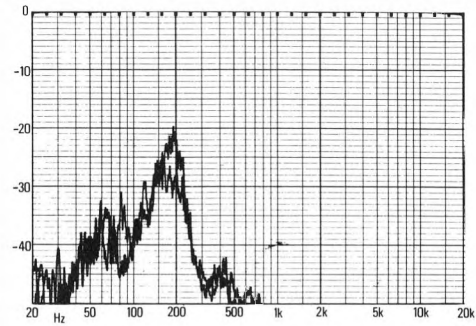
Amplifier response, tone and filter variations.



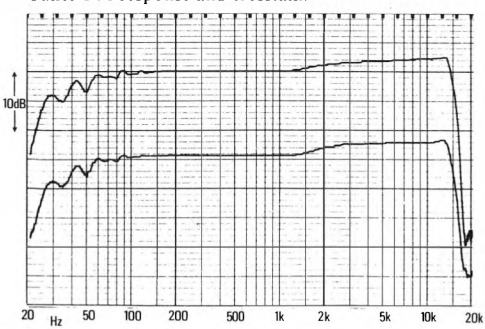
Pickup cartridge response and crosstalk.



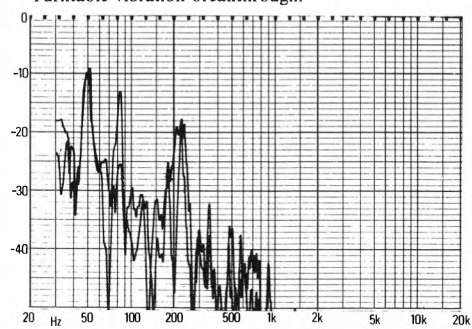
Tuner FM response and crosstalk.



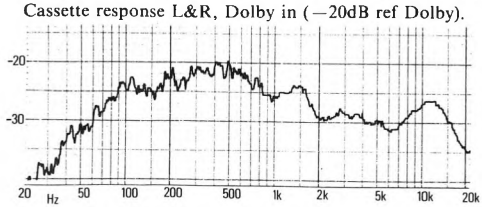
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

Eagle X3

Eagle International, Precision Centre, Heather Park Drive, Wembley HA0 1SU.
Tel: (01) 902 8832

Introduction

Eagle offer three basic systems, differing only slightly from each other, with two different format racks, each available in 'ebony' or 'walnut' finish. One rack is of the vertical variety with record storage in the base, while the other is shorter and 'stubbier' looking.

The *X 3* is the most costly of the three systems and features the most powerful amplifier and most expensive cartridge. The same turntable and cassette deck are used throughout, while the top two systems share the same tuner, the *X 1* using a receiver instead of separates. Matching veneer speakers are also available as optional extras.

General description

The equipment is finished in the standard brushed aluminium alloy fashion with some unusual features such as the backlight behind the amplifier volume control, the microphone input mixing on the amplifier, and the colour coding of the cassette level controls. A four-way mains adaptor is included at the rear of the rack so connection to a domestic supply requires only a single lead. The majority of signal inter-connections are made using phono leads and sockets, though there is provision of a 5-pin DIN plug on the main tape input of the amplifier. No DIN socket however is included at the rear of the cassette deck, but one is fitted on the front to the left of the cassette motion controls.

A ferrite rod aerial is fitted to the rear of the tuner, and this is hinged horizontally but cannot be rotated. No effort has been made to match the finish of the record deck with the rest of the system, the general finish of the deck being mottled matt grey. Adequate space was provided for the storage of records at the base of the rack, though the construction of the rack lacked rigidity.

Amplifier *(A7600)*

The amplifier features some useful extras such as the microphone input and mixing facilities, a tone control cancel switch, comprehensive tape dubbing and monitoring switches and two phono inputs, though unfortunately neither phono input could accommodate the low output moving-coil cartridges that have recently become so popular. The output power of the amplifier was above average at 74.5 watts rising to 92.8 watts with a four ohm load. Hum modulation was acceptable though an 8dB rise at 100Hz was noted when the amplifier was driven to its maximum power output. The signal-to-noise ratio of the amplifier was very good at 89dB, as was the maximum ambient output voltage of 0.8mV (CCIR/ARM weighted). The input impedance of the phono input circuitry was 52kohm though it was noted that the input capacitance was rather high at 424pf, though this seemed to provide a good match to the supplied pickup as it did not seem to have any detrimental effect on the high frequency performance; care should be taken if an alternative pickup is substituted. Crosstalk, channel tracking error and balance were all excellent, whilst the amplifier showed a sensible low-power bandwidth of 11Hz–32kHz. IHF intermodulation distortion was very good, neither of the 2nd or 3rd order components

rising above 68dB below the fundamental tones. The bass, treble and balance controls were all of the position detent rotary type, the volume control being particularly smooth in action. Generally a well thought out amplifier with good presentation and finish.

Tuner *(T7400)*
One minor criticism was that the backlight for the tuner dial was a different colour to that used on the amplifier's volume control and the cassette deck's recording meters. Generally the controls on the tuner were well laid out and included an output level control, an FM muting switch and a 'Quasi' stereo high blend switch that improves the signal-to-noise ratio on weak stereo signals at the expense of the stereo crosstalk. IHF least usable sensitivity was a respectable 1.8uV and maximum signal-to-noise ratio could be achieved by a 270uV stereo signal. The ultimate signal-to-noise ratio on stereo was an average 65dB, as was the AM rejection at −61dB. A ferrite rod aerial is included at the rear of the tuner and this is hinged but not rotatable thus a little care may be needed when positioning the rack if optimum AM reception is a necessity.

Some alternative channel rejection assymetry was apparent on FM, only 38dB of rejection being achieved at 400kHz above the wanted carrier. The audio response of the tuner was a little disappointing as it showed a gradual rise in output over the frequency range, the level at 10kHz being some 3dB above the level at 20Hz. Crosstalk however was very good, remaining above 40dB over the majority of the frequency range. A reasonable design of tuner then with just some criticism of the frequency response and alternate channel rejection.

Cassette deck *(C7800)*
A noticable difference in the record/replay response between channels was apparent when using the Sony *Duad* C60 tape, the response of the right hand channel rising 2–3dB above 2.5kHz. This could either be due to a bias difference between channels or misalignment of the noise reduction system (all record/replay responses taken during this survey were made with the Dolby noise reduction systems switched in). A check using Maxell *UDXL1* tape showed similar differences. Dolby reference level readout was +3dB on the meters whilst the meter ballistics were rather slow, reading −7dB for a 64mS long pulse. However the inclusion of a LED peak indicator eased the problem of tape overload on short signal pulses. The meters are very large and easy to follow even at some distance from the system, but separate recording controls are used for the left and right hand channels, so care is necessary when fading a stereo signal. Wow and flutter was higher than average at 0.14%, whilst erasure was about adequate but not exceptional. The measured signal-to-noise ratio was a little better than average due to an inaccuracy of 2dB in the absolute line up, thus the improved signal-to-noise ratio has been achieved at the expense of possible higher distortion levels.

Record deck *(D7500)*
The plinth is manufactured from plywood with the platter and arm mechanism firmly fixed to the plywood top plate. As the lid is fixed quite firmly to the plinth, the level of acoustic breakthrough is somewhat higher than average. Soft rubber feet are fitted to the base of the deck but unfortunately these are not soft enough to ensure that vibrational breakthrough is minimised.

The deck is fitted with an Eagle *PX 750X* induced magnet cartridge featuring an elliptical stylus, and the performance of the pickup in terms of frequency response and crosstalk was generally good. Unfortunately the tracking ability of the cartridge was below average, the downforce having to be increased by 0.7gm above the recommended value before the 31.5cm/sec band could be tracked. The high effective mass of the arm coupled with the highish compliance pickup (29.5cu) resulted in a subsonic resonance of 6.3Hz, rather lower than desirable. However, the deck has many fine features including excellent levels of wow, flutter and rumble, a well engineered tonearm and the operational ease of the controls.

Listening tests and overall appraisal
Listening tests on the tuner revealed a clean open sound in which the HF response was a little too prominent and required the use of the tone control. Distortion levels were low and stereo imaging was excellent. There was some indication of minor front-end selectivity problems, but the only major criticism that can be brought against the tuner is the HF rise in the audio frequency response.

Good replay quality was noted on many of our pre-recorded cassettes though the heavily orchestrated works did tend to sound a little harsh. When

Eagle X3

using tape the stereo image was reasonably stable but the extreme hf response was slightly lacking, possibly due to the azimuth misalignment. The record/replay response was generally good using the Sony *Duad* tape, the final recording being virtually indistinguishable from the original save for the background tape hiss and the increased wow and flutter. Record quality was smooth but just a little 'toppy' with reservations concerning trackability on the more difficult records. Unfortunately the deck was acoustically sensitive and this could be a problem if the system is located near the loudspeakers.

Although strong criticisms have been raised, at £450 this system nevertheless remains reasonable value for money.

Amplifier (A7600)

Power Output 8ohms/4ohms	74.5/92.8 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/8dB/0dB
Dynamic Headroom	0.8dB
Signal/Noise ratio CCIR/ARM	89dB
Ambient output voltage CCIR/ARM weighted	0.8mV
Phono input impedance/capacitance (inc lead)	52kohm/424pf
Crosstalk 1kHz/10kHz	52dB/49dB
Gain tracking error, ¼/½/¾ setting	0dB/0dB/0.1dBL
Balance	0dB
3dB Bandwidth (at 1W RMS)	11Hz/32kHZ
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	−69dB/−70dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	−68dB/−68dB

Tuner (T7400)

IHF least usable sensitivity	1.8uV
50dB quieting mono/stereo	3.8uV/38uV
Signal/Noise 1mV CCIR/ARM	72dB/65dB
Min signal for max S/N ratio mono/stereo	63uV/270uV
AM rejection	61dB
IF rejection	>+68dB
Image rejection	>+60dB
Capture ratio	2.3dB
Adjacent/Alternate channel rejection	−1dB/58dB/38dBat+400k
RFIM	68dB
Distortion L/−R, L only	0.45%/0.8%
Crosstalk 1kHz/10kHz	37dB/36dB
19k/38k suppression	64dB/72dB

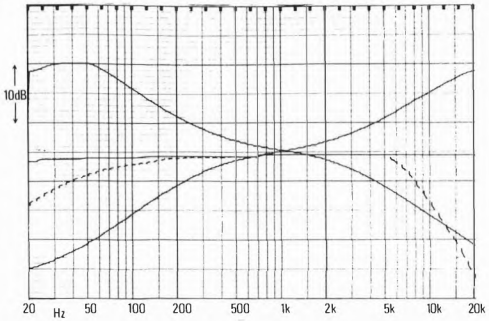
Tape (C7800)

Tape used for tests	Sony Duad C60
Replay azimuth alignment	52°
Wow and Flutter	0.14%
L/R Jitter at 3kHz	20.6°
Dolby ref. level readout on meters. 64mS under-read	+3dB/−7dB
Distortion −6dB, 0dB, +3dB	0.5%/0.95%/1.8%
Line up on replay meters −6dB/0dB/+3dB	−3.9dB/+2dB/+5dB
Erasure efficiency (400Hz at Dolby level)	65dB
Signal/Noise biassed tape CCIR/ARM	52dB/62dB
Tape noise headroom wrt replay noise (no cass)	5.5dB

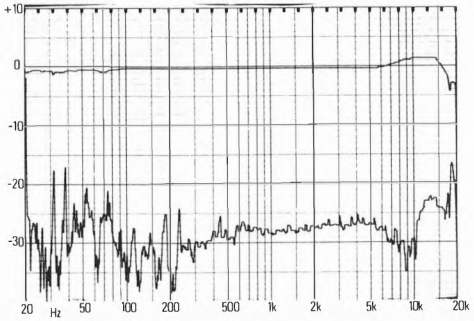
Disc (D7500)

HF Intermodulation distortion (10.8kHz pulsed)	0.36%
Tracks 1k+1.5k 31.5cm/sec band at	2.4gms
Effective mass of pickup + arm	21.5gms
Subsonic resonance freq/dB gain	6.3Hz/7.5dB
Estimated compliance	29.5cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	58dB
Wow and Flutter	0.08%
Rumble (DIN B)	65dB
Tracking weight error setting/actual	1.7gms/1.8gms
Pickup type	Eagle P750X

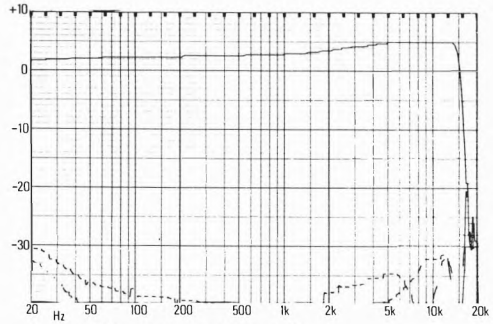
Available facilities	A. B. D. E. H. I. J. M. N. O. R. V. W. X. Y. Z. AA. AB. AD. AE. AK. AL. AM. AN. AW. AX. AY. BA. BC. BD. BM. BN. BQ. BR. BS. ZA
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw type
Ferrite rod aerial	hinged but not rotatable
Typical System price	£450



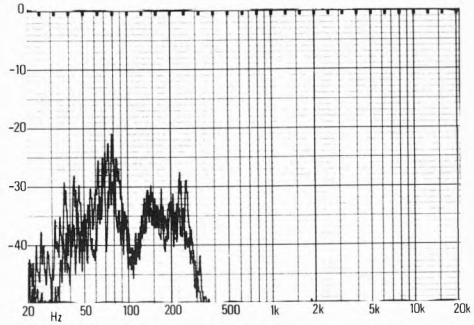
Amplifier response, tone and filter variations.



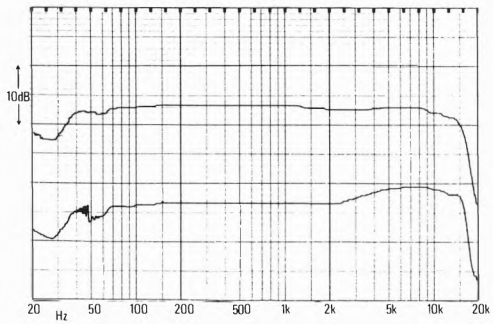
Pickup cartridge response and crosstalk.



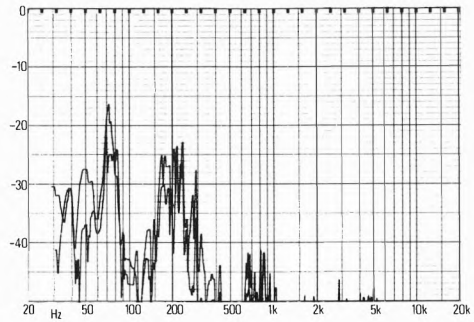
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

Ferguson 20D 3971

Thorn Consumer Electronics Ltd., 284 Southbury Road, Enfield, Middlesex EN1 1TJ. Tel: (01) 363 5353

This is a small unit in the budget price and output power class, the measured power output being about 6.2 watts, absolutely adequate for most domestic sized rooms but unlikely to raise enthusiasm in the hi-fi addict. It is finished in the popular black with brushed aluminium trimmings and having all the main controls and the tuning scale along the vertical front edge outside the hinged Perspex cover. It has a rather unusual tuning scale consisting of a small lamp moving behind a series of small holes with the legends on the front. Though different from most other arrangements it was not particularly liked for the light reduced the visibility of the un-illuminated legends. Seven push-buttons under the tuning scale provided a choice of facilities.

The record deck is an idler driver BSR model 1182, providing manual or semi-automatic playing of 7″, 10″ or 12″ records at any of three speeds. Stylus balance adjustment is included, but it is uncalibrated and so requires a stylus pressure gauge for setting up. The performance was in the 'good' class except in respect of wow and flutter which was on the high side at .26% and at least to one critic was audibly unacceptable. The rumble was also a little on the high side and the drive would benefit from some attention to the mechanical design. The frequency response of the pick-up had a broad peak between 200 and 500Hz falling away gradually above this point and being down by 10dB at 10kHz. Separation was also open to criticism, the curves showing that it was below 20dB over most of the frequency range. The sound quality was criticised by all the assessors on account of the lack of treble and the obvious wow and flutter.

The cassette unit was a large good looking instrument including Dolby noise reduction, a digital footage counter and separate recording level meters for both channels. The mechanical operation was very smooth but the wow and flutter was on the high side at .21% and obvious. Record/replay response was reasonably smooth up to about 3kHz but then fell away slowly and was about 10dB down at 10kHz. the sound quality suffered from the lack of treble and the wow and flutter.

Regrettably, the radio receiver was found to have a budget priced performance. IF rejection being in the 'good' class, but all the other measured parameters reflected the limited price of the unit.

Loudspeakers were on the small side and this restricted the low frequency performance, a shortcoming that set a limit to the performance of the whole system, but the stereo stage was wide, the position of individual instruments nicely defined, this aspect of the overall performance being above average. There was no criticism from the safety point of view.

In summary, a budget priced unit more suitable for the non-enthusiast who is not too critical and is pop-orientated.

Amplifier Section
Power output into 8 ohms 5.3W
Power output into 4 ohms 6.2W
Distortion at low power output 1W . . . . . —
Amplifier noise . . . . . —
Signal to noise ratio for tape output . . . . . —
Input voltage for full modulation Tape . . . . . —
Input voltage for full modulation Aux . . . . . —
Input voltage for full modulation Mike 190μV
Tape output . . . . . —
Stereo crosstalk . . . . . —
Channel balance . . . . . —

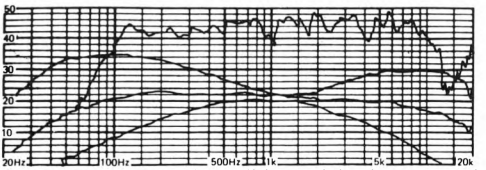
Record Player Section
Frequency response . . . . . poor
Trackability . . . . . average
Signal to noise ratio . . . . . 61dBA average
Channel balance . . . . . good
Wow and flutter at 33⅓ rpm . . . . . 0.26% poor
Rumble . . . . . 56dB fair

Tuner Section
Least usable sensitivity . . . . . 7.5μV fair
Input for 50dB signal/noise . . . . . 220μV poor
Signal/noise for 1mV input . . . . . 61dBA poor
Distortion . . . . . 2.2% poor
AM rejection . . . . . 46dB average
Stereo crosstalk . . . . . poor
Image rejection . . . . . 18dB poor
IF rejection . . . . . 72dB average
Adjacent channel selectivity . . . . . —3dB poor
Capture ratio . . . . . poor
19kHz suppression . . . . . 43dB average
Muting level . . . . . —
Frequency response . . . . . fair

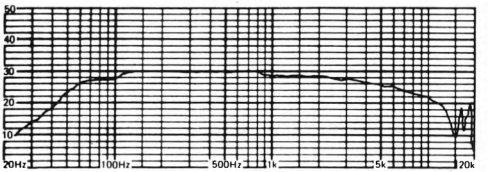
Tape Section
Record/replay frequency response . . . . . fair
Azimuth alignment . . . . . poor
Signal to noise ratio . . . . . 65dBA v. good
Distortion output . . . . . good
Wow and flutter . . . . . 0.21% fair
Erase efficiency . . . . . 56dBA v. good

Loudspeakers (where provided)
Frequency response of amplifier and speaker . . . . . fair
Distortion . . . . . poor
Sensitivity . . . . . v. good
Length of loudspeaker lead . . . . . 3.6m average

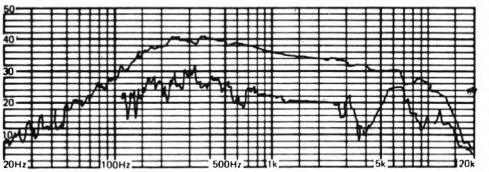
General Data
Compliance with British safety standards . . . . . No failures
Available facilities . . . . . see Introductory Chart
Overall finish and engineering . . . . . good
Overall sound quality . . . . . poor
Typical selling price inc. speakers and VAT £180.00
Typical selling price ex. speakers and inc. VAT . . . . . —



Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Ferguson Studio 50 D

Thorn Consumer Electronics Ltd., 284 Southbury Road, Enfield, Middlesex EN1 1TJ. Tel: (01) 363 5353

Introduction

The *50D* is the top of a range of music centres offered by Ferguson which together comprehensively span the most popular price range; more expensive luxury models are available from other manufacturers, and some are reviewed in this book, but the 50D is very representative of the better specified 'normal' models. Other Ferguson models include the *20D* (reprinted from the last *Music Centres* issue), the *30D* (now only available *via* Co-op stores), and the *40D*, plus a new model at the very bottom of the price scale called the System 12, which features digital display tuning no less! It is perhaps a pity that all models are only supplied complete with speakers, so this useful option is normally denied the purchaser.

General description

This moderately sized 'horizontal' music centre of British origin provides keen competition for many of the similarly priced Japanese systems. Quality of construction overall was considered to be very reasonable considering the competitive price, though the chrome plated plastic control knobs were not well liked by any of the users. A matt black finish is featured with silver highlights, the majority of the controls being positioned along the front of the centre. Operation of the record player and tape deck requires the perspex dust cover to be raised though the cassette deck motor controls are mounted along the front of the unit. The control layout was convenient, the bold white legends being easy to read, even at some distance from the equipment.

Amplifier

The output power of the amplifier section was measured to be 24.5 W RMS into 8 ohms with both channels driven, the output power dropping to 16.9 watts when a 4 ohm load was employed, so care should be taken if substituting loudspeakers. The power supply appeared to be in some difficulty at maximum power levels as the hum modulation at 100Hz was some 31dB. Dynamic headroom using a 20mS 1kHz pulse repeated twice every second was 1.2dB whilst the signal-to-noise ratio was a more than adequate 87.5dB (CCIR/ARM weighting). The overall frequency response was

down by 3dB at 23Hz and 22kHz, a frequency range that is more than adequate and indeed is probably beneficial in this context. The IHF intermodulation distortion measurements taken at a power level 3dB below the maximum power available showed excessive 2nd order distortion when using the 10kHz + 11kHz test signal, though this performance can by no means be considered poor considering the price of the system. The front mounted gain and tone controls are all of the rotary centre indent type, additional switches being available for mono and loudness effects.

Tuner

The IHF least usable sensitivity for the tuner was 2uV, quite a respectable figure, whilst the minimum signal needed for maximum signal-to-noise ratio on stereo was 310uV. These sensitivities are generally more than adequate if a reasonable aerial system is employed, though they will be found to be less than adequate if an internal aerial is used in a fringe signal strength area. AM. IF, adjacent channel and alternate channel rejections were considered to be a little above average, though the capture ratio was a lower than average 3.5dB.

The audio distortion measured with a 100% modulated L = −R carrier was 0.56%, but this figure was only obtained when correctly tuned which was found to require some care using the single LED tuning light facility. Crosstalk at 10kHz was below average at 20dB whilst the 38kHz carrier suppression was considered to be below average at 42dB. The frequency response was smooth over the range with some low frequency fall off being evident, presumably due to the amplifier rather than the tuner. The controls for the tuner were reasonable and featured six touch-sensor preset switches plus a manual override. The presets themselves are situated under a hinged cover between the record and cassette decks and are set using an adjacent electronic (meter) tuning scale; LW, MW and SW facilities are available, though it should be noted that the internal ferrite rod aerial is firmly fixed in one position.

Cassette tape

The tape supplied with the system was a C30 Thorn low noise ferric type but the frequency response obtained using this tape was so poor that it was decided to switch to a Maxell *UDXL1* tape (recommended in the system's instructions). Even so with this tape the response was 1dB down at 10kHz on the left hand channel and some 3dB down at the same frequency on the right hand channel. The tape response was generally smooth with some indication of head contour distortion at the low frequency end. Replay azimuth deviation on arrival was 18.6° at 3kHz, whilst the wow and flutter was a reasonable if not outstanding 0.13%. The L/R phase jitter at 3kHz was some 23°, an average figure that may account for the slight vagueness of image commented on in the listening tests.

Line up and erase efficiency were all found to be quite reasonable, though the signal-to-noise ratios were lower than average, due to the high intrinsic noise level of the electronics when the system was set to the replay mode. In fact the tape noise headroom over the electronic replay noise was only of the order of some 4dB (CCIR/ARM weighted). The mechanically coupled level controls on the tape deck were all a little stiff, though the access lid over the cassette housing was nicely damped. The individual rotary record level controls are fitted at the front of the centre and found little favour with any of the users. The tape deck is fitted with both a memory switch and a three position bias selector marked low, medium and high, probably adequate enough for the majority of users.

Record deck

The centre is fitted with a two-speed belt drive motor of Garrard design, spring mounted with a main frame constructed from pressed metal. Experience has shown that this form of suspension often results in better than average acoustic and vibrational breakthrough: in fact the vibrational breakthrough was excellent, though a severe peak in the acoustic breakthrough was noted at 270Hz, apparently due to a serious arm resonance (see also the crosstalk curves). Apart from this one resonance the acoustic breakthrough may be classed as good. The Shure *M75/6S* magnetic cartridge has a recommended tracking weight of 3gms, the error recorded when fitted to the Garrard deck being of the order of 0.3gm. HF intermodulation distortion was average, and the pickup did manage to track the 31.5cm/sec band at fractionally over its recommended tracking weight which is commendable for a system in this price range. The frequency response curves show a fall in response at both the high and low frequency end of the range, the low frequency loss again being attributed to the ampli-

fier response rather than any fault in the pickup. Crosstalk was rated as good over most of the frequency range, though the severe reduction can be seen at 270Hz, attributed to the main arm resonance.

Loudspeakers

The loudspeakers are a two-way design incorporating an 8-inch woofer and a 2.5-inch tweeter mounted in an IB cabinet. Frequency response measured at 1 metre on the axis of the tweeter was found to be acceptable for this type of system, though there was a noticeable lack of output below 300Hz and a rapid fall off above 11kHz. The sensitivity figure of 88dB for 2.828V of pink noise across the speaker terminals was quite acceptable.

Listening tests and overall appraisal

The listening tests revealed a pleasantly uncoloured system with mild limitations in bandwidth due to the average performance of the loudspeakers. The tape section was pleasantly free from wow and flutter effects and the image stability was good, though some harshness was audible at the high frequency end. The most troublesome problem on tape replay was the high level of electrical noise that was present, even when the cassette section was operated without a tape installed. Disc quality was considered to be reasonable and no outstanding tracking problems were evident, though some reservations have to be made here concerning the arm resonance noted in the crosstalk and acoustic breakthrough tests. (It may well have been that the character of the music used in the tests was conveniently free of any significant output at the arm resonance frequency.) The FM tuner section was really limited by the performance of the loudspeakers: it was found difficult to get a good central image from any of the sources whilst the loudspeaker 'sound' was of a slightly unpleasant mid-band forwardness. In conclusion however we felt that this is a very reasonable system that seems to strike an acceptable and intelligent compromise between price and sound quality.

Amplifier

Power Output 8ohms/4ohms	24.5/16.9 watts
Hum modulation 50Hz/100Hz/150Hz	+3dB/+2.3dB/+3dB
Dynamic Headroom	1.2dB
Signal/Noise ratio CCIR/ARM	87.5dB
Ambient output voltage CCIR/ARM weighted	0.65mV
Phono input impedance/capacitance (inc lead)	50k/110pf
Crosstalk 1kHz/10kHz	57dB/43dB
Gain tracking error, ¼/½/¾ setting	1dB/0dB/0.3dB
Balance	0.2dB
3dB Bandwidth (at 1W RMS)	23Hz/22kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	−60dB/−63dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	−49dB/−59dB

Tuner

IHF least usable sensitivity	2uV
50dB quieting mono/stereo	3.4uV/45uV
Signal/Noise 1mV CCIR/ARM	67dB/66dB
Min signal for max S/N ratio mono/stereo	25uV/310uV
AM rejection	60dB
IF rejection	82dB
Image rejection	80dB
Capture ratio	3.5dB
Adjacent/Alternate channel rejection	0dB/+58dB
RFIM	68dB
Distortion L/−R, L only	0.56%/0.5%
Crosstalk 1kHz/10kHz	39dB/20dB
19k/38k suppression	67dB/42dB

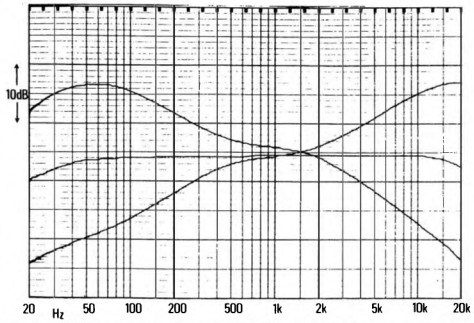
Tape

Tape used for tests	Maxell UDXLI (C60)
Replay azimuth alignment	18.6°
Wow and Flutter	0.13%
L/R Jitter at 3kHz	23°
Dolby ref. level readout on meters, 64mS under-read	+0.4dB/4dB
Distortion −6dB, 0dB, +3dB	0.23%/0.62%/1.0%
Line up on replay meters −6dB/0dB/+3dB	−4.8dB/+1dB/+3.5dB
Erasure efficiency (400Hz at Dolby level)	71dB
Signal/Noise biassed tape CCIR/ARM	49.5dB/59dB
Tape noise headroom wrt replay noise (no cass)	4dB

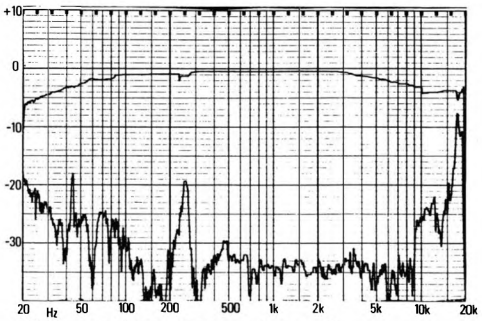
Disc

HF Intermodulation distortion (10.8kHz pulsed)	0.7%
Tracks 1k+1.5k 31.5cm/sec band at	3.2gms
Effective mass of pickup + arm	14.4gms
Subsonic resonance freq/dB gain	—
Estimated compliance	—
Signal/Noise ratio CCIR/ARM ref 1cm/sec	62dB
Wow and Flutter	0.12%
Rumble (DIN B)	63dB
Tracking weight error setting/actual	3gms/3.3gms
Pickup type	Shure M75/6S

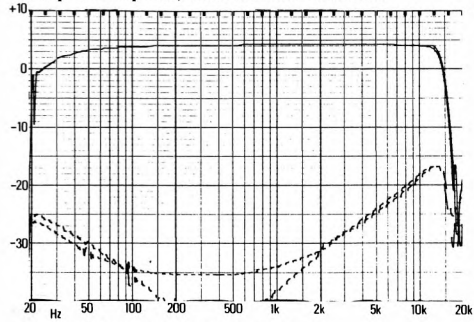
Available facilities	A, B, D, E, F, I, K, M, R, V, Y, Z, AB, AD, AE, AK, AL, AM, AN, AW, AY, AZ, BA, BC, BD, BM, BN, BQ, BR
Loudspeaker sensitivity (2.828V pink noise)	88dB
Length of loudspeaker lead	3.26m
Azimuth adjustment	normal screw-type
Ferrite rod aerial	fixed internal
Typical System price	£325 inc speakers



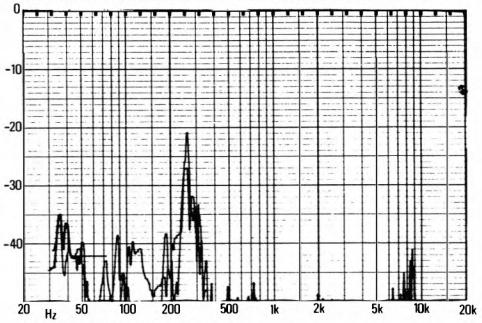
Amplifier response, tone and filter variations.



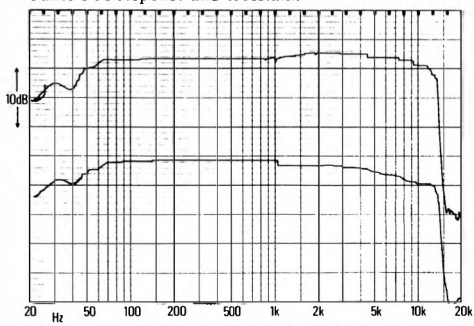
Pickup cartridge response and crosstalk.



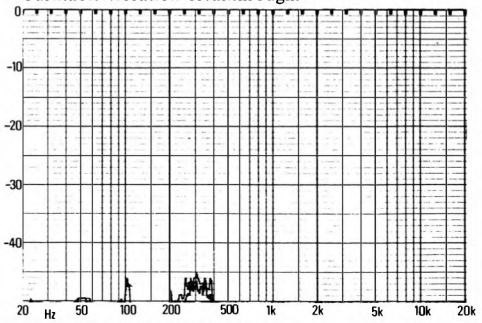
Tuner FM response and crosstalk.



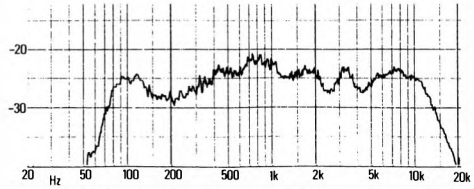
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

With Pioneer's mini-system, you can fill a room with hi-fi sound, and still have space to move. The system comprises the SA-300 Pioneer CS-X3 speakers. See your local Pioneer dealer, or write to Pioneer High Fidelity (GB) Ltd., PO Box 108, Iver, Bucks, SL0 9JL fc

mplifier, the TX-3000 tuner, the CT-3000 cassette deck and the PL-3000 turntable, linked with
ull literature and details of the Pioneer Privilege Purchase Plan, a very low interest credit scheme.

PIONEER®
EVERYTHING YOU HEAR IS TRUE

Ferguson system 25

Thorn Consumer Electronics Ltd., 284 Southbury Road, Enfield,
Middlesex EN1 1TJ. Tel: (01) 363 5353

Introduction

Representing Thorn's recent move towards the hi-fi market proper, *System 25* is a full range of British made electronics separates – even the turntable is manufactured 'in-house'. Available with or without the (Goodmans made) speakers, which are designed to match the height of the cabinet when floorstanding, it is perhaps a pity that the opportunity for designing these with built-in stands to reduce floor reflection colorations was not adopted.

There are no immediate plans to extend the range up-market, but a new model *System 15* was recently announced. This is really a vertical music centre rather than separates, being designed along the same lines cosmetically as a rack system though lacking its flexibility. *System 15* costs about the same as the *50D* music centre, but offers less power and no speakers, due to the extra cost of the cabinetry.

General description

A neatly housed system manufactured in England by the Thorn Group this comprises separate amplifier, tuner and cassette deck with a two-speed belt drive turntable fitted into the specially shaped top shelf of the rack. The equipment is finished in brushed aluminium with clearly visible black legends, all the inter-connections being of the DIN type. An unusual layout has been adopted with record and cassette storage provided below the record deck to the right hand side of the equipment rack. This layout brings the cassette deck less than a foot from floor level, rather inconvenient when making recordings.

Power inter-connections are simply and effectively carried out, with all the separate units connected in parallel to each other with the mains flex and master power switch fitted to the amplifier. Visual matching between units was excellent with large easy-to-operate knobs fitted to the amplifier volume and selector controls, the tuning control and the record level controls on the cassette deck. Bass, treble and balance controls feature position detent markings whilst the main volume control is of the finely stepped rotary type. The system comes complete with a pair of two-way loud-

speakers fitted with a dome tweeter and paper cone woofer, the height of the loudspeakers matching exactly that of the rack.

Amplifier *(3939)*
The amplifier delivered the relatively modest power of 29 watts into 8 ohms, increasing to a respectable 37 watts into 4 ohms. Hum modulation at 100Hz increased by some 24dB at levels approaching maximum power output, a below average performance. Maximum signal-to-noise ratio was outstandingly good at 96dB CCIR/ARM weighted, as was the overall channel crosstalk measured at 1kHz and 10kHz. Gain tracking error on the stereo volume control was absolutely minimal whilst the overall frequency response was sensibly band limited at 15Hz–35kHz. The amplifier is fitted with power meters having the usual ballistic limitations, though Ferguson have included a peak reading LED between the meters to give more accurate indication of the peak power involved.

Comprehensive tape dubbing facilities are provided, as are rumble, loudness and mute (−20dB) switches. Some problems were noted on the IHF intermodulation distortion tests with the 2nd order distortion products being higher than average on both the 4kHz + 5kHz and 10kHz + 11kHz test signals. In summary a well designed amplifier of modest performance offering a reasonably sensible choice of facilities.

Tuner *(3938)*
The tuner is fitted with clearly visible signal strength and centre-tune meters plus AFC mute and mutiplex on/off switches, the latter to allow weak stereo stations to be received in mono to improve the signal/noise ratio. One useful feature of the tuner is a level switch which substitutes the programme with a continuous tone to provide easy setting up of the level controls on the cassette recorder. The tuner is also capable of receiving both LW and MW transmission, though no external ferrite rod aerial is included. The overall technical performance was generally quite reasonable for a tuner of this price class. The IHF least usable sensitivity being 2.1uV, 400uV being needed for optimum reception of a stereo transmission. The RF rejections were all average to above average, though it was noted that the alternate channel rejection was significantly lower than average at −34dB. Capture ratio was a respectable 2dB whilst the radio frequency intermodulation distortion was an average 59dB. The audio distortion on a stereo signal was low at 0.33% for a L=−R 100% modulated carrier, and barely rose at all for single channel modulation. Inter-channel crosstalk was good at 1kHz, but dropped to only 22dB at 10kHz, a barely adequate performance for serious stereo reception. The overall frequency response was smooth though some low frequency loss was apparent, the output level at 30Hz being about 5dB below the level at 1kHz.

Cassette deck *(3936)*
This relatively simple front-loading design features friction-locked concentric record level controls and a three position rotary switch for bias and equalisation setting. The record level meters were reasonably fast in action, under-reading by a little less than 5dB for a 64mS pulse. Tests were carried out using Sony *FeCr* tape giving a reasonably smooth record/replay response that extended well up to 14kHz. The low frequency response was slightly down, however, resulting in a rather thin sound when making recordings from the tuner, a below average performer itself in this respect. Tape transport mechanics were below average, for although the inter-channel phase jitter was low at 17°, the wow and flutter was significantly higher than average at 0.17%. Overall line up was generally satisfactory, resulting in a typical signal-to-noise ratio (with the Dolby noise reduction system operating) of 58.5dB. Replay azimuth alignment was reasonable at 36° whilst the erasure efficiency was more than adequate at 67.5dB. The tape transport keys were considered to be a little stiff to operate, though the hinged cassette compartment is well damped and easy to use. The deck has a number of fine features though the high wow and flutter and restricted low frequency response set a limit to the overall performance.

Record deck *(3937)*
This is a two-speed belt drive design employing a floating sub-chassis carrying the platter and tonearm. The platter/arm assembly is suspended on three foam-damped rubber springs giving a useful amount of vibration isolation both in the vertical and horizontal planes. As would be expected with such a construction the acoustic and vibrational breakthrough are both better than average. The counterweight on the tonearm was very loose and

wobbly and it is thought that this might account for the limited crosstalk performance at the low frequencies.

The overall replay response of the Shure *M75 6S* pickup was very good, being virtually flat right up to 20kHz and beyond. Though the effective mass of the pickup and arm assembly was significantly lower than average the moderately high compliance of the pickup (29cu) resulted in a lower-than-optimum subsonic resonant frequency of 8.5Hz with an amplification of 7.3dB.

Wow, flutter and rumble were tolerable at 0.1% and 60.6dB respectively, whilst the CCIR/ARM weighted signal-to-noise ratio measured with respect to the output from a 1cm/sec 1kHz track was lower than average at 57dB. The deck is fitted with a fine speed control, the speed being adjusted using the stroboscopic etchings on the perimeter of the platter. The high frequency intermodulation distortion measured on the cartridge was quite low and the cartridge was found to track the heavily modulated 31.5cm/sec band at 0.5gms below its recommended tracking weight.

Listening tests and overall appraisal

Sound quality from the tuner was pleasantly clean and free from any excessive distortion or background interference problems; the response was however found to be rather thin when judged subjectively. The Ferguson loudspeakers supplied with the system were not well liked, for though they gave a reasonable stereo image, the lack of mid-frequency and extreme high frequency output resulted in a sound that was tiring after short listening periods. Listening tests conducted using the Mordaunt Short loudspeakers were distinctly more favourable. Quality from records was above average, though bass end performance was somewhat limited. The overall performance of the disc replay system was good, rumble being just audible and acoustic breakthrough commendably low. The overall record/replay quality using the Sony *FeCr* tape was fair, though the low frequency problems mentioned earlier when recording from an FM station were obvious. The high level of wow and flutter on the cassette deck was intrusive, though probably not a problem for the non-enthusiast. Though a number of criticisms of the technical performance have been raised the value for money rating must still be quite high, especially if it is possible to purchase the system without the manufacturer's matching loudspeakers.

Amplifier (3939)

Power Output 8ohms/4ohms	29.4/37.1 watts
Hum modulation 50Hz/100Hz/150Hz	8dB/24dB/4dB
Dynamic Headroom	0.5dB
Signal/Noise ratio CCIR/ARM	96dB
Ambient output voltage CCIR/ARM weighted	0.7mV
Phono input impedance/capacitance (inc lead)	NA—no pickup option capability
Crosstalk 1kHz/10kHz	69dB/48dB
Gain tracking error, ¼/½/¼ setting	0dB/0dB/+0.1dBR
Balance	0dB
3dB Bandwidth (at 1W RMS)	15Hz/35kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	62dB/70dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	60dB/66dB

Tuner (3938)

IHF least usable sensitivity	2.1uV
50dB quieting mono/stereo	4.5uV/52uV
Signal/Noise 1mV CCIR/ARM	71dB/66dB
Min signal for max S/N ratio mono/stereo	50uV/400uV
AM rejection	60dB
IF rejection	60dB
Image rejection	58dB
Capture ratio	2dB
Adjacent/Alternate channel rejection	4dB/34dB
RFIM	59dB
Distortion L/−R. L only	0.33%/0.4%
Crosstalk 1kHz/10kHz	38dB/22dB
19k/38k suppression	65dB/75dB

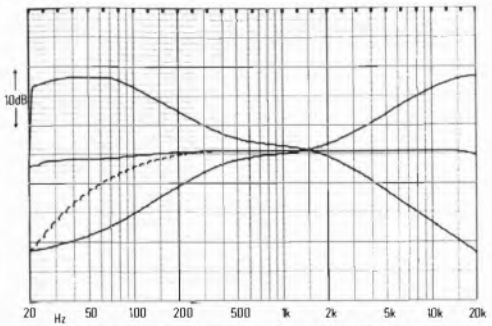
Tape (3936)

Tape used for tests	Sony FeCr C60
Replay azimuth alignment	36°
Wow and Flutter	0.17%
L/R Jitter at 3kHz	17.6°
Dolby ref. level readout on meters, 64mS under-read	+2dB/−4.8dB
Distortion −6dB, 0dB, +3dB	0.24%/0.4%/0.8%
Line up on replay meters −6dB/0dB/+3dB	−7dB/−1dB/+1.5dB
Erasure efficiency (400Hz at Dolby level)	67.5dB
Signal/Noise biassed tape CCIR/ARM	49dB/58.5dB
Tape noise headroom wrt replay noise (no cass)	5.5dB

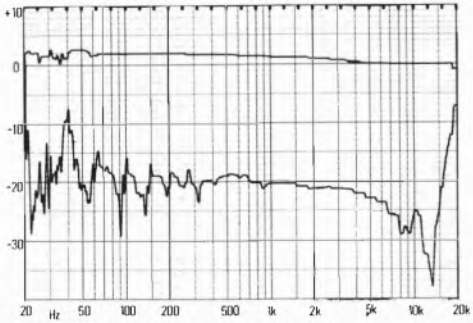
Disc (3937)

HF Intermodulation distortion (10.8kHz pulsed)	0.4%
Tracks 1k+1.5k 31.5cm/sec band at	1.6gms
Effective mass of pickup + arm	11.8gms
Subsonic resonance freq/dB gain	8.5Hz/7.3dB
Estimated compliance	29cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	57dB
Wow and Flutter	0.1%
Rumble (DIN B)	60.5dB
Tracking weight error setting/actual	2gms/2gms
Pickup type	Shure M75-6S

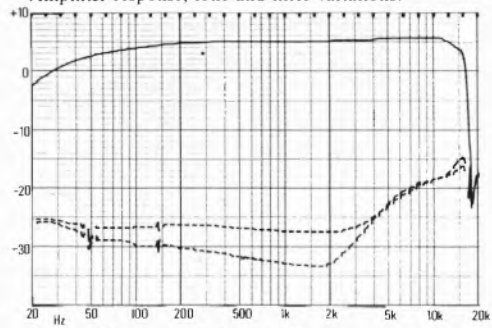
Availablefacilities	A. B. D. E. H. I. J. K. M. N. Q. R V. W. Y. Z. AB. AF. AI. AL. AM. AN. AW. AX. AY. AZ. BA. BC. BD. BM. BN. BQ. BR
Loudspeaker sensitivity (2.828V pink noise)	86dB
Length of loudspeaker lead	3.2m
Azimuth adjustment	unit has to be dismantled to adjust
Ferrite rod aerial	no external ferrite aerial
Typical System price	£460 inc speakers



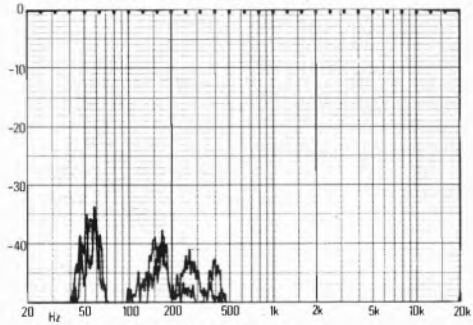
Amplifier response, tone and filter variations.



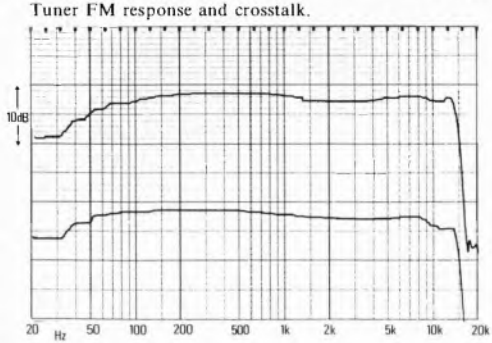
Pickup cartridge response and crosstalk.



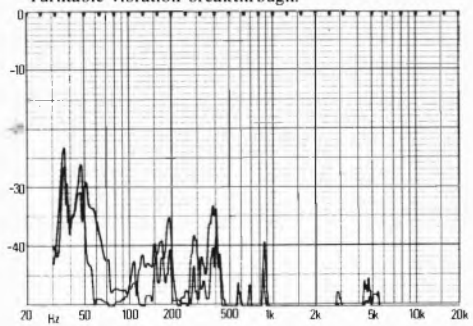
Tuner FM response and crosstalk.



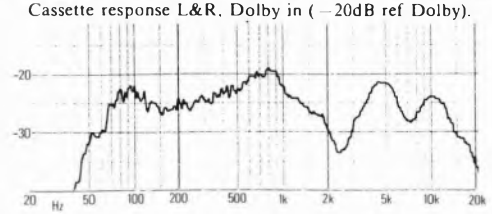
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

Fidelity System 4-40

Fidelity Radio Ltd., Victoria Road, London NW10. 01-965 9235.

This is a music centre complete with two loudspeakers at rather below the average price for all those tested. It is finished in black but differing from most of the others in having all the controls under the hinged Perspex cover that has to be raised for operation. This has some advantage in that all the controls are plainly visible whether the operator is sitting or standing.

The BSR semi-automatic record player unit is resiliently mounted and the controls on this plinth do not significantly disturb the pick-up when they are operated. Performance was a little below average, the wow and flutter and rumble both being rather worse than average. The pick-up supplied with the unit was faulty on arrival resulting in a poor frequency response on one channel and poor trackability. This was replaced by a new example on which all the test data was taken.

The cassette player is mounted in the centre between the radio and record player section. It is larger than average, has large recording level meters and incorporates a digital footage counter and automatic detection of a chromium tape cartridge. The technical performance was about average without being outstanding.

All the radio and microphone controls are grouped on the right hand side with a large illuminated tuning scale and tuning meter and all the facilities have selector buttons. Slider type controls are provided along the front of the unit for volume, balance, bass and treble adjustment and they all work very smoothly. The technical tests revealed some shortcomings in the performance, distortion being on the high side, while image suppression and 19kHz suppression were below average. Crossover type distortion was rather evident at all levels but the circuit diagram revealed no obvious cause. After contacting Fidelity the amplifier section of the music centre was replaced with a modified amplifier resulting in the elimination of the crossover distortion.

BS 415 has evidently been taken to heart by the designers for the unit passed all the prescribed tests.

Listening tests placed the unit some way just below average, but so is the price, a factor that must be taken into account by most would-be purchasers.

In summary a good looking unit for the budget conscious.

Amplifier Section

Power output into 8 ohms	21W
Power output into 4 ohms	25W
Distortion at low power output 1W	0.38% poor
Amplifier noise	poor
Signal to noise ratio for tape output	76dBA fair
Input voltage for full modulation Tape	—
Input voltage for full modulation Aux	134mV
Input voltage for full modulation Mike	350μV
Tape output	165mV
Stereo crosstalk	41dB fair
Channel balance	average

Record Player Section

Frequency response	fair
Trackability	good
Signal to noise ratio	48dBA poor
Channel balance	average
Wow and flutter at 33⅓ rpm	0.26% poor
Rumble	53dB poor

Tuner Section

Least usable sensitivity	8μV poor
Input for 50dB signal/noise	50μV good*
Signal/noise for 1mV input	66dBA average
Distortion	1.4% poor
AM rejection	48.5dB average
Stereo crosstalk	average
Image rejection	20dB poor
IF rejection	82dB good
Adjacent channel selectivity	+3dB good
Capture ratio	fair
19kHz suppression	42dB fair
Muting level	—
Frequency response	average

Tape Section

Record/replay frequency response	average
Azimuth alignment	average
Signal to noise ratio	58dBA average
Distortion output	poor
Wow and flutter	0.16% average
Erase efficiency	56dBA v. good

Loudspeakers (where provided)

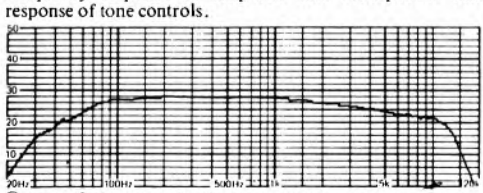
Frequency response of amplifier and speaker	average
Distortion	good
Sensitivity	poor
Length of loudspeaker lead	3.4m average

General Data

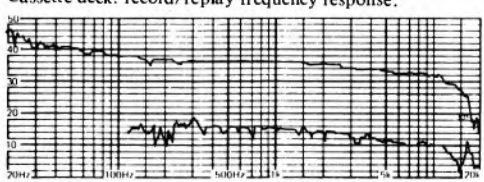
Compliance with British safety standards	No failures
Available facilities	see Introductory Chart
Overall finish and engineering	good
Overall sound quality	fair
Typical selling price inc. speakers and VAT	£215.00
Typical selling price ex. speakers and inc. VAT	£160.00

*See text

Frequency response of amplifier and loudspeaker and response of tone controls.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Fidelity Series 200

Fidelity Radio Ltd., Victoria Road, London NW10 6ND. Tel: (01) 965 8771

Introduction

Fidelity have long been amongst the UK market leaders in transistor radios, record players and music centres. 1979 sees their first move into the hi-fi separates market, with two complete systems sharing only the same cassette deck. The cheaper vertical style *system 200* is tested here, while the higher specification *system 350* is extremely similar to the HMV *series 4000* reviewed elsewhere in this publication. (Technical differences between the two are slight, with fractionally less power offered by the Fidelity, which is silver-finished; much of the reason for the cheaper price of the Fidelity lies in the standard of finish offered and the marketing strategy being adopted.)

The *4-40* music centre, reprinted from *Music Centres,* remains current, while a similarly styled model the *5-50* offers improved record player performance plus Dolby noise reduction on cassette. A brand new *6-60* model with elegant contemporary styling has a specification similar to the *350 system* at a price which reflects the savings in materials made by the music centre format.

General description

This is a taller than average rack system of stark appearance with the rack constructed from black plastic veneered chipboard with simulated wood veneered side panels. For the very low price of £329 the system comes complete with a pair of two-way loudspeakers finished again in simulated wood veneer with black declon grille over the drive units. The amplifier, cassette deck and tuner are all finished in brushed aluminium with DIN type sockets at the rear. Mains interconnections are conveniently made using the shuttered power distribution sockets fitted at the rear of the amplifier, the power switch on the amplifier serving as a master on/off switch. Each piece of equipment has its own supporting shelf with storage space for records below the cassette deck and with a neat record deck housing at the top of the rack. The record deck is a two-speed belt drive design with an auto reject feature, anti-skating force adjustment and a detachable SME type headshell. The tinted plastic cover of the deck had rather loose fittings and in consequence a tendency to drop when a record was being placed on the platter.

Amplifier *(200A)*

This is an amplifier with a modest output power of 18.8 watts rising to just under 20 watts when a 4 ohm load is used. Hum modulation was found to be quite high at maximum power levels, with an increase of 16dB being recorded at 100Hz. A click-stop volume control is fitted with a concentrically mounted centre detent balance control whilst the tone controls are of the rotary centre detent type. Overall frequency response was generally quite smooth and extended up to 75kHz, with tone control ranges of around ±9dB at 100Hz and 10kHz. The IHF intermodulation distortion products were quite reasonable considering the price of the system, though the 2nd order products were noted to be higher than average. Toggle type input selector switches, loudness and stereo/mono switches are provided adjacent to the tone controls. The signal-to-noise ratio measured using the CCIR/ARM weighting network was a very good 86dB and the crosstalk performance was well above average. Because of the budget price of the system many of the usual features found on amplifiers tested in this survey such as connections

for two sets of loudspeakers and switchable filtering, etc are sensibly omitted. At its price the amplifier has a great deal to offer, though it should be noted that the disc input impedance is sufficiently far from the norm to make cartridge substitution a little unpredictable.

Tuner *(200T)*
The tuner sensitivity was lower than average with an IHF least usable sensitivity level of 3.1uV; 550uV being needed to achieve the maximum stereo signal-to-noise ratio of 66dB. This was almost exactly the average of all the systems tested in this survey. Many of the radio frequency rejections including image and alternate channel rejection were considerably worse than average however.

The front panel controls include pushbutton selection of either FM, MW or LW bands, toggle type switches being used to operate the stereo decoder and the AFC facility. The tuner includes a signal strength meter fitted to the extreme right of the tuning scale with a stereo pilot light directly above the multiplex on/off switch. The frequency response of the tuner was generally quite smooth and extended well up to 13kHz with an above average performance in respect of stereo crosstalk.

The audio distortion levels were very high at around 2.5% on both single channel and stereo out-of-phase modulated carriers, possibly the highest measured in this survey. Though technical performance in respect of many of the radio frequency parameters was lower than average, the pilot tone suppression levels were outstandingly good, being 71dB and 81dB respectively at 19kHz and 38kHz. A neat rotatable aerial is accessible at the rear to facilitate optimum reception of AM broadcasts, but no 75 ohm aerial socket is provided, only a 300 ohm termination.

Cassette deck *(350C)*
This is a front loading design with rather stiff piano type tape transport keys and a nicely damped cassette tape housing. The deck features toggle switch selection of the input source, the Dolby noise reduction system and a memory facility, a similar single tape selector switch varying both the bias and equalisation applied to the tape. Best record/replay responses were obtained using a BASF CrO_2 tape, the response then extending reasonably smoothly up to 15kHz. Overall tape line up and Dolby calibration level were only approximated, resulting in rather high levels of distortion but minimising the tape noise.

The deck is fitted with concentric rotary friction-locked record level controls facilitating a balanced stereo fade. Useful coloured lights are located between the twin VU meters indicating use of the record mode and Dolby noise reduction system. The wow and flutter level was very reasonable at 0.1%, interchannel phase jitter being particularly good at 18°. Erasure efficiency on the chrome tape was very good at 67dB whilst the tape headroom with respect to replay noise was an adequate, if not outstanding, 7dB. The record level meters were very slow in operating, reading some 9dB low on a 64mS long pulse, and the lack of any peak reading LED makes good recordings rather difficult to achieve without some practice. The tape counter is awkwardly mounted and difficult to read, particularly with the cassette deck positioned near the bottom of the rack.

Record deck *(200F)*
The record deck is a two-speed belt drive design with the platter, tonearm and plinth all firmly connected together with the base being supported on some notably resilient feet. The vibration breakthrough was about average although the acoustic breakthrough was significantly worse than average. Performance in respect of wow, flutter and rumble was reasonable whilst the signal-to-noise ratio (CCIR/ARM weighted) was particularly good at 64dB. The deck was fitted with a Shure *M756S* cartridge having a reasonable HF intermodulation distortion performance but with some tracking problems in the 31.5cm/sec high velocity band. The overall frequency response of the pickup was reasonable although a 3dB valley centred around 9kHz was obvious together with a mild peak in output occurring at 18kHz. Crosstalk performance was about average for a pickup in this price class whilst the subsonic resonance occurring at 7.4Hz had a lower than average gain of 4.8dB. Speed selection is carried out using a rotary knob to the left of the plinth whilst a similar knob on the other side provides an auto cut facility. The tonearm is of average effective mass and is fitted with user-adjustable tracking and anti-skating correction, an SME type detachable headshell and an integral cueing lever.

Listening tests and overall appraisal
The system comes complete with a pair of two-way

loudspeakers finished in simulated wood veneer to match the side panels of the rack. Although the loudspeakers were reasonably sensitive the on-axis frequency response and the stereo image detail was poor, with distortion performance also below average. The sound quality using these loudspeakers was significantly below average, the pair of Mordaunt-Short *Pageant II* loudspeakers greatly improving the performance. Quality from disc was lower than average, the high frequency response being limited and tracking performance subject to criticism. Distortion was quite low and the wow, flutter and rumble levels were quite acceptable.

Acoustic breakthrough was audible on loud passages particularly when using the Mordaunt-Short loudspeakers. Sound quality from tape was rather limited by the higher than average distortion at high modulation levels, however the general overall quality was quite reasonable with only mild comments regarding high frequency compression. Subjectively judged the wow and flutter and the image stability were above average when using pre-recorded cassettes of high quality. Mild radio frequency interference problems in the form of birdies and whistles were audible on the tuner, but the overall audio response was generally quite smooth with good stereo image detail. The overall sound was rather rough at high modulation levels and the lack of any aid to accurate tuning made it necessary to use some care. Even though a number of criticisms have been raised the whole system is very inexpensive and should certainly be considered by the budget conscious, especially if a better pair of loudspeakers could be used.

Amplifier (200A)

Power Output 8ohms/4ohms	18.8/19.9 watts
Hum modulation 50Hz/100Hz/150Hz	5dB/16dB/0dB
Dynamic Headroom	0.6dB
Signal/Noise ratio CCIR/ARM	86dB
Ambient output voltage CCIR/ARM weighted	0.65mV
Phono input impedance/capacitance (inc lead)	20kohm/436pf
Crosstalk 1kHz/10kHz	46dB/44dB
Gain tracking error, ¼/½/¾ setting	1.2dBL/0dB/0dB
Balance	0.2dBL
3dB Bandwidth (at 1W RMS)	11.6Hz/71kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	63dB/71dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	62dB/69dB

Tuner (200T)

IHF least usable sensitivity	3.1uV
50dB quieting mono/stereo	6uV/80uV
Signal/Noise 1mV CCIR/ARM	71dB/66dB
Min signal for max S/N ratio mono/stereo	80uV/550uV
AM rejection	51dB
IF rejection	65dB
Image rejection	42dB
Capture ratio	2.2dB
Adjacent/Alternate channel rejection	−1dB/36dB
RFIM	56dB
Distortion L/−R, L only	2.5%/2.5%
Crosstalk 1kHz/10kHz	43dB/24dB
19k/38k suppression	71dB/81dB

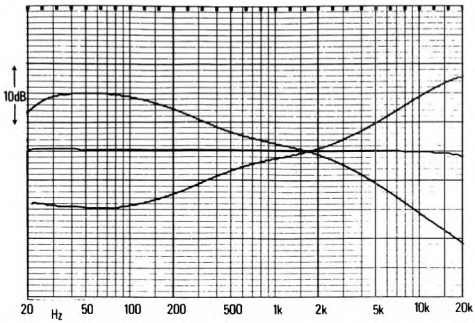
Tape (350C)

Tape used for tests	BASF CrO_2 C60
Replay azimuth alignment	47°
Wow and Flutter	0.1%
L/R Jitter at 3kHz	18°
Dolby ref. level readout on meters, 64mS under-read	+1.5dB/9dB
Distortion −6dB, 0dB, +3dB	0.8%/2%/4%
Line up on replay meters −6dB/0dB/+3dB	−6.4dB/−1dB/+1.5dB
Erasure efficiency (400Hz at Dolby level)	67dB
Signal/Noise biassed tape CCIR/ARM	52dB/61.5dB
Tape noise headroom wrt replay noise (no cass)	7dB

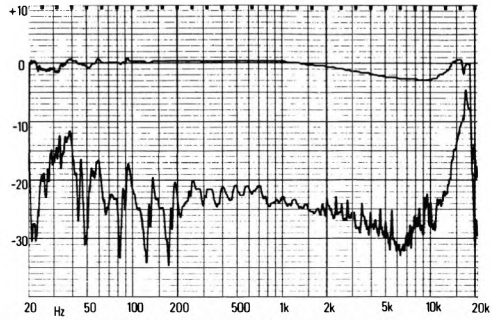
Disc (200P)

HF Intermodulation distortion (10.8kHz pulsed)	0.4%
Tracks 1k+1.5k 31.5cm/sec band at	approx 3gms
Effective mass of pickup + arm	19.4gms
Subsonic resonance freq/dB gain	7.4Hz/8dB
Estimated compliance	23cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	64dB
Wow and Flutter	0.11%
Rumble (DIN B)	61dB
Tracking weight error setting/actual	3gms/2.9gms
Pickup type	Shure M75 6S

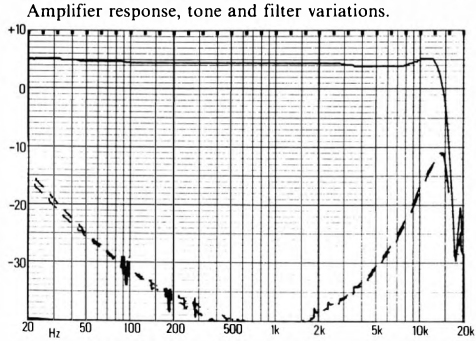
Available facilities	A, B, D, I, M, N, R, V, Y, Z, AB, AC, AE, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BM, BQ
Loudspeaker sensitivity (2.828V pink noise)	86.5dB
Length of loudspeaker lead	3.4m
Azimuth adjustment	normal screw type
Ferrite rod aerial	internal aerial externally rotatable
Typical System price	£329 inc speakers



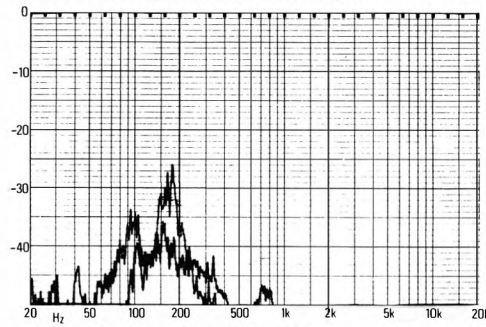
Amplifier response, tone and filter variations.



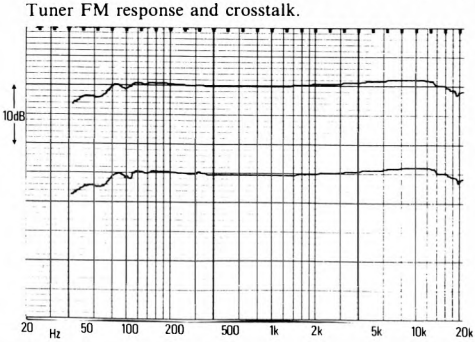
Pickup cartridge response and crosstalk.



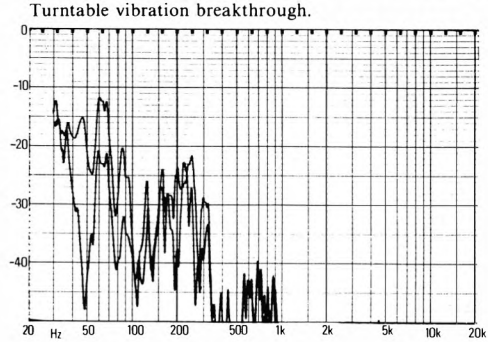
Tuner FM response and crosstalk.



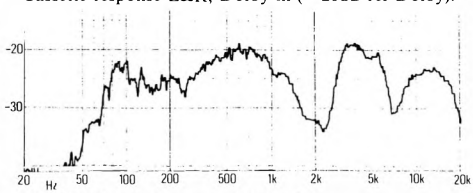
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

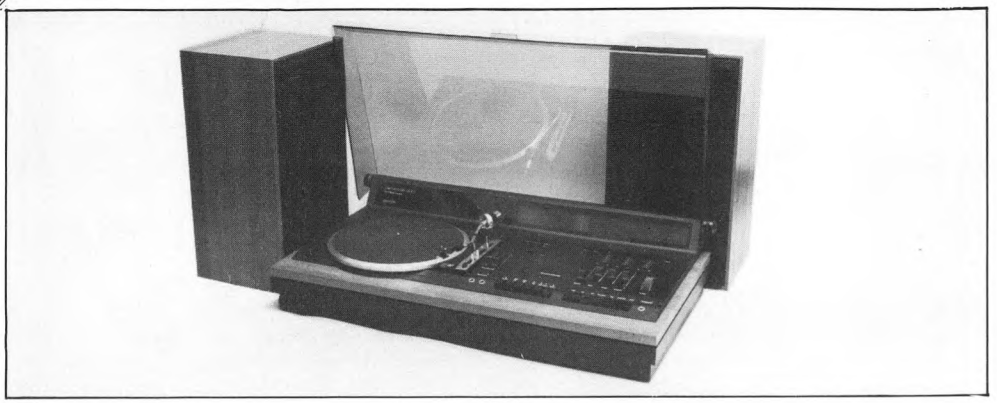


Loudspeaker frequency response, 1m.

RECOMMENDED

Garrard GA-200

Garrard Engineering Ltd., Newcastle Street, Swindon, Wilts. 0793 35381.



This is a relatively high power (30 watt per channel) higher priced unit which performed relatively well. All the controls are mounted on the top deck under the Perspex cover with the tuning scale set at an angle along the back of the deck, nicely illuminated and having very clear markings. At the sides of the tuning scale are three meters, two indicating the recording level and the third an effective tuning meter. Four legends for Dolby, chrome, stereo and record light up when the particular facility is in use.

The record deck is naturally a Garrard, their type GT-15P, a belt drive 2 speed with calibrated stylus load and anti-skating adjustments and fitted with a Shure cartridge. Measured frequency response was within ±1dB between 20Hz and 5kHz with a slow fall-off to about —4dB up to 20kHz. Crosstalk was very good over the whole frequency range. Wow and flutter were good, as were the tracking distortion, rumble level and the signal to noise ratio. Sound quality was above average, the treble and bass being well balanced and the distortion low, while the stereo image was well defined.

The cassette player was large and solid, suggesting a long life. The tape motion controls worked easily and sweetly. Twin recording level meters with separate recording level controls for left and right channels are fitted, and there are push-buttons to select the chrome tape bias, to shift the oscillator frequency to eliminate 'birdie whistles' during recording and to bring the Dolby noise reduction into circuit. The facility in use is indicated by an illuminated legend immediately below the radio tuning scale.

Least usable sensitivity of the radio receiver section is high at 1.1μV and the signal required for a signal to noise ratio of 50dB is low. The signal to noise ratio achieved by a signal of 1mV is higher at 67dBA. AM rejection, Crosstalk, image rejection, IF rejection, the 19kHz rejection and the adjacent channel selectivity are all in the good to very good class. Sound quality was good, bass and treble being well balanced, the distortion is low with a well defined stereo image.

This was one of the systems having speaker leads that are too short to allow optimum placement of the loudspeakers well away from the system. The sample tested was a pre-production unit and the label specifying the working voltage and the instruction for fitting the mains plug has not been included.

In summary, a unit having an above average performance and worthy of detailed consideration.

Garrard GA-200

RECOMMENDED

Amplifier Section

Power output into 8 ohms	26.2W
Power output into 4 ohms	30.4W
Distortion at low power output 1W	0.018% v. good
Amplifier noise	average
Signal to noise ratio for tape output	92dBA v. good
Input voltage for full modulation Tape	115mV
Input voltage for full modulation Aux	—
Input voltage for full modulation Mike	470μV
Tape output	220mV
Stereo crosstalk	45dB good
Channel balance	good

Record Player Section

Frequency response	good
Trackability	average
Signal to noise ratio	56dBA poor
Channel balance	average
Wow and flutter at 33⅓ rpm	0.16% fair
Rumble	60dB good

Tuner Section

Least usable sensitivity	1.1μV good
Input for 50dB signal/noise	28μV v. good
Signal/noise for 1mV input	67dBA good
Distortion	0.65% good
AM rejection	57dB good
Stereo crosstalk	good
Image rejection	53dB good
IF rejection	98dB v. good
Adjacent channel selectivity	+3dB good
Capture ratio	v. good
19kHz suppression	67dB v. good
Muting level	1μV
Frequency response	v. good

Tape Section

Record/replay frequency response	v. good
Azimuth alignment	poor
Signal to noise ratio	62dBA good
Distortion output	poor
Wow and flutter	0.09% v. good
Erase efficiency	55dBA v. good

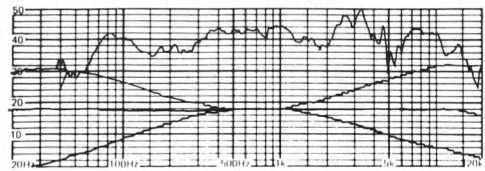
Loudspeakers (where provided)

Frequency response of amplifier and speaker	fair
Distortion	good
Sensitivity	fair
Length of loudspeaker lead	3.55m average

General Data

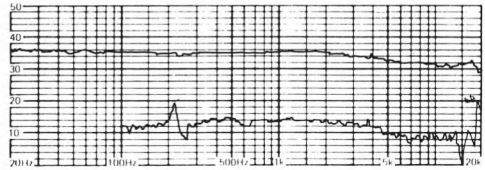
Compliance with British safety standards	1, 2
Available facilities	see Introductory Chart
Overall finish and engineering	—*
Overall sound quality	good
Typical selling price inc. speakers and VAT	£325.00
Typical selling price ex. speakers and inc. VAT	£275.00

*See text.



Frequency response of amplifier and loudspeaker and response of tone controls.

Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Grundig system 30

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

Introduction

The receiver based system tested here is also available in a tower format and with a lower powered amplifier section. Grundig have recently announced ambitious plans for 1980 which involve additional ranges of more 'international' style and size, which will also be available in horizontal and vertical racks and include a micro system, again with appropriate furnishing. The format for the new components will be to separate the pre- and power amplifiers as a range of 'motional feedback' speakers is also being introduced; these enhance the bass performance of a smallish enclosure with special built-in amplifiers, thus obviating the need for a separate power amplifier in the system. These new 'international' components are claimed to be highly competitive as they will be made in Grundig's well established Portuguese plants. from whence originated their successful range of portable radios.

General description

Housed in what must be the largest (and heaviest) rack in this survey the Grundig system comprises an *R48* receiver, a *CNF300* cassette deck and a *PS1020* direct drive record deck. The whole rack is constructed of chipboard with an ingenious black finish simulated wood veneer. An accessory drawer is provided under the cassette deck and this is capable of storing up to 40 boxed cassettes with additional space for 33 more cassettes adjacent to the record deck.

Access to the record deck is made via the large heavy tinted perspex lid with access to storage for around 50 records being provided at the right of the cabinet. One really nice finishing touch is the thermostatically operated cooling fan fitted at the rear of the cabinet and capable of being brought into action when the amplifier is working flat out on warm days. Adjacent to the fan is a mains distribution box (continental standard sockets) thus only one lead is necessary to connect to the mains supply. One annoying point with many of the other systems is that a large distribution box is needed to connect all the separate components to the mains supply.

Receiver *(R48)*

The amplifier section is fitted with three variable tone controls, the normal bass and treble controls and a mid frequency boost and cut control operating at a centre frequency of 2.5kHz. The controls provide overall ranges in excess of ±10dB at 100Hz, 2.5kHz and 10kHz, and in addition a low pass filter is provided with a steep cut off at 7kHz (see response curves). Provisions are available for two loudspeaker systems to be operated either individually or simultaneously, and an optional loudness control is provided.

All the tone controls are of the position-detent type whilst the balance and volume controls are of the multiple stepped rotary type. On the model submitted for assessment, the legends on the receiver were in German, but production models will be labelled in English. Power output is rather below average at 31.8 watts, rising substantially to 47.5 watts into a 4 ohm load. In fact this availability of output at lower loudspeaker impedances is a useful feature when the two sets of external loudspeakers are connected in parallel. Care however must be taken to ensure that neither set of loudspeakers has an impedance that drops sharply below 8 ohms over the reproduced frequency range. Dynamic headroom was a moderate 0.65dB whilst the maximum signal-to-noise ratio was a very useful 93dB (CCIR/ARM weighting).

The phono input impedance was acceptable though the overall input capacities including the interconnecting leads from the record deck was greater than average at 336pf. This high input capacitance was not a problem with the pickup supplied – and indeed might have been increased still further to advantage – but is worth noting if any other pickup is to be used with the system. Gain

tracking error between channels was a mild problem, at worst being over 1dB out between channels, whilst the frequency response extended from 10Hz to 85kHz, somewhat wider than is needed.

The receiver featured many aids to tuning including a digital frequency readout (100kHz steps on FM), a signal strength meter and a 'tunoscope' comprising three LEDs coloured red – green – red; optimum tuning indicated by the green light with near accurate tuning being indicated when either of the red lights are on. Seven pre-sets are available and each can be adjusted using controls hidden behind a small hinged access plate positioned below the tuning strength meter. IHF least usable sensitivity was a moderate 2.5uV with 500uV being needed to ensure maximum signal-to-noise ratio on a stereo signal. The capture ratio was a little lower than average at 3.5dB, and there was some asymmetry present on the alternate channel rejection tests.

The measured intermodulation distortion at radio frequency was high at −62dB as was the audio frequency harmonic distortion measured with a 100% L=−R signal. The harmonic distortion dropped from 1% to 0.8% when a left only modulation mode was adopted, though this level of distortion is still higher than is desirable. Whilst the tuner section of the receiver performed well in many areas the average sensitivity, lower than average capture ratio and higher than average harmonic distortion suggest a performance level inferior to that achieved by the amplifier section.

Cassette deck *(CNF300)*

We have noticed in the past that Grundig engineers always seem to prefer a heavily over-modulated tape with good signal/noise characteristics, and this particular design proves to be no exception. Dolby replay reference level was at −5dB on the VU meters, resulting in recorded tapes being heavily over-modulated with a consequent rise in harmonic distortion – over 3% at 0dB reference replay being measured during tests. The advantage obtained is the 6dB improvement in signal-to-noise ratio, which may be appreciated by the less critical listener but may be criticised by the more serious listener who would find the distortions at high peak level quite objectionable.

One unusual feature of the deck is the small headphone amplifier featured at the left hand end. Inputs are available for both microphone and tape sources and there are facilities for connecting two pairs of headphones to the amplifier. (NB: all the headphone sockets on the system are of the DIN type, so adaptors will be needed for headphone sets that use the normal stereo jack plugs). Volume and balance controls for the headphones are included, unlike many of the other cassette decks tested in this survey, so it is possible to monitor the tapes on headphones without the need of the main amplifier. The Grundig *FeCr* tape used for the record/replay tests showed a drop in response of some 3dB at 3kHz, remaining at this lower plateau level up to 13.5kHz. Record level input controls feature auto record facilities with two options for music and speech to allow for the different transient nature of the signal. The hi-fi enthusiast may not find the automatic level control performance acceptable but there is little doubt that it is an advantage for those less skilled in the art of setting recording levels.

Record deck *(PS1020)*

A two-speed, direct drive semi-automatic deck is included, and fitted with a Shure *M85G* magnetic cartridge. The technical performance of the deck was found to be quite outstanding with rumble levels around −67dB and wow and flutter levels of 0.075%. Both plinth and tonearm are firmly fixed to the moulded plastic base supported on four relatively hard rubber feet. Measurements revealed that both the acoustic and vibrational breakthrough were noticeably higher than average. The effective mass of the arm, pickup and headshell was high at 28gms, and this, coupled with the use of the high compliance (35cu) cartridge resulted in the low subsonic resonance frequency of 5Hz. The signal/noise on the record deck was noticeably below average, a hissy noise being evident which appeared to originate from the early stages of the pre-amplifier. Frequency response curves taken on the Shure pickup revealed a reasonably smooth response up to 10kHz followed by a peak of about 4dB at 16kHz (which might be tamed by a little extra capacitance, *ie* 100pf, at the amplifier disc input).

Loudspeakers

The loudspeakers are a three-way design with the mid-range and tweeter unit mounted above and to one side of the woofer, all the drive units being covered with a removable velour flake finished grille. The on-axis frequency response was smooth

up to 10kHz apart from two small dips at 2.6kHz and 6.3kHz and a peak of 3dB at 12.5kHz. The overall response was however very satisfactory especially considering the size of the units. Sensitivity was average at 87dB whilst the length of the loudspeaker leads was only just adequate for a small to average size living room.

Listening tests and overall appraisal

Listening tests were carried out using both the speakers supplied with the system and the Mordaunt Short *Pageant IF*'s. Sound quality from the tuner was very good, offering a clean neutral sound that was only marred by the subjectively higher than average distortion levels on loud passages. The quality from the pickup was soft and inoffensive, lacking in body with a slight boxy nature, almost bland. Tape recordings sounded about average, the inevitable distortion created by over-modulation being compensated to some extent by the good signal/noise ratio. Pre-recorded cassettes sounded very good, the sound quality really being limited by the quality of the tapes. In summary a well made system of reasonable technical performance that offers a great deal and costs a great deal too!

Amplifier (R48)

Power Output 8ohms/4ohms	31.8/47.5 watts
Hum modulation 50Hz/100Hz/150Hz	5dB/10dB/30dB
Dynamic Headroom	0.65dB
Signal/Noise ratio CCIR/ARM	93dB
Ambient output voltage CCIR/ARM weighted	0.34mV
Phono input impedance/capacitance (inc lead)	42k/336pf
Crosstalk 1kHz/10kHz	55dB/52dB
Gain tracking error. ¼/½/¾ setting	0.7dBR/1.1dBR/0.5dBR
Balance	0.7dBR
3dB Bandwidth (at 1W RMS)	10Hz/85kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	−76dB/−75dB
(−3dBref max pw) 10kHz+11kHz 2nd/3rd order	−76dB/−74dB

Tuner (R48)

IHF least usable sensitivity	2.5uV
50dB quieting mono/stereo	4.7uV/45uV
Signal/Noise 1mV CCIR/ARM	78dB/70dB
Min signal for max S/N ratio mono/stereo	125uV/500uV
AM rejection	61dB
IF rejection	>70dB
Image rejection	approx 80dB
Capture ratio	3.5dB
Adjacent/Alternate channel rejection	5dB/50/+60dB
RFIM	62dB
Distortion L/−R, L only	1%/0.8%
Crosstalk 1kHz/10kHz	42dB/33dB
19k/38k suppression	62dB/55dB

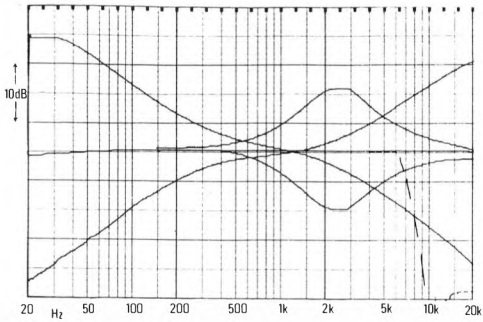
Tape (CNF 300)

Tape used for tests	Grundig PROFI C60 (FeCr)
Replay azimuth alignment	35°
Wow and Flutter	0.12%
L/R Jitter at 3kHz	19.7°
Dolby ref. level readout on meters, 64 mS under-read	−5dB/+2dB
Distortion −6dB, 0dB, +3dB	0.4%/1%/3.3%
Line up on replay meters −6dB/0dB/+3dB	−7dB/−2dB/0dB
Erasure efficiency (400Hz at Dolby level)	70dB
Signal/Noise biassed tape CCIR/ARM	56dB/66dB
Tape noise headroom wrt replay noise (no cass)	7dB

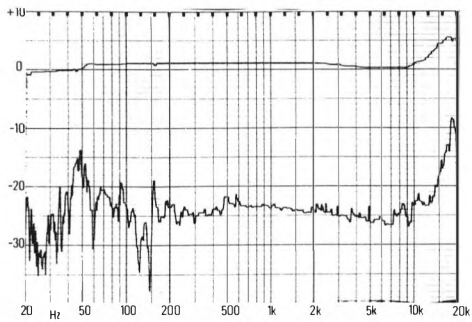
Disc (PS 1020)

HF Intermodulation distortion (10.8kHz pulsed)	0.26%
Tracks 1k+1.5k 31.5cm/sec band at	1.5gms
Effective mass of pickup + arm	28gms
Subsonic resonance freq/dB gain	5Hz/6dB
Estimated compliance	36cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	54dB
Wow and Flutter	.075%
Rumble (DIN B)	67dB
Tracking weight error setting/actual	1.75gms/1.68gms
Pickup type	Shure M85G

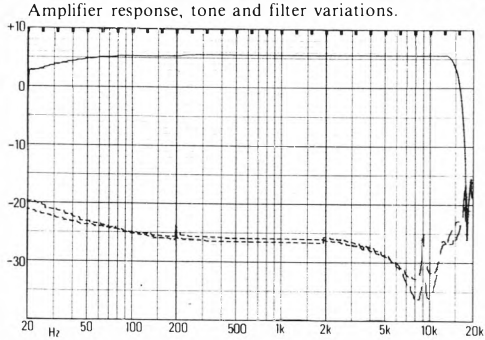
Available facilities	A. B. D. F. H. I. J. K. M. N. R. V. X. Y. Z. AA. AB. AI. AK. AL. AM. AN. AW. AX. AY. AZ. BB. BC. BD. BJ. BM. BQ. BR
Loudspeaker sensitivity (2.828V pink noise)	87dB
Length of loudspeaker lead	3.94m
Azimuth adjustment	normal screw type
Ferrite rod aerial	no external adjustable rod
Typical System price	£835 inc speakers



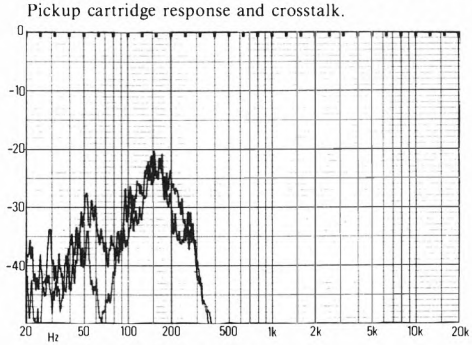
Amplifier response, tone and filter variations.



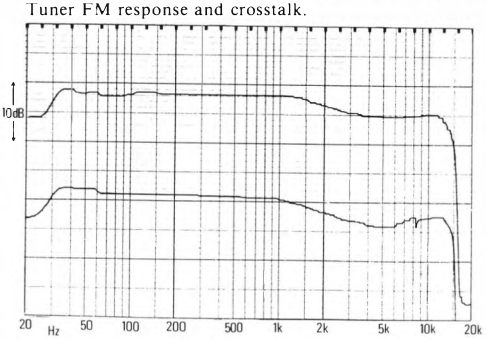
Pickup cartridge response and crosstalk.



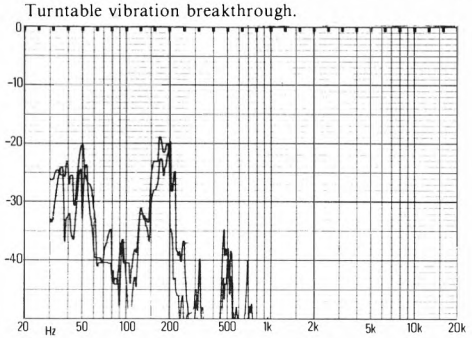
Tuner FM response and crosstalk.



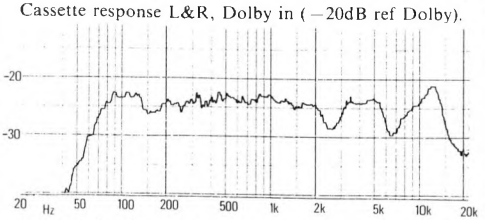
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

BEST BUY

Hitachi system

Hitachi Sales UK Ltd., Hitachi House, Station Road, Hayes, Middlesex UB3 3DR. Tel: (01) 848 8787

Introduction

At the present time Hitachi do not make specific system recommendations, so as to give the customer as wide a choice as possible from some twenty separate components and four rack types. However this flexible approach can itself cause confusion, so there is the possibility that they will revert to their original policy of selecting certain combinations while still permitting variations.

Although the tested system is very modestly priced, some combinations cost even less, and Hitachi are clearly aiming a serious effort at the upper end of the music centre market (including their own successful models) with competitively priced separates systems. The four racks consist of two verticals and two horizontals, the alternatives catering for receiver and slimline separates combinations.

General description

This budget offering from Hitachi consists of a receiver, cassette deck and two-speed direct drive turntable all housed in a simulated wood veneered cabinet. The record storage area is situated below the cassette deck in the usual way and is protected by a hinged tinted plate glass door. The equipment is finished in brushed aluminium, the plinth of the record deck being constructed from pre-formed plastic. The receiver slides into the rack from the rear with only the minimum amount of room being available*, in fact when in position the type number etched above the tuning cursor is screened from view by edge trim at the top of the rack.

Interconnections at the rear of the equipment are of the phono type, 5-pin DIN sockets for tape being provided on the cassette deck and receiver. Loudspeaker connections are pushbutton wire clamps fitted at the rear of the receiver, and a hinged external ferrite rod aerial is fitted to optimise AM reception. The cassette deck boasts a power assisted control mechanism which allows the tape transport keys to be engaged smoothly with the minimum of effort, and indeed all the keys had a very pleasant positive feel about them. The quality of construction and visual matching between units was generally very good, though the rack in which the equipment is housed was not particularly well made.

Receiver *(SR 304L)*

A sensible range of controls are included with position detent tone controls, a centre detent balance control and a finely stepped rotary volume control. Switching is provided to connect either or both of two sets of loudspeakers to the amplifier at any one time, whilst switchable loudness and subsonic filters are also included. The measured power output was 26.4 watts into 8 ohms rising to 33 watts for a 4 ohm load, the IHF intermodulation distortions at levels approaching these maximum power levels being particularly low. Hum modulation was minimal, whilst a useful dynamic headroom of 1.2dB was achieved using a 20mS long pulse driving an 8 ohm load. The overall frequency response of the receiver was very smooth, moderate amounts of equalisation being provided by the

tone controls and a useful subsonic filter. The CCIR/ARM weighted signal-to-noise ratio was particularly good at 91dB, as was the channel crosstalk levels, but it was felt that the high frequency crosstalk performance could have been improved.

The tuner section of the receiver features dual-gate MOSFET circuitry and achieves particularly good sensitivity and signal-to-noise levels. The IHF least usable sensitivity was a very good 1.2uV with only 310uV being needed for optimum stereo reception, whilst the mono and stereo signal-to-noise ratios were 73dB and 70dB respectively. Generally all the radio frequency rejections were above average, though the image rejection was a little below average at 52dB. Capture ratio was particularly good at 1.5dB, as were the audio distortion levels with a fully modulated out of phase stereo carrier.

The frequency response of the receiver was virtually flat right up to 15kHz with reasonable levels of crosstalk that did tend to worsen slightly at high frequency, some 27dB being achieved at 10kHz. The pilot carrier suppression was not particularly good, though probably more than adequate for all but the most critical listener. As mentioned earlier, facilities have been included for AM reception, and a signal strength meter and stereo pilot light are fitted to the tuning cursor, though no optimum tune indication is provided. The tuning knob was a little difficult to operate due to its proximity to the rack trim. It was felt that this is a particularly well designed budget receiver with an above average performance specification, and obviously deserves a strong recommendation.

Cassette deck *(D-40S)*

This is a slimline design featuring power assisted control of the tape motion, five-level peak indicators fitted between large easily read VU meters, and a record mute switch that allows the signal to be cut without resorting to adjustment of the volume control. The azimuth alignment was a little inaccurate on arrival, with wow and flutter being a better than average 0.09% and L/R channel jitter somewhat high at 46°. The large VU meters underread by 7dB on a 64mS pulse, though the peak indicating LEDs fitted between the meters were effective for peaks of less than 32mS duration. The tape supplied with the equipment was Hitachi *LNC60*, and though recommended by the manufacturers it was found that the overall line-up was in error by around 3dB, a situation that improved noticeably when a Maxell *UDXL1* tape was used. The Hitachi *LN* tape was however used for the remainder of the tests, resulting in less than optimum levels of distortion and lower than average signal-to-noise ratios. Tape noise headroom with respect to replay noise was however very good at 12.5dB as was the erasure figure of 66dB. Used with the Maxell tape, the deck would be worthy of a strong recommendation. The concentric record level controls were unfortunately not friction locked, thus a smooth stereo fade requires care.

Record deck *(HT-354)*

The *HT-354* record deck is a two-speed direct drive featuring a DC servo 'unitorque' motor, fine speed control with stroboscopic etchings on the platter, and an auto-cut switch which automatically returns the tonearm to its rest and switches off the motor. The deck is fitted with a Hitachi *MT30* low compliance pickup well matched to the effective mass of the arm, resulting in an optimum subsonic resonance of 11.4Hz of particularly low Q. It is sufficient to note however that though the compliance is low the overall performance of the pickup is very good, with low levels of HF intermodulation distortion, good tracking performance, and a particularly smooth frequency response, with average levels of crosstalk. The unitorque motor fitted to the deck is claimed to achieve particularly low levels of wow and flutter and rumble and this is certainly borne out in practice, though the performance of the deck was marred slightly by the higher-than-average noise levels. The arm, platter and plinth are all firmly connected together, and as usual with this form of construction the acoustic breakthrough is rather high, though the vibrationally induced breakthrough was rated to be a little better than average. The controls on the recorder are conveniently placed and easy to use, though some care had to be exercised to avoid knocking the plinth and minimise the clicks and thumps when the controls were operated.

Listening tests and overall appraisal

The listening tests on the tuner revealed a very impressive sound with a smooth frequency response, low levels of distortion and freedom from radio interference. The tuner proved to be particularly sensitive and in many ways it was a pity that a

BEST BUY

Hitachi system

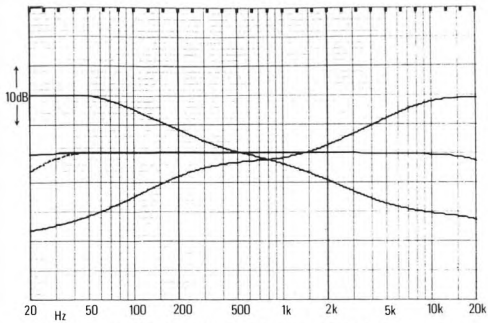
tuning indicator could not have been included to complete an excellent design. Though the measured signal-to-noise ratio on disc was a little lower than average, in practice this is of no significance as the noise present on the majority of records far outweighs that produced by the reproducer system.

The low wow and flutter and rumble levels and the good performance of the pickup all combine to achieve a good overall sound quality, though acoustic breakthrough was becoming noticeable at high listening volumes. The record/replay performance of the cassette deck was generally good, though a lower-than-average signal-to-noise ratio resulted when using the recommended Hitachi *LN* tape. However the performance improved noticeably when the Maxell *UDXL1* tape was used, so assuming our sample is typical we would strongly recommend this tape to be used with the system. Sound quality when replaying the pre-recorded cassette was very good, with low levels of wow and flutter and only minor criticisms of the stereo image shift. In summary then a fine performance particularly in view of the low price, which undoubtedly deserves a best buy rating.

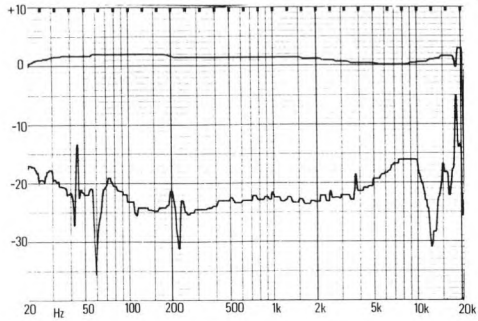
**It appears possible that Hitachi supplied a rack to match slightly different components, differences in the furniture dimensions being small, though we could not positively verify this.*

Amplifier (SR 304L tuner-amplifier)	
Power Output 8ohms/4ohms	26.4/33 watts
Hum modulation 50Hz/100Hz/150Hz	5dB/0dB/2dB
Dynamic Headroom	1.2dB
Signal/Noise ratio CCIR/ARM	91dB
Ambient output voltage CCIR/ARM weighted	0.56mV
Phono input impedance/capacitance (inc lead)	46k/245pf
Crosstalk 1kHz/10kHz	50dB/33dB
Gain tracking error, ¼/½/¾ setting	0dB/0dB/0dB
Balance	0.2dBL
3dB Bandwidth (at 1W RMS)	6.5Hz/45kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	>76dB/>76dB
(−3dB refmax pw) 10kHz+11kHz 2nd/3rdorder	>71dB/>75dB
Tuner (see above)	
IHF least usable sensitivity	1.2uV
50dB quieting mono/stereo	2uV/28uV
Signal/Noise 1mV CCIR/ARM	73dB/70dB
Min signal for max S/N ratio mono/stereo	28uV/310uV
AM rejection	66dB
IF rejection	77dB
Image rejection	52dB
Capture ratio	1.5dB
Adjacent/Alternate channel rejection	3dB/>60dB
RFIM	69dB
Distortion L/−R, L only	0.2%/0.62%
Crosstalk 1kHz/10kHz	32dB/27dB
19k/38k suppression	47dB/42dB
Tape (D-40S)	
Tape used for tests	Hitachi LN C60
Replay azimuth alignment	50°
Wow and Flutter	0.09%
L/R Jitter at 3kHz	46°
Dolby ref. level readout on meters, 64mS under-read	+3.2dB/−7dB
Distortion −6dB, 0dB, +3dB	0.49%/0.9%/1.4%
Line up on replay meters −6dB/0dB/+3dB	−8.5dB/−3dB/+0.5dB
Erasure efficiency (400Hz at Dolby level)	66dB
Signal/Noise biassed tape CCIR/ARM	43dB/53dB
Tape noise headroom wrt replay noise (no cass)	12.5dB
Disc (HT-354)	
HF Intermodulation distortion (10.8kHz pulsed)	0.35%
Tracks 1k+1.5k 31.5cm/sec band at	1.7gms
Effective mass of pickup + arm	20.1gms
Subsonic resonance freq/dB gain	11.4Hz/2dB
Estimated compliance	10cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	57dB
Wow and Flutter	0.078%
Rumble (DIN B)	63dB
Tracking weight error setting/actual	2gms/2gms
Pickup type	Hitachi MT 30
Available facilities	A, B, D, E, I, M, N, R, V, W, Y, Z, AA, AB, AI, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BM, BS
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	not accessible
Ferrite rod aerial	external hinged but not rotatable
Typical System price	£360

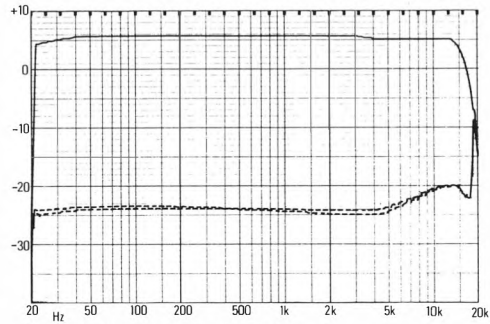
BEST BUY



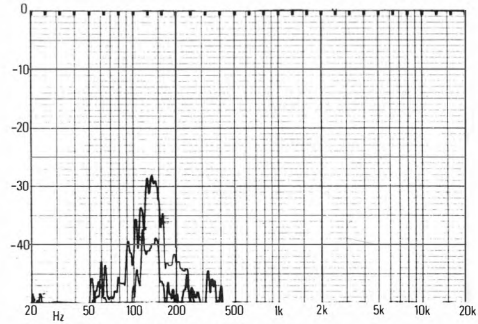
Amplifier response, tone and filter variations.



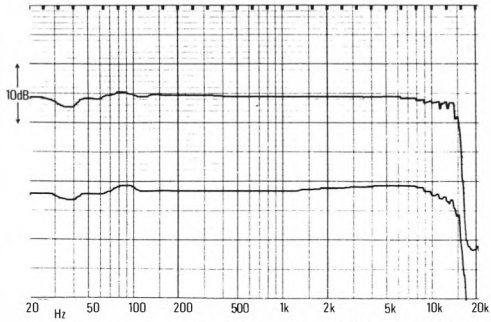
Pickup cartridge response and crosstalk.



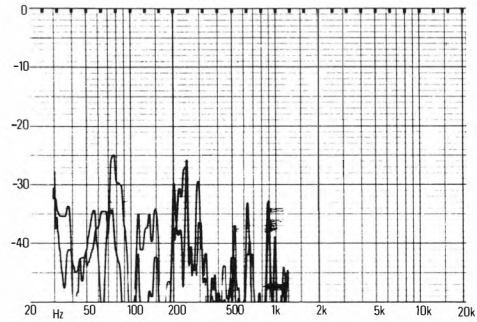
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

HMV Series 4000

Fidelity Radio Ltd., Victoria Road, London NW10 6ND. Tel: (01) 965 8771

Introduction

The revival of the HMV trade mark and logo signals a marketing move by Fidelity to expand beyond the bulk discount traders into the more refined atmosphere of the specialist retailer.

The range as a whole consists of selected Fidelity items with some cosmetic changes, though we understand that a higher standard of finish is maintained particularly on furniture. The *4000* amplifier in the rack system tested offers a slight power increase on specification over the Fidelity *350* equivalent.

General Description

This is a horizontally orientated system of striking appearance finished in mottled black veneered chipboard with simulated wood veneered side panels. Mains connections are easily made with shuttered power distribution being provided at the rear of the amplifier, the power switch of the amplifier serving as a master switch for the entire system. Storage space for records and accessories is provided below the record deck with additional space under the equipment rack for headphones or other items. Supporting panels at the rear of the rack prevent any alternative disposition of the cassette deck, amplifier and tuner. This is regrettable as it brings the cassette deck to within a few inches of the floor making it inconvenient to operate.

All the interconnections at the rear of the equipment are of the DIN type. Signal level controls are provided at the rear of the tuner and cassette deck enabling the signal output of each source to be adjusted to approximately the same level, so avoiding large changes in volume when switching between sources. A two-speed direct drive record deck is neatly inserted in a specially shaped housing to the right of the amplifier and features an "S" shaped tonearm, variable anti-skating force and auto return capability. The quality of construction and visual matching between units was very good, though the large number of knobs, dials and switches will certainly take some getting used to by those not skilled in the art.

Amplifier *(4000A)*

This is a high power output design, delivering some 52 watts into 8 ohms rising to 66.4 watts when a 4 ohm load is used. A rotary switch is included for the selection of phono, aux, tape and tuner, while a similar switch allows either or both of two sets of loudspeakers to be driven from the amplifier. A

click-stop volume control is fitted with a concentrically mounted centre detent balance control. The bass and treble controls are of the usual rotary centre detent type.

The two power meters to the right of the tone controls have the usual ballistics problem, the power meters effectively reading levels of three watts when 50 watt bursts of power of 64mS duration are applied. Hum modulation effects were a little more obvious than average, a 9dB increase in level being recorded at 100Hz at maximum power level, though a useful dynamic headroom of over 1dB was available for pulse durations of less than 20mS. Stereo jack sockets have been fitted for connecting two sets of headphones and switchable scratch and rumble filters are available. An unusual switchable loudness control feature is included which allows the low frequency and high frequency response to be individually adjusted. Generally the overall performance was good, though the high frequency cut-off at 85kHz was thought to be a little over-extended. The third order IHF intermodulation distortion products were notably higher than average.

Tuner *(4000T)*

This model has a comprehensive front panel layout, featuring six pre-set AM-FM pushbuttons, a rotary band selector for MW, LW, SW and FM, switchable AFC and muting and a multiplex on/off switch. Meters are included at either end of the tuning scale to indicate the approximate tuning frequency and signal strength when adjusting the pre-sets. A neat rotatable AM aerial is accessible at the rear of the tuner to aid the achievement of the maximum possible signal/noise ratio. The IHF least usable sensitivity was a fairly average 2.5uV with 480uV being needed for optimum stereo reception. The CCIR/ARM weighted signal-to-noise ratios were good as were the radio frequency rejections (especially image rejection), but the audio distortion levels were a little high at 1% for single channel modulation.

No 75 ohm aerial socket termination is provided which is unusual for a receiver of British origin, so a Balun (coupling transformer) may be needed if the maximum possible performance is required. (In most situations an adequate performance can be achieved by connecting the inner wire of the 75 ohm downlead to one of the 300 ohm terminations and leaving the outer braid unconnected.) The audio frequency response of the tuner was particularly flat up to 15kHz and the 19kHz and 38kHz pilot carrier suppressions were both excellent at 77dB. Generally then a good receiver of average sensitivity but there is some minor criticism of the absence of a centre zero tuning meter.

Cassette deck *(4000C)*

The best record/replay frequency performance was obtained using BASF CrO_2 C60 tape, the response extending smoothly up to 15kHz. Overall tape line up was around 1dB low, compensating to some extent for the slightly inaccurate Dolby level setting of +2dB (should be +3dB). As is usual when using chrome tape the distortion levels at high modulation are high though the signal-to-noise ratios are notably better than average. Wow and flutter was reasonably good at 0.11% though the azimuth alignment on arrival was in error by 78°.

The deck is fitted with switchable input source selection between the microphone and DIN sockets, a memory facility, and a single tape selector switching both the bias and equalisation levels applied to the tape. The concentric rotary friction locked record level controls allow simultaneous fading of both channels. Coloured indicator lights are situated between the twin VU meters and indicate use of the record mode and Dolby noise reduction, but the tape counter read-out is awkwardly mounted and difficult to read. All the tape transport keys were rather stiff to operate though the cassette housing mechanism was nicely damped and azimuth adjustment could be easily carried out by removing the tinted perspex cover over the housing.

Record deck *(4000F)*

The record deck is a two-speed direct drive design of British origin featuring variable electronic speed control, anti-skating and tracking force adjustments, auto return or cut and an SME type detachable headshell. The tonearm, plinth and platter are all firmly connected together in the usual way with the base being supported on some particularly resilient feet. Though the feet did provide some immunity to low frequency shock the general vibration isolation characteristics were only about average, acoustic breakthrough being rather more prominent than on the average unit. The direct drive system did result in an excellent rumble performance but wow and flutter were only average and the weighted signal-to-noise ratio a little worse than average. The Shure *M75 6S*

cartridge fitted to the deck was not found to be particularly good in respect of distortion or trackability performance, the recommended tracking weight having to be exceeded by 0.8gm before the signal from the 31.5cm/sec high velocity band could be resolved correctly. Overall frequency response was reasonably smooth with a wide 3dB valley appearing at 10kHz. Crosstalk was fairly typical of a pickup in this price class. A fairly high mass pickup/arm assembly is fitted resulting in a subsonic resonant frequency of 8.1Hz with a usefully low amplification of 4.5dB.

Listening tests and overall appraisal

The system comes complete with a pair of three-way loudspeakers fitted into simulated wood veneer cabinets matching the finish of the rack housing. Tests showed the loudspeakers to be a reasonably sensitive design of only moderate bandwidth and with an erratic mid frequency performance which suggests crossover problems between the bass and midrange drive units. Listening tests were carried out using both these loudspeakers and the Mordaunt Short *Pageant IIs*. The response from the tuner was very smooth subjectively with low distortion on stereo transmissions. Image detail was good and the noise levels low, though the sensitivity was rather too low to allow reception of weak or distant stations. Generally however, a fine performance but the absence of a tuning meter might be criticised.

Sound quality from tape was also well liked with only mild comments regarding wow and flutter and high frequency distortion when the Dolby system was operated. The cassette deck near to the floor is inconvenient but it was noted that sufficient space is available under the record player to allow the installation of the cassette unit. Sound quality from disc was a disappointment due to the lower than average signal/noise ratio, while the pickup tracking performance could be criticised. Acoustic breakthrough was objectionable, especially when using the *Pageant II* loudspeakers, though the slight loss in HF response was subjectively well liked as was the low wow and flutter and rumble performance. For the price the system does offer a lot, though the overall performance was not considered to be of a sufficiently high level to be accorded recommendation. The very similar but cheaper Fidelity *Series 350* is clearly also likely to be worth consideration.

Amplifier (4000A)

Power Output 8ohms/4ohms	52/66.4 watts
Hum modulation 50Hz/100Hz/150Hz	3dB/9dB/0dB
Dynamic Headroom	1.1dB
Signal/Noise ratio CCIR/ARM	89dB
Ambient output voltage CCIR/ARM weighted	0.88mV
Phono input impedance/capacitance (inc lead)	47k/120pf
Crosstalk 1kHz/10kHz	46dB/46dB
Gain tracking error, ¼/½/¾ setting	0.6dBR/0dB/0.2dBL
Balance	0.1dBL
3dB Bandwidth (at 1W RMS)	8Hz/86kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	75dB/63dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	69dB/63dB

Tuner (4000T)

IHF least usable sensitivity	2.5uV
50dB quieting mono/stereo	3.2uV/50uV
Signal/Noise 1mV CCIR/ARM	70dB/65dB
Min signal for max S/N ratio mono/stereo	52uV/480uV
AM rejection	58dB
IF rejection	>70dB
Image rejection	82dB
Capture ratio	3.4dB
Adjacent/Alternate channel rejection	2dB/53dB
RFIM	75dB
Distortion L/−R, L only	0.36%/1%
Crosstalk 1kHz/10kHz	37dB/29dB
19k/38k suppression	77dB/77dB

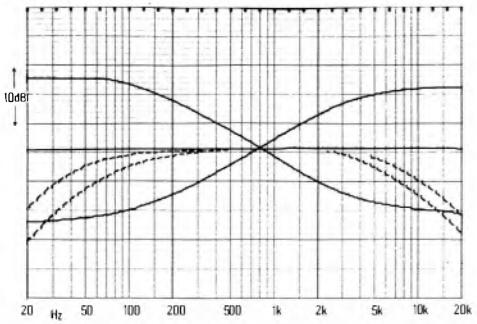
Tape (4000C)

Tape used for tests	BASF CrO_2 (C60)
Replay azimuth alignment	78°
Wow and Flutter	0.11%
L/R Jitter at 3kHz	24.7°
Dolby ref. level readout on meters, 64mS under-read	+2dB/9dB
Distortion −6dB, 0dB, +3dB	0.68%/1.6%/3.8%
Line up on replay meters −6dB/0dB/+3dB	−6.3dB/−0.6dB/+1.8dB
Erasure efficiency (400Hz at Dolby level)	67.5dB
Signal/Noise biassed tape CCIR/ARM	51.5dB/61.5dB
Tape noise headroom wrt replay noise (no cass)	6dB

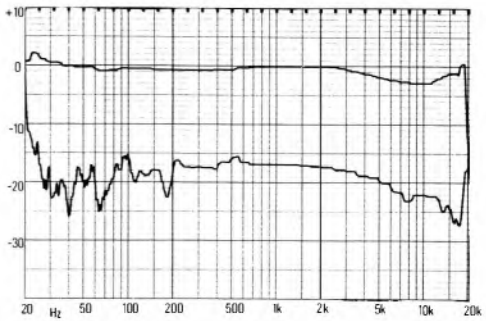
Disc (4000P)

HF Intermodulation distortion (10.8kHz pulsed)	0.73%
Tracks 1k+1.5k 31.5cm/sec band at	3.8gms
Effective mass of pickup + arm	18.9gms
Subsonic resonance freq/dB gain	8.1Hz/4.5dB
Estimated compliance	20cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	56dB
Wow and Flutter	0.11%
Rumble (DIN B)	69dB
Tracking weight error setting/actual	3gms/2.74gms
Pickup type	Shure M756S

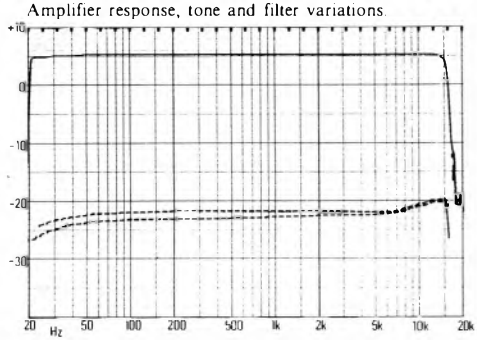
Available facilities	A, B, C, D, F, I, J, K, M, N, R, W, X, Y, Z, AA, AB, AC, AE, AI, AK, AL, AM, AN, AW, AX, AT, AZ, BA, BC, BD, BM, BQ
Loudspeaker sensitivity (2.828V pink noise)	85dB
Length of loudspeaker lead	3.4m
Azimuth adjustment	normal screw-type
Ferrite rod aerial	internal aerial externally rotatable to a degree
Typical System price	£545 inc speakers



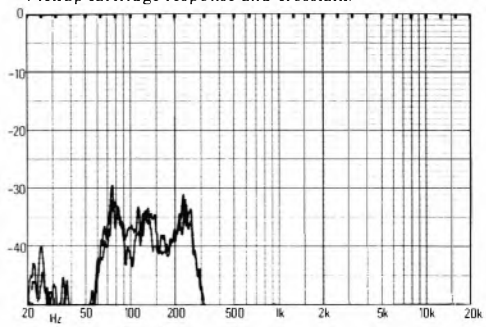
Amplifier response, tone and filter variations.



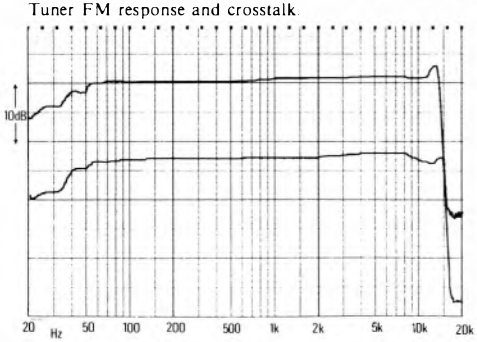
Pickup cartridge response and crosstalk.



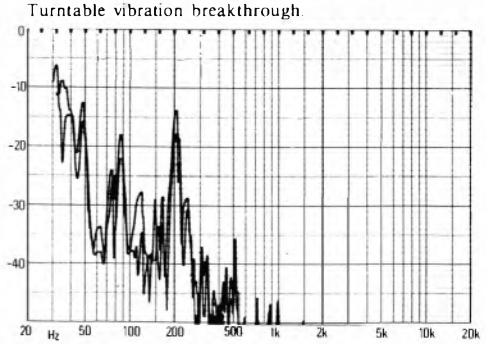
Tuner FM response and crosstalk.



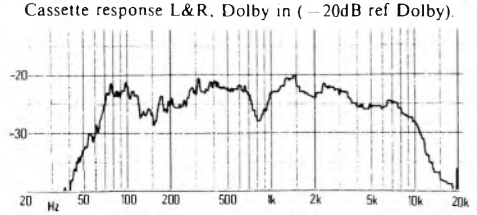
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

ITT system H

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

Introduction

ITT's *HI-FI 80* series has grown fast since its launch in 1978, and is very consciously oriented towards providing matched systems. The range of equipment is based on receivers, with suggested systems listed with and without cassette decks. Furniture is based around a simple vertical trolley with glass-fronted record storage.

Virtually as we were going to press we heard of a new addition to the top of the ITT range, the *5 series*, which offers separate amplifier and tuner for the first time, and more unusually fits a moving-coil cartridge. This highly specified system, which costs nearly £1000, has its own more luxurious trolley plus promise of a special console offering greater immunity to feedback.

General description

The ITT system comprises an *8031* receiver/amplifier, an *8020* cassette deck, an *8014* two-speed belt drive semi automatic turntable and small two-way bookshelf loudspeakers. The equipment is finished in brushed aluminium and fitted in a wood veneered cabinet with record storage being provided below the cassette deck. The glass door covering the record storage area is horizontally hinged and may be slid away from view above the records. Interconnections at the rear of the equipment are mainly of the DIN type though phono sockets are included on the cassette deck. The record deck is placed on top of the receiver and is isolated by four sprung feet, though the usefulness of such feet is debatable. With the equipment stacked directly on top of each other and a receiver used in place of the usual tuner and amplifier, the rack is significantly smaller than average, with an overall height of less than 0.9m. The quality of construction and the visual matching between units was excellent, though the record deck did look a little out of place standing directly on top of the receiver.

Receiver *(8031)*

Position indent rotary tone controls are fitted with a centre indent balance control and a finely stepped large rotary volume control. Facilities on the front panel include loudness, AFC and high frequency filter switches to allow either of two sets of loudspeakers to be connected, and five pre-set selectors for stations in the FM band.

Power output was a modest 20 watts into 8 ohms rising to 26.8 watts when a 4 ohm load is used, whilst the IHF intermodulation distortions were rather worse than average mainly due to the limited power bandwidth of the amplifier above 10kHz. Hum modulation at near maximum power levels was good and the dynamic headroom was 0.9dB. The signal-to-noise ratio was particularly good at 90dB as was the inter-channel crosstalk at low power levels. The input impedance of the phono section was reasonably optimised at 43k ohms though the input capacitance was on the high side at 410pF, significantly limiting the choice of suitable alternative replacement pickups that the owner might wish to use. The overall frequency response of the amplifier was very flat. Generous amounts of cut and boost are provided by the tone control circuits.

The tuner section of the receiver had a good IHF least usable sensitivity level of 2uV with 360uV being needed to achieve the maximum signal/noise ratio for stereo reception. The signal-to-noise ratios achieved in both the mono and stereo modes were above average as were the radio frequency rejection ratios, and though the adjacent channel rejection was well above average at 6dB, the alternate channel rejection was a little disap-

pointing at 48dB. The five pre-set tuning controls are positioned above the main tuning cursor, the actual tuning of these pre-sets being carried out *via* five small tuning knobs covered behind a small panel in the top of the receiver. When the pre-set stations are being tuned the signal strength meter doubles as a tuning frequency indicator of the station frequency.

The radio frequency intermodulation distortion products were very low at 70dB as were the audio distortion levels, the total harmonic distortion using a 100% modulated L=−R carrier being only 0.2% rising to 0.62% when single channel modulation was applied. Stereo crosstalk was about average though the 38kHz pilot carrier suppression was lower than average at 46dB. The overall frequency response of the tuner was generally quite smooth though it did tend to fall away above 10kHz, being some 4dB down at 15kHz. In summary, a receiver of moderate performance that seems to strike an intelligent compromise between price and technical performance.

Cassette deck *(8020)*

The cassette deck is fitted with twin VU meters under-reading by 6.5dB on a 64mS long pulse supplemented by a peak LED indicator that only starts to under-read on pulse durations of less than 16mS. A tape selector switch is included to vary both the equalisation and bias levels simultaneously, though a variable bias control is available for fine adjustments. Tests carried out using the Maxell *UDXL1* tape indicated that the coarse bias setting provided by the tape selector was not optimum, use of the fine control being necessary for optimum tape performance. A user-adjustable bias control is an excellent feature in the hands of a knowledgeable owner, but it may only result in a less-than-optimum performance in other hands. Tape mechanics were only average with a wow and flutter level of 0.14%, though the inter-channel jitter was adequate at 20°.

Recording level adjustment is provided by a single level control at the extreme right hand end of the deck, a separate channel balance control being provided. Tape transport keys were generally positive if a little stiff to operate, whilst the cassette eject mechanism was nicely damped. Overall tape line-up was good, resulting in average levels of distortion and slightly lower than average levels of signal-to-noise ratio. Headphone and microphone input sockets are provided on the front panel, the microphone socket being of the 5-pin DIN type. Generally a well designed deck with some interesting features, though the wow and flutter values were on the high side.

Record deck *(8014)*

The record deck is a two-speed semi-automatic belt drive design with fine speed adjustment, variable anti-skating force and detachable SME type headshell. The tonearm. plinth and platter are all firmly connected together with the base being supported on resilient feet. Though the isolated suspension system looks impressive, its effectiveness in minimising vibrational breakthrough is questionable, and acoustic breakthrough is rather worse than average.

The deck is fitted with an Audio Technica *AT11E* cartridge giving a reasonable performance with low levels of HF intermodulation distortion and an adequate tracking performance. High frequency performance was below average possibly due to the higher than optimum input capacitance of the amplifier, though the crosstalk levels were typical of a pickup in this price class. The DIN weighted wow and flutter levels were particularly low at 0.08% with average levels of signal-to-noise and rumble. The low frequency resonance occurred at 7.2Hz, rather lower than desirable but better than many others.

Listening tests and overall appraisal

The loudspeakers supplied with the system are small two-way bookshelf designs of moderate sensitivity with a clean smooth response limited (as you would expect by the size) at low frequencies. The limited low frequency performance of the loudspeakers is in fact beneficial in reducing the amount of low frequency acoustic breakthrough when records are being played. A noticeable loss of extreme high frequency response was evident on disc, but otherwise the quality was very good with low levels of wow and flutter and rumble when subjectively judged. The quality from the tuner section of the receiver was generally very good with no serious problems on the FM band. The good sensitivity coupled with low distortion and excellent signal-to-noise ratios combined to give the tuner an above average rating.

The wow and flutter levels on the tape deck were subjectively obvious though the well extended record/replay response obtained using the higher than recommended levels of bias certainly im-

ITT system H

proved the quality. The loudspeakers are small and obviously appropriate for true bookshelf housing if space is a serious problem. The system is quite compact considering the record storage space available at the base of the rack and at a price of £450 does represent reasonable value for money. A firm recommendation however cannot be given in view of the higher than average amplifier distortion levels and the acoustic breakthrough levels on the record deck.

Amplifier (8031 Tuner-Amp)

Power Output 8ohms/4ohms	20/26.8 watts
Hum modulation 50Hz/100Hz/150Hz	3.5dB/0dB/2dB
Dynamic Headroom	0.9dB
Signal/Noise ratio CCIR/ARM	90dB
Ambient output voltage CCIR/ARM weighted	0.4mV
Phono input impedance/capacitance (inc lead)	43k/410pf
Crosstalk 1kHz/10kHz	48dB/48dB
Gain tracking error. ¼/½/¾ setting	2.5dBL/0.2dBL/0.7dBL
Balance	0.6dBL
3dB Bandwidth (at 1W RMS)	11Hz/55kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	68dB/65dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	61dB/56dB

Tuner (As above)

IHF least usable sensitivity	2uV
50dB quieting mono/stereo	2.3uV/27uV
Signal/Noise 1mV CCIR/ARM	73.5dB/70dB
Min signal for max S/N ratio mono/stereo	38uV/360uV
AM rejection	62.5dB
IF rejection	>80dB
Image rejection	62dB
Capture ratio	2.5dB
Adjacent/Alternate channel rejection	6dB/48dB
RFIM	70dB
Distortion L/−R. L only	0.2%/0.62%
Crosstalk 1kHz/10kHz	38dB/36dB
19k/38k suppression	59dB/46dB

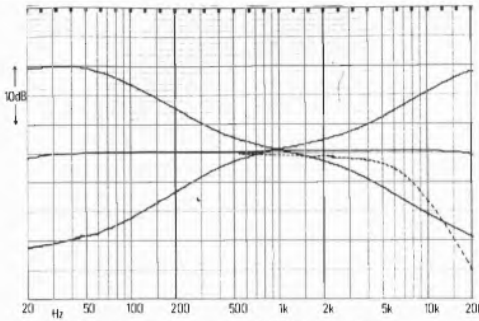
Tape (8020)

Tape used for tests	Maxell UDXLI (C90) (Bias+4)
Replay azimuth alignment	37
Wow and Flutter	0.14%
L/R Jitter at 3kHz	29
Dolby ref. level readout on meters. 64mS under-read	+3.5dB/6.5dB
Distortion −6dB. 0dB. +3dB	0.28%/0.5%/0.75%
Line up on replay meters −6dB/0dB/+dB	−5.5dB/0dB/+3dB
Erasure efficiency (400Hz at Dolby level)	69.5dB
Signal/Noise biassed tape CCIR/ARM	47dB/56dB
Tape noise headroom wrt replay noise (no cass)	6.5dB

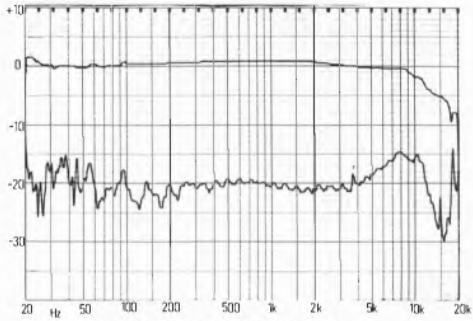
Disc (8014)

HF Intermodulation distortion (10.8kHz pulsed)	0.37%
Tracks 1k+1.5k 31.5cm/sec band at	1.4gms
Effective mass of pickup + arm	19gms
Subsonic resonance freq/dB gain	7.2Hz/7dB
Estimated compliance	27cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	59.5dB
Wow and Flutter	0.08%
Rumble (DIN B)	64dB
Tracking weight error setting/actual	2gms/2gms
Pickup type	Audio Technica AT11E

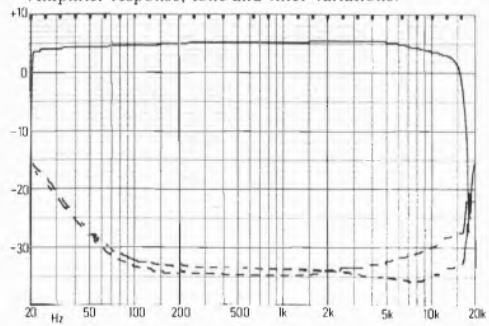
Available facilities	A. B. C. D. E. F. H. I. K. M. N. R. V. X. Y. Z. AA. AB. AE. AI. AK. AL. AM. AN. AW. AX. AY. AZ. BA. BC. BD. BM. BS
Loudspeaker sensitivity (2.828V pink noise)	84dB
Length of loudspeaker lead	no leads supplied
Azimuth adjustment	normal screw-type
Ferrite rod aerial	no external aerial
Typical System price	£450 inc speakers



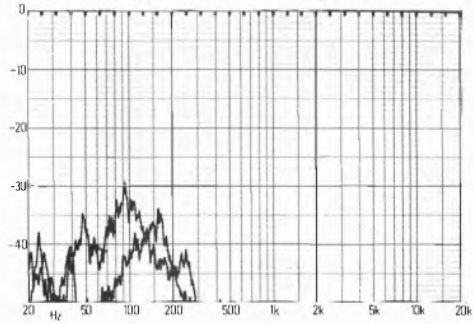
Amplifier response, tone and filter variations.



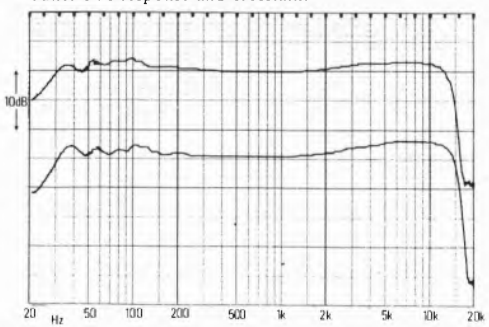
Pickup cartridge response and crosstalk.



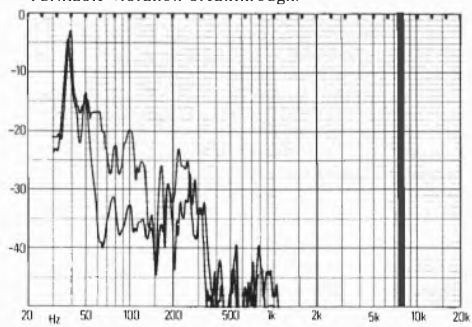
Tuner FM response and crosstalk.



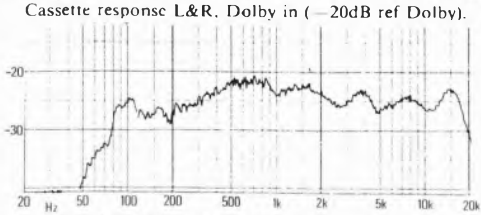
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (—20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

JVC system

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

Introduction

JVC's current policy is not to recommend fixed systems as such but to make available racks to accommodate their large range of separates, the final choice being left to customer and retailer. Although there are only two complete systems in the range, these being the music centres, there are a number of racks including one unusual (and expensive) 'tallboy' model, rather like a slim Welsh dresser, where the amp and tuner for example can be mounted well above the comfortable operating height for the turntable (the availability of this model is rather limited). More generally available are five racks in the *LK* series, and these include one to suit the music centres! JVC have also recently introduced a matching amplifier and tuner in the micro component style, and presumably this will in time expand into a complete range.

General description

For the price of £833 this system comes complete with a cassette deck capable of recording and replaying the new breed of metal tapes and a pair of three-way loudspeaker enclosures. The rack is finished in matt black with some simulated wood veneer and aluminium highlights. The tuner is stacked directly on top of the amplifier although the cassette deck has a shelf of its own above the record storage space. The hinged glass door at the front of the rack was not particularly liked as it tended to get in the way when opened to adjust the equipment, though the door could be removed if not needed.

The majority of the interconnections at the rear of the equipment are of the phono type with colour coded finger screw terminations for two sets of loudspeakers at the rear of the amplifier. The cassette deck, amplifier and tuner are all finished in the obligatory brushed aluminium with particularly large volume and tuning controls. A two-speed auto return belt drive deck is mounted at the top of the rack, the plinth being constructed from silver/grey matt finished plastic. The visual matching between units was very good and the overall quality of construction excellent.

Amplifier *(A-S5)*

The amplifier is fitted with rotary tone controls, a centre detent balance control and a particularly large rotary volume control. All these controls were extremely smooth in action. Pushbutton switches are provided on the front panel for the selection of auxiliary, tuner and phono sources, with a loudness switch adjacent to the volume control. Switches are provided for connecting either or both of two sets of loudspeakers to the amplifier and the comprehensive tape dubbing facilities allow recordings to be made to or from a second tape recorder. The input/output sockets for the separate tape recorder are very conveniently mounted on the front panel.

Power output into 8 ohms was about average at 39.4 watts rising to 45.8 watts when a 4 ohm load was connected. Performance in respect of hum modulation was very good and the overall signal-to-noise ratio was significantly better than average at 97dB. The frequency response was generally quite smooth and sensibly band limited from 9.5Hz to 45kHz with the tone controls providing only a moderate range of variation at 100Hz and 10kHz. The crosstalk performance was excellent as was the overall gain tracking error and channel balance, with the IHF intermodulation distortion products being particularly good at around −74dB. The

amplifier offers a very good overall performance and can easily be recommended.

Tuner *(T-V5L)*
The tuner is fitted with some unusual and effective signal strength and centre zero tuning meters in the form of a horizontal line of LED's below the left hand end of the tuning scale. Pushbutton waveband selectors and FM muting and multiplex switches are provided either side of the tuning knob. The IHF least usable sensitivity was very good at 1.1uV, with 330uV being required to achieve the maximum signal-to-noise ratio. The signal-to-noise ratio of 71dB CCIR/ARM weighted and all the RF rejection values were significantly better than average.

The overall FM frequency response was quite smooth though the response was down some 3dB at 26Hz and 16kHz. The crosstalk performance was outstandingly good, being in excess of 40dB over the majority of the mid frequency band. The harmonic distortion was very good being around 0.2% for both forms of test modulation and the RF IM level of 71dB was quite adequate. An external ferrite rod aerial is fitted at the rear of the tuner and is hinged (though not rotatable) to improve reception quality when receiving AM transmissions.

Cassette deck *(KD-A5)*
The single most expensive part of the system, the cassette deck features solenoid pushbutton tape transport controls, metal tape compatability, and both *ANRS* and *SuperANRS* noise reduction systems. JVC have always used their own noise reduction systems in preference to the more popular Dolby system on their more expensive machines, though replay of Dolby pre-recorded cassettes is usually no problem as the *ANRS* performance is reasonably compatible with that of Dolby B. The *SANRS* system is a little different in that it reduces the transient energy of the signal when recording, with a subtle form of expansion on replay. Tests were carried out using a normal ferric tape (Maxell *UDXL1*) though response curves were also taken with the latest TDK metal tape. The metal tape appeared to have little advantage over normal tape in respect of mid-frequency distortion and tape noise, though the high frequency performance at high modulation levels was outstanding, the record/replay frequency response taken at Dolby level being quite flat up to 16kHz! (If the frequency response is measured thus using a ferric tape, the output is usually down some 15–20dB at 15kHz!)

A row of five peak reading LEDs were located between the VU meters and provided good information on the near-peak signal levels applied to the tape. The overall technical performance of the deck was very good in almost all respects with only a minor criticism concerning the accuracy of tape line up. Concentric friction locked record level controls ease the problem of making a balanced fade. The solenoid operated tape transport controls were well liked and the cassette eject mechanism was particularly smooth in operation.

Record deck *(LA-11)*
This is a two-speed belt drive design fitted with a JVC *ZI-S* cartridge and featuring the usual anti-skating adjustments and reject mechanism. The performance of the pickup was below average, a 2gm increase in recommended tracking force being required before the pickup would track the 31.5cm/sec band reasonably well. The overall frequency response of the pickup was quite smooth with a minor peak occurring at 19kHz and average levels of crosstalk. The high frequency intermodulation distortion was higher than average whilst the subsonic resonant frequency at 7Hz had a lower than average amplification level of 4dB. Performance of the record deck in respect of wow, flutter and rumble was about average whilst the signal-to-noise ratio was a little better than average at 62.5dB. Though the separate components of the deck are solidly connected together the performance in respect of both acoustic and vibrational breakthrough was a little better than average. In summary the deck was a reasonable performer though the limited performance of the pickup prevents any enthusiastic recommendation.

Listening tests and overall appraisal
Listening tests were carried out using the Mordaunt-Short *Pageant* and *Signifer* loudspeakers and the JVC *SK 700 II* loudspeakers supplied with the system. The JVC loudspeakers comprise three drive units in a ported enclosure with mid and high frequency output level controls fitted to the front panel. Though they had a reasonable on-axis frequency response the unusual deployment of the drive units on the front baffle resulted in unsatisfactory stereo imaging. Performance in respect of the harmonic distortions was good and the bass extension was reasonable.

JVC system

Audio quality from the tuner was rated well above average with low levels of distortion and noise and a well extended audio frequency response. The tape quality was also well liked especially when using the metal tape facilities, the performance being obviously superior on wide-band heavily orchestrated music. However ferric tape was found to be more than adequate for the majority of the recordings. The *ANRS* noise reduction system was well liked but the *SANRS* system was heard to 'breathe' occasionally during quieter passages.

Disc quality was reasonable with low levels of acoustic breakthrough and satisfactory levels of wow, flutter and rumble. Tracking performance was about average and though the overall frequency response was smooth some high frequency distortion was audible on difficult musical passages. In summary an interesting offering from JVC with some fine technical features that falls just a little short of a firm recommendation in view of the problems in respect of pickup trackability and loudspeaker imaging detail.

Amplifier (A-S5)

Power Output 8ohms/4ohms	39.4/45.8 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/5dB/2dB
Dynamic Headroom	1dB
Signal/Noise ratio CCIR/ARM	97dB
Ambient output voltage CCIR/ARM weighted	0.62mV
Phono input impedance/capacitance (inc lead)	48kohm/148pf
Crosstalk 1kHz/10kHz	54dB/49dB
Gain tracking error, ¼/½/¾ setting	0.5dBR/0dB/0.1dBR
Balance	0dB
3dB Bandwidth (at 1W RMS)	9.5Hz/45kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	75dB/75dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	73dB/75dB

Tuner (T-V5L)

IHF least usable sensitivity	1.1uV
50dB quieting mono/stereo	2.2uV/28uV
Signal/Noise 1mV CCIR/ARM	73.5dB/71dB
Min signal for max S/N ratio mono/stereo	34uV/330uV
AM rejection	63dB
IF rejection	>75dB
Image rejection	60dB
Capture ratio	1.8dB
Adjacent/Alternate channel rejection	1dB/55dB(50/60)
RFIM	71dB
Distortion L/−R, L only	0.2%/0.18%
Crosstalk 1kHz/10kHz	44dB/43dB
19k/38k suppression	38dB/56dB

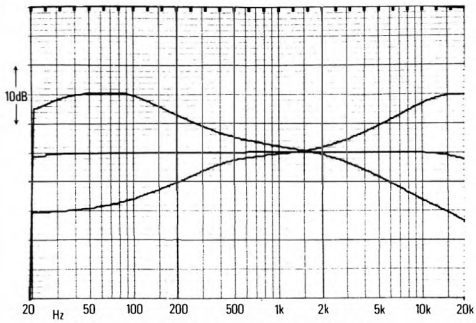
Tape (KD-A5)

Tape used for tests	Maxell UDXLI C90
Replay azimuth alignment	42°
Wow and Flutter	0.093%
L/R Jitter at 3kHz	23°
Dolby ref. level readout on meters, 64mS under-read	+3.2dB/−5.5dB
Distortion −6dB, 0dB, +3dB	0.5%/0.8%/0.8%
Line up on replay meters −6dB/0dB/+3dB	−4.5dB/+1.5dB/+5dB
Erasure efficiency (400Hz at Dolby level)	67dB
Signal/Noise biassed tape CCIR/ARM	48dB/59dB
Tape noise headroom wrt replay noise (no cass)	8dB

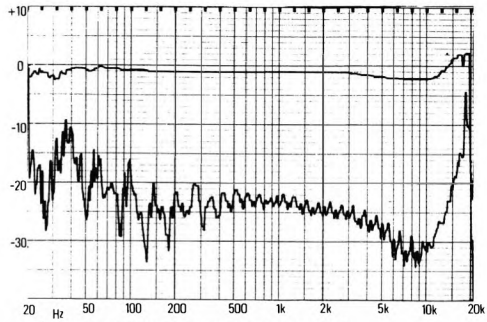
Disc (L-A11)

HF Intermodulation distortion (10.8kHz pulsed)	0.5%
Tracks 1k+1.5k 31.5cm/sec band at	>4gms
Effective mass of pickup + arm	20.6gms
Subsonic resonance freq/dB gain	7Hz/4dB
Estimated compliance	25cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	62.5dB
Wow and Flutter	0.08%
Rumble (DIN B)	64.5dB
Tracking weight error setting/actual	2gms/1.96gms
Pickup type	JVC ZI-S

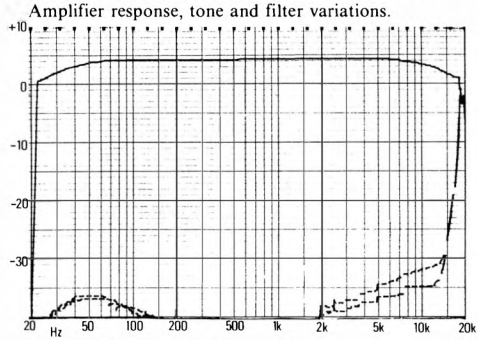
Available facilities	A, B, E, H, I, J, M, N, R, V, Y, Z, AA, AB, AK, AL, AM, AN, AX, AY, AZ, BA, BC, BD, BM, BG, BH, BR, BS
Loudspeaker sensitivity (2.828V pink noise)	91.5dB
Length of loudspeaker lead	—
Azimuth adjustment	not easily accessible
Ferrite rod aerial	hinged but not rotatable
Typical System price	£833 inc speakers



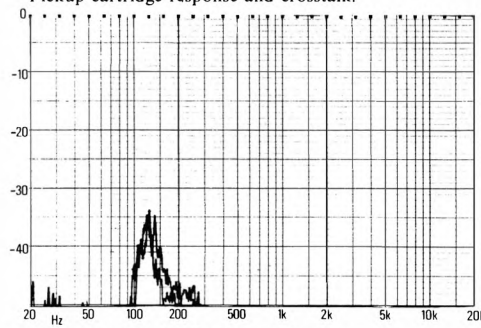
Amplifier response, tone and filter variations.



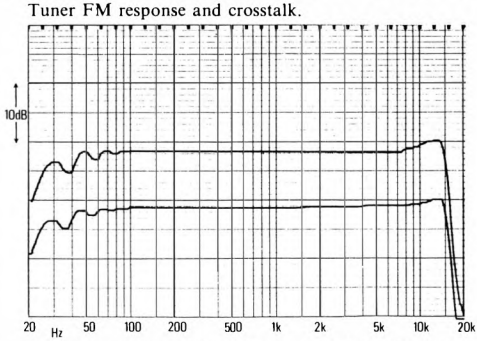
Pickup cartridge response and crosstalk.



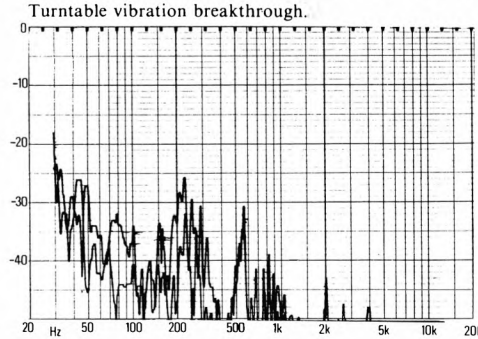
Tuner FM response and crosstalk.



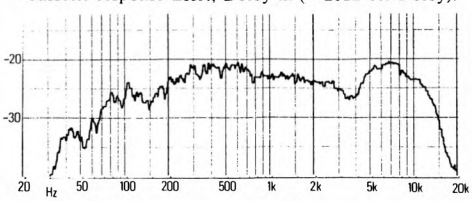
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

Marantz system

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

Introduction

With a range of over eighty models in their catalogue excluding sundries like cartridges and furniture, the Marantz line is sometimes difficult to keep in perspective (we are glad we don't have to stock take). While their catalogue lists certain recommended systems, the one submitted here for review has been selected to incorporate some of the more recent models which were introduced in Autumn 1979.

The policy is to make racks available for housing the wide range of possible separates or receiver combinations, all models showing an unusual degree of styling individuality and a close family identity. The racks are all of the vertical kind, some offering a glass door and record housing.

General description

This larger-than-average equipment is housed in a sturdy, black finished wood veneered rack, storage space for records being provided behind the hinged glass door at the base of the rack. The equipment is finished in a slightly tinted brushed aluminium alloy and features a number of unusual control layouts. The tone controls on the amplifier are of the vertical slider type and are mounted directly above the sequential LED power meters. A source-to-mike mixing facility is included on the amplifier which allows the signal from a mono-microphone (plugged into the socket provided on the amplifier front panel) to be mixed to any degree with any source selected on the amplifier. (This allows the owner to add his own commentary to a recording made from any source.) The tuner features a gyro-touch tuning knob, basically a normal tuning knob with its rotational axis mounted vertically. The cassette deck featured a super hard permalloy head and sequential LED recording meters with virtually PPM characteristics. The tonearm, platter and plinth of the direct drive record deck are all rigidly connected together, the plinth being constructed from a plastic moulding of a similar colour to those used on the sound reproducing equipment. Phono sockets are used throughout with a 5-pin DIN socket being provided on the cassette deck but not on the amplifier.

Amplifier *(PM 280)*

The sequential LED power meters on the amplifier were incorrectly calibrated and overestimated the power output by about 10%. An adequate amount of power is available however, some 48.7 watts into an 8 ohm load. Distortion at near maximum power levels was generally very good though it was noted that the third order high frequency distortion components were creeping up a little. All controls operated easily with the slider tone controls having

position indent markings and the balance control having a centre indent position. A mid-frequency tone control is included modifying the output in the frequency band centred around 800Hz. A single rotary switch is used to select the basic inputs with a tape monitor switch adjacent to the main selector. Hum modulation at maximum power levels tended to be a little disappointing, an increase in output of 8dB being recorded at 50Hz and 7dB at 150Hz. In almost all other respects the amplifier performance was above average.

Tuner *(ST 300)*
Tuning is carried out via the large gyro touch tuning knob mounted on the right hand side of the front panel and rotating on a vertical axis, and the front panel design is obviously intended to match the amplifier and cassette deck. The sensitivity of the tuner was found to be lower than average, the IHF least usable sensitivity being 3.2uV. AM rejection measured using a 30% amplitude modulated carrier was below average at only 43dB, as was the image rejection at 58dB. The IF rejection and the adjacent/alternate channel rejections were all about or above average as was the RFIM distortion. Though the harmonic distortion measured with a 100% L – R signal was reasonable, the single channel distortion levels were well in excess of 1%. The overall frequency response of the tuner was found to be sensibly limited, the response being some 1dB down at 24Hz and 15kHz. Crosstalk levels were generally good, particularly so at 10kHz where the performance was even better than that obtained at 1kHz. In summary a good looking tuner of moderate performance with reservations concerning the audio frequency distortion levels and low RF sensitivity.

Cassette deck *(SD 300D)*
The cassette deck is a front-loading design featuring a super hard permalloy head, a record mute facility, a switchable multiplex filter and a 'compu-skip' control to allow passages on the programme to be skipped. The individual record controls were difficult to operate inasmuch as smooth symmetrical fades were a virtual impossibility. Replay azimuth alignment on arrival was found to have an average error of 38° with left/right hand channel phase jitter 23° and a significantly higher than average wow and flutter level of 0.14%. Dolby reference level on the meters was set at +1db whilst the overall line up on the meters using TDK *SA C60* tape was very good. The lower-than-average Dolby reference level setting accounts to some extent for the higher than normal distortion levels and the slightly improved signal-to-noise ratios. The overall record/replay response was smooth with very little evidence of any head contour distortion, though the output did fall away rather quickly above 14kHz. The performance of the deck was a little disappointing even though it has many excellent points, notably the metering which was particularly fast in action. The rather high values of wow and flutter performance, the high distortion levels and separate record level controls all combine however to withhold recommendation.

Record deck *(6170)*
This robustly constructed two-speed direct drive deck was tested with an ADC *QLM 34* MkIII pickup cartridge, a very reasonably priced model offering an adequate if not outstanding performance. The low compliance of the pickup coupled with the high effective mass of the arm resulted in a subsonic resonant frequency of 9.5Hz with an amplification of 8dB, certainly a step in the right direction when considering the many decks in this survey exhibiting subsonic resonances at 5–7Hz. The platter was fitted with stroboscopic markings and a fine speed control. The deck was supported on large rubber feet isolated from the plinth via large diameter steel springs. Such a construction should ensure good vibration isolation but because the 'Q' of the springs was low and their resonant frequency high the actual isolation achieved was only moderate. Acoustic breakthrough was also rated as moderate to poor, not too surprising when it is considered that the arm, platter and plinth are all solidly connected together. The wow and flutter figures and rumble levels were however outstandingly good, though the measurement of rumble was made rather difficult to some extent by the high level of hum induced into the pickup.

Listening tests and overall appraisal
The lower-than-average sensitivity of the tuner did not appear to be a problem during the listening tests when listening to the relatively strong national stations, but some problems were experienced when using the relatively weak local and commercial stations. The overall sound quality was generally considered clean with some comments concerning slight high frequency emphasis, though

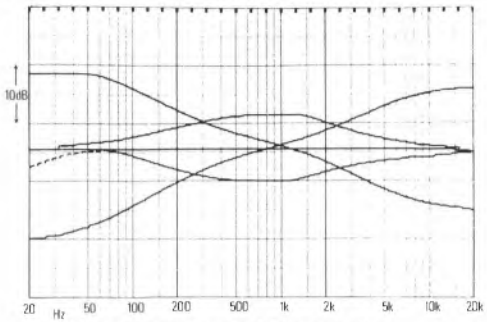
Marantz system

there was no technical foundation for this. The distortion was acceptable though not outstandingly good at high modulation levels, whilst stereo crosstalk and imaging were ranked well above average.

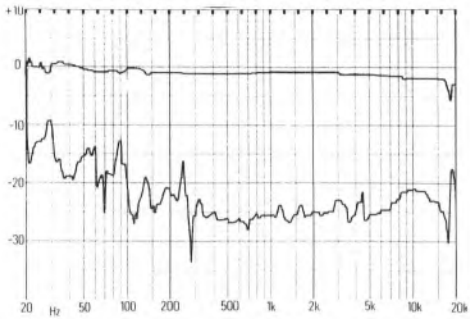
Sound quality from records was also clean, though there were reservations concerning the tracking performance of the pickup.* The hum pickup mentioned earlier was only just audible at normal playing levels with the overall quality being about average with some mild problems due to acoustic breakthrough. It was noticed that the recording meters on the cassette tape deck were a little difficult to see under daylight conditions, though this of course did not affect the subjective judgement which was generally critical of the high wow and flutter and the distortion at high modulation levels. Though more than adequate for the majority of needs, the Marantz system exhibits a number of slight problems which preclude a firm recommendation.

*The tracking weight used was 2.2g, the same as for the sample accorded Best Buy rating in *Cartridges and Headphones*. The stylus/cantilever is designed to permit up to 3g, so some increase above 2.2g might have been appropriate with this sample.

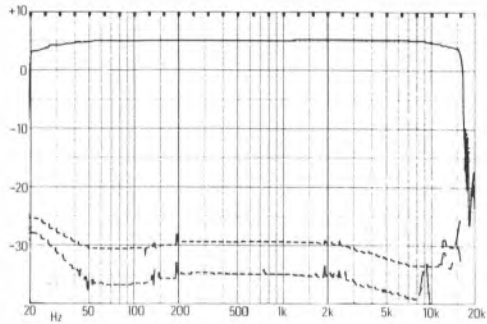
Amplifier (PM 280)	
Power Output 8ohms/4ohms	48.7/56.6 watts
Hum modulation 50Hz/100Hz/150Hz	8dB/0dB/7dB
Dynamic Headroom	1.45dB
Signal/Noise ratio CCIR/ARM	95dB
Ambient output voltage CCIR/ARM weighted	0.45mV
Phono input impedance/capacitance (inc lead)	47k/294pf
Crosstalk 1kHz/10kHz	48dB/44dB
Gain tracking error, ¼/½/¾ setting	0dB/0dB/0.3dBL
Balance	0.3dBL
3dB Bandwidth (at 1W RMS)	6Hz/160kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	>78dB/72dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	73dB/68dB
Tuner (ST 300)	
IHF least usable sensitivity	3.2uV
50dB quieting mono/stereo	5uV/65uV
Signal/Noise 1mV CCIR/ARM	73dB/68dB
Min signal for max S/N ratio mono/stereo	125uV/550uV
AM rejection	43dB
IF rejection	>80dB
Image rejection	58dB
Capture ratio	2.7dB
Adjacent/Alternate channel rejection	+5dB/+58dB
RFIM	69dB
Distortion L/−R, L only	0.45%/1.3%
Crosstalk 1kHz/10kHz	31dB/38dB
19k/38k suppression	65dB/72dB
Tape (SD 300D)	
Tape used for tests	TDK SA C60
Replay azimuth alignment	38
Wow and Flutter	0.14%
L/R Jitter at 3kHz	23
Dolby ref. level readout on meters. 64mS under-read	+1dB/0dB
Distortion −6dB, 0dB, +3dB	0.44%/1.2%/2.5%
Line up on replay meters −6dB/0dB/+3dB	−5dB/0dB/+3dB
Erasure efficiency (400Hz at Dolby level)	68dB
Signal/Noise biassed tape CCIR/ARM	50.5dB/60dB
Tape noise headroom wrt replay noise (no cass)	8dB
Disc (6170)	
HF Intermodulation distortion (10.8kHz pulsed)	0.45%
Tracks 1k+1.5k 31.5cm/sec band at	2.4gms
Effective mass of pickup + arm	21.6gms
Subsonic resonance freq/dB gain	9.5Hz/8dB
Estimated compliance	12cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	59.5dB
Wow and Flutter	0.075%
Rumble (DIN B)	>65dB
Tracking weight error setting/actual	2.2gms/2.08gms
Pickup type	ADC QLM 34 Mk III
Available facilities	A, B, D, E, H, I, J, M, N, R, V, W, Y, Z, AA, AB, AI, AK, AL, AM, AN, AW, AX, AY, AZ, BB, BC, BD, BM, BN, BP
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw type
Ferrite rod aerial	hinged and rotatable
Typical System price	£520



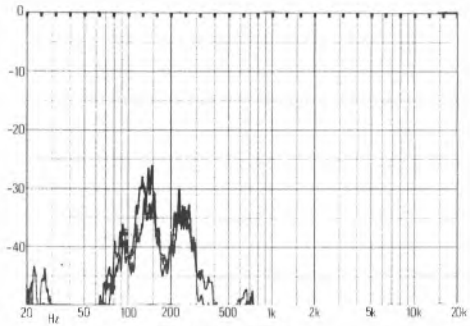
Amplifier response, tone and filter variations.



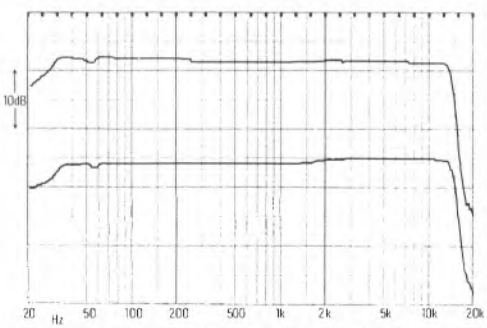
Pickup cartridge response and crosstalk.



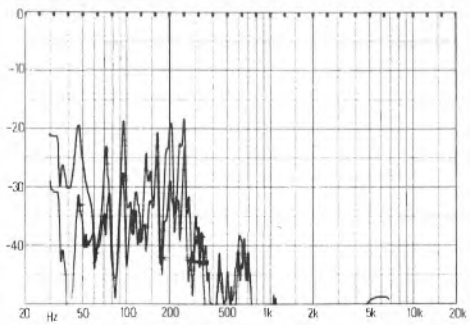
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

RECOMMENDED

Optonica system

Sharp Electronics UK Ltd., Sharp House, 107 Hulme Hall Lane, Manchester M10 8HL. Tel: (061) 205 7321

Introduction

Optonica are the hi-fi division of consumer electronics giant Sharp, who are of course strong contenders in the music centre marketplace and have themselves started moving into the rack system market recently. The tested system is a combination of the cheaper separates items in Optonica's traditionally styled range, though the cabinet can accommodate the more sophisticated and expensive components from the same range without difficulty. A further item of furniture, this time vertically oriented, is expected to be introduced in early '80. The latest components from Optonica amount to three ranges of low profile separates, visually compatible with one another but different to the models tested here. The two styles of presentation are considered complementary and will continue to be marketed side by side for the foreseeable future.

General description

One of the more inexpensive systems in the Optonica range of equipment, the *1616* system is housed in possibly the largest rack seen in this survey. The amplifier, tuner and cassette deck are stacked vertically at the left of the rack, storage space being provided beneath the equipment for headphones and additional accessories. The record deck may be fitted in the top shelf or in a separate compartment to the right of the equipment above the record storage area. A hinged glass door is fitted to protect the record storage space and upper compartment which may be used alternatively as a drinks cabinet. The equipment is finished in brushed aluminium, the majority of the rack being constructed from black tinted veneered chipboard with simulated wood veneered side panels.

All the interconnections at the rear of the equipment are of the phono type, with 5-pin DIN sockets for tape signals being provided on the cassette deck and amplifier. Colour coded wire clamp type terminals are available for loudspeaker connections and a hinged ferrite rod aerial is fitted to the rear of the tuner to improve reception on the AM bands. Quality of construction throughout was exceptional and the aesthetic appeal unquestionable, but the positioning of the amplifier less than a foot from the floor level was not liked.

RECOMMENDED

Amplifier *(SM 1616)*
Fitted with power meters that under-read by 10dB on a 64mS long pulse, the amplifier allows either or both of two sets of loudspeakers to be connected and also offers very comprehensive tape dubbing arrangements. Switched high and low frequency filtering, a loudness switch and a 20dB mute switch are provided. Output power into an 8 ohm load is 45.7 watts rising by 10 watts when a 4 ohm load is used. Performance in respect of hum modulation and dynamic headroom was above average and the signal-to-noise ratio was particularly good at 91dB.

The phono input impedance/capacitance characteristics were reasonably well optimised and whilst increasing the input capacitance could improve the frequency response of the exisiting pickup it does tend to have the effect of restricting the choice of any replacement pickup that may be fitted in the future. The overall frequency response of the amplifier was very smooth and extended from below 6Hz to well over 100kHz, the desirability of such a wide bandwidth being rather questionable. The tone control range was adequate if a little restricted at the high frequency end, the bass and treble controls being of a rotary position detent type with particularly well shaped aluminium knobs. A large rotary detent type volume control is also fitted with the pushbutton mute switch positioned directly below the control and the balance control is of the rotatable centre detent type. The overall technical performance of the amplifier was generally above average although the wide bandwidth is of questionable merit.

Tuner *(ST 1615)*
A dual gate MOSFET design with a phase locked loop decoder, the *ST 1616* Tuner was capable of a very fine technical performance: the IHF least usable sensitivity was 2uV and only 280uV was needed to achieve the maximum signal-to-noise ratio. All the radio frequency rejections were good though the AM rejection was a little lower than average at 48dB. The radio frequency intermodulation distortion figure of 70dB was very good as was the capture ratio of 1.4dB. The tuner is fitted with a 'high blend' switch to improve the signal-to-noise ratio on weak stereo signals, but only at the expense of the crosstalk performance. An unusual feature is an 'air check' calibrator which switches a 400Hz calibration tone in place of the program to enable a tape deck to be easily set up when recording FM broadcasts. Signal strength and centre zero tuning meters are fitted below the tuning scale and the rotary waveband selector positioned adjacent to the large tuning knob switches between LW, MW, FM stereo and FM mono sources.

Audio distortion levels both on L=−R 100% modulated carriers and single channel only modulated carriers were particularly low and the 19kHz and 38kHz pilot rejection levels of 67dB and 74dB were better than average. The audio frequency response was very smooth from 28Hz up to 16kHz and the channel to channel crosstalk performance was particularly good, especially at low modulation levels. In summary an attractive AM/FM tuner capable of a good technical performance and well matched to the amplifier.

Cassette deck *(RT 1616)*
The deck is fitted with the Sharp auto program search system, separate bias and equalisation selectors, a peak reading LED set to flash at Dolby level to supplement the recording meters and an unusual hinged perspex lid to cover the cassette chamber. The technical performance was above average with the azimuth alignment error being near zero and a low wow and flutter level of 0.096%. Inter-channel phase jitter was fairly typical at 25° and Dolby level was set quite accurately at +2.6dB. Overall tape line-up was out by around +2.5dB resulting in slightly higher than usual levels of distortion but a commensurately improved signal-to-noise ratio.

The twin VU meters under-read by 6dB on a pulse of 64mS duration; however the peak reading LED set at Dolby level did not under-read even for very short pulse durations. Using the Maxell *UDXL1* tape the record/replay response was very smooth from 35Hz up to 15kHz with very little difference between channels.

Record deck *(RP 2727)*
The record deck is a two-speed direct drive design with a high density resin motor board which added significantly to the overall weight of the deck. Whilst this perhaps offered significant improvements in very low frequency acoustic breakthrough, at frequencies above 60Hz the breakthrough was fairly typical of decks with the tonearm, plinth and platter all firmly connected together. The rubber feet fitted to the base of the deck did little to reduce the transmission of vibration into the deck. The Ortofon *FF15E Mk II*

RECOMMENDED

Optonica system

cartridge had a very satisfactory performance, distortion being low and trackability above average when the tracking weight was 0.3gm above the manufacturer's recommended figure.

The overall frequency response was generally smooth with a rise in output above 10Hz and the crosstalk levels were typical of a pickup in this price class. There was some indication that the anti-skating force was inaccurate as the tracking performance was improved when the pickup was set to track at 2gms with the anti-skating force set at a nominal 3gm tracking weight. Generally the rumble and signal-to-noise ratio performance was good while the measured wow and flutter were low at 0.07%. Fine speed adjustment is provided and there is an auto start/auto return capability that allows repeated play of a record. Calibration of the stylus pressure was reasonable and the general finish was of a high standard, the cueing action being particularly well liked.

Listening tests and overall appraisal

The audio performance of the tuner was well liked though the higher frequencies were a little over-emphasised. The harmonic distortions were obviously very low and the stereo image and channel crosstalk performance were both excellent. The tuner was notably free from any radio frequency interference problems and sensitivity was sufficiently high to deal easily with weak stations. Tape record/replay quality using the Maxell *UDXL1* tape was generally very clean and particularly free from wow and flutter. On many recordings only the inevitable increase in noise due to tape hiss indicated that it was a tape recording and not the original source. The replay response on pre-recorded cassettes was also fine, and as usual limited more by the quality of the recording than by any shortcomings in the equipment. The record deck was found to be slightly susceptible to acoustic breakthrough at highish listening levels whilst excellent levels of wow and flutter and rumble were measured. The choice of an Ortofon pickup was a wise move as the overall quality of signal from disc was very satisfactory, with only minor reservations concerning the tracking performance at high modulation levels. The excellent quality of construction of the equipment and storage rack and the good overall technical performance justifies a recommendation.

Amplifier (SM 1616)

Power Output 8ohms/4ohms	45.7/57 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/0dB/2dB
Dynamic Headroom	1dB
Signal/Noise ratio CCIR/ARM	91dB
Ambient output voltage CCIR/ARM weighted	0.55mV
Phono input impedance/capacitance (inc lead)	47kohm/150pf
Crosstalk 1kHz/10kHz	47dB/41dB
Gain tracking error, ¼/½/¾ setting	0dB/0dB/+0.3dBR
Balance	+0.3dBR
3dB Bandwidth (at 1W RMS)	6Hz/109kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	76dB/70dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	76dB/68dB

Tuner (ST 1616)

IHF least usable sensitivity	2uV
50dB quieting mono/stereo	2.6uV/36uV
Signal/Noise 1mV CCIR/ARM	72dB/65dB
Min signal for max S/N ratio mono/stereo	50uV/280uV
AM rejection	48dB
IF rejection	>80dB
Image rejection	82dB
Capture ratio	1.2dB
Adjacent/Alternate channel rejection	3.5dB/60/48dB
RFIM	70dB
Distortion L/−R, L only	0.22%/0.2%
Crosstalk 1kHz/10kHz	41dB/33dB
19k/38k suppression	67dB/74dB

Tape (RT 1616)

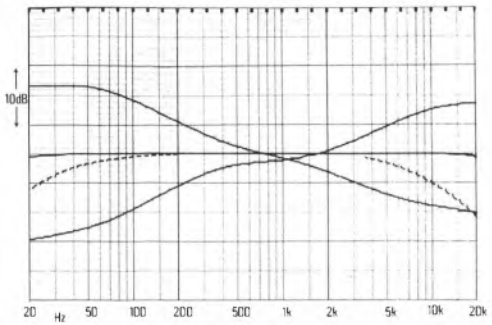
Tape used for tests	Maxell UDXL1 (C60)
Replay azimuth alignment	5°
Wow and Flutter	0.096%
L/R Jitter at 3kHz	25°
Dolby ref. level readout on meters, 64mS under-read	+2.6dB/−6dB
Distortion −6dB, 0dB, +3dB	0.36%/0.7%/1.1%
Line up on replay meters −6dB/0dB/+3dB	−3.8dB/+2.5dB/+5.8dB
Erasure efficiency (400Hz at Dolby level)	70dB
Signal/Noise biassed tape CCIR/ARM	49.5dB/59dB
Tape noise headroom wrt replay noise (no cass)	10dB

Disc (RP 2727)

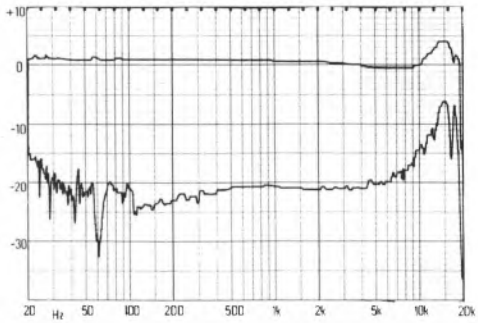
HF Intermodulation distortion (10.8kHz pulsed)	0.27%
Tracks 1k+1.5k 31.5cm/sec band at	2.3gms
Effective mass of pickup + arm	21.2gms
Subsonic resonance freq/dB gain	6.6Hz/9.5dB
Estimated compliance	27cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	63dB
Wow and Flutter	0.07%
Rumble (DIN B)	62dB
Tracking weight error setting/actual	2gms/1.86gms
Pickup type	Ortofon FF15E Mk II

Available facilities	A, B, D, E, H, I, J, N, O, Q, R, V, W, X, Y, Z, AA, AB, AE, AI, AK, AL, AM, AN, AP, AW, AX, AY, AZ, BC, BD, BM, BN, BP, BR, BS
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	no access without dismantling unit
Ferrite rod aerial	hinged but not rotatable
Typical System price	£550

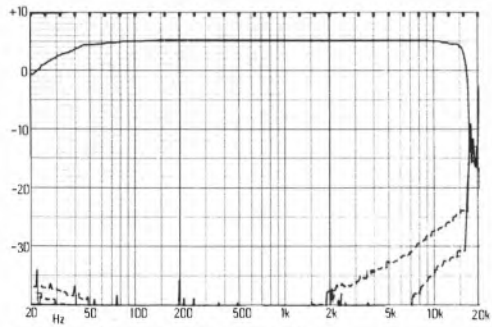
RECOMMENDED



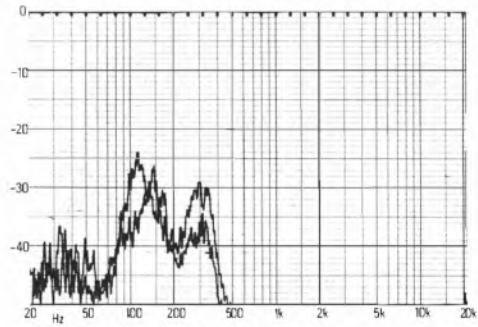
Amplifier response, tone and filter variations.



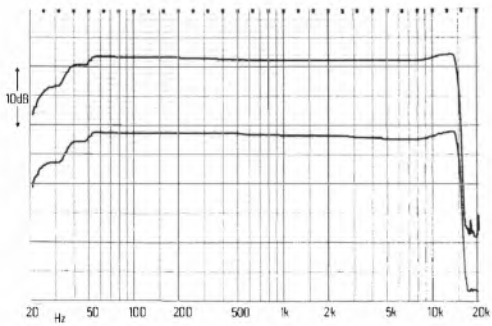
Pickup cartridge response and crosstalk.



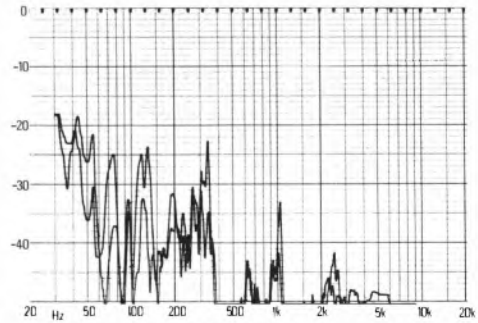
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

Philips '70 Black Tulip system

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

Introduction

The reorganisation of Philips Audio during the past few years led first in 1978 to systems based on a horizontal furniture-look, with silver-fronted components offering integrated styling. 1979 sees the addition of the up-market *Black Tulip* series, which is an even more radical departure for a company that has hitherto been more home entertainment than hi-fi oriented. *Black Tulip* is to be marketed through a limited range of specialist dealers, and a specific service back-up centre is also being set up. The range already comprises two complete systems, the cheaper *'70* being tested here. The *'80* system provides improved specifications including a digital frequency synthesizer tuner with programmable memory. In addition to these electronics packages, a high performance open-reel recorder, a receiver, two turntables and two MFB speakers are incorporated into the package along with other high specification components.

General description

This unusual offering from Philips comprises a 'direct control' record deck, separate power and pre-amplifiers, a slim-line tuner to match the panel dimensions of the amplifiers and a front loading cassette tape recorder. The power amplifier and cassette deck are manufactured in Japan whilst the tuner, record deck and pre-amplifier originate from Belgium. In spite of this the visual matching between units was surprisingly good, though the black finish on the Japanese goods was noticeably more intense than the finish on the European equipment.

All interconnections between units are made at the rear of the equipment and are mainly of the phono type, though 5-pin DIN sockets for tape are included on the cassette deck and the pre-amplifiers. Two inputs are provided on the power amplifier, one of which has a range from DC up to around 100kHz while the other is fitted with a high pass filter with a lower cut-off of 10Hz. Both heat and DC protection circuits are incorporated in the power amplifier, indicators on the front panel lighting up when either trip has been operated. Jack type headphone sockets are fitted to the pre-amplifier, power amplifier and cassette deck with similar mono jack sockets used in the cassette deck for microphone insertion. Unfortunately the rack in which the units are to be mounted was not available to house the equipment at the time of the tests, and in consequence the acoustic breakthrough tests on the record deck had to be carried out with the deck standing on a solid concrete floor. However care was taken to mount the units in the position they would occupy if rack mounted to simulate any interaction effects between the units.

Amplifier *(270 + 370DC)*

One of the most powerful amplifiers in this survey, 76 + 76 watts is available across an 8 ohm load increasing to 98 + 98 watts into a 4 ohm load. The power meters fitted to the main amplifier read low by some 7dB on a 64mS long pulse and by 16dB on a 32mS pulse. Hum modulation was excellent whilst a dynamic headroom of 0.7dB was recorded on an 8 ohm load. Signal-to-noise ratio was lower than average at 74dB (CCIR/ARM weighted), the residual noise being predominately due to the pre-amplifier. The controls of the pre-amplifier are of the centre indent discrete step type for bass, treble and balance adjustment. A large click-type volume control is used on the main amplifier, while additional features include separate high and low frequency filters, a loudness control, a mute switch, temperature and DC protection on the power amplifier and a loudspeaker selection switch

allowing either or both of two sets of loudspeakers to be connected to the amplifier. The frequency response of the amplifier extended well up to 95kHz though this may not have the advantages that are often claimed. The high and low frequency filters had a disappointingly low rate of cut off, the high frequency filter having a performance that differed little from that of the treble tone control.

Tuner *(170)*
Simplicity of operation must have been foremost in the designer's mind, for this tuner has only three controls on the front panel, an on/off switch, a waveband selector and a tuning knob. Sensitivity was below average, the IHF least usable level being 3.2uV, approximately 500uV being required to achieve the maximum stereo signal-to-noise ratio. However the ultimate signal-to-noise ratio was excellent and AM rejection was considered reasonable at 59dB. Serious criticisms have to be made however regarding the image rejection ratio which was low at 30dB, the poor capture ratio of 5.5dB and the alternate channel rejection of only 28dB. Even more serious problems came to light when testing the tuner in the stereo mode, for when using a carrier level of 1mV 100% modulated in the L=−R condition the audio distortion was 1.1% rising to well over 3% when single channel modulation was applied. The overall frequency response was quite smooth and the inter-channel crosstalk was very good, especially at low modulation levels. In view of the rather disappointing performance of the tuner a second sample was requested from Philips, though this proved to be no better than the original. The tuner obviously cannot be recommended.

Cassette deck *(N2537)*
The front loading cassette deck was fitted both with twin VU meters and a peak indicating LED. The LED had an ingenious dual role in that it glowed green when the cassette recorder was in the record mode but glowed red when the +3dB limit on the meters was exceeded. Tape transport controls were of the standard piano key type with three levels of bias and two different equalisation settings available on the tape-select keys. A three position Dolby noise reduction control switch allowed the system to operate both with and without a Multiplex filter.

An output level control is fitted, the recording level being adjusted by friction locked rotatable controls positioned below the VU meters. Frequency response curves were taken both with the Philips CrO_2 tape and Maxell *UDXL1* tape, and though neither were particularly outstanding the Maxell tape was thought to be a little better and was consequently used for the remainder of the tests. Overall record/replay line up was fair, the output levels being some 1.5dB higher than indicated on the meters during recording. Erasure efficiency and tape noise headroom with respect to replay noise were considered to be good, whilst the signal-to-noise ratio using the Dolby system was average at 57.5dB. Though the azimuth alignment was a little out on arrival (48° at 3kHz), the wow and flutter was commendably low at 0.088%, and the inter-channel phase jitter was acceptable at 23°.

Record deck *(AF 729)*
This is a two-speed 'direct control' design employing a floating sub-chassis with an integral stylus force gauge fitted to the arm rest, sophisticated speed control and auto play controls. A speed indicator in the form of three in line LEDs is employed, the central LED lighting up when the speed is correct and the left and right LEDs indicating 'slow' and 'fast'. Fine speed controls, speed selectors and play and reject push-buttons are fitted to the angled panel at the front of the deck and are accessible even with the dust cover down. The floating chassis construction ensures that both acoustic and vibrational breakthrough are reduced to a moderate, if not outstandingly, low level. Wow and flutter was low at 0.07% with rumble a very respectable −68dB. The pickup (Philips *401*) is a moderate compliance design resulting in the arm/pickup resonance occurring at 7.2Hz with an amplification of 9dB. Tracking performance was well above average, though the replay response was some 2dB down between 2.5kHz and 12kHz with a mild 'lump' at 17kHz.

Listening tests and overall appraisal
The sound quality provided by the tuner was generally about average, though distinct 'birdies' were clearly audible on two of the national stations as well as the local stations. Distortion was average except at high modulation levels whilst the overall frequency response was slightly lacking at the low frequency end of the range. The replay response on the cassette deck was very good with low wow and flutter and a stable stereo image, whilst the

Philips'70 Black Tulip system

record/replay response was just a little hard and bright. In fact the increase in output at high frequency that results from using Maxell *UDXL1* tape compensates to some extent for the high frequency response of the pickup cartridge if dubbing discs. The overall quality from records was good however, apart from the slight channel unbalance of 2dB and the limited HF response of the pickup. The deck was pleasantly free from any serious feedback problem and wow and flutter and rumble judged subjectively were very low. Generally then a somewhat above average performance system with some outstanding features, but marred by the significantly lower-than-average performance of the tuner supplied.

Note: Philips have asked us to point out that the tuners tested were pre-production models, and that they intend to sort out the problems we noted forthwith.

Amplifier (270 pre-amp + 370 DC power amp)

Power Output 8ohms/4ohms	76/98.5 watts
Hum modulation 50Hz/100Hz/150Hz	1dB/0dB/0dB
Dynamic Headroom	0.7dB
Signal/Noise ratio CCIR/ARM	74dB
Ambient output voltage CCIR/ARM weighted	5mV
Phono input impedance/capacitance (inc lead)	51k/202pf
Crosstalk 1kHz/10kHz	51dB/39dB
Gain tracking error. ¼/½/¾ setting	0dB/0.7dBR/0.2dBR
Balance	0.3dBL
3dB Bandwidth (at 1W RMS)	11.5Hz/95kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	65dB/73dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	64dB/71dB

Tuner (170)

IHF least usable sensitivity	3.2uV
50dB quieting mono/stereo	6.3uV/48uV
Signal/Noise 1mV CCIR/ARM	71dB/66dB
Min signal for max S/N ratio mono/stereo	63uV/480uV
AM rejection	59dB
IF rejection	58dB
Image rejection	30dB
Capture ratio	5.5dB
Adjacent/Alternate channel rejection	0dB/28dB
RFIM	68dB
Distortion L/−R, L only	1.1%/3.2%
Crosstalk 1kHz/10kHz	36dB/25dB
19k/38k suppression	35dB/30dB

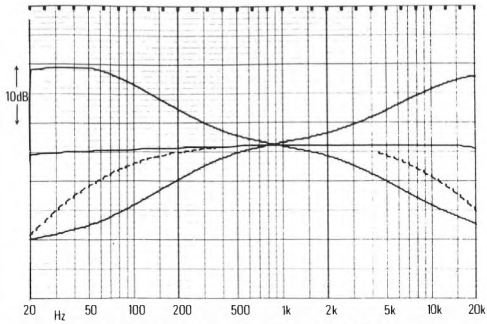
Tape (N2537)

Tape used for tests	Maxell UDXL1 (C60)
Replay azimuth alignment	48°
Wow and Flutter	0.088%
L/R Jitter at 3kHz	23°
Dolby ref. level readout on meters, 64mS under-read	+2dB/4.5dB
Distortion −6dB, 0dB, +3dB	0.4%/0.6%/0.8%
Line up on replay meters −6dB/0dB/+3dB	−4.5dB/+1.5dB/+4.4dB
Erasure efficiency (400Hz at Dolby level)	68.5dB
Signal/Noise biassed tape CCIR/ARM	48dB/57.5dB
Tape noise headroom wrt replay noise (no cass)	10dB

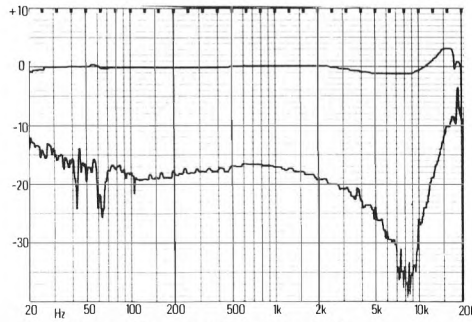
Disc (AF-729)

HF Intermodulation distortion (10.8kHz pulsed)	0.28%
Tracks 1k+1.5k 31.5cm/sec band at	1.3gms
Effective mass of pickup + arm	16.2gms
Subsonic resonance freq/dB gain	7.2Hz/9dB
Estimated compliance	30cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	64dB
Wow and Flutter	0.07%
Rumble (DIN B)	68dB
Tracking weight error setting/actual	2gms/2.16gms
Pickup type	Philips 401

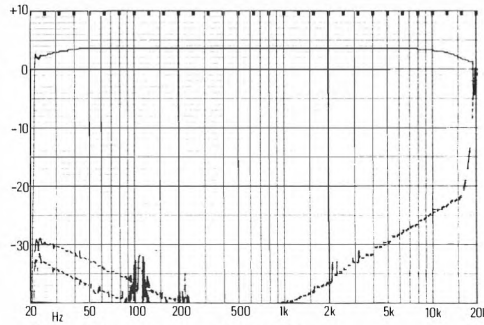
Available facilities	A. B. D. E. I. N. R. V. W. X. Y. Z. AA. AB. AE. AI. AK. AL. AM. AN. AQ. AW. AX. AY. AZ. BA. BD. BM. BN. BR. BS
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw-type
Ferrite rod aerial	no external aerial
Typical System price	£770



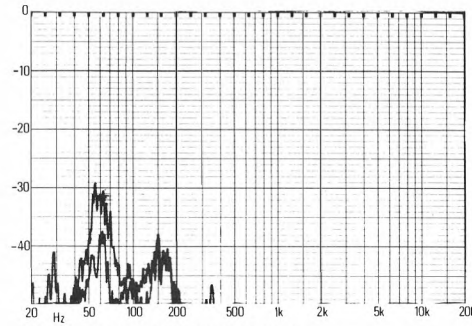
Amplifier response, tone and filter variations.



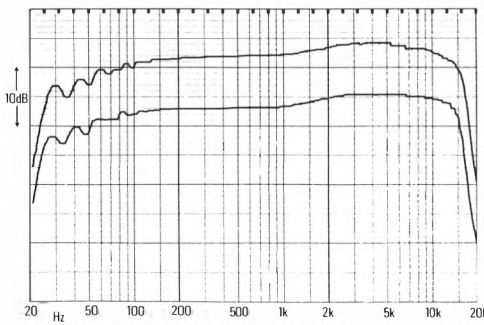
Pickup cartridge response and crosstalk.



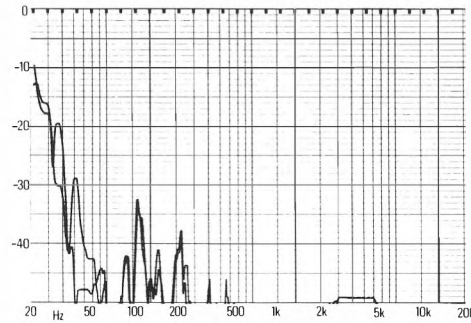
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

RECOMMENDED

Pioneer X55

Pioneer High Fidelity (GB) Ltd., The Ridgeway, Iver, Buckinghamshire SL0 9JL. Tel: (0753) 652222

Introduction

Pioneer were probably the first company to start heavy promotion on hi-fi component systems, their 'black panther' campaign implying that 'serious' hi-fi was now domesticated. (For '79/'80 the panther is baring its teeth: the photo session I am told was quite an experience!) The new range consists of four systems, but offering up to seven styling alternatives, depending on the height and storage space provided with the three more expensive ones.

The *X55* tested here is the second from bottom (or third from top). The three top systems all share the same glass-fronted cabinet with an unusual recessed turntable section which incorporates its own dust cover, imparting a more integrated appearance to the whole; the tuner is also common to these three systems. The *X33, X55* and *X77* share the same cassette deck, but turntable and amplifier become progressively more sophisticated and powerful. The cheaper *X33* uses a slimline amp and tuner and omits the glass lid and player housing arrangement. A proper metal rack is available to match the really expensive components at the top of Pioneer's range, including a reel-to-reel tape recorder in the 'front-loading' style. There is also a 'mini' system with a rather more cosmetic metal housing for shelf mounting, offering very slim components with high specification to match the width of what must be one of the narrowest record decks around.

General Description

The Pioneer equipment is housed in an unusual rack, finished in matt black plastic with hinged plate glass top lid and door. The amplifier, tuner and cassette deck are stacked directly on top of each other and have the usual brushed aluminium front panel finish, with large rotary knobs for volume, tuning and recording level controls. The bar-graph record and power meters fitted to the amplifier and cassette deck are tinted dark blue, matching the LEDs used in the tuning and signal strength meters used on the tuner. Interconnections at the rear of the equipment are of the phono type with 5-pin DIN sockets for tape fitted to the amplifier and cassette deck. The record deck is a two-speed direct drive design with the platter and tonearm fitted on an isolated sub-chassis. A perspex lid is provided with the record deck but it is more convenient to remove this and use the glass hinged cover fitted to the cabinet for dust protection. The quality of construction and visual matching between the units was considered excellent, though the side hung glass door did tend to get in the way when using the system.

Amplifier *(SA 508)*

The amplifier is fitted with two 'bar-graph' power meters fitted with very peak reading LEDs, fast enough to indicate the peak value of an 8mS pulse. Interestingly enough similar meters fitted to the cassette deck read 5dB low on a pulse of 64mS duration. The amplifier is fitted with a click-stop rotary tone, balance and volume controls. Switch-

able subsonic filter and loudness controls are available while a selector switch allows either or both of two sets of loudspeakers to be employed. The measured power output was 37.8 watts into 8 ohms rising to 46.4 watts when a 4 ohm load is used. The distortion levels at −3dB below maximum power were generally excellent though it was noted that the IHF intermodulation distortion rose rapidly at levels greater than 2.5dB below maximum power. Hum modulation effects were low and the signal-to-noise ratio was outstandingly good at 95dB. Crosstalk was particularly good at low power levels as was the overall frequency response; the tone control range was limited to about ±8dB at 100Hz and 10kHz. In summary then a good amplifier with sufficient power and performance to satisfy most needs.

Tuner *(TX 608L)*

Front panel controls on the tuner are kept to a minimum, waveband selector switches and a muting switch being all that are provided. The tuning knob and scales are both large and easy to use with signal strength meters and a tuning indicator meter being fitted above the tuning scale. An external ferrite rod aerial is fitted to the rear of the equipment to aid AM reception; it is both hinged and rotatable to ensure that reasonable reception may be obtained whatever the orientation of the tuner.

The tuner was very sensitive, the IHF least usable sensitivity being 1.6uV with only 360uV being needed to achieve the maximum signal/noise ratio. All the RF rejections were well above average, though the alternate channel rejection values differed on either side of the tuned point.

The overall frequency response of the tuner was particularly smooth, dropping by only 1.4dB at 15kHz with well balanced levels of channel crosstalk. Audio distortions were particularly low, the distortion with a L=−R 100% modulation stereo carrier being around 0.25%. The 19kHz pilot rejection was very good at 67dB though the 38kHz rejection was significantly lower than average at 38dB. Obviously a well made tuner with some sophisticated circuitry that should be suitable for all but the most demanding user.

Cassette deck *(CTF 606)*

The tape transport controls on this deck are particularly well set out with the fast forward/rewind keys being positioned close together as were the record/play keys. With this layout it is possible to push down both the record and play keys at the same time with only one finger, though of course accidental erasure of a precious tape may also occur if care is not taken. The deck is fitted with a bar-graph LED metering system matching the power meters on the amplifier, though as mentioned earlier, the ballistics of the metering on the cassette deck are significantly slower than those of the power meters, the recording level meters under-reading by 5dB on a 64mS pulse. A smooth response extending up to 15kHz was obtained using Maxell *UDXL1* tape, though the bias level did appear to be set a little low, the response rising by some 2dB at 10kHz.

The tape drive mechanics were above average, the wow and flutter level being only 0.09%, interchannel jitter being of the order of 26°. The tape selector switch fitted below the recording level meters controlled both the bias levels and equalization levels simultaneously whilst the input level is adjusted by concentric friction locked controls. Tape line up was very good using the Maxell tape, the distortion levels and signal-to-noise ratios being typical of those found on a good ferric tape. Erasure was an adequate 68dB and the tape headroom with respect to replay noise was well above average at 10.5dB.

Record deck *(PL 200)*

The *PL 200* deck is a two-speed direct drive auto return design featuring fine speed adjustment, detachable SME type headshell and adjustable anti-skating force. The arm and platter assembly are mounted on a well isolated sub-chassis with the result that both acoustic and vibrational breakthrough are commendably low. The direct drive design results in particularly low levels of rumble and wow and flutter, though the signal-to-noise ratio of 57dB (CCIR/ARM weighted) achieved when rotating, was a little lower than average. The replay response of the *PC 110/II* pickup was generally quite smooth, though a high frequency resonance was noticeable at 10kHz. The pickup intermodulation distortion was acceptable at 0.4% as was the tracking performance but the pickup's higher than average compliance coupled with the high mass of the pickup/arm assembly resulted in a particularly low subsonic resonance of 4.7Hz, with a high amplification of 9.3dB. In view of the fine performance of the record deck and system it is a pity that a good cartridge of low compliance could

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Pioneer X55

not have been fitted, especially when considering the high effective mass of the pickup and arm assembly. The performance could be greatly improved by the use of a cartridge more closely matched to the arm.

Listening tests and overall appraisal

Listening tests carried out using the Mordaunt Short *Pageant IIs* and the *Signifers* confirmed the benefits of a tuner with a smooth response, low levels of distortion, good stereo separation and negligible RF interference problems. The controls on the tuner were well liked and easy to use as were the signal strength and optimum-tune meters.

Though the LED record level meters fitted to the cassette deck were slightly slow they were particularly easy both to use and see. Recordings made from record and tuner revealed a smooth even response free from any stereo image problems, with particularly low subjective levels of wow and flutter. Record quality was free of any serious acoustic or vibrational interference with an extended frequency response and reasonable cross-talk levels. The signal-to-noise ratio was not a problem even on the best of discs, though the high frequency resonance of the pickup was objectionable on heavily orchestrated passages. The pickup did tend to bounce around on warped records, but apart from this the overall performance of the system was very good, and a firm recommendation can be easily made, with only minor criticism regarding the awkwardness of the front glass door and the lack of record storage space below the equipment.

Amplifier (SA 508)

Power Output 8ohms/4ohms	37.8/46.4 watts
Hum modulation 50Hz/100Hz/150Hz	4dB/0dB/2dB
Dynamic Headroom	0.9dB
Signal/Noise ratio CCIR/ARM	95dB
Ambient output voltage CCIR/ARM weighted	0.56mV
Phono input impedance/capacitance (inc lead)	55k/145pf
Crosstalk 1kHz/10kHz	51dB/50dB
Gain tracking error, ¼/½/¾ setting	0.6dBL/+0.2dBL/0dB
Balance	0dB
3dB Bandwidth (at 1W RMS)	4.3Hz/46kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	70dB/72dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	71dB/73dB

Tuner (TX 608L)

IHF least usable sensitivity	1.6uV
50dB quieting mono/stereo	3.1uV/46uV
Signal/Noise 1mV CCIR/ARM	74dB/69.5dB
Min signal for max S/N ratio mono/stereo	54uV/360uV
AM rejection	70dB
IF rejection	>75dB
Image rejection	68dB
Capture ratio	1.2dB
Adjacent/Alternate channel rejection	2dB/44/56dB
RFIM	73dB
Distortion L/−R, L only	0.25%/0.2%
Crosstalk 1kHz/10kHz	38dB/35dB
19k/38k suppression	67dB/38dB

Tape (CT F600)

Tape used for tests	Maxell UDXL1 C90
Replay azimuth alignment	24°
Wow and Flutter	0.096%
L/R Jitter at 3kHz	26°
Dolby ref. level readout on meters, 64mS under-read	+3dB/−5dB
Distortion −6dB, 0dB, +3dB	0.4%/0.62%/0.85%
Line up on replay meters −6dB/0dB/+3dB	−6dB/+0.5dB/+3dB
Erasure efficiency (400Hz at Dolby level)	68dB
Signal/Noise biassed tape CCIR/ARM	48.5dB/58.5dB
Tape noise headroom wrt replay noise (no cass)	10.5dB

Disc (PL-200)

HF Intermodulation distortion (10.8kHz pulsed)	0.4%
Tracks 1k+1.5k 31.5cm/sec band at	1.8gms
Effective mass of pickup + arm	24gms
Subsonic resonance freq/dB gain	4.7Hz/9.3dB
Estimated compliance	47cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	57dB
Wow and Flutter	0.086%
Rumble (DIN B)	67dB
Tracking weight error setting/actual	2.2gms/2.2gms
Pickup type	Pioneer PC-110/II

Available facilities	A, B, D, E, H, I, J, M, N, R, V, W, Y, Z, AA, AB, AI, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BM, BR
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw-type
Ferrite rod aerial	hinged and rotatable
Typical System price	£500

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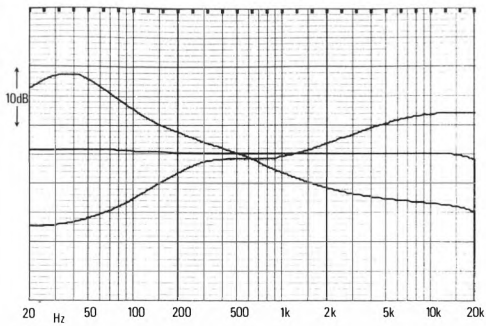
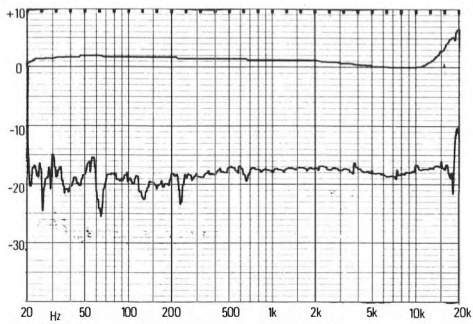
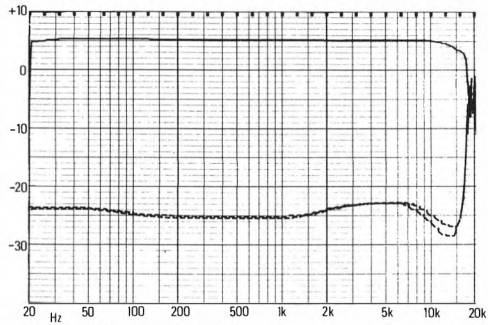


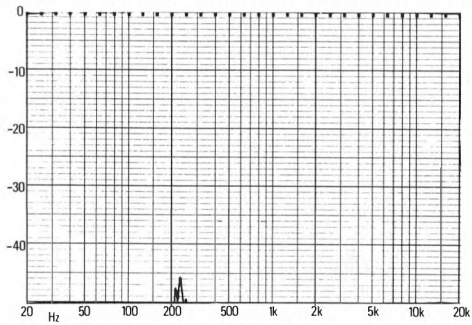
Amplifier response, tone and filter variations.



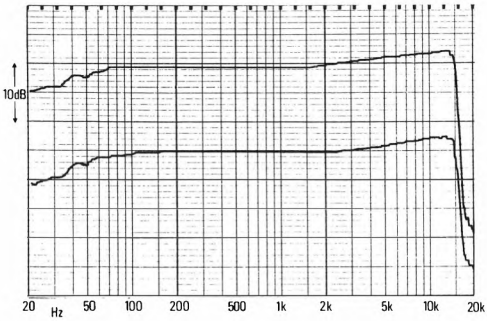
Pickup cartridge response and crosstalk.



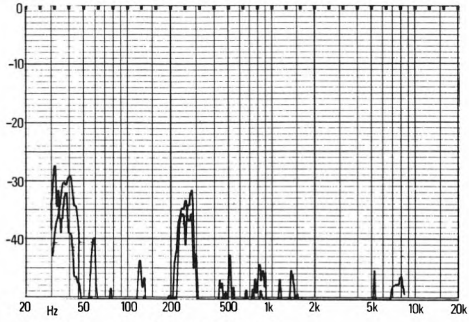
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

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Pye SX6090 Power Tower

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

Introduction

The *6090 Power Tower* is the first integrated separates system to be offered by Pye's comparatively new hi-fi division, though it seems likely that this is merely the beginning, and that lower priced combinations will be announced before too long. The Tower is available in two forms, either complete as tested or without the speakers and turntable; as both these items are listed separately anyway, together with alternatives, this offers some variety of choice. Furniture is also available to house the current range of hi-fi separates.

General description

The Pye system comprises separate pre-amplifier and power amplifiers, a *6190* tuner, *3537* cassette deck and an electronically controlled two-speed record deck. Comparisons between this and the Philips system are inevitable, although on our tests the Pye system must be considered the better of the two. All the electronics are finished with a fairly solid brushed aluminium front panels intended to be bolted on to a 19in rack mounting. Unfortunately no rack was available at the time the tests were carried out, but care was taken to ensure that the equipment was stacked to replicate the rack mounting and hence reproduce any proximity effects that may be encountered.

The majority of sockets at the rear of the equipment are of the phono type although 5-pin DIN sockets for tape are fitted on both the cassette deck and the pre-amplifier. Two input sockets are fitted to the power amplifier, one providing a signal having a frequency response down to DC whilst the other has a high pass filter cutting off at 3Hz. As with the Philips power amplifier both temperature and current protection circuits are included, red LEDs on the front panel indicating when either trip has operated.

The record deck is a two-speed direct control

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design with an isolated subchassis, features including touch sensitive speed selection and reject switching. As no rack was available the acoustic breakthrough tests on the record deck were carried out with the deck standing on a solid concrete floor. This may give a rather unrealistically favourable view of the performance.

Amplifier *(6290 + 6390)*
Two banks of light emitting diodes are fitted to the front panel of the power amplifier giving information on the individual channel power levels from −42dB up to the maximum power available. The LEDs were found to be particularly fast in operation and began to under-read only on pulses of less than 8mS in length. Power output into 8 ohms was a very high 70.9 watts rising to 97.5 watts when a 4 ohm load was connected. Hum modulation performance was better than average and the signal-to-noise ratio of 93dB was excellent. Rotary position-detent bass and treble controls are fitted with a centre detent balance control and a step type volume control. A rotary switch for selecting phono, tuner and auxiliary inputs is provided as are comprehensive tape dubbing facilities. The frequency response was very smooth from 3Hz up to 136kHz (!) with tone control ranges of around ±10dB at 100Hz and 10kHz. High frequency and subsonic filters are provided though the 'subsonic' filtering does in fact affect frequencies as high as 200Hz. Performance in respect of crosstalk and distortion was well above average and the amplifier deserves a strong recommendation.

Tuner *(6190)*
This is a particularly sensitive design with an IHF least usable sensitivity of 1.1uV, 260uV being needed to reach the maximum stereo signal-to-noise ratio. Signal-to-noise performance was very good as were the radio frequency rejections, though the AM rejection was a little lower than average at 52dB. The tuner includes signal strength and centre zero tuning meters fitted to the right of the tuning scale, with a bank of pushbuttons at the top of the scale offering muting, MPX filter, AFC and mono/stereo switching options. An AM/FM waveband selector and stereo pilot light are sited above the tuning meters. The capture ratio was very good at 1dB as was the RFIM level of 70dB. The frequency response was very smooth up to 16kHz with particularly low levels of crosstalk and distortion. Suppression of the 19 and 38kHz carriers were very good. A variable output control is provided on the rear panel, a similar control being fitted on the cassette deck enabling the signal from each source to be set to similar levels to avoid large jumps in signal level when switching between sources. An external ferrite rod aerial is fitted to the rear of the tuner and is both hinged and partially rotatable to facilitate optimum reception of AM broadcasts. Overall this is a fine design that achieves an above average rating in respect of technical performance.

Cassette deck *(3537)*
This is a front loading design with tape transport controls that were rather stiff in operation and a friction damped cassette ejection mechanism. Separate selection of bias and equalisation and Dolby noise reduction with a MPX switching option are provided. A line output control is provided on the front panel adjacent to the concentric friction-locked record level controls.

The deck is fitted with twin VU meters that under-read by 4.3dB on a 64mS pulse with a peak reading LED set to light up at Dolby level. The fast LED was particularly interesting in that it glowed green when the deck was in the record mode but changed to red when the +3dB limit on the meters was exceeded.

The overall tape line up and Dolby calibration levels were accurately set resulting in average levels of distortion and tape noise. The tape used was a Philips CrO_2 C60 type giving a reasonably flat response that extended well up to 15kHz. The wow and flutter was about average at 0.11% and the inter-channel phase jitter was acceptable at 19°. An input selector switch is provided for switching between the microphone DIN sockets and the main line sockets, and this is fitted with a useful mute position which cuts the signal completely without altering the setting of the record level controls.

Record deck *(5877)*
Similar in many ways to the Philips deck, this is a two-speed 'direct control' design with the tonearm and platter mounted on an isolated subchassis. Touch sensors are provided for speed selection, stop and reject functions, and an integrated stylus force gauge is fitted to the tonearm support. The arm is fitted with a Philips *401* cartridge giving a good overall frequency response, but showing a mild depression between 3kHz and 10kHz.

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Pye SX6090 Power Tower

Performance in respect of both tracking and distortion was very good although the subsonic resonance at 7.4Hz was rather pronounced with an amplification of 8dB. The wow and flutter was better than average at 0.08% and the rumble level was particularly low at −69dB. The floating subchassis construction resulted in commendably low levels of acoustic and vibrational breakthrough though these may have been taken under conditions that were more favourable than usual. A row of nine LEDs give information on speed accuracy, the centre LED indicating accurate adjustment of the pitch controls provided. The arm is fitted with a very light non standard headshell clamping arrangement and an adjustable anti-skating force control, the cueing lever being positioned to the right of the arm. In summary, a well designed deck with an overall performance that is significantly above average.

Listening tests and overall appraisal

The loudspeakers supplied with the system were reasonable, though the extreme high frequency response was rather poor and the stereo image detail below average. Surprisingly though the overall effect was not bad when judged subjectively, though in all the tests the less expensive *Pageant II* loudspeakers were preferred. Quality from disc was well above average with an exceptionally clean overall sound. Acoustically the deck was well isolated and the performance of the pickup was very reasonable. The deck controls were particularly well liked.

The record/replay quality from tape using the Philips CrO_2 C60 cassette was very clean with an above-average overall performance limited by the usual problems of HF compression and noise inherent in the medium rather than any shortcomings in the operation of the deck. The high frequency response at low modulation levels was well liked and the record level controls and peak reading LED worked well. Performance from the FM tuner was commendable, frequency response, distortion and crosstalk all being well above average. When considering the excellent overall performance of all the components in the rack (particularly the amplifier, tuner and record deck) the system easily achieves a strong recommendation, albeit with some reservations concerning the quality of the loudspeakers supplied.

Amplifier (6290 pre-amp+6390 power amp)

Power Output 8ohms/4ohms	70.9/97.5 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/3dB/0dB
Dynamic Headroom	1dB
Signal/Noise ratio CCIR/ARM	93dB
Ambient output voltage CCIR/ARM weighted	1.3mV
Phono input impedance/capacitance (inc lead)	52kohm/200pf
Crosstalk 1kHz/10kHz	51dB/46dB
Gain tracking error. ¼/½/¾ setting	0.5dBR/0.2dBR/0.2dBR
Balance	0.2dBR
3dB Bandwidth (at 1W RMS)	3Hz/136kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	>76dB/75dB
(−3dBref max pw) 10kHz+11kHz 2nd/3rdorder	>76dB/75dB

Tuner (6190)

IHF least usable sensitivity	1.1uV
50dB quieting mono/stereo	2.2uV/28uV
Signal/Noise 1mV CCIR/ARM	71dB/68dB
Min signal for max S/N ratio mono/stereo	34uV/260uV
AM rejection	52dB
IF rejection	>80dB
Image rejection	88dB
Capture ratio	1dB
Adjacent/Alternate channel rejection	1dB/58dB
RFIM	70dB
Distortion L/−R, L only	0.28%/0.5%
Crosstalk 1kHz/10kHz	50dB/38dB
19k/38k suppression	64dB/69dB

Tape (3537)

Tape used for tests	Philips CrO_2 (C60)
Replay azimuth alignment	27°
Wow and Flutter	0.11%
L/R Jitter at 3kHz	19°
Dolby ref. level readout on meters. 64mS under-read	+2.3dB/4.3dB
Distortion −6dB. 0dB. +3dB	0.6%/1.1%/2.1%
Line up on replay meters −6dB/0dB/+3dB	−5.5dB/0dB/+3dB
Erasure efficiency (400Hz at Dolby level)	69dB
Signal/Noise biassed tape CCIR/ARM	50.5dB/60dB
Tape noise headroom wrt replay noise (no cass)	8dB

Disc (5877)

HF Intermodulation distortion (10.8kHz pulsed)	0.32%
Tracks 1k+1.5k 31.5cm/sec band at	1.25gms
Effective mass of pickup + arm	15.2gms
Subsonic resonance freq/dB gain	7.4Hz/8dB
Estimated compliance	30cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	60dB
Wow and Flutter	0.08%
Rumble (DIN B)	69dB
Tracking weight error setting/actual	1.75gms/1.9gms
Pickup type	Philips 401

Available facilities	A. B. D. E. H. I. J. K. M. N. O. R. V. W. X. Y. Z. AA. AB. AE. AJ. AK. AL. AM. AN. AW. AX. AY. AZ. BA. BC. BD. BM. BN. BR. BS
Loudspeaker sensitivity (2.828V pink noise)	86dB
Length of loudspeaker lead	3m
Azimuth adjustment	normal screw type
Ferrite rod aerial	hinged and rotatable
Typical System price	£820 inc speakers

Pye SX6090 Power Tower

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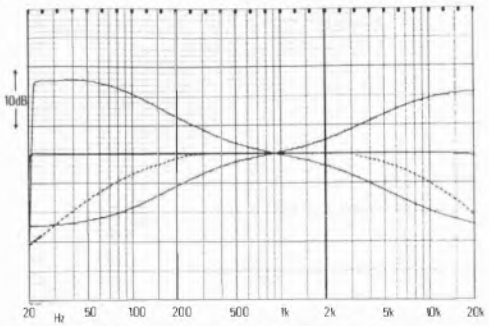
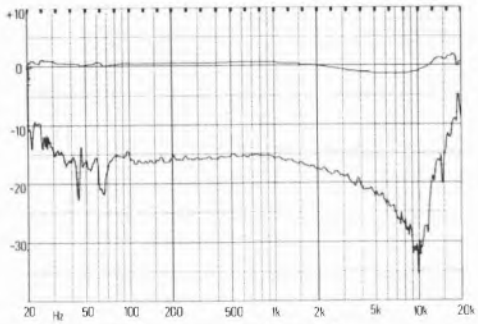
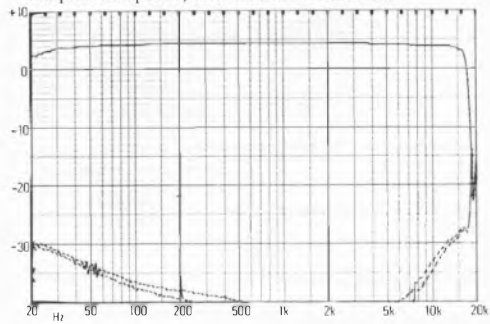


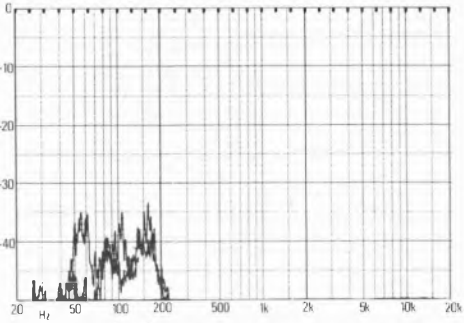
Amplifier response, tone and filter variations.



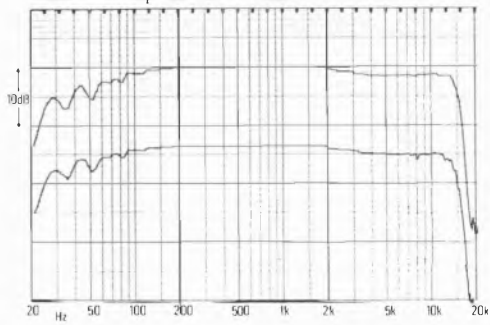
Pickup cartridge response and crosstalk.



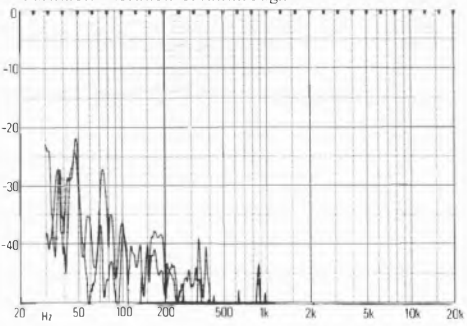
Tuner FM response and crosstalk.



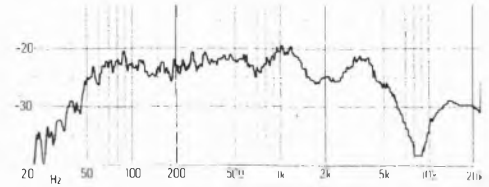
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

BEST BUY

Rotel RM-5010

2–4 Erica Road, Stacey Bushes, Milton Keynes, Buckinghamshire.
Tel: (0908) 317707

This is a good looking system in the high power category (35 watts per channel). The usual black top deck is relieved by a small amount of metallic trim and enclosed by teak finished ends. All the main controls and the radio tuning scale are mounted on a vertical front panel. Large black knobs are used for the sound controls and for the choice of the facilities, but push buttons are employed for the selection of the auxiliary provisions.

The cassette unit is impressively massive, employing a two speed DC servo controlled turntable having stroboscope markings round its perimeter. The 'S' shaped arm is a nicely engineered component having a calibrated stylus loading adjustment, and unusually, one of the thread-and-counterweight types of anti-skating compensators. Manual cueing and separate pitch controls for the two turntable speeds are provided. Trackability is good, as is wow and flutter, rumble and channel balance, while the signal to noise ratio at 86dBA is very good. The sound quality was well liked, being a considerable improvement on the reference unit.

The cassette section has two large VU meters, Dolby noise reduction, a digital footage counter and unusually, separate microphone and line colume controls to allow the mixing of speech and music during recording. Although the tape motion controls are on the top deck, the front panel carries illuminated legends indicating the tape control in use. The performance of the cassette section was on the same high level as the record player, signal to noise ratio, distortion and frequency response being very good, only wow and flutter being average. Sound quality from cassette was on a par with that from the record player.

The least usable sensitivy of the receiver section was high at 1.1μV, and the input for a 50dBA signal to noise ratio was low. The signal to noise ratio achieved for a 1mV input signal was average at 66dBA, though this is a very good figure in absolute terms. Distortion was very good at .16%, whilst the AM rejection, IF rejection, stereo crosstalk, image rejection and capture ratio were all in the good to very good class. Adjacent channel selectivity was average at +2.5dB. The aerial to loudspeaker terminal frequency response was within ±2dB from about 30Hz-14kHz.

Sound quality was well liked, the distortion being low and the quality clean. Bass was slightly deficient and sibilants slightly emphasised on female speech, but the overall performance was rated as very good.

There was no criticism on safety aspects, so generally the system ranks as having good sound quality and being very good value for money.

Rotel RM-5010

BEST BUY

Amplifier Section

Power output into 8 ohms	28.3W
Power output into 4 ohms	35W
Distortion at low power output 1W	0.028% v. good
Amplifier noise	good
Signal to noise ratio for tape output	88dBA v. good
Input voltage for full modulation Tape	160mV
Input voltage for full modulation Aux	—
Input voltage for full modulation Mike	540μV
Tape output	145mV
Stereo crosstalk	45dB good
Channel balance	v. good

Record Player Section

Frequency response	good
Trackability	good
Signal to noise ratio	68dBA v. good
Channel balance	good
Wow and flutter at 33⅓ rpm	0.1% good
Rumble	60.5dB good

Tuner Section

Least usable sensitivity	1.1μV good
Input for 50dB signal/noise	33μV good
Signal/noise for 1mV input	66 dBA average
Distortion	0.16% v. good
AM rejection	57.5dB good
Stereo crosstalk	v. good
Image rejection	60dB v. good
IF rejection	91dB v. good
Adjacent channel selectivity	+2.5dB average
Capture ratio	good
19kHz suppression	43dB average
Muting level	1.6μV
Frequency response	v. good

Tape Section

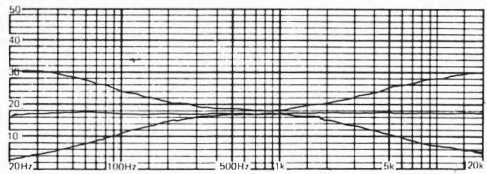
Record/replay frequency response	v. good
Azimuth alignment	good
Signal to noise ratio	63dBA v. good
Distortion output	v. good
Wow and flutter	0.16% average
Erase efficiency	52dBA average

Loudspeakers (where provided)

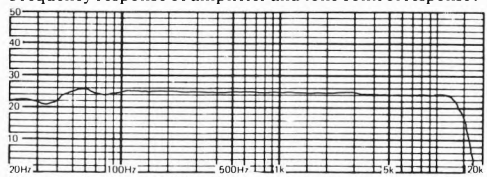
Frequency response of amplifier and speaker	—
Distortion	—
Sensitivity	—
Length of loudspeaker lead	—

General Data

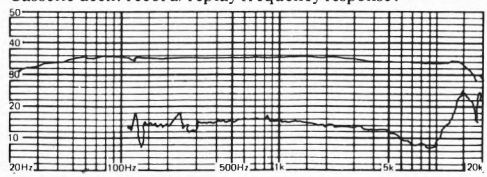
Compliance with British safety standards	No failures
Available facilities	see Introductory Chart
Overall finish and engineering	excellent
Overall sound quality	v. good
Typical selling price inc. speakers and VAT	—
Typical selling price ex. speakers and inc. VAT	£310.00



Frequency response of amplifier and tone control response.



Cassette deck: record/replay frequency response.



Record deck: frequency response and crosstalk, (1 channel).

Rotel system

2–4 Erica Road, Stacey Bushes, Milton Keynes, Buckinghamshire.
Tel: (0908) 317707

Introduction

In addition to the *RM 5010* centre reprinted from *Music Centres*, but now approaching the end of its commercial life, Rotel offer some five rack type systems. The *A350* tested here is in the middle of three 'budget' systems, and mid-priced and high-priced systems are also available, one variant adopting the horizontal format. Rotel are notably amongst the first of the Japanese companies widely to adopt low mass pickup arms in line with current European thinking. The silver-finished separates currently available are shortly to be joined by a range of dark-finished slimline separates which will be highly competitively priced, it is claimed.

General description

Considering it is one of the most inexpensive systems in this survey the Rotel system certainly offers a lot, including amplifier, tuner, cassette deck and record player and a large horizontally orientated rack – all for the price of a music centre. Storage space is available for records and cassettes, etc., below the two sliding doors fitted at the base of the rack, whilst the record deck is neatly inserted in a specially shaped housing to the right of the amplifier, convenient space for sleeves and record cleaning equipment being available above the amplifier. The equipment is finished in the almost obligatory brushed aluminium, with tinted perspex screens over the tuning scale, cassette housing and recording meters. The majority of inter-connections at the rear of the equipment are of the phono type with 5-pin DIN sockets for the tape output being provided on the cassette deck and amplifier. The two-speed semi-automatic belt drive turntable features a straight tonearm with a non-universal detachable headshell that had to be clamped in place via a thumb bolt positioned at the end of the arm. A hinged ferrite rod aerial is fitted to the tuner to aid AM reception and loudspeaker

connections are made via the two sets of push-button colour-coded wire clamps at the rear of the amplifier.

Amplifier *(RA-350)*
The neatly finished amplifier features comprehensive tape dubbing facilities and an array of signal lights to indicate which particular input source has been selected. The bass and treble controls are of the rotary position detent type with a centre detent balance control and a large rotary volume control. Switching is provided to allow either or both pairs of loudspeakers to be connected to the amplifier, whilst a rotary front panel switch selects the signal from the tuner, phono cartridge or auxiliary sources. The sensitivity and input impedance of the phono input was generally satisfactory though the input capacitance was rather high, consequently restricting the choice of replacement pickups that could be fitted in the future. The overall performance of the tone control circuits was good, whilst the frequency response extended from 10Hz to well over 133kHz. Further front panel pushbutton switches select the mono or stereo modes of operation and the loudness control which boosts the low and high frequencies in the usual way. Power output was an adequate 44.7 watts rising to 51 watts into a 4 ohm load. In virtually every other respect the technical performance was well above average for an amplifier in this price range.

Tuner *(RT-300)*
The tuning knob is positioned ergonomically at the centre of the front panel, matching the volume control position on the amplifier. Front panel controls are kept to an absolute minimum with only one rotary switch to select LW, MW, FM or FM auto modes of reception. The tuning dial is fitted with a useful signal strength meter and stereo pilot light fitted to the left of the tuning knob. The IHF least usable sensitivity was about average at 2.5uV with some 500uV being needed to achieve the maximum signal/noise ratio. Though the AM rejection was above average at 59dB all the other radio frequency rejections, especially the alternate frequency rejection, were below average. The overall frequency response was only fair, with a gradual rise in output up to 10kHz falling away sharply above this frequency. Crosstalk was particularly good even at high modulation levels, though unfortunately both the radio frequency intermodulation distortion products and the audio distortion levels were higher than average. Quality of construction was very good as was the visual matching with the amplifier and cassette deck, but the lower than average technical performance results in the tuner being unsuitable for serious hi-fi reception.

Cassette deck *(RD-306)*
This is a front loading design with a nicely damped cassette housing mechanism and includes separate switching for bias and equalisation. Large twin VU meters have been fitted, and though the ballistics leave a little to be desired the peak reading LED fitted between the meters ensures that the tape is not heavily over modulated on short duration bursts of signal. The azimuth alignment error on arrival was good at 28° and the inter-channel jitter was particularly low at 14°, but unfortunately the wow and flutter level was significantly higher than average at 0.19%. Overall tape line-up was quite good using Sony *FeCr C60* tape, resulting in fairly average values of distortion and signal-to-noise ratio, but the record/replay response, though well extended, was a little lumpy above 1kHz. Erasure efficiency was above average at 68dB and the tape noise headroom with respect to replay noise a useful 8dB. Recordings are made via concentric friction locked controls with small lights fitted above the record level controls to indicate when the record mode and Dolby noise reduction systems are in use. In summary, a very reasonable offering considering the price class, though the high wow and flutter level rather limits a strong recommendation.

Record deck *(RP-306)*
This unusual two-speed belt drive design features a semi automatic rejection control, variable anti-skating force and a significantly lighter than average tonearm, the effective mass of the arm and pickup being only 14.2gms. A relatively high compliance pickup has been fitted however resulting in the subsonic resonance occurring at a lower than optimum frequency with an amplification of 7.5dB. The performance in respect of signal-to-noise ratio and rumble was below average, though wow and flutter was excellent at 0.07%.

As mentioned in the introduction, the cartridge is fitted to a non-standard headshell which is clamped to the end of the tonearm using a neat thumb bolt, so if a second or third pickup is to be used often it will help to purchase the special headshells from Rotel. The platter and tonearm

have been fitted to a floating sub-chassis, though the degree of isolation is not particularly good resulting in average levels of acoustic and vibrational breakthrough. The straight metal tonearm is of an unusual construction with plastic pivot and headshell fixing assemblies and appears to be particularly free of any major resonance problems. The high frequency intermodulation distortion was a little lower than average whilst the pickup was found to track the 31.5cm/sec band at a tracking force some 0.5gm lower than the recommended value. The frequency response using the outer bands of the B&K *QR2009* gliding test record was generally quite smooth though the inter-channel crosstalk was notably asymmetrical, the left to right crosstalk at 1kHz being 15dB with 36dB being achieved in the other direction. In summary then a well finished deck of average technical performance that appears to offer a sensible compromise between price and overall quality.

Listening tests and overall appraisal

The unusual frequency response and high distortion levels measured on the tuner resulted in a rather brittle sound that became tiring after a short period. The good stereo image and the low susceptibility to any RF interference were however points in its favour. Rumble was obtrusive when playing records, as was the higher than average phono pre-amp noise, though the levels of wow and flutter were particularly low. The tracking performance of the pickup was better than average but stereo imaging, though good, was thought to be limited by the asymmetrical crosstalk characteristics of the pickup.

With the acoustic breakthrough being tolerably low the good tracking performance and smooth frequency response did result in an above average overall sound quality from disc when the Mordaunt Short *Pageant II* loudspeakers were used. The record/replay performance of the cassette deck was reasonable with good high frequency extension even at higher modulation levels, but the wow and flutter performance was below average. Adjustment of the recording level was found to be very easy using the friction locked rotary record level controls, the large VU meters and the peak reading LEDs. Though some aspects of the performance have been criticised it should be remembered that this is one of the most inexpensive systems included in this survey and in terms of value for money it does offer a great deal.

Amplifier (RA 350)

Power Output 8ohms/4ohms	44.7/51 watts
Hum modulation 50Hz/100Hz/150Hz	0dB/4dB/3dB
Dynamic Headroom	0.9dB
Signal/Noise ratio CCIR/ARM	86dB
Ambient output voltage CCIR/ARM weighted	1.1mV
Phono input impedance/capacitance (inc lead)	49.5k/467pf
Crosstalk 1kHz/10kHz	48dB/45dB
Gain tracking error, ¼/½/¾ setting	0dB/0.4dBR/0.6dBR
Balance	0.2dBR
3dB Bandwidth (at 1W RMS)	10Hz/133kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	68dB/75dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	67dB/74dB

Tuner (RT-300)

IHF least usable sensitivity	2.5uV
50dB quieting mono/stereo	6.3uV/63uV
Signal/Noise 1mV CCIR/ARM	72dB/67dB
Min signal for max S/N ratio mono/stereo	100uV/500uV
AM rejection	59dB
IF rejection	54dB
Image rejection	42dB
Capture ratio	2.8dB
Adjacent/Alternate channel rejection	−2dB/+34dB
RFIM	62dB
Distortion L/−R, L only	1%/1.9%
Crosstalk 1kHz/10kHz	45dB/33dB
19k/38k suppression	37dB/34dB

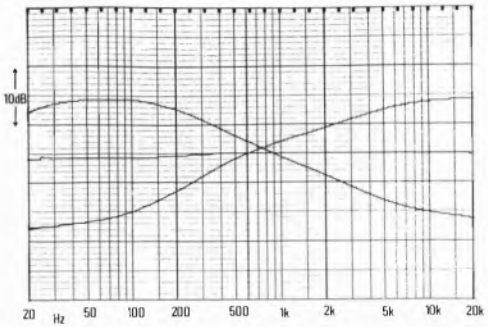
Tape (RD-300)

Tape used for tests	Sony FeCr
Replay azimuth alignment	28°
Wow and Flutter	0.19%
L/R Jitter at 3kHz	14°
Dolby ref. level readout on meters, 64mS under-read	+4dB/6dB
Distortion −6dB, 0dB, +3dB	0.4%/0.63%/0.8%
Line up on replay meters −6dB/0dB/+3dB	−6dB/+1dB/+4dB
Erasure efficiency (400Hz at Dolby level)	68dB
Signal/Noise biassed tape CCIR/ARM	47dB/57dB
Tape noise headroom wrt replay noise (no cass)	8dB

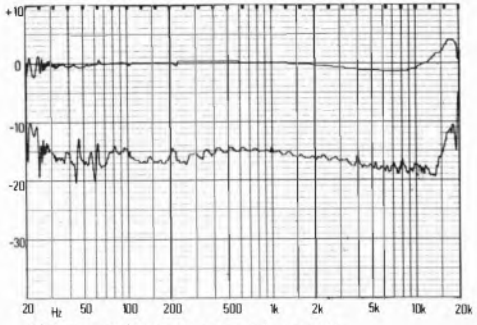
Disc (RP 300)

HF Intermodulation distortion (10.8kHz pulsed)	0.35%
Tracks 1k+1.5k 31.5cm/sec band at	2gms
Effective mass of pickup + arm	14.2gms
Subsonic resonance freq/dB gain	7.1Hz/7.5dB
Estimated compliance	35cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	55dB
Wow and Flutter	0.07%
Rumble (DIN B)	55dB
Tracking weight error setting/actual	2.5gms/2.3gms
Pickup type	Rotel ZRC-4

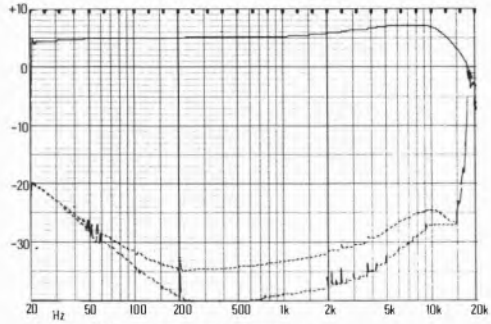
Available facilities	A, B, D, E, I, M, N, R, V, Y, Z, AA, AB, AE, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BM, BN, BR, BS
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw type
Ferrite rod aerial	hinged but not rotatable
Typical System price	£350



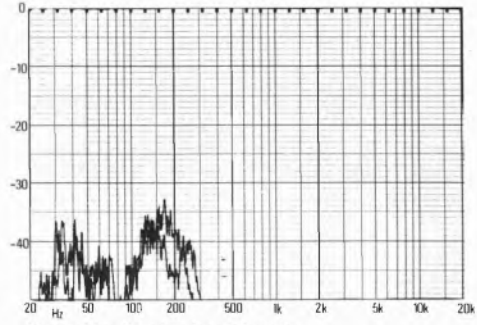
Amplifier response, tone and filter variations.



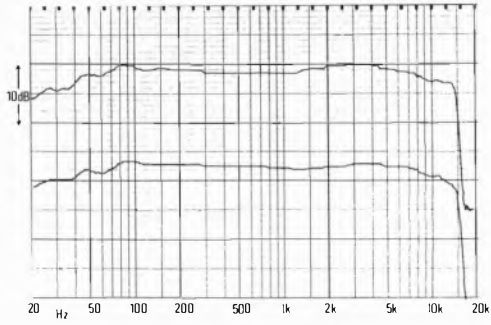
Pickup cartridge response and crosstalk.



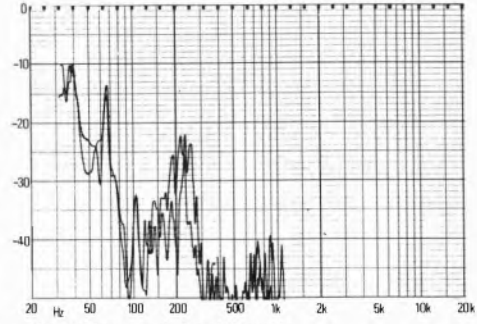
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

BEST BUY

Sansui system

Sansui UK Ltd., Unit 10a, Lyon Industrial Estate, Rockware Avenue, Greenford, Middlesex. Tel: (01) 575 1133

Introduction

Sansui do not make specific equipment combination recommendations, feeling that this is better left to the customer and dealer, though there are some obvious 'natural' groupings like the one submitted here. Sansui have adopted the international 19in rack standard for virtually all the models in their hi-fi range, so a rack once purchased permits upgrading without any fuss. Two racks are offered: the *GX5* used with the review system, plus a lower cheaper model more suited to the low profile components than the more expensive larger models.

Autumn '79 saw the launch of a brand new range of budget Sansui separates which were too late for this report. These represent a significant cost saving over the hi-fi range, partly by abandoning the standard rack capability and saving on cabinetwork. Accordingly the budget range has its own racks, three in all, and components do not fit the *GX* racks or *vice versa.*

General description

One of the more visually aggressive designs, this Sansui system is finished in matt black with wood finish sides and black lustre base trim to match the record deck finish. A perforated metal trim is fitted at the rear sides of the cabinet to aid cooling and access. An audio accessory drawer was included in the system we tested and could be fitted to the 19in rack mountings in the same way as the tuner, amplifier and cassette deck, a very useful feature. Incidentally this was one of the few systems that adheres to the internationally adopted 19in rack configuration, the majority of manufacturers adopting dimensions that suit their own requirements. Interconnections are made at the rear of the equipment and heavily feature phono sockets though a 5-pin DIN socket is included on the tape deck.

Amplifier *(AU 217 II)*

The output power of the amplifier was measured to be 58 watts into an 8 ohm load increasing to 71 watts when a 4 ohm load was used. The data shows the amplifier to have an outstanding technical performance in respect of hum modulation, signal-to-noise, intermodulation distortion and bandwidth, though we would doubt whether a frequency response that is flat up to 75kHz is of use to anybody other than the advertising department. The large finely stepped volume control was smooth to operate and the centre and position indents in the bass, treble and balance controls were well liked. A loudness switch and high filter switch are included on the front fascia whilst the input selector switch includes phono input selection both with and without a subsonic filter. It is worthwhile noting that while such filters do reduce the output due to the subsonic resonance of the arm/pickup combination, they have no effect on the more elusive problems of a high 'Q' resonance such as poor trackability, increased scrub flutter, etc.

BEST BUY

Tuner *(TU 217)*
Sensitivities of the *TU-217* tuner were a little lower than average though certainly more than adequate for all but the most demanding listener. Both the IF rejection and the image rejection were very good though the AM rejection was slightly worse than average at 57dB. The alternate channel selectivity was noticeably asymmetrical, being 60dB or more at −400kHz but only 45dB at +400kHz. Audio distortion was excellent at 0.2% for 100% modulation, one of the best receivers in this respect in this series of tests. Facilities have been kept to a sensible minimum with only an FM muting/mono switch and FM/AM selector switch being included on the front panel. The large tuning knob located on the right of the equipment is smooth and easy to operate and matches the volume control knob fitted to the amplifier. Frequency response and crosstalk curves indicated a very flat response that extended well up to 15kHz, with a crosstalk level that remained almost constant over the whole of the audio range at around 30dB. In summary a more than adequate design with just a few points (AM rejection, 38kHz carrier suppression, etc.) that could be improved upon; this tuner should be quite at home in all but the most troublesome areas of reception.

Cassette deck *(SC 1110)*
The tape recommended for use with this system was TDK *SA,* but unfortunately the resulting record/replay responses were rather worse than the claimed performance at high frequencies (typically 4dB down at 10kHz), so it was decided to use another of the recommended tapes, Maxell *UDXL1,* for all the tests. The big feature of this deck must surely be the 'Direct-O-Matic' mounting arrangement for the cassette, the tape simply being pushed into the housing mechanism on the front fascia of the unit. As well as the unusual tape access facility a plate is fitted below the tape housing with the usual control markings, the plate itself being hinged to provide dual function of protecting the tape heads and giving access to the azimuth adjustment screw. An optional tape lead-in facility is included which automatically skips over the first 8–12 seconds of the cassette tape, thus avoiding recording on the tape leader and suffering the poor quality that usually results in the first few seconds. Replay azimuth alignment was far from optimum at 76 degrees, though the wow, flutter and the interchannel phase jitter were all better than average. The VU meters were of the highly damped type, and as no peak indicating LED is included care and concentration will be needed if tape overload distortion or poor signal/noise ratio is to be avoided.

Recording controls are of the concentric friction locked type serving both the line and mic/DIN input, selection being made via the switch adjacent to the recording level control. A tape selector switch is included allowing normal, Fe-Cr, and CrO_2 cassettes to be used, though no separate facility is available for adjusting the bias setting Signal-to-noise ratios were just slightly below average whilst the tape/noise headroom with respect to replay noise was barely adequate at 6dB. As with the tuner the tape deck appears to have great potential if the few small criticisms such as azimuth alignment and meter ballistics could be seen to.

Record deck *(SR 222 II)*
The record deck is a two-speed belt drive manually operated design, the motor and arm being mounted on a chipboard base finished in black lustre. The assembly is supported on four large soft rubber feet. These were particularly effective in reducing the breakthrough of vibration though the acoustic breakthrough was below average (a comment that is standard for housings made from chipboard with the arm and platter firmly fixed down to the top board). The measured signal-to-noise ratio was noisier than average due to interference from the motor, the signal-to-noise ratio CCIR weighted improving by some 3dB or more when the motor is switched off. Wow and flutter was outstandingly good at 0.068% as indeed was the rumble at −68dB (DIN B subjective weighting).

The effective mass of the pickup and arm was high at 22.8gms, consequently any replacement cartridge should have a compliance of around 12–15cu to ensure that any arm/cartridge resonance falls into the 10–15Hz band. The Sansui *SC-37* cartridge supplied with the deck has a compliance of 25cu so the resulting resonant frequency is located around 6.6Hz, somewhat lower than optimum. Pickup trackability was quite good, the 10.8kHz high frequency intermodulation distortion being 0.35% whilst the pickup was found to track the 31.5cm/sec peak velocity band at a stylus load of 1.9gms, appreciably lower than the recommended 2.5gms tracking weight. The frequency response of the pickup showed a 2dB drop at

BEST BUY

Sansui system

around 8kHz followed by a peak of 3dB or more at 15kHz.

The overall performance of the deck was about average, being limited by the lower-than-average performance of the cartridge.

Listening tests and overall appraisal

Listening tests were carried out using both the Mordaunt Short *Pageant 2*s and *Signifers*, the former being used for the majority of the tests. The overall sound quality of the system was considered to be quite neutral with some reservations concerning the sound quality of the pickup. Arm resonance and acoustic breakthrough were problems, and it was suspected that these coupled with the pickup's inferior HF response were the main reasons for criticism. In fact additional listening tests were carried out using the Ortofon *FF15E MkII* cartridge, and the subjective comments were more favourable. In conclusion the system was felt to be well designed and easy to operate and although there are some slight reservations about the performance of the pickup cartridge, the unit deserves a strong recommendation and a best buy rating.

Amplifier (AU 217 II)

Power Output 8ohms/4 ohms	58.7/71.2 watts
Hum modulation 50Hz/100Hz/150Hz	0dB/0dB/6dB
Dynamic Headroom	1.6dB
Signal/Noise ratio CCIR/ARM	95dB
Ambient output voltage CCIR/ARM weighted	0.73mV
Phono input impedance/capacitance (inc lead)	50k/138pf
Crosstalk 1kHz/10kHz	56dB/49dB
Gain tracking error, ¼/½/¾ setting	0.3dBL/0.3dBR/0dB
Balance	0dB
3dB Bandwidth (at 1W RMS)	2.2Hz/75kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	75dB/74dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	74dB/72dB

Tuner (TU 217)

IHF least usable sensitivity	2.5uV
50dB quieting mono/stereo	4.5uV/50uV
Signal/Noise 1mV CCIR/ARM	69dB/64dB
Min signal for max S/N ratio mono/stereo	63uV/310uV
AM rejection	57dB
IF rejection	>80dB
Image rejection	>82dB
Capture ratio	1.5dB
Adjacent/Alternate channel rejection	3dB/+60/+45dB
RFIM	70dB
Distortion L/−R, L only	<0.2%/0.45%
Crosstalk 1kHz/10kHz	31dB/30dB
19k/38k suppression	63dB/40dB

Tape (SC 1110)

Tape used for tests	Maxell UDXL1
Replay azimuth alignment	76°
Wow and Flutter	0.093%
L/R Jitter at 3kHz	17°
Dolby ref. level readout on meters, 64 mS under-read	+3dB/−7dB
Distortion −6dB, 0dB, +3dB	0.4%/0.5%/0.8%
Line up on replay meters −6dB/0dB/+3dB	−4.5dB/+1.4dB/+4.3dB
Erasure efficiency (400Hz at Dolby level)	67dB
Signal/Noise biassed tape CCIR/ARM	48dB/58dB
Tape noise headroom wrt replay noise (no cass)	6dB

Disc (SR 222 Mk II)

HF Intermodulation distortion (10.8kHz pulsed)	0.35%
Tracks 1k+1.5k 31.5cm/sec band at	1.9gms
Effective mass of pickup + arm	22.8gms
Subsonic resonance freq/dB gain	6.6Hz/6dB
Estimated compliance	25cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	55dB
Wow and Flutter	0.068%
Rumble (DIN B)	68dB
Tracking weight error setting/actual	2.5gms/2.5gms
Pickup type	Sansui SC-37

Available facilities	A, B, D, E, H, I, J, N, R, V, X, Y, Z, AB, AC, AK, AL, AM, AN, AM, AX, AY, AZ, BA, BC, BD, BM
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw-type
Ferrite rod aerial	hinged and rotatable
Typical System price	£440

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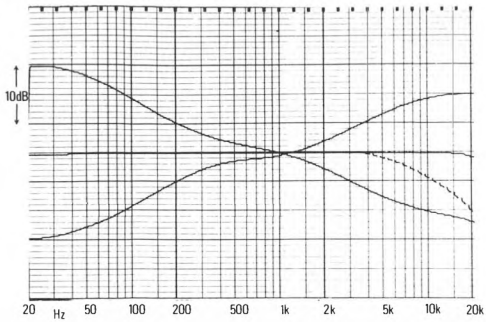
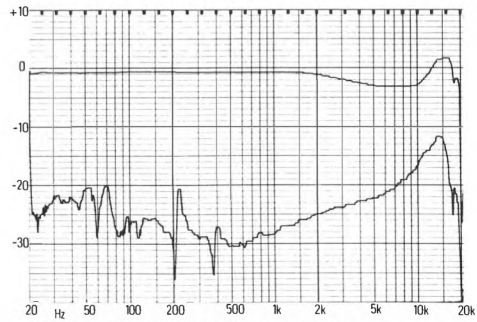
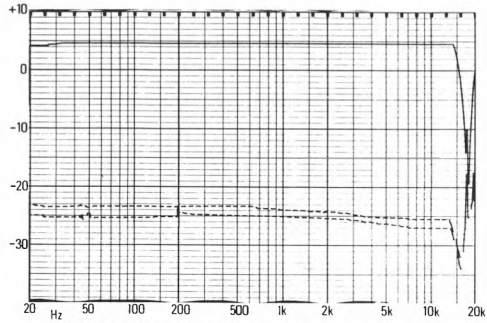


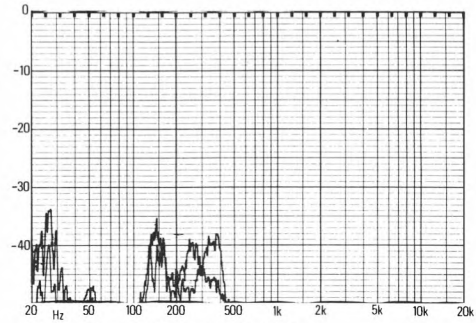
Amplifier response, tone and filter variations.



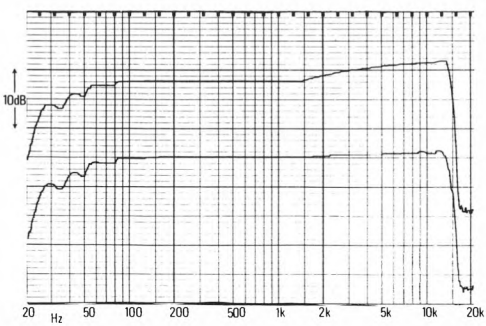
Pickup cartridge response and crosstalk.



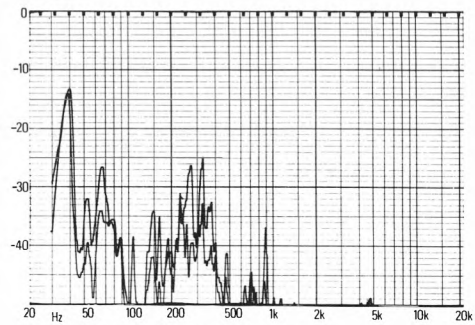
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

Schneider Team 6035

Wren Electronics Ltd., Dawson Road, Mount Farm Estate, Milton Keynes, Buckinghamshire. Tel: (0908) 71611

Introduction

The Wren organisation which handles Schneider also offers the Tensai range of components which represent something of a contrast. There are two Schneider systems, one of which is tested here, and each is available in vertical or horizontal formats, with considerable emphasis placed on the standard of finish and furniture.

The Tensai models are rather cheaper and are generally marketed through the major discount outlets at very competitive prices. Two Scandinavian-made racks are being introduced to accompany Tensai, but which can be adjusted to suit almost any components, and these are claimed to offer a superior 'furniture' standard of finish.

General description

This unusual West German offering is distributed by Wren Electronics in this country and consists of a graphic equaliser, amplifier, tuner and cassette deck all supported in a pre-formed hammer finished rack fitted with equipment support ledges. The ledges are removable and can be positioned at an angle to allow easy access to the inevitable array of dials and switches. Hand grips are provided at the front edges of the equipment to allow easy positioning and removal. the Dual two-speed belt drive deck fits snugly at the top of the rack and is mounted in a plinth featuring the same finish as that used for the rack. All the front control panels of the equipment are finished in a dark tinted brushed alloy with bright orange legends to complete the unusual facia appearance. Mains interconnections are simple and effective, each unit being connected in parallel to the last using the leads supplied, resulting in only one main lead having to be connected to the domestic supply. All signal interconnections are made using DIN leads though phono sockets have been included at the rear of the cassette deck. The graphic equaliser is an 'optional extra', so some storage space is available at the bottom of the rack if it is not used, though not enough to store records properly. Incidentally, the equaliser supplied was the wrong colour owing to supply difficulties at the time of test; usually its facia would match those of the tuner, amplifier and cassette deck.

Amplifier *(6035A)*

The amplifier features two very fast reading power meters that if anything tend to overshoot, the meter movement hitting hard over on a 64mS pulse. Accurate assessment of the meter's performance was hampered by an unbalance in the RHC of around +2dB, rather limiting its usefulness. Sufficient power (48 watts) is available for the majority of users when a reasonably efficient loudspeaker system is employed. Hum modulation at maximum power was commendably low. Signal-to-noise ratio measured on the amplifier was 97dB, probably one of the best levels measured in this survey. The volume control is of the finely stepped rotary type, whilst the balance, treble and bass controls are provided with indents that have a nice

feel. A row of switches positioned directly below the tone controls include stereo/mono, rumble, noise, mute and loudness switches. Headphone outputs are provided both via the usual jack socket and the increasingly popular DIN socket found in the European countries. One unusual feature is the inclusion of the second tape input socket fitted to the front panel of the amplifier, eliminating the need to dismantle the rack if replay or copying from a second tape recorder is required. Unfortunately the UHF intermodulation distortion tests revealed significant levels of 2nd and 3rd order distortion at power levels 3dB below the maximum available, limiting what would otherwise have been considered a fine technical performance.

Tuner *(6030T)*
The tuner covers long, medium, FM and short wavebands, and includes a total of seven pre-sets capable of operating on either the FM, MW or LW bands. Three meters are included on the left of the tuning scale providing an indication of frequency plus optimum tuning and signal strength information. The sensitivity of the tuner on the FM band was considered to be adequate if not outstanding, the IHF least usable sensitivity being 2uV, but an output of 380uV was required to achieve maximum signal-to-noise ratio on stereo transmissions. AM rejection and capture ratio were both below average though the IF and Image rejections were well above average. The harmonic distortion on a stereo transmission was particularly high at 2.2% falling only slightly to 1.9% when a left only modulation mode was adopted. This level of distortion is rather disappointing when compared with the performance of other less expensive designs. It was also noticed that the 38kHz carrier suppression was lower than average at −32dB, though the 19kHz rejection was very reasonable at 55dB. The frequency response was generally about average though a pronounced drop in output did occur above 10kHz, the output level being over 4dB down at 15kHz. Crosstalk was unusual, the low frequency crosstalk falling to only −12dB at 50Hz, though the audibility of crosstalk at this end of the frequency band is questionable.

Cassette deck *(6030C)*
This front-loading design (as indeed are the majority of decks tested in this survey) has the infuriating feature of separate rotary record level controls. An accurately balanced fade is a virtual impossibility with separate controls, though of course they do not affect the technical performance of the deck. Azimuth alignment was fair at 54° with wow, flutter and interchannel phase jitter all very satisfactory. The Dolby reference level readout was a sensible +2.5dB on the record meters though the meter was found to under-read by 5.6dB on a tone pulse 64mS long. Many of the key controls for the deck were stiff to operate, sufficient force to move the deck having to be applied before the keys would lock correctly. Tape selectors are provided between the recording controls though there is no visual indication of the purpose of these controls. Absolute line up and harmonic distortion were average when using Maxell *UDXL1* tape though the erase efficiency was a little lower than average at 64dB. The overall signal-to-noise ratio was about 1dB lower than average, possibly due to the tape noise headroom with respect to the cassette deck replay noise being only 4.2dB.

Record deck *(6030F)*
A semi-automatic belt drive is employed with the platter assembly mounted on the main plinth via rubber damped coil springs. Such a construction should have ensured good effective reduction of vibration transmission from the shelf upon which the equipment stands, though the test results show that the performance is only moderate in this respect. Acoustic breakthrough was reasonably low and should prove more than adequate in all but most trying locations. The effective mass of the arm and pickup, though on the high side (17.4 grams), was significantly lower than the majority of designs included in this survey, resulting in a higher than average subsonic resonant frequency of 7.7Hz when used with the Dual *DMS220* cartridge having a compliance of 24.5cu. Stroboscopic markings are etched around the edge of the platter, a small lamp being fitted below a prism adjacent to the motor controls. Variations in pitch can be made using the rotary control mounted concentrically on the speed change. The measured signal-to-noise ratio was excellent at 61dB (ref 1cm/sec at 1kHz reference track) though the wow and flutter at 0.13% and the rumble at −58.5dB left a little to be desired. Pickup trackability was quite good, the Dual pickup tracking the difficult 31.5cm/sec track at 1.6gms whilst at 2gms the high frequency intermodulation distortion was a low 0.28%. The pickup response was very smooth up to 18kHz, the output falling just slightly around 3–7kHz whilst

the crosstalk (generally in excess of 22dB) fell to around 15dB at 9kHz. The pickup was fitted to a custom designed plate that could be easily removed from the arm, so if alternative pickups are desired another mounting plate (Dual type *TK230*) could be purchased.

Listening tests and overall appraisal

Listening tests conducted using both the Schneider loudspeakers supplied with the system and the Mordaunt Short loudspeakers revealed that though the unusual crosstalk performance exhibited by the tuner was not a problem when playing classical music some detrimental effects were becoming audible on pop music. The overall frequency response of the tuner was considered to be very flat though the high harmonic distortion revealed by the objective tests was confirmed on stereo transmissions at high modulation depths. The record/replay response of the cassette deck was smooth but a little bright as indicated by the measured response curves taken with Maxell *UDXL1* tape. It was found difficult to get an accurate channel balance on the meters due to their small size and the awkwardness of the recording controls. Generally the replay quality was excellent though the electronic noise was just audible on particularly quiet passages. Listening tests on record revealed a slightly muffled sound with an adequate if not outstanding separation between channels. Tracking was good even on particularly difficult passages, but the overall impression was a little bland. The Mordaunt Short loudspeakers were generally preferred to those supplied with the system, the Schneider speakers having an irregular response with excessive hf output and higher than average midband distortion levels. In view of the various criticisms involving distortion, frequency response, wow and flutter, etc, the system would not appear to be a prime choice.

Amplifier (6035A)

Power Output 8ohms/4ohms	48.2/61.8 watts
Hum modulation 50Hz/100Hz/150Hz	1.5dB/0dB/2dB
Dynamic Headroom	0.75dB
Signal/Noise ratio CCIR/ARM	97dB
Ambient output voltage CCIR/ARM weighted	0.3mV
Phono input impedance/capacitance (inc lead)	47k/166pf
Crosstalk 1kHz/10kHz	47dB/47dB
Gain tracking error, ¼/½/¾ setting	+1.2dBR/0.2dBR/0.2dBL
Balance	+0.5dBR
3dB Bandwidth (at 1W RMS)	4.7Hz/40kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	−51dB/−59dB
(−3dB refmax pw) 10kHz+11kHz 2nd/3rdorder	−51dB/−53dB

Tuner (6030T)

IHF least usable sensitivity	2uV
50dB quieting mono/stereo	5uV/54uV
Signal/Noise 1mV CCIR/ARM	70dB/65dB
Min signal for max S/N ratio mono/stereo	54uV/380uV
AM rejection	55dB
IF rejection	>80dB
Image rejection	68dB
Capture ratio	3dB
Adjacent/Alternate channel rejection	1.5dB/5.1dB
RFIM	72dB
Distortion L/−R, L only	2.2%/1.9%
Crosstalk 1kHz/10kHz	34dB/31dB
19k/38k suppression	55dB/32dB

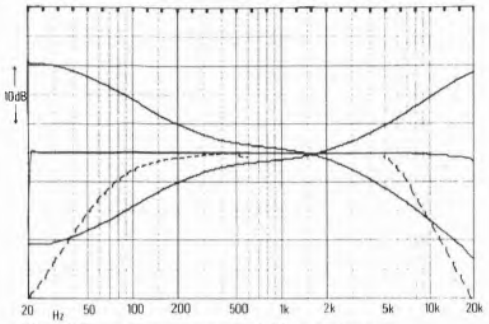
Tape (6030C)

Tape used for tests	Maxell UDXL1 C90
Replay azimuth alignment	54'
Wow and Flutter	0.093%
L/R Jitter at 3kHz	18.3°
Dolby ref. levelreadout on meters, 64mS under-read	+2.5dB/−5.6dB
Distortion −6dB, 0dB, +3dB	0.35%/0.52%/0.9%
Line up on replay meters −6dB/0dB/+3dB	−4dB/+0.9dB/+3.1dB
Erasure efficiency (400Hz at Dolby level)	64dB
Signal/Noise biassed tape CCIR/ARM	48dB/57.5dB
Tape noise headroom wrt replay noise (no cass)	4.2dB

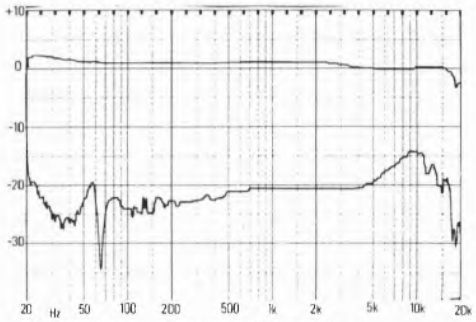
Disc (6030P) (Dual 418A auto belt drive)

HF Intermodulation distortion (10.8kHz pulsed)	0.28%
Tracks 1k+1 5k 31.5cm/sec band at	1.6gms
Effective mass of pickup + arm	17.4gms
Subsonic resonance freq/dB gain	7.7Hz/8dB
Estimated compliance	24.5cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	61dB
Wow and Flutter	0.13%
Rumble (DIN B)	58.5dB
Tracking weight error setting/actual	2gms/2.1gms
Pickup type	Dual DMS 220

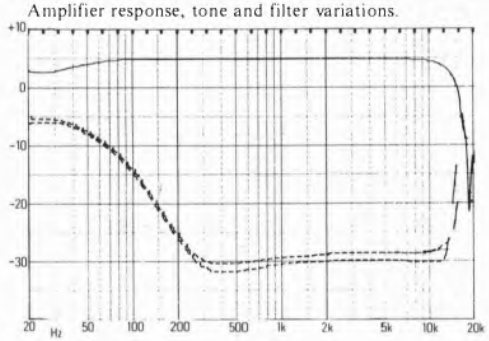
Available facilities	A, B, C, D, E, F, H, I, K, N, J, R, V, W, X, Y, Z, AA, AB, AE, AI, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BM, BN
Loudspeaker sensitivity (2.828V pink noise)	87dB
Length of loudspeaker lead	4.4m
Azimuth adjustment	normal screw type
Ferrite rod aerial	no external aerial
Typical System price	£650 inc speakers



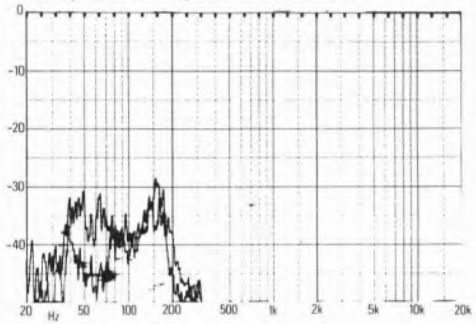
Amplifier response, tone and filter variations.



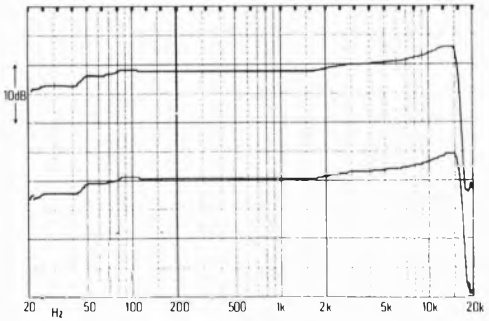
Pickup cartridge response and crosstalk.



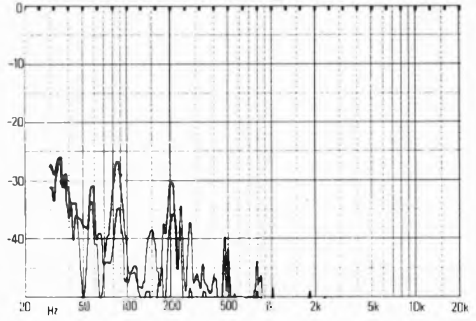
Tuner FM response and crosstalk.



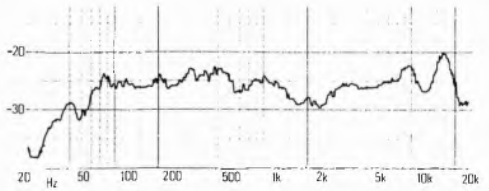
Turntable vibration breakthrough.



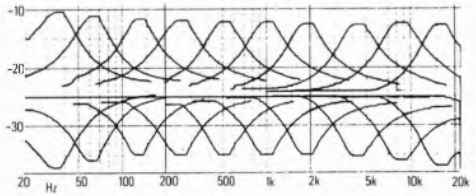
Cassette response L&R, Dolby in (−20dB ref Dolby).



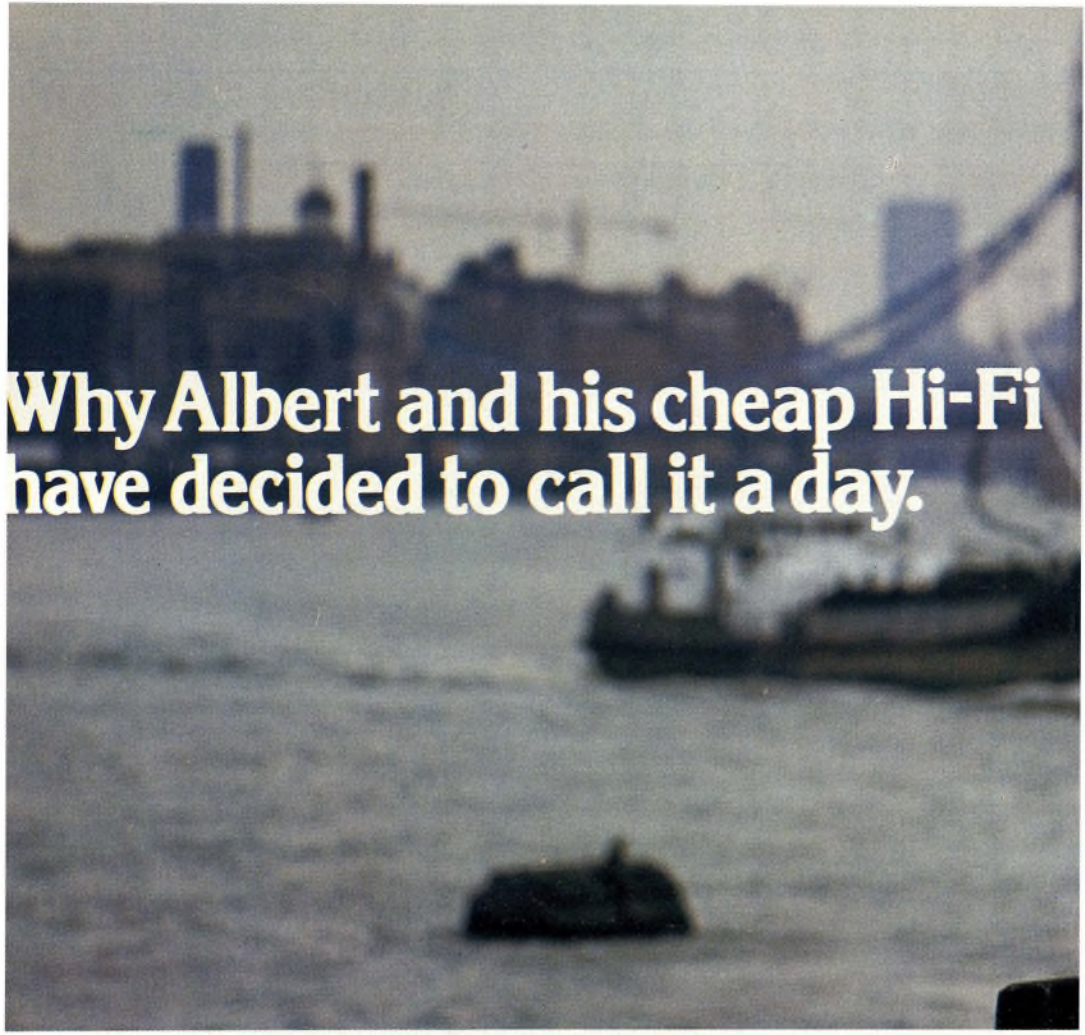
Turntable acoustic breakthrough



Loudspeaker frequency response, 1m.



Equaliser responses



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Sony HMK 80

Sony UK Ltd., 134 Regent Street, London W1. Tel: (01) 439 3874

Introduction

The Sony range is so large that it is quite impossible to summarise their systems in a few short lines. The *HMK80* music centre has been tested here partly because none of the new separates systems were available for our deadlines, and is a good example of the *genre*. Sony currently offer a range of seven music centres ranging in price from £225–£875, the *HMK80* being the middle model in terms of specifications; full remote control is offered on the more expensive models.

There are also no less than thirteen separates systems in the range, priced (including speakers) from £450 to over £1400. These include most of the possible variations of style, shape and format, such as receiver, tuner plus amplifier, slimline and small scale component based systems, in both vertical and horizontal layouts.

General description

This is a low profile centre with the majority of the controls positioned on the vertical brushed aluminium front panel, the remainder of the centre being constructed from plastics with wood veneered side panels. Loudspeaker connections are made *via* the two sets of DIN sockets at the rear of the centre, whilst phono sockets are also available for connecting an external tape recorder. A hinged perspex lid covers the two-speed direct drive fully automatic turntable whilst the cassette deck is positioned in the top of the centre to the right of the turntable. Additional storage space is available at the rear of the cassette mechanism for six cassette tapes and is covered with a hinged plastic lid. The centre is provided with a cassette tape which gave fairly comprehensive pre-recorded instructions on how to operate the equipment whilst stereo headphones and a stereo microphone are provided as standard accessories.

Amplifier

Considering the overall size of the centre the amplifier produced a surprisingly high 37.3 watts into 8 ohms, rising to 45.7 watts when a 4 ohm load was used, though it was noted that the hum modulation increased considerably near maximum power levels, the 100Hz component rising by 22dB. A small dynamic headroom of 0.7dB was recorded, the signal-to-noise ratio being an excellent 90dB (CCIR/ARM weighting). The phono

input impedance/capacitance was well optimised for the pickup supplied and the crosstalk was better than average. Slider type bass, treble and balance controls are fitted with centre detents, whilst the volume control is of the discretely stepped rotary type. Six pushbuttons below the volume control allow selection of LW, SW, MW and FM, phono and cassette tape sources.

The gain tracking error over the majority of the volume control range was very good, although an inbalance of 1.8dB was recorded with low settings of the control. The frequency response of the amplifier was very smooth and extended from 12Hz to a questionably high 140kHz. The tone control range was typical but it was noted that the high frequency filter provided no more attenuation than that available from the treble control. The IHF intermodulation distortion products were significantly higher than average at levels 3dB below the maximum power output available and it was noted that the second order distortion products actually reduced as the test frequencies were increased. Pushbutton switching is available for connecting either or both of two sets of loudspeakers, and a jack type headphone socket is provided below the loudspeaker selector switches.

Tuner

The tuner section is equipped with five pre-set pushbuttons and a manual over-ride. Tuning of the pre-sets is carried out by five knobs discretely positioned below the side panel at the left hand end of the centre, with information on the frequency being tuned displayed on a small scale. The main tuning knob is positioned at the end of the tuning scale proper, adjacent to the visually identical volume control.

The technical performance of the tuner was quite outstanding considering the price of the centre. The IHF least usable sensitivity was a very low 1.2uV with only 310uV being needed for optimum stereo reception. Signal-to-noise ratios were very good although the image and AM rejections were a little below average. The Intermediate Frequency rejection was well above average at over 80dB and the capture ratio was outstanding at 1.3dB, one of the best figures measured in this survey. The FM frequency response was generally quite smooth with a response extending from 24Hz to 12kHz, whilst the crosstalk characteristics were rather unusual, the low frequency crosstalk being around 15dB but rising to 35dB at 1kHz and then falling again to around 25dB at 10kHz. Both the radio frequency intermodulation distortion and the audio frequency distortion performances were well above average and the pilot carrier suppression was excellent at 19kHz though about average at 38kHz. In summary then a fine tuner performance better than usually found in systems in this price class.

Cassette deck

This is a top loading cassette deck with a well damped access lid and piano type tape transport keys that were somewhat stiff to operate. Twin VU meters are fitted in the front panel below the cassette housing and under-read by 7dB on a 64mS pulse, though the peak indicating LED set to indicate at Dolby level is accurate down to pulse durations of 8mS. Record/replay responses taken on both Sony *FeCr* tape and Maxell *UDXL I* tape gave poor performances at high frequencies suggesting possible Dolby mistracking. Wow and flutter were rather high at 0.27% with interchannel tape jitter of around 16°. There was an azimuth alignment error at 79° as delivered, but both the erasure efficiency and tape headroom with respect to replay noise were considered to be more than adequate. Tape line up was good but because the Dolby level was seriously mis-set at −2dB the distortion levels were significantly higher than average (though with correspondingly low levels of tape noise). The recording level is set by the friction locked concentric rotary controls fitted at the right hand end of the front panel with tape select pushbuttons sited below the recording meters. In all a rather disappointing overall performance however, characterised by high wow and flutter levels.

Record deck

The record deck is a fully automatic two-speed direct drive design mounted on a metal chassis isolated from the main assembly via damped springs. A metal chassis construction of this nature usually results in particularly low levels of acoustic and vibrational breakthrough and this deck certainly proves to be no exception. The pickup cartridge fitted is a Sony *ND 134G* and gives a fine overall performance with lower than average HF intermodulation distortion and a smooth frequency response that extends to well above 20kHz. The pickup was found to track the 31.5cm/sec band at a downforce some 0.4gm less than the manufac-

Sony HMK 80

turer's recommended figure. The wow and flutter level of 0.08% was particularly good though the rumble measurements were spoilt by vibration originating from the transformer. The true rumble level is probably significantly lower than this, though the interference due to the mains hum does resemble rumble and therefore should be judged accordingly. The fully automatic cueing is useful but care is needed to pre-select the correct record diameter before operation using the rotary switch provided. Variable pitch controls are provided, accurate adjustment of speed being carried out using the stroboscopic markings etched around the perimeter of the platter.

Listening tests and overall appraisal

For around £400 the system comes complete with a pair of two-way infinite baffle loudspeakers fitted with a soft dome tweeter and a paper cone woofer. The frequency response of the loudspeaker system was not subjectively bad, although the excessive output between 300Hz and 2kHz proved to be tiring after long listening periods. The low susceptibility to radio interference, high sensitivity, and particularly low distortion levels all helped to achieve a fine audio quality from the tuner, offset to some extent by the limited high frequency response. The unusual crosstalk characteristics of the tuner had no obvious adverse effect on the overall sound quality, the stereo imaging being if anything more stable than usual. Cassette tape quality was rather disappointing for though the tape noise was lower than average the high distortion levels and the limited frequency responses resulted in lower than average sound quality. High wow and flutter was also a problem though a level of 0.27% can probably be tolerated by anyone needing only background music from the cassette system. Quality from disc was limited a little by the higher than average 'rumble' levels but wow and flutter was low and the overall quality of the Sony cartridge was well liked. The extended response of the pickup was spoilt by the bandwidth limitation of the Sony loudspeakers, significantly better quality being achieved using the *Pageant IIs*. At the modest selling price of £400 including speakers the centre does offer a great deal; however, the many criticisms raised in the text conspire to prohibit a formal recommendation.

Amplifier

Power Output 8ohms/4ohms	37.2/45.7 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/22dB/4dB
Dynamic Headroom	0.7dB
Signal/Noise ratio CCIR/ARM	90dB
Ambient output voltage CCIR/ARM weighted	0.55mV
Phono input impedance/capacitance (inc lead)	49kohm/145pf
Crosstalk 1kHz/10kHz	53dB/40dB
Gain tracking error, ¼/½/¼ setting	1.8dBL/0.5dBL/0.2dBL
Balance	0.2dBL
3dB Bandwidth (at 1W RMS)	12Hz/130kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	54dB/62dB
(−3dB ref max pwr) 10kHz+11kHz 2nd/3rd order	58dB/60dB

Tuner

IHF least usable sensitivity	1.2uV
50dB quieting mono/stereo	2.5uV/31uV
Signal/Noise 1mV CCIR/ARM	71dB/66dB
Min signal for max S/N ratio mono/stereo	31uV/310uV
AM rejection	52dB
IF rejection	>80dB
Image rejection	44dB
Capture ratio	1.3dB
Adjacent/Alternate channel rejection	1dB/49dB
RFIM	70dB
Distortion L/−R, L only	0.28%/0.3%
Crosstalk 1kHz/10kHz	39dB/26dB
19k/38k suppression	73dB/41dB

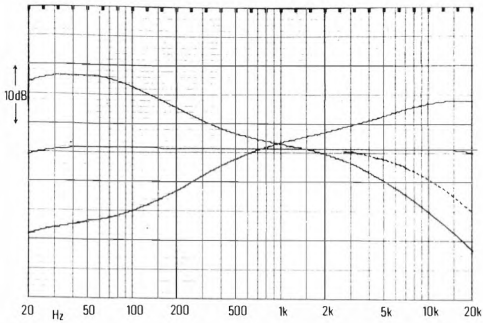
Tape

Tape used for tests	Sony FeCr C60
Replay azimuth alignment	79°
Wow and Flutter	0.27%
L/R Jitter at 3kHz	16°
Dolby ref. level readout on meters, 64mS under-read	−2dB/7dB
Distortion −6dB, 0dB, +3dB	0.4%/0.7%/2%
Line up on replay meters −6dB/0dB/+3dB	−5.8dB/0dB/+2.8dB
Erasure efficiency (400Hz at Dolby level)	71dB
Signal/Noise biassed tape CCIR/ARM	53dB/63dB
Tape noise headroom wrt replay noise (no cass)	7dB

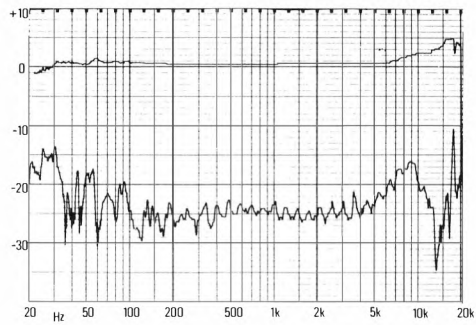
Disc

HF Intermodulation distortion (10.8kHz pulsed)	0.35%
Tracks 1k+1.5k 31.5cm/sec band at	1.6gms
Effective mass of pickup + arm	18.3gms
Subsonic resonance freq/dB gain	7Hz/6dB
Estimated compliance	28cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	57dB
Wow and Flutter	0.08%
Rumble (DIN B)	58dB
Tracking weight error setting/actual	2gms/1.96gms
Pickup type	Sony ND 1346

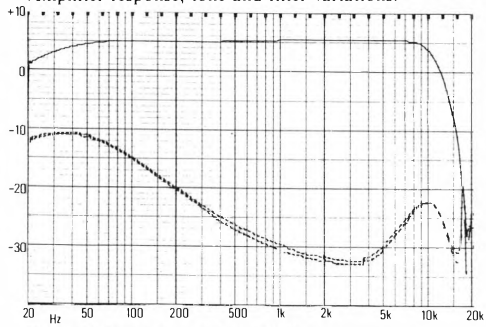
Availablefacilities	A, B, C, D, E, F, H, I, J, M, P, R, V, X, Y, Z, AA, AB, AE, AI, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BL, BM, BR, BS
Loudspeaker sensitivity (2.828V pink noise)	87dB
Length of loudspeaker lead	3.55m
Azimuth adjustment	normal screw type
Ferrite rod aerial	no external aerial
Typical System price	£400



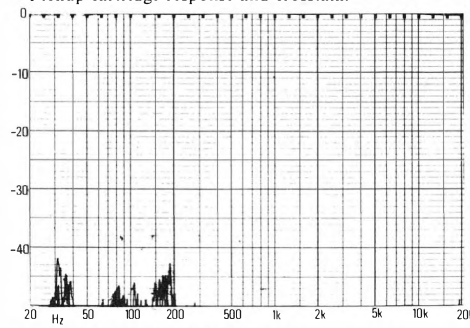
Amplifier response, tone and filter variations.



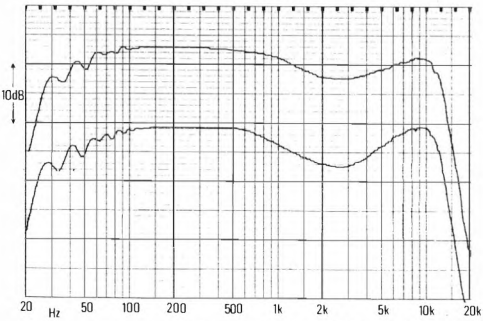
Pickup cartridge response and crosstalk.



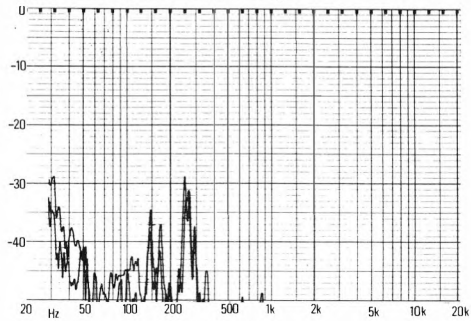
Tuner FM response and crosstalk.



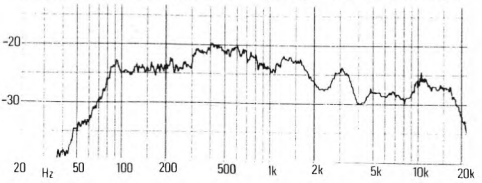
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

Teac Libero 3000

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

Introduction

Originally known in this country for their tape machines, and the cassette format in particular, Teac have offered full ranges of equipment in Japan for a number of years, and these are now being introduced more widely to the UK.

Two basic component systems are offered, named *Libero 3000* and *Libero 5000*, the cheaper one being reviewed here. In fact in error Harman sent the *CX 270* cassette deck instead of the *CX 210* which is normally offered. The *270* is normally supplied as part of the *5000* system, but the only real difference between the decks is that the *210* has conventional metering and costs £20 less. The *TX 300* tuner is common to both systems, though the *5000* has a more powerful amplifier and more sophisticated turntable.

General description

The whole system is mounted in a large attractive walnut finished rack with the cassette deck nearest the record storage area and the amplifier mounted above the tuner. Though the three units were stacked on top of each other there was no sign of any instability. The two speed direct drive deck is mounted in a moulded plastic cabinet, one of the few designs in this test series to veer away from the more traditional metal or chipboard constructions. Controls were smooth and easy to operate, the volume and tone controls on the amplifier being particularly smooth in action, though it was noted that there was slight mechanical interference between some of the switches and the tuner front panel.

All interconnections between the separate units were of the phono type though 5 pin DIN type sockets were provided on the amplifier and tape deck. A hinged and rotatable ferrite rod aerial is fitted to the rear of the tuner so there should be little problem in adjusting this without moving the whole system when optimum AM reception is required.

Amplifier *(BX 300)*

The amplifier was finished with the now almost mandatory brushed aluminium front panel, the controls being laid out in an easy to understand and simple manner. Position indent bass and treble controls are mounted to the right of the large volume control whilst the small centre indent balance control is positioned just below the volume control. Facilities include pickup input sensitivities suitable for both moving-coil and moving iron/magnet pickups, and routing switches that enable tape-to-tape copying from two externally connected tape recorders.

Amplifier power was a respectable 38.7 watts rising to 44.4 watts when a 4 ohm load is used. The measured response was very flat from 35Hz up to a ridiculous 255kHz, but the HF tone control was just a little limited in range, offering only ±6.5dB at 10kHz. Crosstalk, balance, and channel tracking error were all above average. The signal-to-noise ratio of 91dB taken with the CCIR/ARM

noise weighting filter was outstanding, as was the IHF intermodulation distortion, the 2nd and 3rd order components being some 76dB below the fundamental. Input capacitance on the phono input appeared to be rather lower than average, and this may have explained the excessive high frequency response from the cartridge (see pickup response curves).

Tuner *(TX 300)*
The various sensitivity parameters were rather lower than average, 650uV being needed before maximum signal-to-noise ratio could be obtained on a stereo transmission. When the tuner was in the stereo mode it was noted that the output connections were reversed, the left signal being fed to the right hand channel and vice versa. All the RF rejections were about average though the image rejection was a little lower than average. The third order ratio frequency intermodulation distortion was noted to be significantly higher than average at −54dB. and this aspect of the performance was confirmed on the subsequent listening tests.

Crosstalk between channels was found to be 38.5dB at 1kHz falling to 29dB at 10kHz. The signal-to-noise ratio achieved on some of the weaker stereo stations could be improved by using the front panel Hi-Blend switch to reduce the channel separation. The harmonic distortions, the 38kHz subcarrier suppression and the capture ratio were all above average, but these advantages were offset to some extent by lower than average sensitivity, the rather rough switches, the incorrect output terminations and the below average RFIM figure.

Cassette deck *(CX 270)*
This is unusual in that it features a fluorescent record level metering display* that has to be used to be appreciated; the system comprises a horizontal row of lights for both left and right hand channels, the length of the illuminated section being controlled by the level of the signal to be recorded; there are therefore no ballistic problems as with normal moving-coil meters. The system was found to be true 'peak' reading indicator on signal pulses as short as 10 milliseconds, and a useful feature was the provision of a peak-hold facility to provide a positive indication of overmodulation.

Replay azimuth was somewhat out of alignment with an error of 78°. Wow and flutter figures were very good at 0.088%. The recommended tape for the cassette deck was Maxell *UDXL1,* though the results obtained using this tape were not entirely satisfactory. The HF response was up some 2dB at 2.5kHz and continued to remain at this level up to 10kHz, followed by a minor peak in output at 14kHz. The signal-to-noise ratio at 58dB was average whilst the electronic noise was about 8dB below tape noise. In use the tape deck was quite well liked, though little things such as the separate left and right hand channel record level controls and the azimuth misalignment were irritating; the record meters were really a joy to operate and use.

Record deck *(PX 300)*
The two speed direct drive record deck is fitted with a high mass 'S' shaped arm and an Ortofon *FF15E MkII* cartridge. The performance of the deck in terms of wow and flutter and rumble was quite outstanding, but unfortunately the light plastic housing and poor external isolation resulted in lower than average performances for acoustic and vibrational breakthrough. Frequency response using the Ortofon *FF15E* was smooth up to 10kHz but it then rose to a peak of about 5dB at 15.5kHz.** The crosstalk levels were moderately constant over the whole of the important frequency range, the L – R crosstalk levels being just a little worse than the R – L levels. Some of the controls including pitch, speed selection and cue could all be operated with the dust cover down, but the cover has to be raised if the tone arm has to be moved. The general performance of the Ortofon pickup was very good, but the high effective mass of the tonearm resulted in a subsonic resonance around 7Hz with resonant gain of about 9dB. In summary the record deck probably offers a good average performance in its price class, the usual problems such as the sensitivity to external noise and vibration and the high effective arm mass and rather pronounced subsonic resonance being offset by the good trackability performance of the pickup and the excellent wow, flutter and rumble levels.

Listening tests and overall appraisal
Listening tests on the tuner revealed a lower than average sensitivity, some hiss being evident even on a relatively strong signal. The RF IM problems revealed themselves in the form of stations appearing all over the popular frequency bands making tuning a little difficult for the novice. The good frequency response, low crosstalk values and the

Teac Libero 3000

low harmonic distortion ensured excellent sound quality on a good transmission. Sound quality from tape was above average with perhaps a slight loss of high frequency response due to the poor azimuth alignment. The record meters were very effective in use and should provide all the information needed to ensure a good recording even on peaky music. Judged subjectively record/replay sound quality was thought to be rather bright but not objectionable. The record deck was prone to some acoustic feedback at very high listening levels but no real problems were apparent at normal to high levels. Some surface noise was audible due to the excessive high frequency response of the pickup, but the general overall performance of the disc replay system was good. In summary then a reasonable system with many good features, but there were a few aspects of the performance that could be criticised bringing the overall performance a little below that obtained from some other similarly priced systems.

*System *Libero 3000* is normally supplied with the *CX210* deck which uses conventional metering and costs about £20 less.

**Harman UK are distributors of both Ortofon and Teac, the former's cartridges requiring a load of about 400pf, higher than the amplifier provided. A simple Ortofon accessory *CAP 210* which fits between the cartridge pins would have accomplished this admirably, and presumably overcome the problems of rising HF response.

Amplifier (BX 300)

Power Output 8ohms/4ohms	38.7/44.4 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/0dB/1dB
Dynamic Headroom	1.7dB
Signal/Noise ratio CCIR/ARM	91dB
Ambient output voltage CCIR/ARM weighted	0.58mV
Phono input impedance/capacitance (inc lead)	74k/140pf
Crosstalk 1kHz/10kHz	49dB/39dB
Gain tracking error. ¼/½/¾ setting	0.4dBR/1.1dBR/0.3dBL
Balance	0.4dBL
3dB Bandwidth (at 1W RMS)	3.5Hz/255kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	>−78dB/>−78dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	>−76dB/>−76dB

Tuner (TX 300)

IHF least usable sensitivity	1.6uV
50dB quieting mono/stereo	4uV/66uV
Signal/Noise 1mV CCIR/ARM	72dB/62dB
Min signal for max S/N ratio mono/stereo	125uV/650uV
AM rejection	69dB
IF rejection	>80dB
Image rejection	approx 58dB
Capture ratio	1.5dB
Adjacent/Alternate channel rejection	2dB/>+48dB
RFIM	54dB
Distortion L/−R, L only	0.31%/0.3%
Crosstalk 1kHz/10kHz	38.5dB/29dB
19k/38k suppression	52dB/67dB

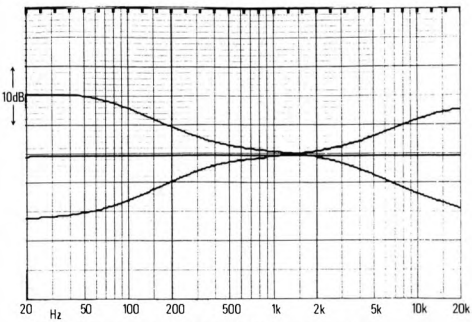
Tape (CX 270)

Tape used for tests	Maxell UDXLI C60
Replay azimuth alignment	78°
Wow and Flutter	0.088%
	21.8°
Dolby ref. level readout on meters, 64mS under-read	0dB/0dB
Distortion −6dB, 0dB, +3dB	0.9%/1.1%/1.85%
Line up on replay meters −6dB/0dB/+3dB	−5dB/+1dB/>+3dB
Erasure efficiency (400Hz at Dolby level)	68dB
Signal/Noise biassed tape CCIR/ARM	49.5dB/58dB
Tape noise headroom wrt replay noise (no cass)	8dB

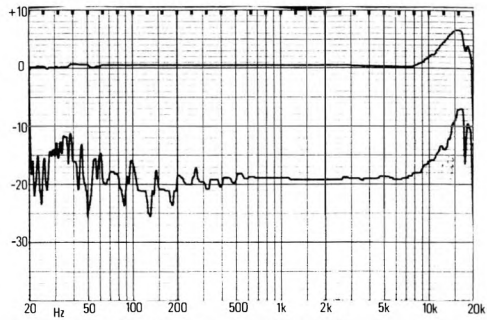
Disc (PX 300)

HF Intermodulation distortion (10.8kHz pulsed)	0.24%
Tracks 1k+1.5k 31.5cm/sec band at	2.1gms
Effective mass of pickup + arm	21gms
Subsonic resonance freq/dB gain	6.9Hz/10dB
Estimated compliance	25cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	59.5db
Wow and Flutter	0.06%
Rumble (DIN B)	67dB
Tracking weight error setting/actual	2gms/1.8gms
Pickup type	Ortofon FF15E MkII

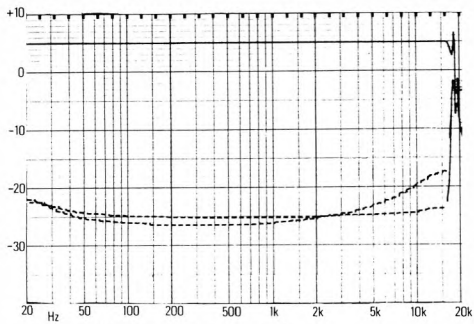
Available facilities	A, B, D, E, H, I, J, M, N, O, R, V, Y, Z, AA, AB, AI, AK, AL, AM, AN, AW, AX, AT, AZ, BB, BC, BD, BM, BR
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw-type
Ferrite rod aerial	hinged and rotatable
Typical System price	£460



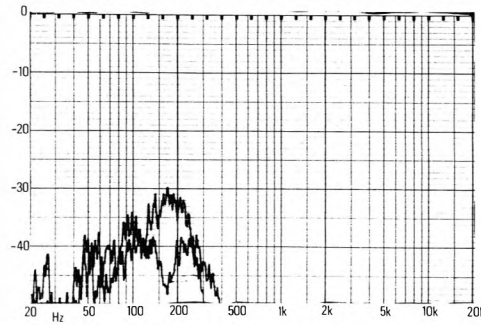
Amplifier response, tone and filter variations.



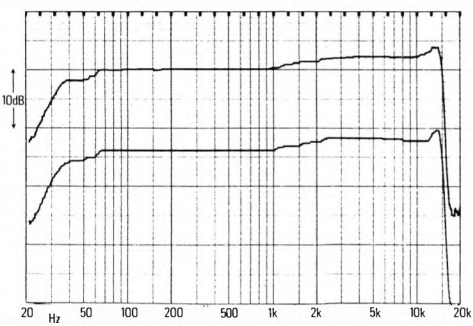
Pickup cartridge response and crosstalk.



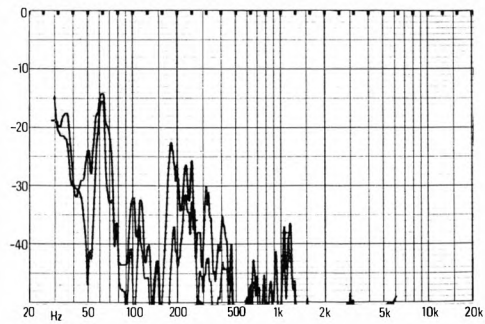
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

RECOMMENDED

Technics system

Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berkshire SL1 3DR. Tel: (0753) 27516

Introduction

Technics were probably the strongest influence in creating the 'professional look' in audio fashion, with first the heavyweight *9600* series and then the slimline *9000* series. These were very much at the top end of hi-fi, but the format has now been carried down to a large range of components which comprise the bulk of the Technics separates.

The catalogue lists five basic systems, but the dimensions suit a wide range of components, so presumably the possible permutations are practically infinite. Four basic rack styles are offered – one horizontal and three vertical with glass-fronted record storage, one for a receiver based system, one with optional finish for slimline components, and one for the 'fatter' components. Normally speaking the cheaper models are finished in silver, with the more prestigious ones a dark green/brown, though there are exceptions and options so that a low cost dark finish separates system can be put together.

The more expensive systems offer a range of extra modules of unusual versatility, including meters, equalisers, and even a microprocessor controlled programmable device for automatically switching on a sequence of 32 radio programmes from up to eight stations for remote tape recording!

General description

This is a particularly neat system, fitted in a glass-fronted cabinet finished in simulated wood veneer with the record deck at the top of the rack. The amplifier, cassette deck and tuner are stacked directly on top of each other and mounted on a shelf directly over the record storage space. All three units are finished in brushed aluminium. The majority of interconnections at the rear of the equipment are of the phono type although 5-pin sockets for tape are provided on the amplifier and cassette deck. Colour coded wire clamps are provided for two sets of loudspeakers at the rear of the amplifier. The *SL-B2* record deck is a two-speed belt drive design with electronic speed control and variable pitch adjustment. The hinged glass door was not well liked as it always seemed to get in the way when adjusting the equipment settings, although the door could be easily removed. All the equipment was manufactured in Japan and the overall quality of construction and visual matching between units was considered excellent.

Amplifier *(SU 8022)*

The amplifier is fitted with rotary controls for the adjustment of bass, treble and balance with a large rotary volume control fitted on the extreme right. The absence of any click stop on the main volume control should certainly please some users who

find them inconvenient. A rotary switch is provided to select the signal source. Comprehensive tape dubbing facilities are provided to allow recording to and from a second tape recorder. Two pushbutton switches allow either or both sets of loudspeakers to be connected to the amplifier at any one time. Subsonic and high frequency filter switches are located adjacent to the volume control.

Power output into 8 ohms was a very respectable 45.8 watts rising to 51 watts when a 4 ohm load was used. Increase in the hum components at maximum power levels was small and the overall signal-to-noise ratio was significantly better than average at 94dB. The amplifier frequency response was very smooth and extended well up to 62kHz, but it was noted that the range provided by the tone controls was a little limited, being around +10dB but only −7dB at both 100Hz and 10kHz. Crosstalk, gain tracking error and balance were generally better than average and likewise the IHF intermodulation distortion product performance. In all the amplifier offers a very good overall performance and can be confidently recommended.

Tuner *(ST 8011L)*

The tuner is fitted with a very neat signal strength meter in the form of a number of small LEDs fitted to the tuning cursor, strong signals lighting up all the LEDs while weak signals only lit a couple of them, although it was noted that the LEDs were a little difficult to see under daylight conditions. Pushbutton waveband selectors and an FM muting-multiplex on/off switch are provided below the tuning scale. The tuner was found to be particularly sensitive with an IHF least usable level of 1.3uV, 350uV being required for maximum stereo signal-to-noise ratio. This in turn was a little better than average at 68dB, with most of the radio frequency rejections being notably better than average.

The frequency response was very smooth extending well up to 16kHz with particularly low levels of crosstalk. A stereo pilot light is provided below the tuning scale and terminations are provided at the rear of the tuner for both 75 ohm and 300 ohm aerial connections. Distortion measured with both the L=−R 100% modulated carriers and single channel only carriers was generally better than average as was the radio frequency intermodulation distortion performance. The tuning control was found to be particularly smooth in operation, although the absence of any zero tuning indication was a disappointment. In summary the tuner was considered to offer performance that was significantly above average.

Cassette deck *(M 10)*

This is a front loading design with piano type tape transport controls and a particularly smooth eject mechanism. Concentric friction locked record level controls are fitted below the twin VU meters with a record light between the meters to indicate the record mode. The meters under-read by 7.5dB on a 64mS long pulse, and as there is no peak reading LED indicator some care and practice is needed if tape overloading is to be avoided. Input and Dolby system switches are fitted as is a single tape selector switch providing simultaneous control of both the bias and equalisation.

Tests were carried out using Maxell *UDXL1* tape which gave a generally smooth overall frequency response that extended well up to 15kHz, but was down in level by around 1dB between 9kHz and 15kHz. The wow and flutter performance was about average at 0.12% and the azimuth misalignment was particularly low. Overall tape line up and Dolby calibration level was good resulting in average values of tape distortion and noise. The erasure efficiency was better than average at 70dB whilst the tape noise headroom with respect to replay noise was reasonable at 8dB. In general the performance was thought to be good although the absence of any peak reading indicator to supplement the slow reading VU meters was regretted.

Record deck *(SL-B2)*

The record deck is a two-speed belt drive design with pitch adjustment and electronic speed control. The pitch adjustment, speed selector switch and reject button can all be operated with the dust cover down, although cueing has to be carried out manually with the dust cover up. The platter, plinth and tonearm are all firmly connected together and the unit was supported on four fairly stiff rubber feet. Vibrational breakthrough was reasonably low although the acoustic breakthrough was a little higher than average with a notable resonance occurring at 220Hz.

Stroboscopic markings are etched around the perimeter of the platter with a strobe illuminator/pilot lamp adjacent to the platter. The tonearm was

RECOMMENDED

Technics system

fitted with a Technics *270C* cartridge with a recommended tracking force of 1.75gms. The pickup was found to resolve the 31.5cm/sec high velocity band at around 1.6gms although performance in respect of high frequency intermodulation distortion was only average. The frequency response using the outer bands of the Bruel and Kjaer *QR 2009* test record was generally smooth although a minor rise in output was apparent at 12.5kHz. The compliance of the pickup was estimated to be 24cu, resulting in a subsonic resonant frequency of 7.7Hz with an average gain of 6dB. The tonearm had user-adjustable tracking and anti-skating force and was fitted with an integral cueing lever and a detachable SME type headshell. Performance of the record deck in respect of both wow and flutter and rumble was particularly good, with the signal-to-noise ratio being a little better than average at 61dB.

Listening tests and overall appraisal

The high sensitivity of the tuner was found to be particularly useful in pulling in the more distant stations. The overall frequency response was particularly smooth with excellent stereo image detail. Distortion at high modulation levels was low and the absence of any radio interference problems was commendable. The overall performance was obviously well above average although it was difficult to see the stereo pilot light and the signal strength LEDs under daylight conditions. Overall sound quality from tape using the Maxell *UDXL1* tape was above average with a good high frequency response and low distortion at high modulation depths. Tape noise was subjectively judged to be a little higher than average as was the wow and flutter, but the good stereo image detail, low distortion levels and good frequency response all ensured that the cassette deck received a higher than average rating in respect of sound quality. Sound quality from disc was very clean, wow, flutter and rumble were not too obvious though the acoustic breakthrough was audible at very high listening levels. The performance of the Technics pickup was reasonable with a smooth frequency response and good crosstalk performance but the tracking performance was not outstanding. As it stands the system can be firmly recommended, though the performance from disc would be improved if a better pickup were fitted.

Amplifier (SU 8022)

Power Output 8ohms/4ohms	45.8/51.0 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/0dB/1.5dB
Dynamic Headroom	1.5dB
Signal/Noise ratio CCIR/ARM	94dB
Ambient output voltage CCIR/ARM weighted	0.6mV
Phono input impedance/capacitance (inc lead)	44kohm/126pf
Crosstalk 1kHz/10kHz	49dB/46dB
Gain tracking error, ¼/½/¾ setting	0.8dBL/0.6dBL/0.3dBL
Balance	0.3dB
3dB Bandwidth (at 1W RMS)	5Hz/62kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	−75dB/−77dB
(−3dB ref max pw) 10kHz+11kHz2nd/3rd order	−76dB/−75dB

Tuner (ST 8011L)

IHF least usable sensitivity	1.3uV
50dB quieting mono/stereo	2.3uV/31uV
Signal/Noise 1mV CCIR/ARM	73dB/68dB
Min signal for max S/N ratio mono/stereo	43uV/250uV
AM rejection	59dB
IF rejection	>68dB
Image rejection	>75dB
Capture ratio	2.2dB
Adjacent/Alternate channel rejection	2dB/53dB
RFIM	76dB
Distortion L/−R. L only	0.32%/0.35%
Crosstalk 1kHz/10kHz	44dB/24dB
19k/38k suppression	36dB/44dB

Tape (M10)

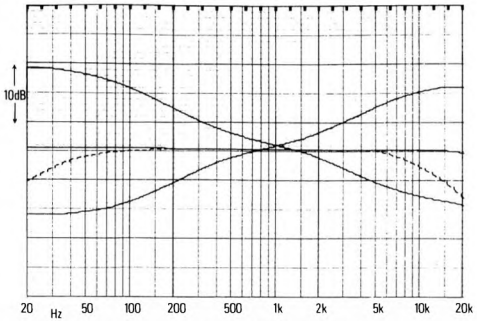
Tape used for tests	Maxell UDXL1
Replay azimuth alignment	18°
Wow and Flutter	0.12%
L/R Jitter at 3kHz	22.6°
Dolby ref. level readout on meters. 64mS under-read	+2.2dB/−7.5dB
Distortion −6dB, 0dB, +3dB	0.32%/0.5%/0.8%
Line up on replay meters −6dB/0dB/+3dB	−2.4dB/+3.3dB/+5.9dB
Erasure efficiency (400Hz at Dolby level)	−70dB
Signal/Noise biassed tape CCIR/ARM	49dB/59dB
Tape noise headroom wrt replay noise (no cass)	8dB

Disc (SL-B2)

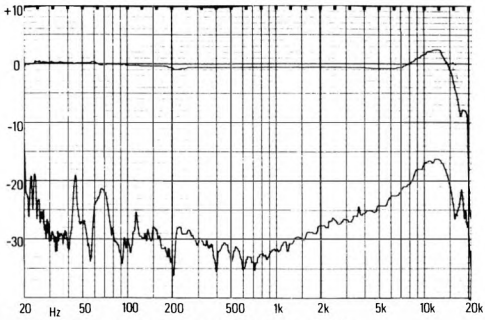
HF Intermodulation distortion (10.8kHz pulsed)	0.45%
Tracks 1k+1.5k 31.5cm/sec band at	1.6gms
Effective mass of pickup + arm	17.8gms
Subsonic resonance freq/dB gain	7.7Hz/6dB
Estimated compliance	24cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	61dB
Wow and Flutter	0.07%
Rumble (DIN B)	67dB
Tracking weight error setting/actual	1.75gms/1.72gms
Pickup type	Technics 270C

Available facilities	A. B. D. E. I. J. M. N. R. V. W. X. Y. Z. AA. AB. AI. AK. AL. AM. AN. AW. AX. AY. AZ. VU. BC. BD. BM. BR
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw type
Ferrite rod aerial	internal fixed
Typical System price	£515

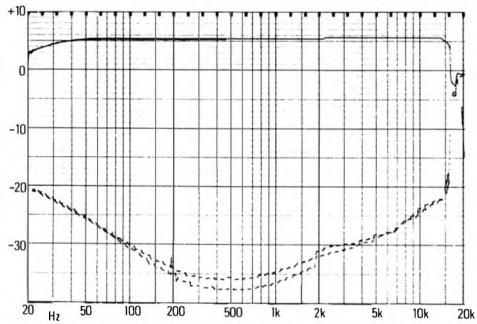
RECOMMENDED



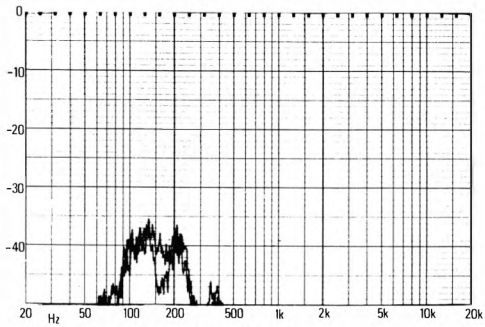
Amplifier response, tone and filter variations.



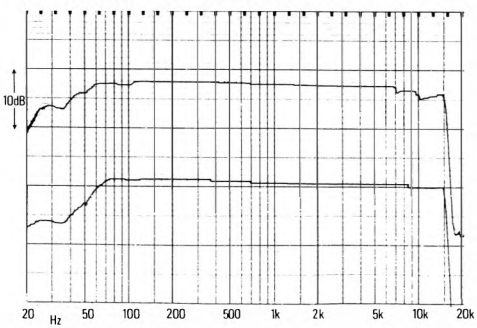
Pickup cartridge response and crosstalk.



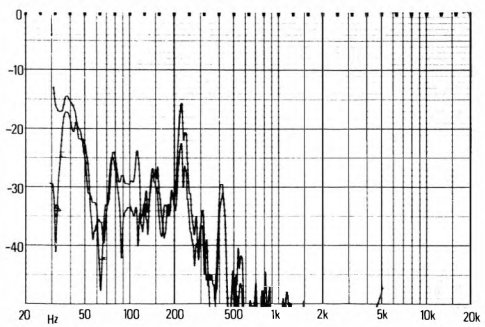
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

Teleton TC302

Teleton Electro (UK) Co. Ltd., Somerton Works, Prince Avenue, Westcliff-on-Sea, Essex SS0 0HU. Tel: (0702) 337681

Introduction

Teleton have been established in the market for low-priced audio, hi-fi separates and music centres for some years now, and the arrival of the racked system concept has seen them move firmly up-market into this field, with no less than three racks (disregarding the similar-looking but unusual 'home entertainment' modules with built in TV sets). These are all based around the *500* series components, and include a compact vertical 'casseiver' based system, a horizontally styled receiver plus cassette deck combination, and the fully 'separate' tower rack tested here. Turntable and speakers are common to all three, while each furniture unit offers disc and/or cassette storage.

General description

The loudspeakers, record deck and equipment rack are all finished in an attractive simulated wood veneer, whilst the front panels feature a dark tinted brushed alloy finish. The system features power meters and microphone mixing facilities on the amplifier, output level control and a multipath distortion reducing switch on the tuner and a headphone output level control on the cassette deck. Interconnections are all made via DIN sockets at the rear of the equipment, though phono sockets have been fitted to the cassette deck. Comprehensive tape dubbing facilities are included on the amplifier to enable recordings to be made from one external tape recorder to another. The record deck is a two-speed belt drive design with the platter, plinth and tonearm all solidly connected together. Provision is made for the storage of records at the base of the rack, with the record storage area hidden from view by a tinted glass door.

Amplifier *(A500)*

The ballistics of the meters fitted to the Teleton amplifier are questionable, under-reading by 12dB on a 64mS pulse and consequently only capable of giving a broad indication of the level of power being delivered. The amplifier is fitted with a microphone input facility which allows the mono signal from the microphone to be mixed with any source selected. Centre indent rotary bass, treble and balance controls and a large finely stepped rotary volume control are fitted. A selector switch is included to allow either or both of two sets of loudspeakers to be connected to the amplifier at any one time. The measured amplifier's output power was 33.4 watts into 8 ohms rising to 43.7 watts when a 4 ohm load was used. Hum modulation was low, none of the 50Hz, 100Hz and 150Hz hum components rising by more than 6dB when the amplifier was driven to its full power output. The overall frequency response of the amplifier was quite flat with a low-power bandwidth of 4.7Hz to 46kHz. It was noted that the performance achieved by the switchable filters was

little better than that obtained with suitable settings of the tone controls. The CCIR/ARM weighted signal-to-noise ratio of the amplifier was very good at 91dB whilst both the second and third order IHF intermodulation products were commendably low. Generally a well designed amplifier with a good specification and a few unnecessary frills.

Tuner *(T500)*
The tuner is fitted with a multipath distortion limiting circuit which allows the interference from signal reflections to be minimised. Other facilities include a multiplex on/off switch (to allow weak stereo stations to be received in mono), AFC and muting switches, and an output level control. The tuner is fitted with both signal strength and centre tune meters positioned at the left hand side of the tuning dial. The overall sensitivity was average, with most of the radio frequency rejection figures being about average, though the image rejection was somewhat lower than desirable at 46dB.

Capture ratio was a respectable 2dB whilst the third order radio frequency intermodulation distortion was very low at 68dB. The frequency response of the tuner was quite flat, though it did tend to fall away slightly above 7kHz and then rapidly above 16kHz. Crosstalk was adequately low even at the lower modulation levels, though the audio distortion levels were slightly high, especially on single channel modulation. The tuner is capable of receiving both LW and MW transmissions and a hinged (but not rotatable) ferrite rod aerial is fitted at the rear of the tuner to optimum reception of any desired local station. A 300 ohm twin feeder type of aerial socket is fitted, but there is no provision for a 75 ohm coaxial connection, thus it may be necessary to employ a low loss coupling transformer (balun) if the best possible performance is required from a 75 ohm type aerial. (In most situations an adequate performance can be obtained by simply connecting the inner conductor of the downlead to one of the 300 ohm terminals and leaving the outer braid unconnected.) In summary, a tuner of average capabilities matching the performance of the amplifier.

Cassette deck *(C500)*
The cassette deck is fitted with a peak reading LED to minimise tape overload on peaky signals, an output level control for the headphone socket and two concentric (but not friction locked) record level controls. The lack of coupling between the two separate channels does mean that care has to be taken when attempting a smooth stereo fade. All the key type tape transport controls were rather too stiff in operation for comfort. Tape selector switches are provided for normal, FeCr and CrO_2 tapes, with the combined duty of varying the bias and equalisation. Azimuth alignment error was on the high side at 83° and though the wow and flutter level was average at 0.11% the left/right channel phase jitter was a little high, particularly at the end of the test tape. The overall record/replay response using Maxell *UDXL1* tape was average on the right hand channel, though high frequency performance of the left hand channel was notably inferior, the output at 10kHz being some 4dB below that obtained at 1kHz. The signal-to-noise ratio and distortion were rather better than average whilst erasure was above average at 68dB. The meters under-read by 6.5dB on a 64mS pulse, but fortunately the peak reading LED (set to Dolby level) provided an accurate indication of the peak level of these short duration signals.

Record deck *(TRP200)*
As usual with decks of this construction, the acoustic breakthrough was rather high, though the vibrational breakthrough was lower than average. The deck is fitted with a tonearm of high effective mass and this, coupled with the high compliance pickup, results in the subsonic resonance occurring at the very low frequency of 5.6Hz, but with a usefully low amplification of 6dB. Wow and flutter was only marginally acceptable at 0.12%, whilst the rumble was a reasonable, if not outstanding, 62dB. The replay response of the pickup was characterised by a severe peak (HF resonance) in output at 17kHz, though the response over the remainder of the audio range was generally quite smooth, with tolerable levels of crosstalk. The high frequency tracking distortion using the Shure *TTR 103* record was average at 0.43%, though it was noted that the tracking weight had to be increased by 0.3gm above the recommended value to trace the high velocity 31.5cm/sec band correctly. The deck features an auto-return facility, push-button speed control and an SME type detachable headshell system. Though a number of criticisms have been raised it was felt that the deck did offer good value for money at the price. Major improvements in the trackability, frequency response and arm/cartridge resonances could be made however if the cartridge compliance was more accurately

to the mass of the arm.

Listening tests and overall appraisal

As with other music systems supplied with their own loudspeakers the major controlling factor in the final quality assessment was the loudspeaker performance; the Teleton loudspeakers did not compare favourably with the Mordaunt Short *Pageant II* speakers. The extreme low frequency and high frequency responses were below average with an erratic mid frequency performance that resulted in a hard forward stereo image that lacked positional precision. (But it should be noted that the price of the Teleton loudspeakers is significantly lower than that of the *Pageants*.)

Tuner quality was very reasonable with good stereo separation, low audio distortion. The serious high frequency response peak from the pickup compensated to some extent for the poor HF response of the loudspeakers, though the lower than average wow and flutter and trackability resulted in a lower than average sound quality rating. Interestingly enough acoustic breakthrough was not a serious problem except when using good loudspeakers with an extended low frequency response, which was the result of the predominant low frequency resonance in the acoustic breakthrough characteristic occurring at a low 38Hz. This is one aspect of the performance that benefits from the use of poor quality loudspeakers with a limited low frequency performance.

The tape record/replay response was about average, though an obvious loss in extreme high frequency response was apparent and the overall stereo definition appeared rather vague. The limited HF performance was also apparent on tape replay, probably due to azimuth misalignment. The system can obviously not receive a firm recommendation.

Amplifier (A500)

Power Output 8ohms/4ohms	3.4/4.3.7 watts
Hum modulation 50Hz/100Hz/150Hz	4dB/6dB/5dB
Dynamic Headroom	0.6dB
Signal/Noise ratio CCIR/ARM	91dB
Ambient output voltage CCIR/ARM weighted	0.55mV
Phono input impedance/capacitance (inc lead)	49k/214pf
Crosstalk 1kHz/10kHz	53dB/38dB
Gain tracking error, ¼/½/¾ setting	0.6dB/0dB/0dB
Balance	0dB
3dB Bandwidth (at 1W RMS)	4.7Hz/46kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	>76dB/>76dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	>76dB/>76dB

Tuner (T500)

IHF least usable sensitivity	2.5uV
50dB quieting mono/stereo	3.6uV/60uV
Signal/Noise 1mV CCIR/ARM	72.5dB/62dB
Min signal for max S/N ratio mono/stereo	63uV/360uV
AM rejection	60dB
IF rejection	72dB
Image rejection	46dB
Capture ratio	2dB
Adjacent/Alternate channel rejection	3dB/>60dB
RFIM	68dB
Distortion L/−R, L only	0.45%/0.98%
Crosstalk 1kHz/10kHz	37dB/32dB
19k/38k suppression	62dB/61dB

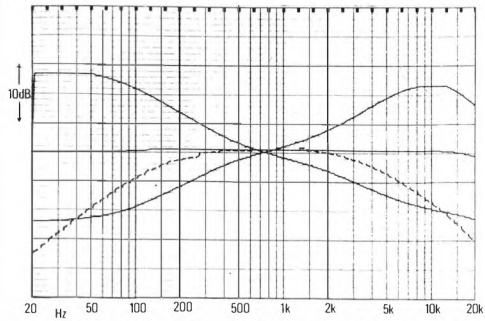
Tape (C500)

Tape used for tests	Maxell UDXLI
Replay azimuth alignment	83°
Wow and Flutter	0.11%
L/R Jitter at 3kHz	29.9°
Dolby ref. level readout on meters, 64mS under-read	+3dB/−6.5dB
Distortion −6dB, 0dB, +3dB	0.4%/0.65%/1.2%
Line upon replay meters −6dB/0dB/+3dB	−5.5dB/+0.6dB/+4dB
Erasure efficiency (400Hz at Dolby level)	68dB
Signal/Noise biassed tape CCIR/ARM	48dB/58dB
Tape noise headroom wrt replay noise (no cass)	7dB

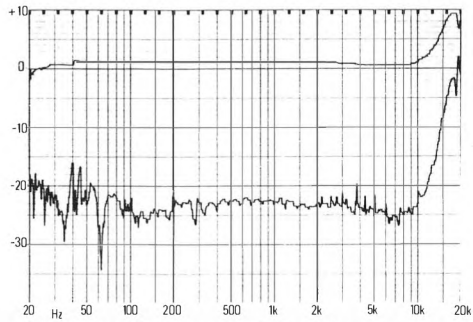
Disc (TRP 200)

HF Intermodulation distortion (10.8kHz pulsed)	0.43%
Tracks 1k+1.5k 315cm/sec band at	2.8gms
Effective mass of pickup + arm	21.3gms
Subsonic resonance freq/dB gain	5.6Hz/6dB
Estimated compliance	38cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	59dB
Wow and Flutter	0.12%
Rumble (DIN B)	62dB
Tracking weight error setting/actual	2.5gms/2.4gms
Pickup type	Jelco D

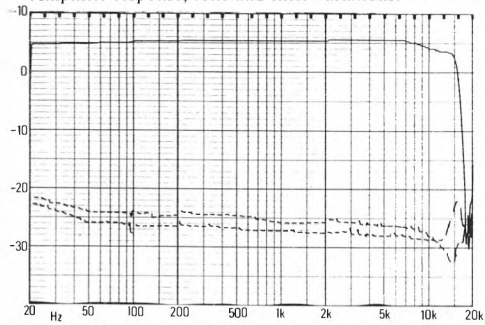
Available facilities	A, B, D, H, I, J, K, M, N, R, V, W, X, Y, Z, AA, AB, AE, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BM, BR, BS
Loudspeaker sensitivity (2.828V pink noise)	87.5dB
Length of loudspeaker lead	3.6m
Azimuth adjustment	normal screw type
Ferrite rod aerial	hinged but not rotatable
Typical System price	£480 inc speakers



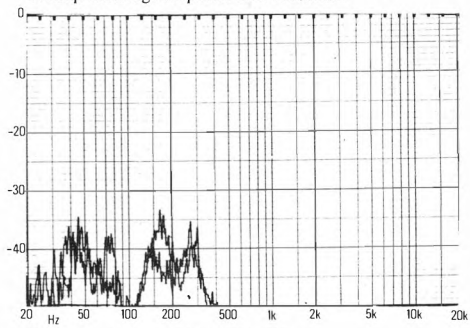
Amplifier response, tone and filter variations.



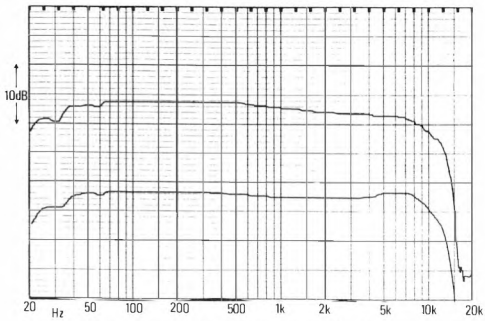
Pickup cartridge response and crosstalk.



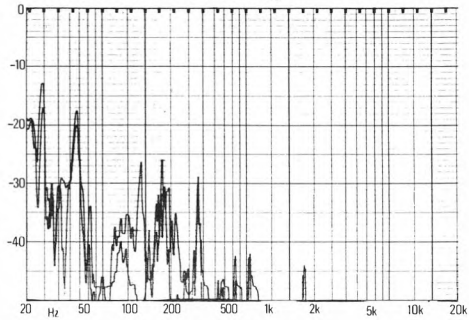
Tuner FM response and crosstalk.



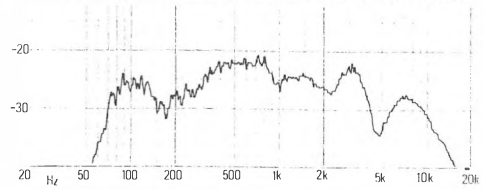
Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.



Loudspeaker frequency response, 1m.

Toshiba system 225

Toshiba UK Ltd., Toshiba House, Frimley Road, Frimley, Camberley, Surrey GU16 5JJ. Tel: (0276) 62222

Introduction

The rack plays an important part in Toshiba's marketing policy, with no fewer than six combinations without component duplication. All items are silver fronted, a number of them in a low profile format. Though the *225* system tested here has a horizontal presentation, the other models are all vertical racks with record storage, and the variations on standard of finish and accommodation amount to four basic models. All the systems are based on separate amps and tuners, with a couple of the more powerful slimline models further separating pre- and power amps.

General description

This is a low line horizontal design with record deck and amplifier fitted to one side of the cabinet above the record storage area and the cassette deck and tuner housed above the cassette storage drawer on the other side of the cabinet. A 'toast rack' type of metal grille is fitted within the drawer to allow 42 cassettes to be neatly stored away from view whilst the free space at the side of the record deck is useful for placing empty sleeves and record cleaning equipment.

The majority of the inter-connections at the rear of the equipment are of the phono type, though a 5-pin DIN socket is included on the cassette deck; pushbutton terminals on the amplifier make the loudspeaker connections. The equipment is finished in brushed aluminium with tinted perspex screens covering the tuning scale, the cassette housing and the recording meters. Although the quality of construction and visual matching between units was very good the cabinet construction was well below average, many of the partitions failing to come flush with the top or side panels.

Amplifier *(SB-225)*

The amplifier is a low profile design with rotary

bass and treble controls, a rotary centre detent balance control and a large click stop rotary volume control. The front panel is fitted with five LEDs to indicate the output signal level, a microphone mixing facility, loudness and tape monitor switches. The ballistics of the LED power meter were such that the LED's only started to under-read with pulse durations of less than 16mS. Output power was 36.9 watts into an 8 ohm load, rising to 43.8 watts into 4 ohms.

A useful dynamic headroom of over 1dB is also available for signals having a duration of less than 20mS and the overall signal-to-noise ratio of the amplifier was an outstanding 101dB, the best measured during this survey. The overall frequency response was generally smooth, though the high frequency output was down some 3dB at 18kHz. The phono input impedance and capacitance levels were pretty well optimum, and the crosstalk, channel balance and distortion performances were well above average. In summary, a fine amplifier with an excellent overall performance that was difficult to fault.

Tuner *(ST-225)*

This low profile design has the minimum of front panel controls including a multiplex on/off switch, waveband selectors and a large rotary tuning knob. The IHF least usable sensitivity was good at 2uV with 430uV being required to reach the maximum signal/noise ratio. The latter and all the radio frequency rejections were generally better than average. Capture ratio was particularly good at 1.5dB, as were the audio distortion levels both with the 100% modulated L=−R carrier and with single channel modulation.

The overall frequency response was a little disappointing, being some 3dB down at 27Hz and 12.5kHz, but otherwise the tuner performance was above average, particularly when the price is considered. An external ferrite rod aerial is fitted at the rear of the tuner and is hinged (though not rotatable) to improve reception quality when receiving AM transmissions. A centre zero tuning meter is fitted below the tuning cursor behind the perspex screen and this, in conjunction with the stereo pilot light, considerably facilitates tuning.

Cassette deck *(PC-230D)*

The cassette deck is fitted with separate record level controls for the two channels, an output control, separate bias and equalisation selector switches and a peak reading LED to supplement the large easily read twin VU meters. The deck is inconveniently positioned less than a foot away from the floor and the ergonomics are marred by the separate record level controls that require simultaneous operation for a successful fade. Azimuth alignment error was excellent at 17° and the inter-channel jitter was low, though the wow and flutter performance was rather worse than average. The best frequency response was obtained using the high bias TDK *SA C60* tape, though the output falls away rather rapidly above 12kHz. As is usual with chrome or pseudo-chrome tapes the distortion at high modulation levels was noticeably higher than when using ferric oxide or ferrichrome tape, but some improvement in signal-to-noise was achieved making the overall performance rather better than average. The twin VU meter ballistics under-read by 6dB on a 64mS long pulse, though the peak reading LEDs provided a good indication of the peak value even with pulse durations shorter than 16mS. It is usual to set such LEDs to flash at Dolby level but in this sample the LEDs has been set to flash at 3dB above Dolby, so it will be necessary to advance the record level controls until the LEDs just flicker and then to retard the controls a little if optimum recording quality is to be obtained. In general a fine deck with some excellent features though the higher than average wow and flutter figure could be criticised.

Record deck *(SR-F225)*

The *SR-F225* is a two-speed fully automatic belt drive design complete with repeat play facilities, anti-skating adjustment and an SME type detachable headshell. The plinth is constructed from preformed plastic; the tonearm, platter, plinth and dust cover are all firmly connected together with the base supported on rubber feet. Acoustic and vibrational breakthrough performance were both classed as below average as would be expected from a deck of this construction. The Toshiba *C-290M* cartridge fitted to the tonearm has a lower than average performance in respect of trackability and distortion, with the high frequency response being a little low by some 2dB at 10kHz. Such a response usually results in a subjectively lower level of record noise pickup, though it is doubtful whether this has any advantage in this instance as the signal-to-noise ratio measured using the CCIR/ARM weighting network was only 50dB. Investigation showed that the noise, mainly in the form of

Toshiba system 225

hum components, originated from the cartridge pre-amplifier making accurate measurement of rumble impossible. The fully automatic cueing and repeat play features were liked, especially the front control layout, the main controls being accessible even with the dust cover down. Though the wow and flutter performance was good, the many criticisms in respect of trackability, acoustic breakthrough, signal-to-noise ratio and frequency response make it difficult to give recommendation.

Listening tests and overall appraisal

Tuner tests confirmed the good sensitivity, with easy reception of even the more difficult to receive local and commercial FM stations. The frequency response was well extended and the crosstalk low, whilst the loss of extreme HF response was noticeable though not obvious as would appear from the response curves. Distortion was particularly low even at high modulation levels and the overall performance was considered well above average. Sound quality from tape was generally very good with a well extended response and a firm image, though the wow and flutter was obtrusive on the more sensitive passages of music. The tape transport keys were found to be rather stiff and the positioning of the unit near the floor did make operation rather inconvenient. The mains hum component commented on in the record player assessment was audible and the tracking performance of the cartridge on loud passages inferior. Acoustic breakthrough did not prove troublesome except at very high listening levels. Though the overall sound quality from the amplifier, tuner and cassette deck was above average, the performance of the disc system was below average and consequently a recommendation cannot be given, though the system should certainly be considered by those users who don't consider records to be their first choice of programme source.

Amplifier (SB-225)

Power Output 8ohms/4ohms	36.9/43.8 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/2dB/1dB
Dynamic Headroom	1.1dB
Signal/Noise ratio CCIR/ARM	101dB
Ambient output voltage CCIR/ARM weighted	0.3mV
Phono input impedance/capacitance (inc lead)	48k/150pf
Crosstalk 1kHz/10kHz	51dB/44dB
Gain tracking error, ¼/½/¾ setting	0.5dBL/0.3dBL/0.3dBL
Balance	0dB
3dB Bandwidth (at 1W RMS)	4.4Hz/18kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	72dB/>75dB
7 (−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	72dB/75dB

Tuner (ST-225)

IHF least usable sensitivity	2uV
50dB quieting mono/stereo	3.3uV/44uV
Signal/Noise 1mV CCIR/ARM	72dB/67dB
Min signal for max S/N ratio mono/stereo	56uV/430uV
AM rejection	65dB
IF rejection	69dB
Image rejection	56dB
Capture ratio	1.6dB
Acjacent/Alternate chan. reject.	2.5dB/48dB(+400kHz)/>60(−400kHz)
RFIM	72dB
Distortion L/−R, L only	0.2%/0.28%
Crosstalk 1kHz/10kHz	35dB/29dB
19k/38k suppression	42dB/56dB

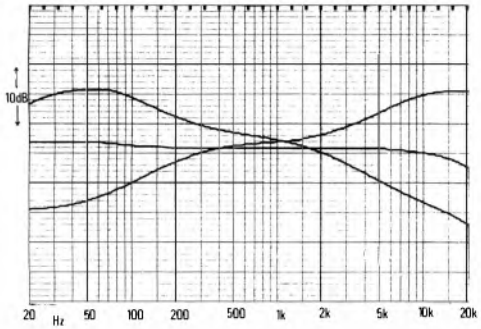
Tape (PC-230D)

Tape used for tests	TDK SA C60
Replay azimuth alignment	17°
Wow and Flutter	0.13%
L/R Jitter at 3kHz	28°
Dolby ref. level readout on meters, 64mS under-read	+2.5dB/6dB
Distortion −6dB, 0dB, +3dB	0.45%/0.8%/1.6%
Line up on replay meters −6dB/0dB/+3dB	−5.2dB/+0.7dB/+3.4dB
Erasure efficiency (400Hz at Dolby level)	68.5dB
Signal/Noise biassed tape CCIR/ARM	51dB/61dB
Tape noise headroom wrt replay noise (no cass)	9dB

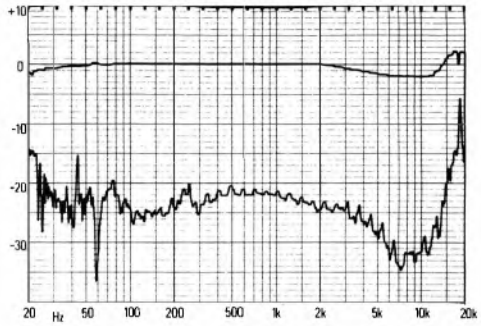
Disc (SR-F225)

HF Intermodulation distortion (10.8kHz pulsed)	0.48%
Tracks 1k+1.5k 31.5cm/sec band at	2.6gms
Effective mass of pickup + arm	21.0gms
Subsonic resonance freq/dB gain	6.3Hz/4.5dB
Estimated compliance	31cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	50dB
Wow and Flutter	0.08%
Rumble (DIN B)	limited by poor S/N ratio
Tracking weight error setting/actual	2gms/2.06gms
Pickup type	Toshiba C-290M

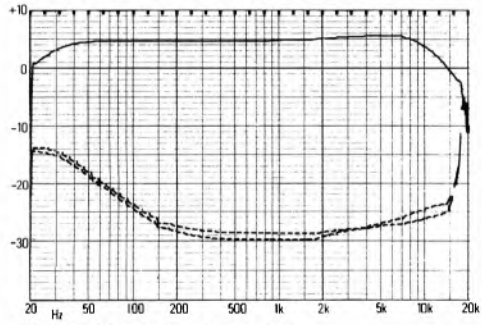
Available facilities	A, B, D, E, H, I, J, M, R, V, Y, Z, AB, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BM, BN, BS
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw-type
Ferrite rod aerial	hinged but not rotatable
Typical System price	£500



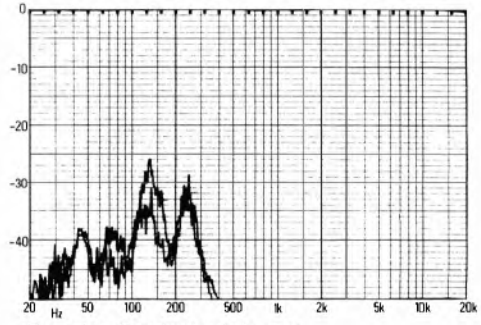
Amplifier response, tone and filter variations.



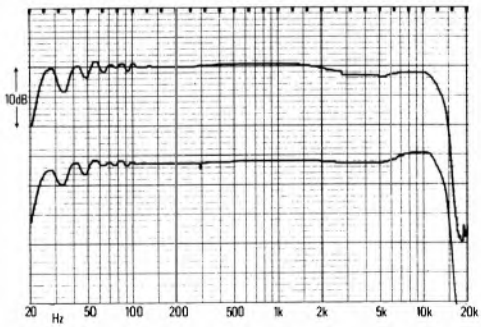
Pickup cartridge response and crosstalk.



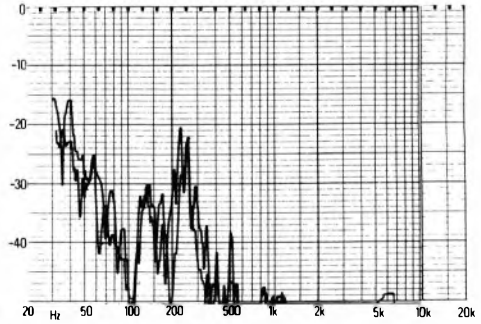
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

RECOMMENDED

Trio TRS 55

B. H. Morris & Co. (Radio) Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex HA0 1SU. Tel: (01) 902 9422

Introduction

There are five basic Trio systems being marketed, and each is available in vertical and horizontal formats, ranging from less than £400 to around £800, representing for example power outputs between 20 and 60 watts per channel. By the time this is published all will be supplied with the Ortofon *FF15E* cartridge as standard, a modification which was instituted after our measurements had unfortunately been taken. Trio have long been established in the specialist dealers, but their systems can now also be found in major department stores (see Boots system introduction). They are generally sold at a small discount against the accumulative cost of the various individual components.

General description

A slightly unusual layout has been adopted on the Trio rack with the disc and cassette storage area being positioned to the right of the sound reproducing equipment. One major disadvantage with this layout is that adjustment to the tuner and amplifier controls is made difficult as they are so near to ground level. Phono type interconnections are the norm, though there is provision for the usual 5-pin DIN socket on the tape deck. An unusual feature of the tape deck is the push to hold/push to release access plate over the tape housing. This results in the cassette having to be manually housed and removed from the mechanism, a design feature that is becoming increasingly popular amongst the Japanese manufacturers. The rack is finished in mottled black vinyl with silver edge trim to match the brushed alloy front panels of the equipment.

Amplifier *(KA3700)*

The amplifier's controls were well laid out, simple

RECOMMENDED

and easy to operate. The balance, treble and bass controls all featured position indents whilst the volume control was of the usual smooth rotary type. Input selection to phono, tuner and aux is made using a rotary switch adjacent to and matching the volume control, whilst a tape/source pushbutton selector is provided to the right of the input selector.

Output power was measured to be 33.5 watts (both channels driven) into 8 ohms rising slightly to 37 watts into 4 ohms. The frequency response was very flat and extended from 3Hz up to 150kHz, whilst the tone controls were of the usual type but with a slightly limited range of only ±7.5dB at 10kHz. Simplicity allied to good performance appears to be Trio's philosophy with this particular amplifier, and they certainly seem to have achieved their goal, particularly in view of the very reasonable price. All the measured parameters were considered to be above average, especially the dynamic headroom, crosstalk and IHF intermodulation distortion. The distortion components were all more than 70dB down at 3dB below maximum power output.

Tuner *(KT5500)*

The simplicity of front layout featured on the amplifier is carried through to the tuner, the only front panel controls being the main tuning control, an auto-muting/mono switch and an AM/FM selector. IHF least usable sensitivity was very good at 1.2uV, whilst the minimum signal needed for maximum signal/noise ratio on stereo was a very reasonable 250uV. The tuner frequency response showed a rather excessive loss below 100Hz, the output at 30Hz being some 6dB below the 1kHz level. The high frequency response was also slightly limited being some 3dB down at 15kHz, though subjectively this was of academic importance. Crosstalk was quite smooth over the whole audio range and the left and right channel crosstalk levels were virtually identical. All the RF rejections were good, particularly the IF rejection, whilst the Radio Frequency Intermodulation distortion was a very good −7dB. Harmonic distortion was a little better than average at 0.4% (L=−R 100% mod) though the 19kHz and 38kHz rejections were somewhat lower than average at 40dB and 46dB respectively. Apart from the restricted low frequency response the tuner performed very well indeed and, like the amplifier, proved to be very pleasant to use.

Cassette deck *(KX530)*

This is basically a front loading design featuring friction locked rotary record controls and including bias and equalisation settings for both normal and chrome tape. The tape transport controls were easy to operate and well liked by all the users, as was the unusual perspex access panel over the cassette housing. The record metering was of the usual VU type, the meters under-reading by only 4dB on a 64mS pulse. The record/replay response using Maxell *UDXL1* tape was really very good, being virtually flat up to 14.5kHz, the left hand channel being 1dB up at 10kHz with respect to the right hand channel output. The distortion and line up levels were all above average for a deck of this price class while the wow and flutter was better than average at 0.09%. Erasure measured well and the signal-to-noise ratios were typical of a cassette deck operating with a normal bias tape. Azimuth alignment was typical at 32°, as was the tape headroom noise with respect to replay noise. Again the overall technical performance was very good considering the price of the machine. The performance of the cassette deck nicely matched that of the amplifier and tuner.

Record deck *(KD 1033)*

The *KD-1033* is a well-established two-speed belt drive deck mounted on a chipboard base with relatively hard rubber feet. Acoustic isolation is achieved by mounting the metal plinth carrying the platter and arm on foam damped metal springs, a measure that usually proves to be effective in reducing acoustic breakthrough. This was borne out in our measurements, the acoustic and vibration breakthrough performances being rated as above average.

The deck was originally fitted with a Goldring *G800* cartridge and it was this which really limited the performance of the whole system. The pickup would not follow the 31.5cm/sec high velocity track even at 3.5gms, whilst the HF intermodulation distortion was high at 0.93%. The frequency response of the pickup left much to be desired, a broad dip in the response occurring around 4–8kHz with a slight rise at 13kHz. Crosstalk was reasonable though a prominent arm resonance was apparent at 250Hz.

Rumble was high at −54dB due apparently to the motor being poorly isolated from the plinth. The low frequency arm/cartridge resonance occurred at 10.3Hz, a reasonable performance

RECOMMENDED

Trio TRS 55

achieved not by a low mass arm but by the low compliance Goldring cartridge. Wow and flutter was a little above 0.1% though the signal-to-noise ratio was a satisfactory 60dB.

The deck does show great promise, especially in respect of acoustic and vibrational breakthrough but the problem areas such as rumble, pickup performance and arm resonance really prevent any firm recommendation. After tests had been completed Trio informed us that they now fit an Ortofon *FF15E MkII* in preference to the Goldring cartridge. If the Ortofon cartridge was used and if the rumble level could be improved by some 6dB the overall system would offer outstanding value for money.

Listening tests and overall appraisal

As can be seen from the above sections the only area of real criticism is the record deck. The cassette deck, amplifier and tuner all complementing each other both in terms of technical performance and ease of use. Listening tests confirmed that the record deck was not outstanding, the rumble being audible but not too intrusive with the distortion from the Goldring pickup being moderate to high. Significant improvements in respect of frequency response, trackability and image detail were achieved using the Ortofon cartridge. The tape deck produced a very clean sound at the HF end with a good stable image though one listener did complain of a 'fuzzy' bass. Overall sound quality was however above average, as was the sound from the FM receiver, though its lack of bass did result in a rather thin sound.

Overall the system was thought to be particularly impressive with just a few problem areas which, if attended to*, would certainly result in the system attaining a strong recommendation. As it stands at the moment however, the system is recommended but with slight reservations.

**Trio have further advised us that all systems available by the time of publication will have the Ortofon cartridge fitted, thereby countering a significant reservation.*

Amplifier (KA 3700)

Power Output 8ohms/4ohms	33.5/37 watts
Hum modulation 50Hz/100Hz/150Hz	6dB/0dB/3dB
Dynamic Headroom	1.2dB
Signal/Noise ratio CCIR/ARM	88dB
Ambient output voltage CCIR/ARM weighted	0.8mV
Phono input impedance/capacitance (inc lead)	51k/191pf
Crosstalk 1kHz/10kHz	45dB/45dB
Gain tracking error, ¼/½/¾ setting	+0.2dBR/0.2dBL/+0.2dBR
Balance	0dB
3dB Bandwidth (at 1W RMS)	3Hz/150kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	76dB/74dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	72dB/72dB

Tuner (KT 5500)

IHF least usable sensitivity	1.2uV
50dB quieting mono/stereo	2.2uV/28uV
Signal/Noise 1mV CCIR/ARM	72dB/67dB
Min signal for max S/N ratio mono/stereo	34uV/250uV
AM rejection	61dB
IF rejection	>80dB
Image rejection	60dB
Capture ratio	1.6dB
Adjacent/Alternate channel rejection	5dB/>60dB
RFIM	74dB
Distortion L/−R, L only	0.4%/0.8%
Crosstalk 1kHz/10kHz	32dB/31dB
19k/38k suppression	40dB/46dB

Tape (KX 530)

Tape used for tests	Maxell UDXL1
Replay azimuth alignment	32°
Wow and Flutter	0.09%
L/R Jitter at 3kHz	21°
Dolby ref. level readout on meters, 64mS under-read	+3.2dB/−4dB
Distortion −6dB, 0dB, +3dB	0.25%/0.45%/0.8%
Line up on replay meters −6dB/0dB/+3dB	−5.6dB/+1dB/+4.3dB
Erasure efficiency (400Hz at Dolby level)	69dB
Signal/Noise biassed tape CCIR/ARM	48.5dB/58dB
Tape noise headroom wrt replay noise (no cass)	8dB

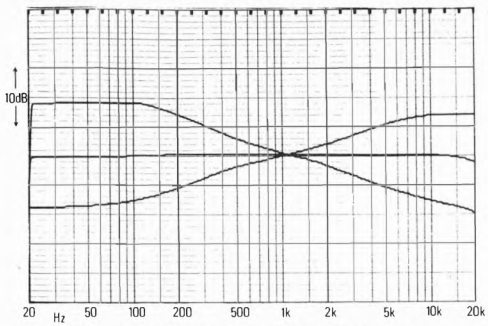
Disc (KD 1033)

HF Intermodulation distortion (10.8kHz pulsed)	0.93%*
Tracks 1k+1.5k 31.5cm/sec band at	failed*
Effective mass of pickup + arm	22.7gms
Subsonic resonance freq/dB gain	10.3kHz/6dB
Estimated compliance	10.5cu*
Signal/Noise ratio CCIR/ARM ref 1cm/sec	60dB
Wow and Flutter	0.11%
Rumble (DIN B)	54dB
Tracking weight error setting/actual	3gms/2.94gms
Pickup type	Goldring G800*

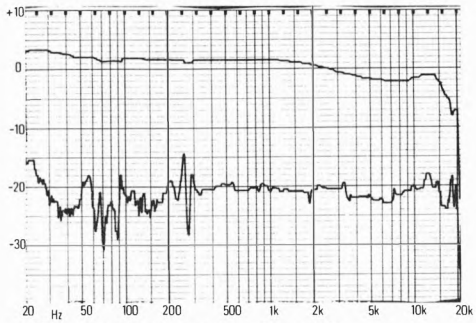
Available facilities	A, B, D, E, H, I, J, M, N, R, V, Y, AB, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BM, BN
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	only by dismantling equipment
Ferrite rod aerial	no external
Typical System price	£415

note cartridge change

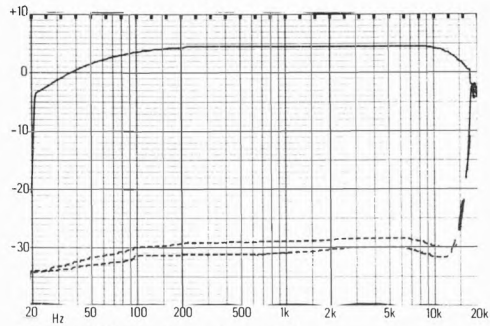
RECOMMENDED



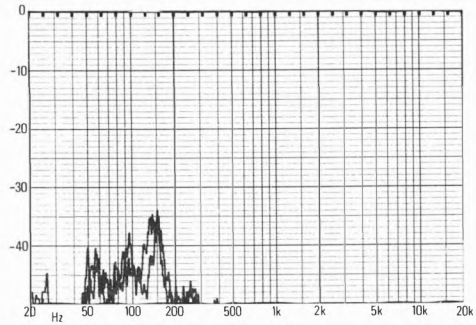
Amplifier response, tone and filter variations.



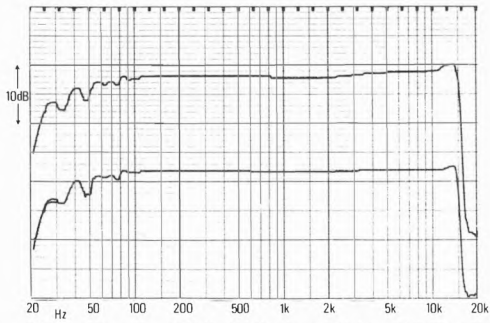
Pickup cartridge response and crosstalk.



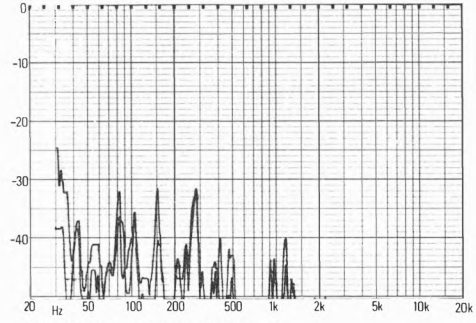
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

Uher system

Uher Ltd., 24 Market Place, London NW11. Tel: (01) 455 1771

Introduction

The visually impressive unit tested here is the sole representative of full-sized Uher components marketed in rack format in the UK, so further elaboration here is unnecessary. However Uher could justly claim to be amongst the micro-system pioneers, based around their well-established mains/portable *CR240* cassette recorder, which has always been a leader in providing high specification and versatility in an extraordinarily compact package. This has now been joined by mains powered Pre- and power amplifiers and a tuner with digital display; all are finished in black. Only the cassette deck is capable of doubling as an in-car device, while the power amp is designed to be controlled remotely from the pre-amp and therefore can be mounted out of sight, further enhancing the visual discretion of the system.

General description

The amplifier, tuner and cassette deck are stacked directly on top of one another and positioned over a cassette storage drawer, which is itself above the record storage area. A hinged glass door is fitted onto the record storage compartment, whilst a removable moulded cassette rack, capable of housing 39 boxed cassette tapes, is included within the drawer. All the units including the record deck are finished in matt black with easily visible bold white legends, many of which were printed in German on this sample. The equipment includes many useful features such as the provision of a reference tone on the FM tuner to facilitate setting the recording level, a microphone mixing facility on the amplifier, and a headphone volume control fitted to the cassette deck. The majority of interconnecting sockets at the rear of the equipment were of the phono type, though 5-pin DIN sockets were provided for the tape deck and tuner, and a DIN input socket was available on one of the phono inputs. The amplifier and cassette deck were provided with the DIN type of headphone socket with matching DIN sockets for the microphone inputs, thus adaptors may be needed for the many headphone sets and mikes fitted with jack plugs.

Amplifier *(VG 850)*

More than adequate power was available from this amplifier, some 82 watts into 8 ohms falling only slightly to 76 watts when a 4 ohm load is used. Hum modulation was good and a useful dynamic headroom of 1.3dB was available, highlighting again the excellent power output capability of the amplifier. Position indent bass and treble controls are provided, and a cancel switch is fitted to allow comparisons to be made between program both with and without the tone controls operational. A switchable subsonic filter is provided below 20Hz, complementing the sensible bandwidth-limited response of the amplifier. Comprehensive switching arrangements are provided for copying from one tape recorder to another, and two phono inputs are available (though neither had adequate sensi-

tivity for the increasingly popular moving-coil pickups). Facilities are provided for driving two sets of loudspeakers, either or both sets being selected by a front switch. The fine technical performance of the amplifier was slightly marred by the higher than normal 3rd order intermodulation products (measured at 3dB below maximum power output), though it is unlikely that these levels of distortion will have any serious detrimental effect on the subjective quality of the amplifier.

Tuner *(EG 750)*
As with the amplifier and cassette deck the tuner is enclosed in a black finished metal case with black plastic trim around the perimeter of the front panel. Tuning is carried out via the moderately sized knob fitted at the right hand end of the tuning scale with clearly illuminated signal strength and centre zero tuning meters being provided below the tuning scale. The IHF least usable sensitivity was a very respectable 1uV with 220uV being needed for optimum reception of stereo signals. AM rejection was a little disappointing though the image rejection and the IF rejection were both very satisfactory. Features include a high-blend switch to improve the signal-to-noise ratio on weak stereo signals, though this is achieved at the expense of reduced channel separation at the higher frequencies, an output level control, and a multipath setting on the signal strength meter which indicates the strength of any multipath interference. The tuning indicator was slightly mis-aligned, and the optimum tuning point on the meter did not coincide with the minimum distortion possible; some 0.63% distortion was measured at the tuning point indicated by the meter, while a possible minimum distortion level of 0.25% was obtainable if the tuning meter was ignored. Channel-to-channel crosstalk was also affected by the mis-alignment problems, the maximum crosstalk possible being in excess of 40dB at 1kHz though only 28dB was recorded for the indicated 'optimum tune' condition. In summary a tuner with great promise which failed to do particularly well in the comparison because of mis-alignment problems.

Cassette deck *(CG 340)*
This front-loading design is fitted with rotatable friction locked recording controls, separate bias and equalisation switches, a volume control for the headphone socket, a memory switch, and an optional overload limiter to reduce the input signal to an acceptable level when it exceeds the overload setting on the record meters. The mechanics of the cassette transport system were generally good with a wow and flutter level of 0.11% and a noticeably low left/right hand channel phase jitter level of less than 10° measured at 3kHz. Azimuth alignment on arrival was fair at 38° and the tape noise headroom with respect to replay noise was adequate at 7.5dB. Dolby reference level was set to +5dB on the record meters, thus the signal-to-noise ratio when measured with respect to the 0VU level was lower than average at 53dB (Dolby in). The overall record/replay line up was not outstanding, a negative error of around 2dB being measured when using Maxell *UDXL1* C60 tape. The overall record/replay response was remarkably flat up to 14kHz with a small 1dB lump at 15.5kHz falling off rapidly above 16kHz. Meter ballistics were a problem, the meters reading low by 7dB on a 64mS long pulse making it difficult to achieve a nice balance between tape overload distortion and a good signal-to-noise ratio.

Record deck *(PS 950)*
The motor and tonearm are mounted on a chipboard plinth with direct drive platter, tonearm, dust cover and plinth all solidly connected together. Problems in respect of acoustic breakthrough generally arise when this style of construction is adopted, and this deck proves no exception, though transmission of vibration from the mounting shelf into the deck has been minimised by the use of rubber damped springs inside the feet of the record deck. The mechanical performance of the deck is about average with wow and flutter at 0.1% and a rumble level of 59dB. The HF intermodulation distortion was on the high side on the pickup, which was a low compliance design intended probably to ensure that the subsonic resonance of the pickup/arm combination occurs at a reasonable frequency. In fact it occurs at 9.2Hz with a rather high resonant amplification of 11.5dB at this frequency. The overall response of the pickup was reasonably flat with just a slight rise in output of around 1.5dB between 10kHz and 18kHz. Crosstalk was quite reasonable though some arm resonance effects were seen at 250Hz. However this deck cannot really be recommended in view of its poor pickup performance, high acoustic breakthrough and moderate rumble levels.

Uher system

Listening tests and overall appraisal

The subjective quality on record was of a generally pleasant overall sound, the stereo image being well balanced though there were some doubts about the tracking performance of the pickup. The frequency response was considered well extended, wow and flutter was subjectively low with rumble just detectable and acoustic breakthrough obvious on the louder passages. The sound quality was good using pre-recorded cassettes though the usual problems relating to high frequency response were evident. Wow and flutter was tolerably low and the stereo image firm, but the signal-to-noise ratio was a problem on the recordings made using the cassette deck, confirming the findings of the objective tests. The overall quality of the tuner was also good with the problems relating to line up being subjectively less objectionable than they appeared on the objective tests. One unusual criticism of the tuner is that a strange audible whine emanated directly from the casing probably originating from the mains transformer. In summary then a system that sounded better than the objective tests would have indicated, and which is consequently probably more than adequate for the majority of listeners, although at £660 it does not represent good value for money.

Amplifier (VG 850)

Power Output 8ohms/4ohms	82/76 watts
Hum modulation 50Hz/100Hz/150Hz	4dB/2dB/0dB
Dynamic Headroom	1.3dB
Signal/Noise ratio CCIR/ARM	86.5dB
Ambient output voltage CCIR/ARM weighted	1.3mV
Phono input impedance/capacitance (inc lead)	44k/280pf
Crosstalk 1kHz/10kHz	49dB/38dB
Gain tracking error, ¼/½/¾ setting	0.4dBR/0dB/0.2dBR
Balance	0dB
3dB Bandwidth (at 1W RMS)	5.2Hz/35kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	>80dB/65dB
(−3dB ref max pw) 10kHz+11kHz 2nd/3rd order	>80dB/63dB

Tuner (EG 750)

IHF least usable sensitivity	1uV
50dB quieting mono/stereo	2.5uV/36uV
Signal/Noise 1mV CCIR/ARM	69dB/65dB
Min signal for max S/N ratio mono/stereo	28uV/220uV
AM rejection	56dB
IF rejection	>65dB
Image rejection	77dB
Capture ratio	2.8dB
Adjacent/Alternate channel rejection	1dB/58dB
RFIM	68dB
Distortion L/−R, L only	0.63%/1.2%
Crosstalk 1kHz/10kHz	28dB/26dB
19k/38k suppression	74dB/68dB

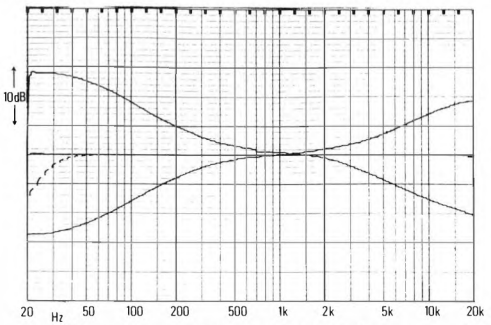
Tape (CG 340)

Tape used for tests	Maxell UL C60
Replay azimuth alignment	38°
Wow and Flutter	0.11%
L/R Jitter at 3kHz	9°
Dolby ref. level readout on meters, 64mS under-read	+5.5dB/−7dB
Distortion −6dB, 0dB, +3dB	0.44%/1.2%/1.8%
Line up on replay meters −6dB/0dB/+3dB	−9dB/−2dB/+1.2dB
Erasure efficiency (400Hz at Dolby level)	66dB
Signal/Noise biassed tape CCIR/ARM	44dB/53dB
Tape noise headroom wrt replay noise (no cass)	7.5dB

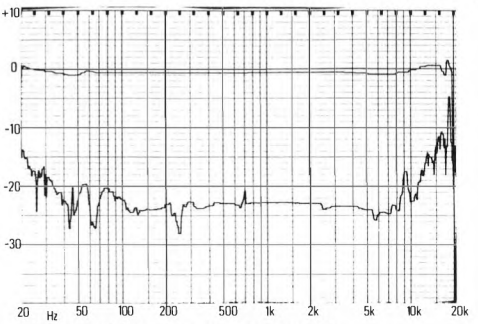
Disc (PS 950)

HF Intermodulation distortion (10.8kHz pulsed)	0.93%
Tracks 1k+1.5k 31.5cm/sec band at	1.2gms
Effective mass of pickup + arm	22.7gms
Subsonic resonance freq/dB gain	9.2Hz/11.5dB
Estimated compliance	13cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	60dB
Wow and Flutter	0.1%
Rumble (DIN B)	59dB
Tracking weight error setting/actual	2gms/2.18gms
Pickup type	Uher Z950

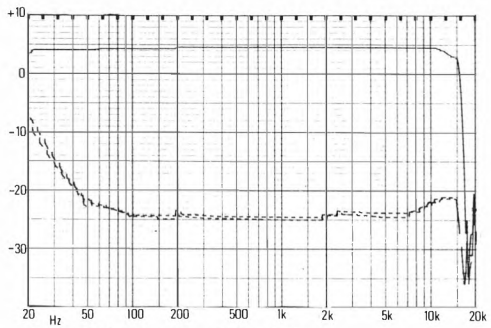
Available facilities	A. B. D. E. H. I. J. K. M. N. Q. R. V. W. Y. Z. AA. AB. AD. AE. AI. AK. AL. AM. AN. AW. AX. AY. AZ. BA. BC. BD. BM. BN. BO. BQ
Loudspeaker sensitivity (2.828V pink noise)	NA
Length of loudspeaker lead	NA
Azimuth adjustment	normal screw adjustment
Ferrite rod aerial	external hinged
Typical System price	£660



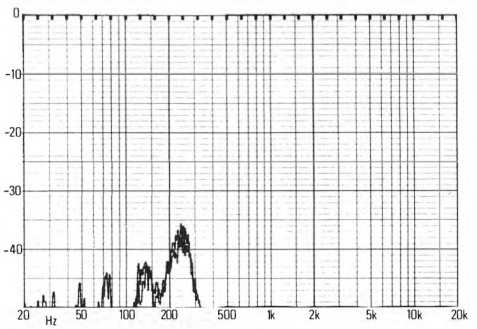
Amplifier response, tone and filter variations.



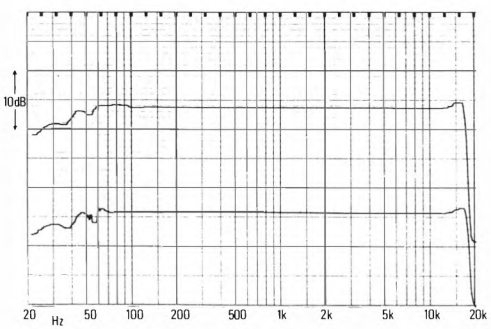
Pickup cartridge response and crosstalk.



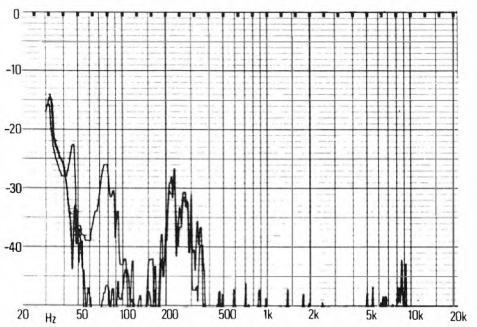
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

RECOMMENDED

'Editor's choice' separates

Introduction

Choosing the components to put together for a 'separates' system is bound to be to some extent arbitrary, but the Rega turntable and Nytech receiver have the distinction of not having been reviewed in *Choice* before, although I have used them myself as a personal mid-priced reference for a couple of years (with the *Pageant II* speakers). The JVC cassette deck is a logical companion, being one of the few slant format decks to complement the Nytech now available. The system as a combination has been well-touted by 'subjective' reviewers, so it is interesting to see how it fares under a less emotional 'objective' examination.

General description

The Hi-Fi Choice separates system, compiled this time by our editor Paul Messenger, comprises a Nytech *CTA-252XD II* receiver, a JVC *KD-720* cassette deck and a Rega *Planar 2* record deck fitted with an Audio Technica moving-coil cartridge. As would be expected from a system chosen by PM, a disproportionate amount of money has been concentrated on the disc reproducing equipment, although to be fair to Paul the overall quality was not compromised as the budget priced JVC cassette deck did achieve a Best Buy rating in the recent *Hi-Fi Choice* cassette deck survey. In total the system costs around £500, some £60 lower than the estimated average price of the systems and centres reviewed in this book, and is probably representative of what could be offered by a specialist dealer devoted more to sound quality than visual appearance; naturally there is no furniture element in the price.

The Nytech receiver is finished in matt black with an angled tinted perspex screen positioned halfway along the receiver and protecting the tuning frequency, centre-tune and signal strength meters. Connection facilities at the rear of the receiver include three sets of DIN loudspeaker sockets, one direct and two switchable, a 5-pin DIN socket for tape, unusual phono sockets at the end of a 6in length of lead and a useful pre-

RECOMMENDED

amp/main amp access socket. The Nytech tested was fitted with circuitry to match a moving-coil cartridge, an ex-factory option to the more conventional moving magnet cartridge input. The Rega deck is fitted with a large tinted perspex lid with the somewhat thin base being finished with a dark wood strip. The cassette deck is fitted with a sloping front panel finished in brushed aluminium with the case constructed from silver/grey plastic.

Receiver *(*Nytech *CTA 252XD II)*
This usually styled receiver is manufactured by Nytech Audio from near Bristol and features slider type balance, tone and volume controls, a bank of selector switches that are particularly smooth in operation, a knurled wheel tuning control and a group of pre-sets selecting four stations in the FM band. The amplifier delivers a modest 26.7 watts into 8 ohms rising to 35.9 watts into 4 ohms, the hum modulation performance at high power levels being well above average. The signal-to-noise ratio was adequate at 83dB (CCIR/ARM weighted) as was the crosstalk performance. Bandwidth was sensibly limited to 7.5Hz and 20kHz with the tone controls providing a more than adequate range of adjustment. Useful high and low frequency filters are fitted to the receiver as is a variable midrange control centred at 2.6kHz. Generally all the slider controls were rather stiff in operation and centre detents on the tone controls and balance control would have been appreciated.

The IHF intermodulation distortion products were reasonably low, though it was noted that the third order products were significantly worse than the 2nd order products.

The tuner section also has a lower than average performance in respect of IHF least usable sensitivity, although the minimum signal needed for maximum signal-to-noise ratio was only a little worse than average at 380uV. The radio frequency rejections were generally good, though performance in respect of AM rejection was disappointing at 47dB. Tuning was carried out using a small 'knurled wheel' tuning knob fitted below the volume and tone control section, four similar tuning knobs for pre-setting stations being secreted below a sliding plastic panel. Some dexterity is needed in tuning as it was found that when the finger was removed from the main tuning wheel the frequency of tune could easily shift by as much as 200kHz.

The audio distortion levels were higher than average whilst the performance in respect of radio frequency distortion was very good. The overall frequency response of the tuner was very smooth up to 15kHz with crosstalk levels typically around 25dB. The three meters fitted to the receiver give information on the tuning frequency, signal strength and the correct tuning point. A stereo pilot light is included at the extreme right hand end of the perspex screen. In all then a clever overall design with many good features, although the difficulty in tuning and the absence of centre detents on some of the controls might be criticised.

Cassette deck *(JVC KD720)*
As mentioned in the introduction the cassette deck used is a JVC *KD-720* which was awarded a 'best buy' rating in the *Cassette Deck and Tapes* publication. Tape azimuth alignment error was negligible whilst the wow, flutter and phase jitter performances were commendable. Maxell *UDXL1* tape was used for the objective tests giving a smooth response up to 15kHz, a very slight rise in output of just over 1dB at 15kHz being recorded on the right hand channel. The switching facility allows the separate selection of bias and equalisation values. Slider type record level controls are included adjacent to the record level meters. These meters are both large and easy to read but underread by 6dB on a 64mS pulse. As no peak reading LED is provided some care is needed to ensure that the tape is not seriously overmodulated on signals of short duration.

Tape line-up was generally good as was the Dolby reference level setting, resulting in average levels of distortion and tape noise, the signal-to-noise ratio being improved by 10.5dB (CCIR/ARM weighting) with the Dolby noise reduction circuitry in operation. Erasure efficiency was above average at 67dB and a very good tape noise headroom of 11dB was achieved. Jack type sockets are provided for the connection of headphones and microphones whilst input/output phono sockets and a 5-pin DIN socket are available at the rear of the deck. The overall performance of the deck was well above average and it obviously represents excellent value for money.

Record deck *(Rega Planar 2)*
The Rega deck is a two-speed belt drive design with a heavy plate glass platter 10mm thick, speed changes being possible only by removing the platter and repositioning the rubber drive band to another pulley. The platter, arm and baseboard are all firmly connected together resulting in typical levels

of acoustic breakthrough and rather higher than average levels of vibrational breakthrough. The deck was fitted with an Audio Technica *AT30E* moving-coil cartridge, the pre-amplifier in the Nytech receiver providing the higher than usual sensitivity levels needed for a moving-coil design. Frequency and crosstalk performance of the pickup was very good although some high frequency emphasis was apparent above 7kHz, the output rising to a 3dB shelf at 10kHz. Tracking performance was good although the tracking weight had to be increased some 0.3gms above the manufacturer's recommended value before the 31.5cm high velocity band could be resolved. High frequency intermodulation distortion was lower than average and although the subsonic resonance occurred at a lower than optimum frequency of 6.6Hz the low amplification level of only 4dB was commendable. The mechanical performance of the deck was outstanding with particularly low levels of wow and flutter and rumble but the start up time was significantly slower than usual owing to the combination of low motor torque and a heavy platter.

Listening tests and overall appraisal

Quality from disc was free of any obvious wow, flutter or rumble although some acoustic breakthrough was audible at high listening levels. The quality of the sound from disc was judged to be very pleasant though slightly sibilant with a delicate neutral quality that was liked. The sound quality provided by the tuner was free of any radio frequency interference with a smooth audio frequency response. The weaker local and commercial stations were a little noisy even when a good aerial system was used. Tuning was rather troublesome for removal of the finger from the knurled tuning wheel resulted in a change in the tuned frequency. However the pre-set controls were found easier to operate.

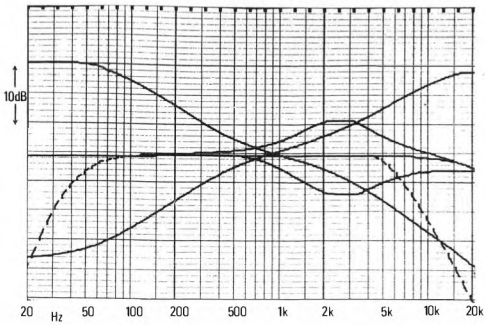
The sound quality provided by the cassette deck was particularly good with low levels of wow and flutter and good image stability. Distortion levels and high frequency compression effects were audibly better than average with tape noise levels being about average. The large VU meters were well liked although the lack of any peak indication required some experience if successful recordings were to be achieved. The system can clearly be recommended and certainly shows what can be achieved when the separate components are selected wisely.

Amplifier (Nytech CTA 252 XD II)	
Power Output 8ohms/4ohms	26.7/35.9 watts
Hum modulation 50Hz/100Hz/150Hz	2dB/0dB/3dB
Dynamic Headroom	0.8dB
Signal/Noise ratio CCIR/ARM	83dB
Ambient output voltage CCIR/ARM weighted	1.05mV
Phono input impedance/capacitance (inc lead)	N/A (moving coil i/p)
Crosstalk 1kHz/10kHz	50dB/35dB
Gain tracking error, ¼/½/¾ setting	0.2dBL/0.3dBL/0.2dBL
Balance	0.7dBL
3dB Bandwidth (at 1W RMS)	7.5Hz/20kHz
IHF Intermodulation 4kHz+5kHz 2nd/3rd order	−72dB/−66dB
(−3dB refmax pw) 10kHz+11kHz 2nd/3rd order	−72dB/−62dB
Tuner (As amplifier)	
IHF least usable sensitivity	3.2uV
50dB quieting mono/stereo	8uV/80uV
Signal/Noise 1mV CCIR/ARM	66dB/63dB
Min signal for max S/N ratio mono/stereo	80uV/380uV
AM rejection	47dB
IF rejection	>75dB
Image rejection	55dB
Capture ratio	1.7dB
Adjacent/Alternate channel rejection	0dB/47dB
RFIM	approx 74dB
Distortion L/−R, L only	1%/1.5%
Crosstalk 1kHz/10kHz	27dB/25dB
19k/38k suppression	45dB/71dB
Tape (JVC KD-720)	
Tape used for tests	Maxell UDXL1 (C90)
Replay azimuth alignment	10°
Wow and Flutter	0.088%
L/R Jitter at 3kHz	17°
Dolby ref. level readout on meters, 64mS under-read	+3.4dB/6dB
Distortion −6dB, 0dB, +3dB	0.5%/0.8%/1.1%
Line upon replay meters −6dB/0dB/+3dB	−5dB/+0.9dB/+3.7dB
Erasure efficiency (400Hz at Dolby level)	67dB
Signal/Noise biassed tape CCIR/ARM	48dB/58.5dB
Tape noise headroom wrt replay noise (no cass)	11dB
Disc (Rega Planar 2+Aud Tech AT30E)	
HF Intermodulation distortion (10.8kHz pulsed)	0.34%
Tracks 1k+1.5k 31.5cm/sec band at	2gms
Effective mass of pickup + arm	19.2gms
Subsonic resonance freq/dB gain	6.6Hz/4dB
Estimated compliance	30cu
Signal/Noise ratio CCIR/ARM ref 1cm/sec	60dB
Wow and Flutter	0.06%
Rumble (DIN B)	66dB
Tracking weight error setting/actual	1.7gms/1.66gms
Pickup type	AT 30E (moving coil)
Available facilities	A, E, F, H, I, K, M, N, RC, V, W, X, Y, Z, ZA, AA, AB, AE, AF, AK, AL, AM, AN, AW, AX, AY, AZ, BA, BC, BD, BM, BN
Loudspeaker sensitivity (2.828V pink noise)	—
Length of loudspeaker lead	—
Azimuth adjustment	normal screw type
Ferrite rod aerial	—
Typical System price	£5.00

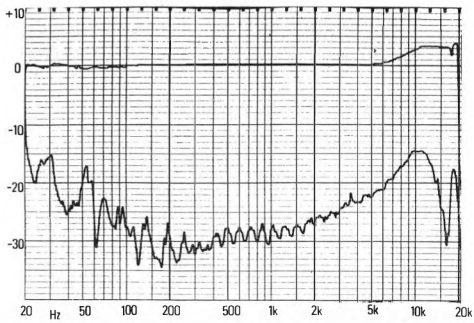
Note: The designers of Rega and Nytech consider that current test techniques are often simplistic and may be misleading. In their opinion equipment should only be purchased after personal listening evaluation.

'Editor's choice' separates

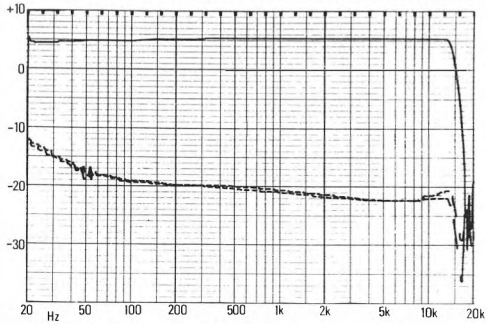
RECOMMENDED



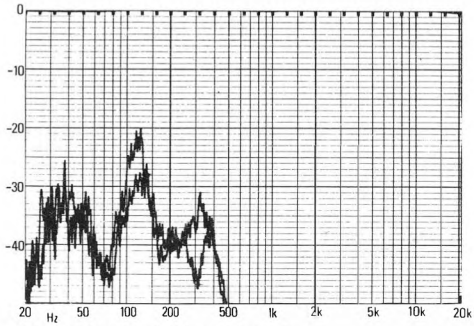
Amplifier response, tone and filter variations.



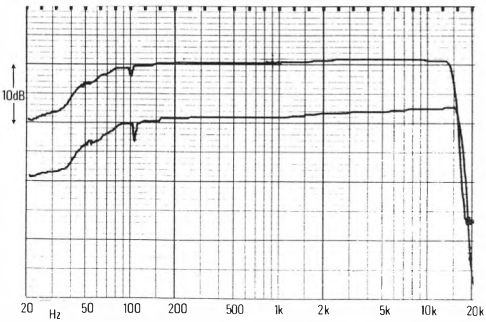
Pickup cartridge response and crosstalk.



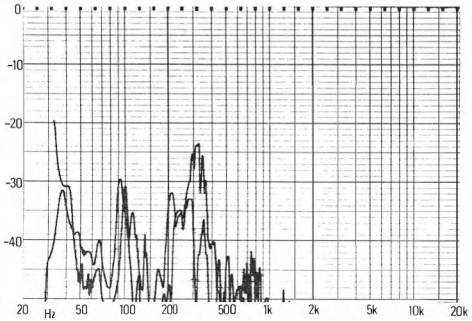
Tuner FM response and crosstalk.



Turntable vibration breakthrough.



Cassette response L&R, Dolby in (−20dB ref Dolby).



Turntable acoustic breakthrough.

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The system illustrated includes Turntable CS 650 RC; Tuner CT 1540 RC; Amplifier CV 1500 RC; and Cassette Deck C 839 RC. All of these units are mounted in rack system type 3010 and the hi fi collection 1500 RC is completed by the infra-red transmitter RC 154.

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Conclusions

In this second *Hi-Fi Choice* book on Hi-Fi systems and centres some 30 new designs have been reviewed, many of the original centres tested having now been superseded. In this book we have concentrated quite deliberately on the new wave of rack mounted systems currently flooding the market, and consequently the conclusions listed here are derived almost exclusively from the performance achieved by these. Almost without exception it is true to say that better sound quality is achieved by an equally priced rack system than integral centre, though the reasons for this are difficult to pin down.

The majority of the amplifiers fitted to the racks have selection switches to enable one or two sets of loudspeakers to be simultaneously driven from the amplifier. This can be useful when fitting a second set of loudspeakers in an adjacent room (or bedroom) though of course you will still need to approach the equipment when making adjustments to the controls (care needs to be taken with speaker impedances if operating two pairs at once). Many amplifiers have a detent switching action on the tone and balance controls which are useful in ensuring that optimum response and stereo balance are achieved if set correctly. The large click stop volume controls are also a popular feature with manufacturers, though some users find them inconvenient. Without doubt the least limiting section of the rack is the amplifier, many of them achieving performances so far in advance of the source quality that it is debatable whether relevant measurements can even be carried out.

The average signal-to-noise ratio measured on the amplifiers was around 88dB which should be adequate for all but the most demanding signal sources, with distortion levels always significantly lower than those achieved on cassette tape or disc. However many amplifier designers in an attempt to enhance the technical specification have allowed the frequency response to extend to ridiculously high frequencies, often well above 100kHz. These comments do not suggest that the cheap low powered amplifiers sound as good as, or better than, the more expensive designs, for under limit conditions the high power, low distortion, bandwidth limited amplifier will always have the advantage. What is being said is that under normal domestic conditions the majority of amplifiers can now achieve their required goal (i.e. to amplify the signal without adding or detracting from it in any significant way) with the minimum of trouble.

Tuner sensitivities seemed to have gradually improved since our last tests, the average IHF least usable sensitivity for these rack systems being exactly 1.9uV. None of the tuners had any trouble in receiving the major BBC transmissions at the laboratory 25 miles north of London, though reception of the weaker local or commercial stations was a little more troublesome on the lower sensitivity designs. Many of the radio frequency rejection ratios are becoming difficult to measure, for the performance of the best receivers is comparable with that of the available test equipment, so we can only quote them as being 'better than', for example, 80dB. This again indicates the commendable improvement that has taken place, for only a few years ago it would have been quite easy to rank the tuners in respect of, say, image rejections, with 'good' tuners having rejections as much as 50dB and tuners at the bottom of the range only achieving in the region of 25dB. As the general standards have improved over the years, the more troublesome aspects of a tuner's performance that have become increasingly important include the reduction of the radio frequency intermodulation distortion, of the signal required to achieve an adequate signal/noise ratio and of the audio distortion at maximum modulation. The best tuners have audio distortions not significantly higher than that of the test equipment. On many of the inexpensive tuners only one tuning meter is provided, usually reading signal strength; experience suggests that a centre zero tuning meter is more useful. A few tuners (notably two which are manufactured in this country) are supplied without the normal 72 ohm downlead socket, only a balanced 300 ohm twin feeder socket. When fitting a rooftop aerial (even the most basic dipole type) it is usual to connect the aerial to the tuner using a coaxial downlead cable having a characteristic impedance of around 72 ohms. If correctly terminated using a 72 ohm socket the best possible coupling is achieved between aerial and tuner but if incorrectly terminated *via* the 300 ohm twin feeder socket a small but significant loss in sensitivity will result due to the impedance mis-match.

We found it very useful to have a multiplex (stereo) on/off switch allowing the tuner to be used in the mono mode to improve the signal-to-noise ratio. Good noise free monophonic reception is infinitely preferable to poor stereo reception.

The cassette decks tested in the survey were almost universally of the front loading type with the

Conclusions

controls spread fairly evenly across the front panel. It was found difficult to achieve a successful stereo fade with separate level controls provided for the left and right channels; separate controls with some friction locking are preferable. Separate slider type record controls mounted side by side were also well liked, but are more often fitted on the top loading cassette decks. The VU meters fitted to the decks were generally too slow to give adequate information about the peak level of the signals and many designers are now including peak reading LEDs to supplement the meter reading. Certainly the most successful arrangement included twin VU meters that under-read on a 64mS pulse by no more than 6dB, with a single peak reading LED to indicate Dolby level. Meters that were accurately calibrated with a Dolby reference level set at +3dB and concentric friction locked record level controls made it easy to achieve good recordings. Some designers appeared to have set up the Dolby level to over-modulate the tape, for this improves the signal/noise ratio at the expense of some increase in audio distortion. Coupled tape type selector switches simultaneously varying both the bias and equalisation are often fitted to the decks, and though this greatly simplifies the operation of the cassette deck it is often advantageous to have separate switches.

Cassette mechanisms appear to have improved over the last few years, the average DIN weighted wow and flutter level for the cassette decks now being 0.12% though this is still not as low as the average record deck wow and flutter level of 0.09%. Azimuth adjustments were accessible on many of the cassette decks, and though they were not intended to be set by the user they can be useful to those knowledgeable in the art to optimise the replay quality from cassettes recorded on a deck whose azimuth was inaccurately set. It is worthwhile noting that all the cassette decks tested except the more expensive JVC model were fitted with the Dolby *B* noise reduction system, the JVC *ANRS* system being reasonably compatible with the Dolby *B* system when replaying pre-recorded Dolby tapes.

Not surprisingly both the subjective and objective tests revealed that the quality available from disc is still superior to that from cassette tape, even when carefully pre recorded cassettes of the highest standard are used. However disc reproduction still has many problems, not the least of which is the inability of the average pickup to track a heavily modulated groove correctly. In some cases the tracking performance of the pickup was controlled by the effective mass of the tonearm, and it is certainly true that this effective mass is generally far higher than desirable, the average figure for the pickup + arm assemblies being just under 19gms. With such a high effective mass it is inevitable that a fairly low frequency subsonic resonance will occur usually in the 5–8dB band, and generally with an amplification of around 7dB.

The manufacturers could alleviate the situation in many instances simply by fitting a cartridge of low compliance. This has the effect of moving the resonant frequency away from record warp frequencies and there is certainly no reason to believe that low compliance cartridges of around 10cu are necessarily any worse in respect of trackability than their high compliance counterparts.

Decks constructed with the tonearm, platter and plinth all solidly connected together are always worse in respect of acoustic and vibrational breakthrough than those with the platter and arm fitted to an isolated subchassis. Obviously those listeners who run their hi-fi systems at only moderate listening levels will not be as troubled by acoustic breakthrough as those who require peak levels around 90–100dB in the listening room. For this reason it is worthwhile noting that most decks gave a reasonable performance in respect of acoustic isolation, though decoupled subchassis platter and arm mounting assembly such as those used on the B&O and Pye decks should certainly be considered by those intending to operate their systems at high listening levels.

The two weakest links in any hi-fi system must be the pickup cartridge and the loudspeakers. Though it is now possible to achieve remarkably good frequency responses and low hum susceptibility from even the cheapest pickup, the problems associated with trying to retrieve all the information available from a record groove are enormous, and attempts to achieve a significant improvement in sound quality may be simply uneconomic. However as can be seen from the individual reviews the sound quality from disc can be very high and is probably more than adequate for all but the most critical ears. The loudspeakers which were supplied as part of the system generally set a limit to the overall quality available, some examples exhibiting peaks and dips in excess of ±10dB. Thus we would almost always recommend that the system or centre be bought without the

loudspeakers. Where doubt exists over which loudspeaker to purchase we would recommend that the recent *Hi-Fi Choice* publication *Loudspeakers* be consulted. In any domestic situation it is usually required that the loudspeakers be positioned a fair distance away from the equipment, though the loudspeaker leads supplied with the equipment were rarely long enough to allow the purchaser to have much choice of speaker location.

The arrangement of units within the rack often left one unit (usually the cassette deck) only a few inches above the floor, making it very inconvenient to operate. Those systems that locate the cassette deck over a record storage area ensure that the lowest piece of equipment is more than 18in from floor level. Some racks were fitted with castors to facilitate easy movement, though those without were more stable when in the final position. Those racks fitted with hinged glass doors in front of the equipment were generally disliked as the doors appeared to impair access to the equipment, though to be fair to the manufacturers the doors could always be removed if they were not needed.

Mains connections are always a problem but even more so when purchasing a system, for one generally has to find four adjacent 13amp sockets to plug in all the equipment. This is rarely possible, so a four-way adaptor is usually the only answer, though some manufacturers (notably Schneider, Ferguson, Grundig and Fidelity) have arranged the mains interconnections in such a manner that it is only necessary to connect one lead to the mains.

Updating a system can be a difficult and complex exercise, though without doubt many of the systems would benefit from the use of a better quality cartridge. For this reason we have included data on the input impedance and capacitance characteristics of the system (including the lead connecting the pickup to the amplifier). This information is necessary when deciding on a suitable replacement pickup (see *Cartridges and Headphones*).

It was found difficult to give an absolute overall performance rating when there are so many different variables. For example, some systems may have a limited performance in respect of quality from disc while the tuner and cassette deck may be more than adequate for those listeners whose prime requirements do not include disc reproduction. Under these kind of conditions a system that did not receive a firm recommendation could quite justifiably be well worth consideration. As with all the *Hi-Fi Choice* publications, it is important that each review be examined carefully without restricting the examination to those systems that have been accorded recommendation or a 'best buy' tag.

Note: *The editor (with the consent of the reviewers) wishes to point out that he does not necessarily agree with some of the comparative value judgements made above (while admitting that in the context of the book they represent a lot of commonsense).*

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Selecting the 'best buy' and 'recommended' systems is not a simple matter, as much depends on how much money you have to spend. There is little doubt that a Rolls Royce is a 'recommended' car, but the price makes it prohibitive for most people. In a similar way one's own affluence and interests will affect the choice of sound system. For example, if you are a hi-fi enthusiast, and sound quality is the most important criterion, you will be unimpressed by a multiplicity of facilities or the pretty lighting effects offered by some systems. So, a lot of factors have to be taken into account when making a final decision.

Many of the units are available without loudspeakers, and it is obviously necessary to take this into account when comparing prices. For the purposes of this section, where loudspeakers were not supplied, we have quoted a price which is the cost of the basic system plus one-third of the system price, in order to allow for the purchase of loudspeakers. We have suggested that you should allow one-third of the unit cost for the price of the loudspeakers, but whether this should be one-half, one-quarter or one-fifth of the unit price is debatable — it depends on how much you wish to spend. In some cases the amount of money allowed for the loudspeakers is critical in terms of what price category the system falls in, and many are borderline cases, being able to fit into two price groups depending on the cost of the loudspeakers. So please regard the following price groups as somewhat fluid.

Systems costing below £500 (inc speakers)

The **Ferguson 50D** music centre is worthy of comment being the most inexpensive centre measured in this survey. Obviously it is unfair to expect too much at the price though at £329 including speakers it does offer a lot. The main criticisms were the lower than average performance of the loudspeakers and the high level of electrical noise on the tape deck.

Though not entirely free from criticism the **Fidelity** system at £329 including loudspeakers and a large rack is also good value for the money. Most of the objectively assessed parameters reached reasonable standards, though the tuner and record deck performances were considered lower than average and the two-way loudspeakers supplied with the system were criticised.

The **ITT** system at £450 came complete with an aesthetically appealing rack and a reasonable pair of two-way bookshelf loudspeakers. Cost had been minimised by using a receiver instead of a separate amplifier and tuner. In general the performance was considered to be very good though a firm recommendation was withheld owing to the higher than average amplifier distortions and the above average levels of acoustic breakthrough on the record deck. In its favour the system is very compact and should be seriously considered by those with space problems whose prime requirements do not include outstanding quality from disc.

The **Rotel** system also has a lot to offer including separate amplifier, cassette deck, tuner and record deck all mounted in a low profile rack and selling for around £453* (with 33% added for speakers). Though there were some adverse comments about the technical performance of the tuner, the above average sound quality from disc and the overall performance of the amplifier and cassette deck are strong points in its favour.

The **Hitachi** system was the only system below £500* to receive a best buy rating. The overall sound quality using the Mordaunt-Short *Pageant II* loudspeakers was well liked and the objectively assessed parameters were well above average. Tape line-up on the cassette deck was a problem when the Hitachi tape supplied with the deck was used, but if a better quality tape such as Maxell *UDXL1* was used the criticism concerning signal-to-noise ratio would be removed.

Systems costing approximately £500–£600 (inc speakers)

An interesting offering in this price range was the **Boots/Sansui** system selling at £509 including some (fairly expensive) loudspeakers. Though not technically a racked system (the receiver and cassette deck are simply bolted together with common side panels) the system does offer the compactness and styling so favoured by the purchasers of racked systems. The system is to be marketed exclusively through the Boots audio departments with the cassette deck, receiver and record deck all imported from Sansui whilst the loudspeakers are manufactured in this country. The overall performance was generally above average though the exclusion of any anti-skating force compensation on the record deck and the rather high wow and flutter levels limits a recommendation. However it is worth remembering this

**includes 33% allowance for loudspeakers*

system, particularly as Boots have indicated that a different record deck is to be fitted with an improved performance.

The **Trio** system costing around £553* is an attractive looking combination with an above average performance. We had some criticism of the pickup quality (a budget Goldring *G800* cartridge had been fitted), though Trio have now informed us that they intend to sell the system with the Ortofon *FF15E Mk II* which should improve matters considerably. The quality of the radio, cassette deck and amplifier sections were well above average, and if the Ortofon pickup is fitted the system certainly deserves a strong recommendation. The aggressive looking **Sansui** system at £580* definitely deserves a best buy rating though we would recommend that it be purchased if possible without the Sansui *SC-37* cartridge (alternatives from ADC or Ortofon may be appropriate). The high power output of the amplifier, good sensitivity and distortion levels on the tuner, and reasonable cassette and record deck performances all combined to ensure that this system received an above-average rating. The visual appeal to those wishing to own an eye-catching system was unquestionable and the overall quality of construction excellent.

Systems costing approximately £600–£700
(inc speakers)

The **Editor's Choice** system compiled by Paul Messenger obviously falls into this price bracket when an allowance of around £166 for loudspeakers is made (roughly the price of the *Pageant IIs* used extensively in the listening tests, and which had been used by PM for some time with this system). The system is rather unusual, combining the original styling of the Nytech *CTA-252XD II* receiver, the excellent value-for-money performance of the JVC *KD-720* cassette deck and the unusual Audio Technica *AT-30E* moving-coil cartridge in the Rega *Planar 2* turntable. A direct price comparison is perhaps a little unfair as no allowance for the price of a rack has been taken into account, though at £666* the general performance achieved was significantly above average. We had some criticism of the tuning facilities and of the rather sibilant quality of the pickup, but overall the system should certainly be considered by those primarily interested in sound quality, and it does indicate what can be achieved if separates are chosen wisely.

The **Toshiba** system was thought to be quite good value at £666*, though the below average performance in respect of signal-to-noise ratio, trackability and acoustic breakthrough on record deck resulted in a recommendation being withheld. Certainly it may be considered by those who feel that quality from disc is not too important, the overall performance of the amplifier, tuner and cassette deck all being well above average.

The **Technics** was another attractive unit and though rather on the expensive side at £686*, it can nevertheless be recommended as the performance reached a good standard in almost every respect. The rack is well finished in simulated wood veneer with a hinged glass door covering the equipment and record storage areas. The performance of the tuner and amplifier were well above average and it is only the lower-than-average performance of the cartridge that prevents a best buy rating being awarded.

Another recommended system in this price class is the **Pioneer** with the quality from all the sources receiving favourable comment. The isolated sub-chassis fitted to the record deck ensures that vibrational and acoustic breakthrough are significantly lower than average, so this system should certainly be considered by those wishing to achieve high sound levels from disc. The general performance of the electronic circuitry is excellent and the system must be recommended though care should be taken in choosing the right loudspeakers if full advantage of the performance is to be taken.

Systems costing approximately £700–£900
(inc speakers)

The **Optonica** is included in this section and is supplied with a particularly well finished cabinet, though the positioning of the amplifier so close to floor level might be criticised. One notable aspect of the rack layout is that the record deck may be fitted either directly on the top shelf or within a separate compartment above the record storage area. The technical performance of the equipment was consistently well above average and the system deserves a strong recommendation.

Also to be recommended is the **Pye** system at £833 including its own loudspeakers, though we would suggest that alternative loudspeakers are purchased. Although the system is expensive, the

**includes 33% allowance for loudspeakers*

excellent performance of the amplifier, tuner and record deck ensure recommendation. The higher than average power output from the amplifier and the isolated subchassis construction of the record deck means that this system is particularly suitable for those wishing to achieve high sound levels from disc.

Advancing a little further up the price scale we get to the **Grundig** system, comprising a receiver, cassette deck and turntable all mounted in an attractive cabinet, which is fitted with a large hinged perspex cover over the record deck area, a thermostatically operated cooling fan at the back of the receiver and a useful mains distribution box. Unfortunately the technical performance was not outstanding, with lower than average performances in respect of stereo sensitivity, cassette tape line-up and record deck signal-to-noise. Nonetheless the system does offer a lot and represents reasonable value for money.

Systems costing more than £900 (inc speakers)

Only four systems are included in this price bracket with all but one of them receiving some recommendation. The two B&O music centres are worth talking about as in many ways they offer similar performance levels at virtually identical prices, though the *7000* system does have the advantage of a very sophisticated infra-red remote control unit (had we been certain of receiving the *7000* in time at the start of the project we might have omitted the *4000/2002*). Though the combination does receive a very good rating, it is the new music centre that is recommended.

The cheaper **B&O** system comprises a **4000** centre, housing the tuner, amplifier and cassette deck, plus a separate **2200** record deck. The fully automatic controls on the record deck allow it to be operated with the dust cover down, though some manual adjustment is necessary if a particular track on a long playing record is to be cued. The overall performance was well above average but there was some criticism of the mechanics and metering of the cassette deck.

The **B&O 7000** centre is a remarkable design offering armchair control of all the major functions including volume adjustments, pre-selection of all the sound sources, tape recording from disc or radio and fully automatic operation of the record deck. The overall technical performance was well above average and the centre justifiably receives a strong recommendation.

However if the B&O system seems expensive the **Aurex** micro system at £1266* including the cost of loudspeakers (but not including a record deck) must be in a class of its own on price. A truly micro-system of amazingly small size, it offers high power output, digital synthesizer tuning controls and solenoid controlled tape transport operation. Cheaper versions of the system with less exotic facilities are promised in the near future, so it may be worthwhile waiting until these appear in the market place if you find the cost prohibitive. The technical performance and subjective quality were judged to be well above average and the system deserves a recommendation even though it is very expensive.

Systems reprinted from Music Centres

Three of the centres which we have reprinted received recommendation in *Music Centres,* and should still be available.

Cheapest of these was the **Garrard GA-220,** which is still listed at around £330 inc speakers, and provided the pre-production model tested was typical of current production clearly continues to merit recommendation.

At an estimated speaker inclusive price of £400*, the **Rotel RM5010** will still be available for a limited time. One of the best of the music centres tested in the last edition, its Best Buy rating remains appropriate.

The **B&O 4600** may also be considered a Best Buy at an estimated price of £600*, due to its excellent all-round technical performance and high standard of finish and presentation, offering in many ways similar standards of performance to the more expensive B&O systems reviewed this time.

Editorial note: Due to oversight the entry for the **Monitor Audio MA6** loudspeaker was omitted from this section in our recent *Loudspeakers* edition. This model should be regarded as worthy of recommendation, as stated in the review itself.

Overall Comparison Chart

	Amplifier		Tuner				Cassette Tape			
	Power output (8 ohms)	Distortion	Sensitivity Stereo	Signal to noise (St)	RFIM	Audio distortion	Azimuth alignment	Wow and flutter	Distortion (0dB)	Signal to noise
AIWA	27.1	average	av+	average	average	average	av+	av+	av+	av+
AUREX	48.6	av+	average	average	av+	av++	av−	av+	av+	average
B&O 7000	39.2	average	average	av+	av+	av+	av++	av+	av−−	av+
B&O 4000/2200	33.5	av+	av+	av+	av+	average	av−	av−	average	average
BOOTS/SANSUI	51.7	average	average	average	av+	av+	average	average	av+	av−
EAGLE	74.5	average	av+	average	average	average	av−	av−	average	av+
FERGUSON 50D	24.5	av−	av+	average	average	average	av+	average	av+	average
FERGUSON 25	29.4	average	average	average	av−	av+	average	av−	av+	average
FIDELITY	18.8	average	av−−	average	av−	av−−	average	av+	av−−	av+
GRUNDIG	31.8	av+	av−	av+	av−	average	average	average	average	av++
HITACHI	26.4	av+	av+	av+	average	av+	av−	av+	average	av−−
HMV	52	average	av−	average	av+	average	av−−	average	av−−	av+
ITT	20	average	average	av+	average	av+	average	av−	av+	av−
JVC	39.4	av+	average	av+	average	av++	average	av+	average	average
MARANTZ	48.7	average	av−−	average	average	average	average	av−	av−	av+
OPTONICA	45.7	average	av+	average	average	av+	av++	av+	average	average
PHILIPS	76	average	av−	average	average	av−−	average	av+	av+	av−
PIONEER	37.8	average	average	av+	av+	av+	av+	av+	av+	average
PYE	70.9	av+	av+	average	average	av+	av+	average	av−	av+
ROTEL	44.7	average	av−	average	av−	av−	av+	av−−	av+	av−
SANSUI	58.7	av+	av+	average	average	av+	av−−	av+	av+	average
SCHNEIDER	48.2	av−	average	average	average	av−−	av−	av+	av+	av−
SONY	37.3	av−	av+	average	average	av+	av−−	av−−	average	av++
TEAC	38.7	av+	av−−	average	av−	av+	av−−	av+	av−	average
TECHNICS	45.8	av+	av+	average	av+	av+	av+	average	av+	average
TELETON	33.4	av+	average	average	average	average	av−−	average	av+	average
TOSHIBA	36.9	av+	av−	average	average	av+	av+	average	average	av+
TRIO	33.5	av+	av+	average	av+	average	av+	av+	av+	average
UHER	82	average	av+	average	average	average	average	average	av−	av−−
EDITOR'S CHOICE	26.7	average	average	average	av+	av−	av++	av+	average	average

Note 1) The above chart summarises many aspects of system performance, but also leaves many others out to avoid becoming too complicated. It should only therefore be considered a rough guide.

Disc				Loud-speaker frequency response	Overall sound quality	Typical selling price inc. speakers	Typical selling price exc. speakers	Overall value judgement	
HF internal	Wow and flutter	Rumble	Signal to noise						
average	av+	av−	average	—	av	460	395		AIWA
—	—	—	—	—	av++	—	950	Recommended	AUREX
average	av−	av+	av+	—	av+	—	725	Recommended	B&O 7000
av+	av+	av+	av+	—	av+	—	695	Good	B&O 4000/2200
av+	av−−	av	av+	av+	av	509	359	Good	BOOTS/SANSUI
av+	average	average	av−	—	av	—	450		EAGLE
av−−	av−	average	av+	av−	av−	325	—		FERGUSON 50D
average	average	av−	av−	av−	av	460	—		FERGUSON 25
average	av−	av−	av++	av−	av−	329	300		FIDELITY
av+	av+	av+	av−	av+	av+	835	650	Good	GRUNDIG
av+	av+	average	av−	—	av+	—	359	Best Buy	HITACHI
av−−	av−	av+	av−	av	av	545	475		HMV
average	average	average	average	av+	av	450		Good	ITT
av−	average	average	av+	av		833	630		JVC
average	av+	average	average	—	av	—	520		MARANTZ
av+	av+	av−	av+	—	av+	—	550	Recommended	OPTONICA
av+	av+	av+	av++	—	av	—	770		PHILIPS
average	average	av+	av−	—	av++	—	520	Recommended	PIONEER
av+	average	av+	average	av+	av++	820	690	Recommended	PYE
av+	av+	av−−	av−−	—	av−	—	340	Good	ROTEL
av+	av+	av+	av−−	—	av+	—	435	Best Buy	SANSUI
av+	av−−	av−	av+	av−	av	650	—		SCHNEIDER
average	average	av−−	av−	av	av	480	390		SONY
av+	av+	av+	average	—	av	—	460		TEAC
average	av+	av+	av+	—	av+	—	515	Recommended	TECHNICS
average	av−	av−	average	av−	av	479	—		TELETON
average	average	—	av−−	—	av	—	500	Good	TOSHIBA
av−−	av−	av−−	average	—	av	—	415	Recommended	TRIO
av−−	average	av−	average	—	av	—	660		UHER
av+	av+	av+	average	—	av+	—	500	Recommended	EDITOR'S CHOICE

Note 2) Value judgements have deliberately been based on an 'average' performance, the five ratings being well below (av−−), below (av−), about (average), above (av+) and well above (av++).

Note 3) Due to difficulties in making accurate correlations we have not attempted to include data on systems reprinted from *Music Centres.*

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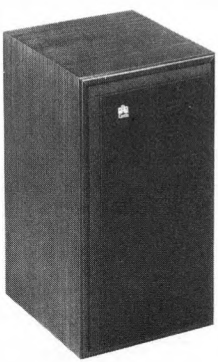

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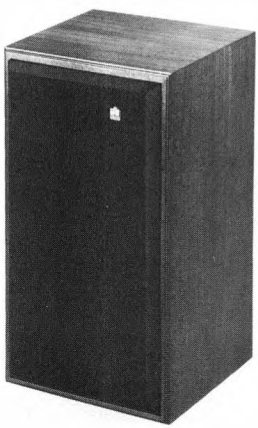

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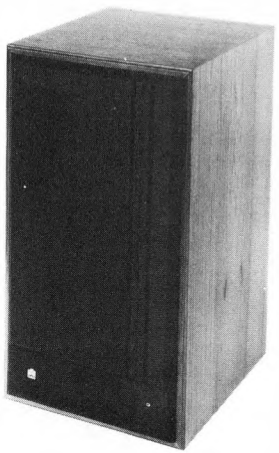

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INTRODUCTION

As every audio enthusiast will have observed, the accessories business is booming, and new names are constantly appearing as enterprising manufacturers climb on to the bits-and-bobs bandwagon. The area of record care dominates, and has become complex and competitive. Then there is the maintenance of tape machines, to which we can add a plethora of products which make hi-fi life more interesting or convenient.

Some of the smaller items are essential, and many of the major ones are properly regarded as luxuries. There are some interesting peripherals, hardly warranting a high place in the list of priorities. And there are some clever innovations, a few of which seem destined to join the folk-lore of hi-fi. You can be sure that, as Christmas draws near, there will be something new for the man who has everything.

In putting together a critique of accessories it is difficult to decide where to draw the line. A price limit seems a fair criterion and in fact a high proportion of products mentioned will cost you less than £15 (at the time of writing, it must be said in sheer self-defence). But a selection of more expensive items is included.

The critique starts with the care of discs (and related topics), goes on to accessories for tape users, and concludes with a miscellany of general interest. Prices quoted include VAT at the going rate, but any obvious approximations should be checked prior to purchase. In general, and unless otherwise stated, foreign products had UK distributors when the information was assembled.

CARE OF DISCS

Without doubt the majority of discs purchased are very badly treated, though this may not be thought surprising in view of the abysmal standard of reproduction that is also frequently accepted as normal. Many are left out of their sleeves to become scuffed and collect dust and other pollution. Users of hi-fi equipment may well find this horrifying, but they are more aware than most of the disc's potential (and escalating expense), and also the need to protect vulnerable grooves from the ravages of dust.

Storage schemes are outside the scope of this survey because properly designed cabinets, keeping discs well supported in vertical groups while excluding dust, must really be regarded as furniture rather than accessories. For the user whose collection grows only slowly there is shelf storage and racks of various designs which can be seen at record and hi-fi shops. Since these offer little protection, the counsel of perfection is to enclose each disc in an outer bag, especially if household dust is very apparent. Whatever the storage method, an LP should be put away so that the openings of the inner bag and outer sleeve do not coincide. Seven-inch singles come to no harm if stored in small stacks in a cupboard or drawer.

Since a vinyl disc in new condition has a high surface polish, it is capable of providing a very low noise level (and by implication a wide dynamic range). Equipment shortcomings such as mismatching that degrade the signal-to-noise ratio, or disc blemishes caused in manufacture or distribution, may make the user impatient or sceptical of such claims; but that is another matter, and it is better here to emphasise good modern practice than dwell on the lost cause of noisy reproduction that is not directly related to normal maintenance routines.

As for disc-cleaning, it is best to start with a warning that over-zealous assaults on grooves may bring disastrous results. Only the most gentle treatments are really safe, and those which introduce substances into grooves or cause abrasion are generally suspect. Any exceptions to the rule, mostly concerning badly contaminated discs, will become apparent as we go along. It is surely beyond dispute, though, that very many expensive LPs have been killed by kindness, and mostly by well-meaning users who have blamed all the ills of sound quality on dust or static electricity. It is better to leave discs alone than to rub them or apply messy substances which can dry out in the grooves, trapping 'noisy' dirt.

There is no point whatever in devising elaborate routines where new discs are played and local conditions show no evidence of special problems such as high atmospheric pollution. Particles which have become trapped in grooves at the manufacturing stage may not all be dislodged by pre-play cleaning, and where this is a mild problem it is helpful first to play the disc through in the usual way without listening to it. If it is a serious problem, however, the disc must be a reject and should be returned to the supplier, as should examples which are blemished, badly warped or unplayable due to pressing faults.

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Dust collection

A pre-play collection of dust by the gentlest of means is recommended, and it is convenient to do this while the disc rotates. Probably the longest-established tool of merit is the Watts *Parostatik Preener* (£1.14), which holds its own among the confusion of accessories and has the virtue of cheapness.

A recent innovation is a hand-held brush employing extremely fine carbon-fibre filaments (typically 8 microns thick) which reach well into the grooves and exert a very gentle action. Since a metal handle is fitted, the whole device is electrically conductive and there is a useful dispersal of static charges when the filaments touch the disc.

This latter effect is only temporary and depends

Goldring ExStatic disc cleaner

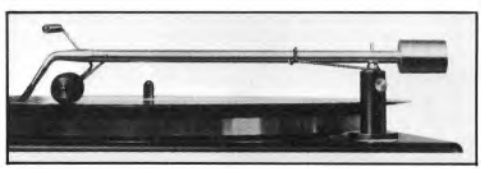
to some extent on platter and mat design, and in any event the dust-collecting function is the more useful. Also, anything but the most gentle action will soon cause the filaments to become ragged. A warning, too: the brush should not be held anywhere near mains wiring, as there might be a risk of electric shock. Recent devices of this kind are the Decca *Brush,* the Goldring *ExStatic,* the Metrosound *Microniser* and the *Statibrush* (French, imported by Swisstone). Prices are around £5 to £7.

Very useful to augment the pre-play treatment is the tracking dust-collector which picks up particles arriving on the disc while it is being played. Much depends on local conditions: in a dust-laden atmosphere the device will collect debris which would otherwise accumulate on the pickup stylus, adding to its mass and possibly causing distortion and mistracking.

Most of these devices are pivoted arms carrying a plush pad and a small brush. The brush is mainly useful as a guide and the pad collects most of the dust. It is necessary to assign a corner of the record deck to the gadget, and not all decks provide enough space. Setting-up is somewhat critical, since inaccuracy may cause the collector to lag behind the pickup as it traverses the disc, thus defeating the object of the exercise. However, such a device will always collect some dirt and cannot do much harm, although there have been suggestions that vibrations induced in the disc by the brush may affect sound quality, and there could be mechanical objections to using these cleaners with suspended subchassis types (*eg* Thorens, Linn, AR, B&O).

Bib supply several such gadgets. A typical example, and good value is *model 42* (£2.76), which is of metal construction and looks like a miniature pickup. Height and tracking pressure are adjustable. Many others are similar in principle but far too numerous to warrant detailed comment here. Examples are by BASF, Decca, KMAL, Metrosound, Ross and others. The Nagaoka *Auto-1* is particularly neat at about £5.70. The longest established is the Watts *Dust-Bug,* £2.07. A few, such as the Decca and the *Staticleaner* (via Swisstone, beautifully made but a daunting £19.50), incorporate conductive carbon-fibre brushes.

It has been found that tracking dust-collectors working at a pressure of about 1.5 grams can cause a slowing of the turntable. This, of course, applies only to turntables with low torque and is more a criticism of turntable design than of tracking cleaners. *(Note: there is sound theoretical justification for a low torque high inertia turntable platter – Ed.)* If it *does* happen, the frictional drag will not be constant throughout the record side and,



Bib Groov-Kleen model 42

therefore, will not be susceptible to correction by a 'pitch' control on the turntable. However, there is the alternative of a radial-tracking device (Bib, Ross, Nagaoka, Metrosound) in which the pad is

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carried across a radius of the disc. This type works at a lower pressure but by the same token tends to be less efficient in dust-collection.

Other common and cheap items are cloths and pads. Most of the cloths offered have been impregnated to give an anti-static property and are inclined to leave residues on discs. Pads used dry cause abrasion and exacerbate the static problem, and pads using moisture come under the heading of messy methods and are best avoided. All are unnecessary, for there are safer ways of collecting dirt; so none will be itemised here.

At this stage it may be as well to offer a reminder that our object is to prevent foreign substances from entering grooves, not deliberately to introduce them! Any exceptions to the rule will become apparent as we reach them. This seems to have been well understood by the designers of tacky-surfaced rollers which are intended to be passed across the disc surface to pick up particles. If there is any problem with such gadgets, it is that any large and unusually abrasive particles will be returned to the disc during one traverse of the roller, possibly causing damage. Therefore any suspicious-looking debris should be lightly flicked from the disc before rolling commences.

One such device is the *Pixall* (£3.74) from Milty Products, probably the first of its kind. The roller consists of a drum on which is wound at least 1.5 metres of tacky tape. A length can be unwound, cut off and discarded when dirty. A refill can be fitted when all the tape has been used. It works very well.

Metrosound do the same job with the *M96 Rotary Cleaner* (£5.45) but this has a roller made from a soft and tacky high-polymer. The advantage here is that the roller can be washed in soapy water. Tests indicate that washing does not impair the roller's surface tension, but care must be taken when drying because of the risk of leaving fluff on the surface.

The Nagaoka *RC100 Rolling Cleaner* (£7.94) is the same in principle and luxuriously presented. Model *RC200* costs 50 per cent more, though the difference in design is minimal. Rollers of this type are very effective and, bearing in mind the hazard of trapped abrasive particles already mentioned, can remove a great deal of dust fairly quickly. They also lift some other contaminations which tracking cleaners and the like would leave behind. The Metrosound roller is particularly good value.

Two other kinds of cleaning aid require brief mention. One is the *Groovac II,* in effect a miniature vacuum-cleaner which tracks the disc. The other is a device, exemplified by the *Vac-O-Rec,* which spins and brushes the disc while exhausting dust into the atmosphere. Both work well but are relatively costly and elaborate: cheaper aids can do all that is necessary.

Thorough cleaning

Most of the simplest cleaners are intended for nominally clean and well cared-for discs. But it may be desirable to refurbish badly contaminated LPs for hi-fi use. Sticky and greasy deposits may be due to general pollution, the previous application of ill-chosen 'cleaning' substances, or sheer accident. Some users devise homely washing methods when nothing else is available. One way is to turn the disc, edge-on in a bowl of tepid water to which a few drops of detergent have been added. A fine-haired brush is used to scrub around the grooves. This is followed by rinsing with plain water. A drop or two of photographic wetting-agent is helpful here. Very careful drying is necessary.

This time-consuming process may still leave the disc with uneven noise levels unless it is carried out meticulously, but at least it can make a useless disc playable. Most effective of all is the cleaning service offered by some record and hi-fi shops which have installed the KMAL professional cleaning machine. A list of suitably equipped shops can be obtained by sending a stamped envelope to Keith Monks Audio Ltd, Reading Road South, Fleet, Hampshire.

Although the emphasis has been on dry dust-collection for domestic use, it is also possible to opt for a 'wet-play' method. This involves the use of a tracking device which spreads a wet film over the disc, holding dirt in suspension and overcoming the effects of static and noise. Moisture which does not dry has to be mopped up. A possible disadvantage is that once started it is necessary to continue wet-playing on all subsequent playings, as a residue is left in the groove after evaporation. We have just heard that the Lenco system is to be re-introduced to the UK market by Goldring.

Reverting to recent innovations, there has been something of an outburst of tools and kits which demand a buffing action on discs for the application of fluids or removal of dust. Such methods raise evident risks of abrasion or trapped, dried-out residues which become at least as troublesome as the dry particles we are seeking to remove.

In general, though, and when only new or

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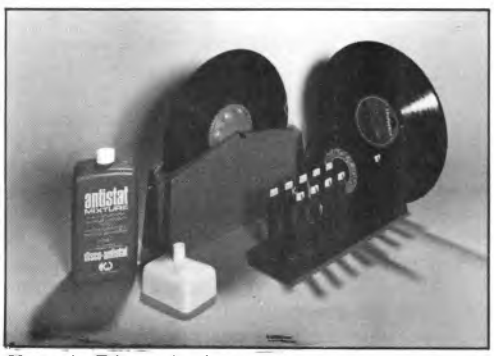
nominally clean discs are played, it is difficult to justify elaborate and time-consuming routines. As already pointed out, the needs of careful folk are unlikely to extend beyond the gentle removal of dust and the collection of particles that arrive while the disc is exposed on the turntable. But still the accessories reach the market, often supported by a certain amount of pseudo-science, and presumably the buyers are supposed to use them more as an act of faith than because there is any proof of necessity. One feels, too, that too many manufacturers trade on the disc's reputation for being an intolerably 'noisy' medium – all part of hi-fi folklore.



Knowin Disco-Antistat

Clearly an attempt to remove real contamination from fouled discs (including residues from unscientific record-cleaners) is worth the trouble. If a disc is bad enough you can really only improve its condition. In that connection there is much to be said for Sound Guard's *Cleaner Kit* (£4.48). The instructions specify use of a wet film which is left for up to 30 seconds; then the fluid and suspended dirt is mopped up with a sponge, any remaining moisture being removed on a velvet pad. This fairly lengthy process can be made to work well, and it gives a worthwhile though temporary reduction of static.

For any treatment of this sort it is necessary to place the disc on a clean surface which will prevent slipping. Accordingly Sound Guard can supply a *Work Pad* (about £5), a non-slip pad of rubber, suitably contoured and non-conductive. A luxury, but certainly making for convenience.

A German-made kit by Knowin displays an approach which is every bit as thorough as Sound Guard's. The *Disco-Antistat* (£17) is designed to brush the disc while it is rotated in a bath of fluid. Main contents are a bath with fixed brushes which contact each side of the disc, a drying rack, a one-litre bottle of fluid, and a spindle and clamp which enables the disc to be rotated while disposed vertically with its labels protected. Some LPs were deliberately fouled and left for a couple of weeks before treatment. Greasy and sticky deposits were removed very effectively; static was sharply reduced and did not show a significant return during handling and occasional playing through a period of two weeks (the distributors claim permanence).

It is said that the fluid can be used 'several' times, and so a funnel and filter papers are included. The litre of fluid is reckoned to treat about 200 discs at a cost of 3p each, but anyone in such dire need of a washing treatment must be unusually careless! However, if the benefit is held to be static-reduction rather than cleaning, then we are getting into a different area, as we shall see.

Returning to the products of Sound Guard, an American company which seems to leave no possibility unexplored (if you followed all their strictures 'worn-out records would be unheard of'), we find that preservation is held to be as important as cleaning. While also suggesting that respect for the language is as important as enthusiasm, one may question the need for the main constituent of the *Record Preservation Kit* (about £5). This is a fast-evaporating dry lubricant, intended for re-application every 25 plays using a buffing action with a velvet pad.

So the emphasis is on groove-wear. Without treatment, we are told, 'tiny shavings of vinyl curl off', but Sound Guard claim to offer indefinite protection. At least it can be said that the process, if time-consuming, does not leave smears on the disc; but obviously the grooves must be very clean before such a potentially abrasive action is applied.

Most importantly: in view of the very real advances in disc replay, what need is there for such a negative approach? Emphasis on gross damage to grooves hardly reflects an interest in state-of-art audio. Perhaps Sound Guard address themselves to users of inferior or outmoded equipment, but that possibility is not worth investigating in a *Hi-Fi Choice* context.

EMI enter the scene with a product called *Clean Sound* (£3.40), which they obtain from Recoton, an American firm. This comprises a large plush-surfaced applicator and a non-smear fluid, and the

method is to apply a little fluid along one edge of the applicator for dust-collection. Then the dry edge is passed lightly around the grooves to collect remaining moisture. It proved difficult to avoid traces of dirt on the disc after treatment, but otherwise it was clear that the plush pile entered grooves effectively. There was some short-lived dispersal of static, but excessive pressure will exacerbate the charges which the manufacturer intended to dispel. The product may appeal where there is a severe dust problem. Failing that, it seems to be as unnecessary as many such products now arriving in such profusion.

If only to demonstrate the variety of approach that is possible, a brief mention of Empire *Disco-Film* is warranted. This American product, which seems to have been spasmodically available in the UK, is a viscous solution. It is spread over both sides of the disc, excepting the labels. Harmless to vinyl, this water-soluble material dries to a film and is then pulled off, bringing all the dirt with it. So it is not a messy process and for that reason can be commended. On the other hand a tacky-surfaced roller does a similar job in a fraction of the time.

Stylus cleaning

The condition of the stylus-tip betrays the ill-advised use of messy disc-cleaning methods which leave residues. Sticky substances in grooves will build up behind the tip, so that accurate tracing of the recorded modulations becomes progressively more haphazard.

Further, some discs exude extremely small amounts of stabiliser (which is an addition to the vinyl and colouring used as stock for pressing) and this, too, will add to the contamination. At worst, and with the neglect that is all too common, the deposits will harden and change the finely-shaped diamond into a mis-shapen blob.

It seems characteristic of some accessory-makers that, having supplied the means to contaminate grooves, they stress the need for stylus-cleaning and so supply accessories for that purpose. However, some cleaning is vital for the hi-fi user, and this starts with the use of a miniature brush for removing fluff from the stylus; a tuft of nylon is suitable. A very soft and floppy brush will not be very effective and it is better to use the stiffer nylon tuft and apply it with a gentle action, passing it from rear to front of the stylus tip.

A drop of solvent on the brush is a useful part of regular maintenance. Representative of commercial products are the Bib *Stylus Cleaner fluid* (48p) and a kit from Metrosound (79p) which are effective if used regularly.

Stylus tips carrying more stubborn encrustations demand more rigorous treatment, though patience and a gentle touch are always essential. Pure alcohol may be the only possible agent for restoration: if that is difficult to obtain, the somewhat less pure vodka may be used instead. (A miniature bottle will last for a year or two. In the event of overwhelming temptation, buy a bigger bottle!) Preparations containing alcohol, such as medicines, must not be used because they will leave residues.

Sound Guard, in characteristically thorough-going fashion, offer a *Stylus Care Kit* (£4.45). This contains a brush for dry fluff-removal, a cleaning fluid with applicator, a bulb air-blower to puff away dust (and to dry the stylus, believe it or not) and a magnifier. The latter has ×3 and ×10 lenses, so it is more useful for confirming the removal of gross debris than for observing more subtle details.

One of the cheapest of the smaller tools is the Watts *Stylus Cleaner* (45p), combining close-pile nylon plush with a plastics holder. It can also be used with a solvent. Then there is the Nagaoka *Brush* (about £1.15) with its tuft of horse-hair. KMAL is another supplier of cleaning aids, and Goldring are bringing out a carbon-fibre stylus brush kit which includes an inspection mirror. Also useful is the Discwasher kit *SC1*, incorporating fluid, brush and mirror at £3.99.

If this area of hi-fi housekeeping seems somewhat lightweight it must be remembered that the stylus/groove relationship is of vital importance. There is scant point in worrying about other details if the disc is not traced with any attempt at precision. Residues left in grooves for reasons already mentioned may be augmented by household contaminations which arrive in aerosol form, especially cooking vapours and tobacco smoke (both are sticky). It should readily be visualised that regular stylus-cleaning (once a week is not too much) makes its contribution to audio quality. Neglect takes the sparkle out of the sound, and it can cause more audible distortion than would be generated by other links in the audio chain.

Static – how important?

Every serious observer will know that electrostatic charges affect a variety of household items made from certain plastics (nylon and vinyl, for in-

stance). These, when subjected to friction or even gentler handling, exhibit static potentials which typically range from a thousand volts (a kilovolt) up to 15kV or higher. Gramophone records are among the most common items carrying strong charges.

Few users have any great interest in the mechanism of static but they may be aware that the phenomenon has a lot to do with the plastics material's properties as an electrical insulator. (If records were metallic the much-vaunted static problem would not exist.) Many users will also be aware that providing a path to earth, even by quite inefficient means, can be beneficial, although the relaxation of static is only temporary. By promoting electrical conductivity on the material a longer-lasting effect can be achieved.

Some record-users claim to be much troubled by static, while others seem to pay little regard to it. What is beyond dispute is that static attracts and holds dust particles. Not forgetting that some dust will fall on discs irrespective of static, it is true that relaxation of the charge will enable surfaces to be kept clean more easily. It is demonstrable that more dust will be collected by pre-play cleaners or tracking devices if static is first reduced.

The problem of static – where it *is* a problem – is clearly associated with disc-cleaning and yet to some extent it can be viewed separately, if only because static varies so much with local conditions. Special difficulties have been reported by those who play discs in very dry atmospheres with central heating or air-conditioning, most particularly where particles arrive from carpets and fabrics in the room. Other users prefer a higher level of humidity and encounter fewer problems.

Static is sometimes a problem not because it directly causes any noise but because it leads record-users into frenetic attempts to clean vulnerable grooves. All manner of abrasive and messy methods are tried and these lead to higher noise levels and may even increase the static.

This is not to say that obviously serious static should not be countered in some way. It must be stressed, however, that intolerably noisy reproduction may be due to equipment mismatching, causing inferior signal-to-noise ratios, or to poor transient response of the system. In short, technical deficiencies may reveal impulsive noise (clicks and pops) which should go unnoticed. This may be bad news for those who have spent large sums on badly-planned systems, but it does not lessen the truth of the argument.

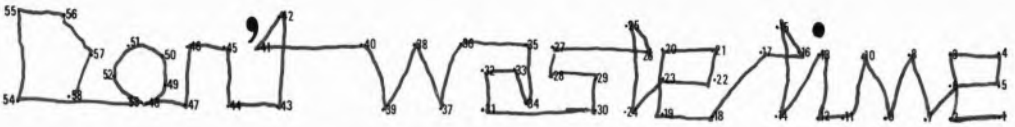
Another technical quirk arises with carelessly connected or badly designed systems. In particular a pickup without really efficient earth bonding (or with poor screening) may reproduce discharges of static which arrive at the loudspeakers as an explosive noise. Dramatic improvements have been achieved by separately bonding the cartridge body to the pickup arm.

If for many happy hi-fi users static is not the bogey which it is often assumed to be, our main purpose here is to comment on accessories which can bring solace to those who are plagued by heavy dust deposits. Zerostat have led the way with their 'gun' device (around £7) and others have followed. Examples are the Watts *Xstatic* (£6.90) and a similar gadget by Bib. These incorporate piezo-electric elements to generate high voltages. A recent innovation is the Bib *Electronic 3000* (£9.55), which is battery-powered and features a voltage-multiplying circuit. The Nagaoka *Kilovolt* (about £19) is similar.

Such generators create an ionized zone around the charged disc surface and thereby neutralise the static. Several operations may be needed, but tests with a laboratory-built static voltmeter have shown reductions from 15kV to negligible levels. This is true of all the devices instanced. The effect is temporary and the charge soon returns with further handling of the discs. Treatment of the disc on the turntable gives variable results and is not advised. It is best to hold the disc in one hand while operating the 'gun' with the other. Any draught or the rising air from a heater will render the treatment all but useless.

Clear advantages are that nothing touches the disc during treatment and that operation can be repeated quickly and often. It may be considered ungrateful if it is pointed out that useful static-relaxation can be obtained by holding the naked LP for a short while outdoors on a humid evening (most British evenings will qualify). But a purpose-made instrument is obviously more convenient.

An alternative device is offered by Nagaoka. Their *Rotor-Stat* (about £16) resembles a laboratory instrument and incorporates a support for the disc, a swinging discharge brush and provision for earthing the charge. Although it is prettily done, it is difficult to see how it can appeal in the face of devices which are easier to use. Certain dust-collecting devices mentioned earlier are similar in principle, and with any such method it is possible



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to secure reductions of charge by leaking it away – a purely temporary effect.

Several preparations offering temporary or longer-lasting relief have already been mentioned, and to these we can add a newly introduced Bib product known as *Groov-Guard XL2,* modestly priced at £2.48. This consists of a small supply of fluid in a spray-pump container and a velvet-surfaced applicator. A conservative estimate of the number of discs treated by one container is 12–15.

It was found that considerable buffing was needed to return the disc to a shiny state after fluid application as instructed, and indeed it was felt that the cylindrical applicator could with benefit be made somewhat bigger and given a better handle to aid this necessary process. Anything less than the required rigorous polishing left traces behind the stylus tip at the first playing. But investigation with the static voltmeter showed that the charge was eliminated and could not be provoked by rubbing. There was no return of static after 20 playings, so the makers' claim of charge-elimination for 'the expected life of the record' seems not unreasonable.

Permostat, which sells at £5.30, was apparently the first of its kind on the UK market. Again it is required to buff the disc until it is shiny and free from residue, and again there is a risk of residue unless the treatment is thorough. The claim of permanence is likely to be justified: the charge did not return, and could not be made to do so, after 20 playings. This kit treats about 25–30 discs.

Use of the Permostat and Bib products is an exclusive process in that other fluid-type treatments cannot be used on the same discs, but a dry dust-collector can of course be used to pick up the falling dust in the usual way. They are appropriate to clean discs only. Contaminated discs will first have to be washed, preferably on a professional cleaning machine (or the Knowin complete treatment might be used instead).

Indeed, even a nominally clean disc should be carefully inspected before spraying and buffing to ensure that no abrasive particles are retained. To all this, however, it must be added that a check with a test disc did not reveal any detectable impact on frequency response due to the use of the products mentioned.

Some authorities feel that static-control is really the province of the record companies. But these organisations, for all their resources, have made little progress in a long time and it is hardly surprising that their customers seek relief from static by a variety of means, or that the accessory-makers respond with such evident enthusiasm. Uncompromising safety is ensured by anti-static devices which do not actually touch the recorded grooves, but in general these afford only temporary relief. Treatments which make discs electrically neutral and keep them that way are based on the application of fluids (until another innovation comes along). It is possible to apply these so that no residues are left, but the buffing action needed for this must cause some slight misgivings because the risk of abrasion cannot always be ruled out.

In that connection it is seriously suggested that accessory specialists miss many opportunities to inform and educate their customers. The same can be said of the record companies, whose best advice has been to clean discs with a 'barely damp cloth'. Since ideas about dampness vary so much the advice is questionable, to say the least. However, the outcome of recent developments is that the user can no longer use static as the whipping-boy and must look for other causes of a degraded signal-to-noise ratio if this persists.

Turntable accessories

Now we pass on to some of the esoterica of audio. In doing so we do not altogether leave the troubled area of static, since anti-static turntable mats now feature in the mushrooming accessories business. These can be regarded as panaceas affording some temporary relief when charged discs are placed on them, but they can hardly be said to be within the mainstream of developments. Most are of thin felt, made conductive, but one (the Scotch *Dustguard*) is made from reticulated plastics foam. Conductive rubber mats have also been marketed. Prices are typically £2.50 to £5, and makers include Bib, Goldring, Discwasher, Nion, QED and Scotch (3M).

The limited success achieved with such mats brings in a selection of factors which are not easily isolated. Details of turntable construction and earthing have been found to influence efficacy. Some manufacturers imply that the mat should replace the existing rubber mat while others suggest that an anti-static mat can be used as an addition.

If it is impossible to view anti-static mats with any great enthusiasm, this is mainly because of reasons which have nothing to do with static and a lot to do with the support offered to the disc and the

REVIEW

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Deserving special mention are Mordaunt-Short, who seem to produce a speaker at each price level which can be thoroughly recommended. Starting with the CARNIVAL at £88.00, the FESTIVAL at £117.00, the larger PAGEANT at £176.00 and the top-of-the-range SIGNIFER at £515.00, all these speakers . . . can be strongly recommended against all their competitors. It is highly unusual to find a Company producing such consistently good products all along the line. For this they have earned our sincere admiration."

'Popular HI-FI'
August, 1979.

damping imposed on the platter. Many rubber mats seem to have been designed as afterthoughts – and very badly too. However, it is not permissible to presume that mat quality will be well related to the ostensible quality of the turntable. Some expensive turntables have totally inadequate mats.

At the very least we expect the mat to support a nominally flat disc. The best arrangement is a solid sandwich formed by the disc, mat and platter. Since most platters are of cast metal (aluminium or zinc alloy) they will readily ring when excited unless something is done to damp the resonance. So another function of the mat may be to provide some damping.

Good damping can be secured by bonding the mat to its platter, but it is preferable to be able to remove the mat for washing. Damping can also be applied by 'undersealing' the platter with a compound to add mass, always assuming there is space for the extra thickness, but this raises problems of balance. More generally it is true to say that there is scope for more intelligent design: it should not be an insuperable problem to formulate a material which can combine good damping with other desirable properties.

Lively interest is shown by the accessory specialists. There is little interest in conductive properties but some emphasis on the mat as an item which can influence audible results. For example, hardness in the vertical direction is held to be important. Indeed, it is demonstrable that contrasts in mat compliance may show up in the reproduction if the standard of system performance is high enough to permit detailed study; but other aspects of turntable and plinth design are also influential and these are outside the scope of this survey.

Again, a smooth-surfaced mat is best able to support the disc provided the surface contour is correct. Mats with raised ribs or other shapes seem to be made that way for 'cosmetic' reasons yet are most inclined to harbour dust. Further, it is difficult to see any sense in leaving spaces between mat and disc, bearing in mind the forces involved in the pickup/disc relationship and the tendency of the disc to vibrate.

Doubtless most mats have been designed from a static viewpoint (in the strictly mechanical sense this time), not in the light of dynamic conditions. The extreme case is the platter with a few small studs to support the disc, a large space being left underneath. This approach has been taken by manufacturers seeking a new 'look' and by those lacking the foundry facilities required for a more conventional platter.

Disc accessories by Spectra

Of a selection of speciality mats, one example is the *Spectra*. This French product (via Swisstone, about £20) weighs around 350 grams and so is not particularly heavy. Also, it is softer than average. The makers appear to place some emphasis on rumble reduction, but the reason remains a mystery.

One obvious virtue of this mat is its damping effect, and another is good support for discs. It has tacky surfaces and the result is not only that it 'sits down' well but also that any dust particles on the disc's underside are left on the mat after play. But the mat responds well to washing and is very easily dried. It must also be noted that the Spectra gave off a pungent odour and that the finish of the sample was not all that could be expected of an expensive product.

The Hiraoka *Disk-SE22* is imported by Osawa, the Nagaoka distributors, and sells at nearly £15. (Apparently Harman UK have also imported it.) Of natural rubber with a filler, the mat weighs nearly 750 grams. Attributes are good disc support and platter-damping, and the high mass may be welcomed by users of insubstantial turntables. But it could also be argued that buyers of relatively cheap turntables are least likely to seek expensive mats.

With their *Crystal Mat GL602* Nagaoka stress the merits of a firm and heavy 'sandwich' of disc and supporting parts and the provision of a hard platter, aiming at prevention of vibration rather than damping. Accordingly the mat is of 6mm tempered glass and weighs nearly 1kg. With

smooth, hardened surfaces and precisely dimensioned central indentation, support is very good. A stabiliser of a synthetic elastomer is supplied and, when pushed over the centre-spindle, it grips the disc label. The standard of manufacture and presentation is superior, as befits a product with a recommended price of around £57!

Similarly GA Audio offer the *Soundisc* (£11.80), which again weighs about 1kg, although there is a somewhat lighter and thinner version. Choice would depend on details of platter construction. The length of protruding centre-spindle must be checked in any situation where an extra-thick mat is to be used; and some spindles have a long taper which could be troublesome if any part of the taper coincides with the hole in the LP.

With any thick mat it is likely that pickup height will require adjustment, and this is mainly a feature of separate arms. Few integrated turntable/arm units make such provision. Further, no special mat can be used on a platter which is not flat; on the other hand a rigid mat (glass, especially) is useful on turntables which give only multi-point support (Michell and the like).

All the mats mentioned display distinct merits, but it should not be assumed that dramatic changes will follow from their use. Much bigger differences can be made by modifications elsewhere, and these are not necessarily costly. But successful hi-fi is very much a matter of attending to details, and a properly designed mat comes into the equation.

Audible differences are detected if the system is already to a high standard and sufficiently analytical, but it is difficult to say what users of less ambitious outfits would make of it all. On test, the hardest mats were preferred: the *Soundisc* and the (impossibly expensive) Nagaoka promoted firmer bass and a subtly brighter sound than other types on highly-modulated programmes. Glass mats do in any case offer a unique advantage where disc-support would otherwise be poor.

The *Disk-SE22* improves on lightweight and ribbed mats without really justifying its cost. The Spectra was liked for its damping property and support, though any other special virtues, sufficient to justify its price, never became apparent.

It seems that some manufacturers with a feeling for luxury-style accessories have gone into the mat business with alacrity. A substantial mat does make sense, but more research would help to back the claims that are being made. There is no doubt that many ordinary platter-mats are sorry specimens and that a more thoughtful approach can yield audible improvements. However, it is earnestly to be wished that someone can come up with a mat which exhibits a sensible balance of attributes while selling at only a few pounds.

Where the mat already gives reasonably good support it may be thought adequate to reduce the risk of resonances by pressing the disc down firmly with a weight. Since this can only normally be applied on the label, it is likely that a warped disc will look even more warped when under pressure, depending on the nature of the fault. Otherwise the method may be worthwhile, especially where there are obvious air-spaces between disc and mat. The added rotational inertia is unlikely to be an advantage, and there is also the possibility of increasing bearing loading and wear.

Weights have been introduced at prices from around £4 upwards, usually of brass with a protective finish. The KMAL weight is typical and weighs about 500 grams, while the Audio-Technica *Stabiliser* is a little heavier. Most ambitious is the Nagaoka *Crystal Stabiliser*, beautifully made from glass and weighing 700 grams. At approximately £20 it can almost appeal as an 'executive toy' with its strobe marks and a ball-and-scale gadget to aid turntable levelling. There are even spacers to fit beneath the label of a dished record when it shows signs of rising at its circumference.

It was impossible to attribute any audible change whatever to the use of a weight when the disc was already properly supported, but there was some cleaning-up of bass and mid-range with light platters and flimsy mats. Since one does not usually associate cheap turntables with systems capable of exposing subtle nuances of sound (although such conditions were contrived for test purposes), we may well wonder about the suppliers' motives.

A clamp can also be used to press the disc against the mat, and again the force can only be applied on the label area. The difference is that a simple clamp will not impose the mass of a stabiliser weight. Two devices of this kind, costing only a few pounds, have been tried and were found to have beneficial effects on poorly designed mat and platter combinations, although their use on high-grade components did not seem necessary. These gadgets are equally suitable for use where the spindle does not have a long taper. Clamping is not possible where the spindle tapers above the

section which accepts the hole in the disc.

Metrosound's anti-resonance clamp is a clear acrylic disc edged with a rubber ring. A central screw-collet is tightened on the turntable spindle after the device has been pushed down on the label. A clamp made by Yulon is similar in principle but is of metal and has a felt underside to contact the label. Other devices on the market include one from Michell and a new tripod designed gadget, known as the *Pod* from Monitor Audio.

Metrosound anti-resonance clamp

Aids for tape users

Minor products for users of open-spool and cassette tapes form a compact group. Requirements seem to be well defined and we have not seen any spectacular developments in recent times. Cleaning of accessible parts of tape machines heads the list but there are some interesting aids to tape editing and deck maintenance.

Nowadays tape machines, like other units, carry the solemn warning: 'No user-replaceable parts inside.' In part it is a reminder that mechanical assemblies and other parts have become more dependable, needing less attention. For domestic users maintenance routines have become confined to the top-deck, mainly the heads, capstan and associated parts. Specialists such as Bib, Metrosound and Ross provide what is needed, and nearly all makers of tape produce their own maintenance kits. Examples, far too numerous to itemise, are by Agfa-Gevaert, BASF, Fuji, Philips, Scotch, TDK and others.

Whereas the pressure has been on disc-users to clean their LPs, tape users have been less exposed to such admonitions. The result has been sheer neglect. Attention, however, is to be directed not at the tapes but at the deck's accessible parts, which soon suffer from an accumulation compounded of household dust, tape-coating particles and general pollution. Heads are particularly vulnerable, and regular cleaning can be seen as the counterpart of stylus-cleaning in disc reproduction.

On cassette machines it is often easiest to use a cleaning tape in a cassette housing, since it can be loaded in the usual way and will clean the heads, capstan and pinch roller in one or two passes. This should be done after every few hours of use or according to specific instructions. The method is useful because the heads in many decks are virtually inaccessible.

Several materials have been tried in cleaning cassettes but probably the best is a textile tape which can be run either dry or slightly moistened with a cleaning fluid. The Bib, Metrosound and Ross cleaners at under £1 are typical. Fluids are available separately. There is also the Metrosound *M87* kit (£1.64) which includes a tool for separate removal of deposits as well as a tape in cassette format. The same firm supplies *Klenzatape* (£1.53), an excellent cleaning tape for open-spool machines.

Where accessibility to heads is better than average in either cassette or open-spool decks, and especially where there are heavy oxide deposits, a manual cleaning with tools, fluid and inspection mirror is advised. Representative products of top quality are the TDK *HC-03* kit (£3.50) and the Bib *Head Cleaner type 115* (£5.08). The TDK kit includes fluid, mirror and a probe with a supply of felts which can be cut off as they become dirty. Bib include similar items but the cleaning tool is cleverly adjustable and comes with a supply of cleaning tips.

Advice concerning regular demagnetising (or 'degaussing') of record/replay heads, in order to remove residual magnetism, has often been proffered but very largely ignored. The idea is to maximise signal-noise ratios, though the manufacturers' instructions on the matter (if they offer any) depend on the head construction used. For both cassette and open-spool decks it is possible to use an AC-powered probe (Bib, Ross, TDK and others) if the heads are accessible. There is a bonus: in skilful hands the probe can be used for 'spot editing' of tapes on occasions where the precision of cut-and-splice editing is not essential.

Latest innovation is the demagnetiser in cassette

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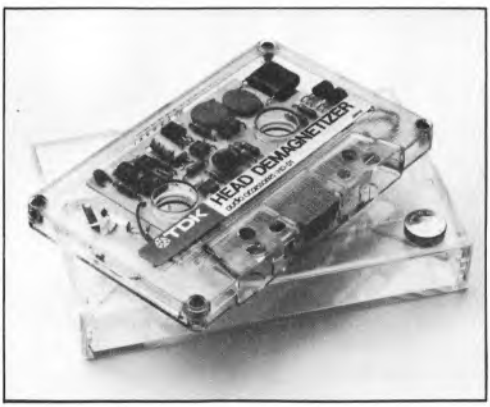
format incorporating a cleaning tape and permanent magnet (from around £3). Bib and Metrosound offer suitable devices. More elaborate and certainly the most effective is the TDK *HD-01* (£8.90), which is electronic and powered by a miniature silver-oxide cell. It is designed to emit a series of sharp-wavefront pulses while loaded in the deck mechanism.

Enthusiastic users of open-spool tape will hardly need reminding that the tape companies and accessory specialists supply editing aids such as splicing blocks at very modest prices. It is not so widely appreciated that cassette tapes can be extracted from their housings for purposes of salvage, or even to add new lengths of tape, although the scope for editing recorded tapes is limited. A simple kit by 3M (the makers of Scotch recording tape) facilitates tape retrieval and editing and costs only £1.20.



TDK Head Demagnetiser

BASF, Bib and Metrosound supply splicers for cassette and quarter-inch tapes. Kits of cutters, splicers and jointing tape are also available. A useful Bib item is the *Fast Tape Winder* (£1.59), a geared device which enables a cassette to be wound or rewound while the machine is engaged in playing another. This firm also offers a *Stereo Test Cassette* at £3.70.

Miscellany

Most pickups have some kind of lift/lower device and many integrated players provide auto return of the pickup to its rest. In the absence of the desired facilities a separate pickup lift may be useful, especially if automatic in operation. Monitor Audio and Audio-Technica make such devices. The latter's *AT-6006*, engagingly called *Safety Raiser* (about £12), pushes on the pickup near its pivots when a small antenna is touched by the arm. Positioning is tricky but operation is nicely delicate. Metrosound are introducing Thorens trip-and-lift device at £6.

A well-equipped pickup has a calibrated counterweight for setting tracking pressure within fine limits. Otherwise, there are plenty of gauges or stylus balances. Typical examples are by Bib, Metrosound, Musonic and Shure, and none cost more than a few pounds. Probably the most accurate in general use is the Transcriptors balance, used by the author for his published tests on pickups. This is a unipivot balance with a set of weights which have been manufactured against a standard.

Gauges of the bubble type to check level are supplied by Bib and Goldring. The latter firm has introduced the *Highlight* turntable light (£13.80) which fits on the turntable dust cover to give illumination, with auto switching, where it is most needed. Nion produce the *Checklight* (about £4), a combined penlight and mirror for inspecting cartridges, tape-deck parts and connections which lurk in inconveniently dark corners. For precise pickup adjustment the Howland-West alignment protractor, at about 90p, is particularly recommended.

Mild controversy over the use of 'special' (and very expensive) loudspeaker cables will not be enjoined here. However, it is common sense that long runs of cable can cause resistance, and accordingly QED have been supplying a twin 42-strand copper cable. Now they add an excellent 79-strand (per conductor) cable, selling at about 50p a metre. Looking to the other end of the system, Nagaoka offer sets of cartridge lead wires for use within headshells and provide a choice of silver Litz, plain silver and copper ribbon at prices from about £2.30 per set. Choice seems to be a matter of taste: there is no evidence of any practical difference.

Plug-in headshells to the IEC standard are readily available, usually in aluminium alloy or magnesium. Examples are by ADC, Audio-Technica, Howland-West and Nagaoka, the latter's aluminium shell being especially neat though expensive at £8. Twin pickup leads and signal interconnectors are common enough, and nice examples with gold-plated terminals are

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marketed by Nagaoka, Audio-Technica and Zerostat (Gold Ens).

A few manufacturers take an interest in compliant mounts for turntables, used where existing provision for resistance to shock-excitation and acoustic feedback is found inadequate. Discwasher's *Isolation System* (£12.95 per set) is intended for use under the feet of turntable plinths. KMAL also supply isolating mounts of this kind. It must be emphasised that, by the nature of the problem, a mounting system cannot be very broad in its application. Much depends on local conditions, especially the solidity of support provided for the turntable and the proximity of the loudspeakers. It is a pity that suppliers claim so much for devices that can be nothing but a panacea, having recognised a symptom without the means to effect a universal cure.

Never short of a new idea, QED are introducing a Renovation Kit at about £5 for the removal of scratches from acrylic dust covers. This comprises a tube of slightly abrasive cream, a bottle of polish and appropriate dusters. Experiment shows that superficial marks are easily dealt with. Deeper scratches will need a lot of patient work.

The same firm is well known for its surround-sound adaptor and also a series of mains distribution units which enable a selection of audio units to be powered from one wall socket. Model *19/1*, at just over £16, includes a suppression network for mains-borne interference and offers four outlets with miniature three-pin sockets. Rating is 750 watts and the input is the usual 13A standard plug. Suppressors for individual switches are also available, and QED is a mine of information on the subject.

Stand-mounting is often essential for loudspeakers to ensure acceptable tonal balance and HF dispersion for seated listeners. If stands are not available from the speaker manufacturer, specialist firms can help. The Appolo stand (around £19) from Grabern Audio suits medium-sized speakers and is fitted with castors. This supplier has swivel-action wall brackets at about £11 for speakers up to 50lb. Metrosound also are introducing wall-fixing swivels, again to take 50lb weight. TVA is another supplier.

None of the accessory-makers put together an audio toolkit of any merit, perhaps because some of the items would already be found in most homes. A useful kit would include a couple of instrument screwdrivers, side-cutters or a wire-stripper (Bib supply this), pliers, tweezers, a selection of fuses, screws and nuts, and a duster or tissues. Most likely addition would be a dispenser of Multicore solder and a miniature soldering tool such as the Antex, which has interchangeable bits.

Of many complaints to be laid at the doors of the record companies, one concerns the use of inner sleeves which cling to disc surfaces. Some companies improve on these by using plain paper bags; others have changed to bags of thin plastics film – to good effect. For replacement of existing inners try the *Discwasher VRP*, a square bag of polypropylene film marketed by Zerostat at £1.95 for 10. Similar but cheaper, shaped with a rounded bottom, is Nagaoka *102*, at £5.74 for a pack of 50. Both are excellent.

Plugs and sockets in profusion are available to experimenters and those with practical talents. QAS are prominent: examples from their Ariel series are neat plastics-sheathed DIN 5-pin and speaker plugs at 42p and 30p respectively. If you do not care for soldering you will find plenty of packaged leads: DIN-to-DIN, phono-to-DIN, loudspeaker connections, split connectors to accept two headphones where the amplifier caters for only one . . . every eventuality is covered. QAS, Tape Recorder Spares and Ross Electronics are well known for anticipating enthusiasts' needs.

Gold-plated connectors add the luxury touch and have practical merit. The Golden series by Ross is particularly attractive and includes the *RG-87* (around £3.50) which, with conversion from 180-degree DIN 5-pin to phono sockets, will prove a boon to tape enthusiasts. A double low-loss 1.5 metre lead with phono plugs is *RG-63* (£3.80); and another version is *RG-96* (£7.70) offering conversion from 5-pin DIN to four separately screened phono leads. The same firm supplies simpler leads (not gold-plated) such as *RE-78* (£1.65) linking 5-pin DIN to four phonos. Shielded adaptors without leads sell at a low 37p for all patterns – excellent value.

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AFC: Automatic Frequency Correction; a special circuit that compensates for slight mis-tuning or tuning drift.

AM: Amplitude modulation; a form of radio transmission appropriate nowadays to information rather than hi-fi music (see *MW, LW, SW*).

ANRS: A cassette deck noise reduction system developed and used by JVC, reasonably compatible with Dolby *B* for replay of pre-recorded cassettes, unlike SANRS which however offers greater noise reduction.

AM rejection: Ability of an FM tuner to discriminate against unwanted AM interference signals.

Acoustic breakthrough: The tendency of record playing systems to behave microphonically with a consequent increase in distortion.

Adjacent (and alternate) channel selectivity: The ability of the tuning (RF) section of a tuner to reject interference from stations which are close in broadcast frequency to the required station.

Amplitude: Size or magnitude, and hence level or loudness of a signal, for example.

Axis: The axis of a loudspeaker is the line along which the voice-coil vibrates and on which measurements of frequency response are usually made (either on the treble unit axis or midway between the midrange and treble axes).

Azimuth: Refers to the accuracy of alignment of the tape record/playback heads in relation to the path of tape travel. This is less important when recording and playing back on the same machine than when reproducing pre-recorded cassettes or those made on another machine.

Balance: Can refer to the relative levels of each of two stereo channels or to perceived frequency response variations (*ie* changes in tonal balance).

Bandwidth: A range of frequencies with presumed defined upper and lower limits. This may refer to the range of frequencies which can be heard (*ie* the audio bandwidth, usually taken as 20Hz–20kHz) or to radio broadcast frequency bands.

Bass: The lowest frequencies or deepest notes which are audible.

Belt drive: A turntable engineering technique whereby the motor is connected to the platter *via* a flexible belt which can help reduce the transmission of spurious motor vibrations.

Bias: 1) A high frequency current passing through a tape record head, which enables the audio signal to modulate the tape in a fairly linear manner; any machine/tape type combination has optimum values of bias and equalisation to give a flat frequency response, and some machines enable one to vary bias to accommodate different tape types (alternatively it is necessary to change tape type).

2) A lateral force created by the combination of stylus/groove friction and arm geometry, which is countered by a *bias compensator* acting at an approximate value in the opposite direction (also *sidethrust*, skating effect).

'Birdies': A form of FM radio interference.

CCIR/ARM: A weighting function used in signal/noise measurements.

Capacitance: An element of electrical impedance that is particularly important when matching pickup cartridge, arm leads and amplifier input characteristics to achieve a flat frequency response from discs.

Capture ratio: The ability of a tuner to reject an unwanted station in favour of a slightly stronger wanted one on the same broadcast frequency.

Channel: Stereo requires the reproduction of two channels of information.

Clipping: This is the state reached when a circuit is overloaded and overdriven, resulting in bad waveform distortion and audibly unpleasant effects.

Compliance: A measure of the springiness (or conversely stiffness) of the stylus/cantilever seen from the cartridge body. It forms a mathematical relationship with the effective mass of the arm/cartridge combination to determine the frequency of the LF resonance.

Coloration: A general term used to describe the audible effects of distortions, particularly in loudspeakers and record players. These are usually caused by frequency response irregularities and/or resonances.

Crosstalk: The leakage from one channel to the other in a two channel stereo system.

dB: Decibel.

DIN: German standards body, responsible amongst other things for a popular range of standard plugs and socket specifications.

DNL: Dynamic Noise Limiter; a replay only cassette tape noise reduction system developed by Philips which is of limited interest to the hi-fi user.

Damping: A technique which promotes the decay and hence control of resonances by means of resistance; may be mechanical or electrical and is commonly found in transducer systems (*eg* loudspeakers and cartridges).

Decibel: A logarithmic unit used in audio to indicate the relative intensity of a sound or the relative strength of a signal.

Decoder: The circuit in a tuner which separates the left and right signals from an FM multiplexed (stereo) transmission.

Dispersion (diffraction): Pattern of radiation of a loudspeaker.

Direct drive: A turntable engineering technique whereby a low speed motor forms part of the platter itself.

Distortion: The total percentage of unwanted signal present in a wanted signal.

Dolby: The *B*-type noise reduction system from Dolby Labs is fitted under licence to most hi-fi cassette decks. This selectively boosts the HF signals arriving prior to recording, and then provides the inverse cancelling cut on replay, the latter therefore effecting a reduction in the tape noise perceived.

Dolby level: A fairly high reference level of recorded flux (signal amplitude) to which the majority of cassette deck measurements are referenced, thus providing a common basis for comparison.

Downforce: The weight measured at the stylus.

Drive unit (driver or unit): A single 'raw' loudspeaker without enclosure; usually more than one drive unit is combined with a crossover network and an enclosure to make a complete speaker system.

Effective mass: The inertia or resistance to a force possessed

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by the mass of an object, used with respect to arm/cartridge combinations as part of the relationship between compliance and LF resonant frequency.

Equalisation: The deliberate modification of frequency response, usually in response to some engineering limitation or deficiency in the component (*eg* loudspeakers) or the information medium (*eg* disc and tape).

Erase efficiency: The ability of a cassette deck to wipe clean a previously recorded tape.

FM: Frequency modulation; the technique used to encode audio information for transmission with good fidelity using very high frequency (VHF) transmission.

Feedback: A situation in which some of the output of a system is fed back to the input. This may be used to advantage, as in minimising amplifier distortion, all commercial designs employing feedback. Alternatively it can be the source of coloration, as in the feedback that may be induced in a record player by the signals from the loudspeaker.

Ferrite rod: A short rod type aerial used for AM reception; may be fitted internally or externally to tuner or receiver.

Filter: A circuit (normally) used to restrict the bandwidth of a system; may be fixed or switchable.

Flutter: Causes a rapid change of pitch or a 'blurring' due to repeated small speed variations (*eg* in both tape and disc players). Usually measured in combination with *Wow*.

Frequency: The rate of a cyclic (repeated) vibration. Those occurring in the audio band, at rates between say 20 and 20,000 vibrations per second, produce tones whose pitch corresponds to the frequency.

Frequency response: Abbreviated from amplitude/frequency response, this prime graphical measurement examines whether all frequencies across the spectrum are reproduced or generated at the same relative level.

Frequency range or spectrum: A continuous inclusive group of frequencies.

HF: High Frequencies; the treble end of the audio band, musically consisting largely of harmonics.

Hz: Hertz=cycles per second; the measure of frequency.

Harmonic: Harmonics are the whole number multiples of a base frequency called the *fundamental*. No musical instrument makes a single pure tone (except electronically), and the difference between say a piano and a saxophone playing the same note lies in the different proportions of the various harmonics present.

Harmonic distortion: The addition of unwanted harmonics to a signal. Because the structure of music is already rich in harmonics, the audible effects of moderate levels of harmonic distortion are rarely objectionable, but may be evidence of engineering limitations.

Headshell: A pickup cartridge mounting platform that fits at the end of a tonearm. This is usually (though probably undesirably) detachable, many conforming to a standard universal format, though in order to reduce mass there has been a recent increase of non-standard lighter designs.

Hum: Self explanatory and onamatapoeic; caused by interference of mains frequency or harmonics (50Hz etc in UK), perhaps as a result of poor earthing arrangements.

Hum modulation: A measurement which can show relative degrees of stress in power supply regulation and rectification.

IB: Infinite baffle; a speaker enclosure design based on the sealed box; widely used because of its simplicity.

IHF: American Institute of High Fidelity, an important standards body, many of whose recommendations on measurement techniques have been adopted in this book.

IM: Intermodulation. Interference between two or more single frequency tones can cause non-harmonic distortion components such as sum, and difference frequency signals to occur.

Impedance: The measure of an electrical load when using alternating currents as in audio, combining resistance, capacitance and inductance.

Infrasonic: Below audibility, *ie* frequencies below about 20Hz.

Jack plug/socket: Post Office style plug/socket standard, widely used for headphone and microphone connections both in mono and stereo formats.

Kilo- (k-): Prefix for units meaning $\times 1000$ (*eg* 1kHz= 1000Hz).

LED: Light Emitting Diode; an indicator light.

LF: Low frequencies; the bass end of the audio frequency range.

LW: Long wave; a poor quality AM transmission band; UK Radio 4 is sometimes only obtainable on LW during the daytime!

Level: Size, amplitude or loudness of a signal.

Limiter: Electrical circuit designed to pre-empt possible overloading by signal peaks by reducing their amplitude when necessary.

'Loudness': An equalisation circuit frequency switchable on amplifiers which is designed to compensate for presumed hearing characteristics at low listening levels by boosting bass and treble.

Load: The impedance presented by a component to an electrical signal.

Medium wave: An AM transmission band incapable of high fidelity signals.

Micro- (u-): Prefix for units meaning one millionth of (*eg* seconds, farads).

Midrange: The middle part of the audio frequency band.

Milli- (m-): Prefix for units meaning one thousandth of (*eg* volts, etc.).

Modulation: An alternating (*eg* audio) signal.

Mono: Single channel signal; should give a single central image when reproduced through both channels of a stereo system.

Moving-coil (m-c): Type of transducer, used in some cartridges and widely in loudspeaker drive units.

Moving-magnet (m-m): Type of transducer widely used in cartridges.

Multiplex: An encoding system that allows the transmission of two or more separate signals on a single carrier, whereby stereo FM broadcasts are transmitted; a *multiplex filter* removes the pilot tones after decoding to avoid frequency interference.

Muting: Muting circuitry is fitted to FM tuners to cut out interstation hiss and weak stations, making it easier to find the

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strong signals which come through above the *muting threshold.*

Noise: Random unwanted low level signals generated fundamentally through thermal excitation on the molecular level. Poor system design may make it intrusive.

Octave: An octave is a range of frequencies in which the highest has twice the frequency of the lowest. One octave therefore covers frequencies between 50Hz and 100Hz, and similarly between 10kHz and 20kHz.

Ohm (also *eg* kohm): measure of the load presented by a device to an electrical source.

Offset angle: The angle that the line of the pickup cartridge/cantilever makes with the line joining the stylus and horizontal pivots of the tonearm; this must be set very precisely to minimise tracking error distortions.

Peak: The point of greatest amplitude of a signal; being extreme cases, these can cause trouble in all signal media.

Phase: Signals of the same frequency that are 'in phase' are those which are 'in step', so that their combination results in a larger signal; 'out of phase' signals of the same frequency will cause partial or total cancellation when added.

Phono: The most commonly used plug/socket combination in audio components.

Pilot tone: The 19kHz signal in a stereo FM broadcast which activates the stereo decoder; carries L—R signal.

Playing weight: See *Downforce* (also *Tracking weight*).

Port: The opening in the enclosure needed for reflex loading a loudspeaker; hence a 'ported enclosure'.

Power amplifier: The part of an amplifier that provides power to drive the loudspeakers; usually integrated it is sometimes a separate component.

Pre-amplifier: The part of an amplifier that accepts the input signals, sorts them, applies any necessary equalisation, and then passes the signal to the (normally integral) power amplifiers.

Pre-emphasis: A form of equalisation applied to a source signal which is then de-emphasised by the signal source, consequently improving the S/N ratio.

Presence: Area of frequency band in upper mid/lower treble which emphasises any forward quality in the human voice.

'Q': 1) A measure of the characteristics of a resonance.
2) A measure of sound distribution pattern around a loudspeaker.

RF: Radio Frequencies.

RIAA: Strictly speaking the Record Industry Association of America. This has set down standards for the pre- and de-emphasis for disc recording and replay which are universally adhered to.

Reflex: A form of loudspeaker enclosure design that includes a ported opening tuned to the drive unit and enclosure characteristics.

Resonance: A condition whereby energy is stored in a mechanical or electrical system over a particular range of frequencies, giving rise to unwanted colorations.

Ringing: Describes the effects of a resonance at HF, the energy storage causing a single note or harmonics to continue 'ringing' onamatapoeically after the drive signal ceases.

Rumble: Spurious signals at LF caused by turntables.

SW: Short Wave; AM transmission bands rarely used by commercial radio stations.

Sealed Box: Loudspeaker enclosure design also known as an *Infinite Baffle.*

Selectivity: The ability of a tuner to discriminate against unwanted signals transmitting on frequencies near to a wanted one. Increasing selectivity beyond a certain point degrades the audio quality, so the more sophisticated designs sometimes offer different degrees of switchable sensitivity.

Sensitivity: The amount of signal input required to generate a specified signal level output, or *vice-versa.*

Separation: The independence of one stereo channel from the other, effectively the same as *crosstalk.*

Sidethrust: see *Bias Compensation.*

Signal-to-noise, signal/noise, S/N: The difference in total output when an applied signal is removed.

Subsonic: Below audibility; signals below 20Hz.

Trackability: The ability of a record player (and the cartridge in particular) to cope with extremely high signal levels.

Tracking weight: see *Downforce* (also *Playing weight*).

Transducer: A component which converts energy from one form to another (*eg* pickup cartridge, loudspeaker).

Transient: Signal of very short duration.

Tweeter: Loudspeaker drive unit designed to operate over the HF part of the audio band.

Ultrasonic: Signals above audibility (*ie* 20kHz and above).

VU: Volume unit; a specified meter reaction time, the specification being rarely adhered to on domestic cassette decks. So-called VU-meters are frequently too slow in reaction to be really useful.

Vibration Breakthrough: A measure of a record player's susceptibility to structure-borne feedback effects.

Volt: A measure of the amplitude of a signal in electrical form.

Watt: A measure of electrical power, combining the voltage (amplitude) with the current required to drive the 'motor' of a loudspeaker.

Weighting: Derived from psycho-acoustic or engineering considerations, this is a bias applied to a test method to improve its subjective relevance (hence also *unweighted*).

Woofer: LF loudspeaker drive unit.

Wow: Medium-term pitch changes resulting from speed fluctuations in cassette or disc drive mechanism (see also *flutter*).

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
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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

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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%

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