

HI-FI CHOICE

AMPLIFIERS

**The most comprehensive guide to buying
amplifiers ever published.**



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the beginning!

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HI FI CHOICE No. 25

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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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HOW TO USE THIS BOOK

This book follows the format we have developed over the years in the *Choice* series, so regular readers should have no difficulty in finding their way around; for the newcomer, the book is divided up for convenience into a number of sections. First is a short *Editorial Introduction*, which is an opportunity to explain the reasons behind some of the decisions made concerning the project as a whole, and also make a few excuses for the products that have been left out!

The *Consumer's Introduction* is an attempt to discuss many of the different aspects of amplifiers and their performance in non-technical language that is as jargon-free as possible. The first section examines the evolution of the amplifier over the years, which gives an interesting perspective on today's designs. The second section examines the role of the amplifier itself in rather more detail, discussing the necessities and the 'frills', the matching and the design requirements. The third section discusses the review procedure itself, explaining what we have done and why we have done it; the various technical parameters found in the reviews themselves are explained (albeit less than rigorously), and some of their implications examined. The fourth section suggests the criteria a would-be purchaser should bear in mind when considering buying an amp, together with a few words of advice on what not to do when he has bought it! The *Technical Introduction*, freed from constraints of avoiding technicalities, explains in some detail the test procedures adopted and their rationale.

The *Reviews* themselves provide a straightforward written description of the various amplifiers, conveniently grouped under subheadings which discuss the design itself, its lab performance, the results of our listening tests, and a general summing-up. Each report is accompanied by selected data from our tests to enable the product's compatibility with other components to be established, and the basis of our judgements to be examined.

The *Conclusions* looks in retrospect at the overall findings of the project, discussing such trends as may have been established, while the *Best Buys and Recommendations* highlights those products that have performed particularly well, both in absolute terms, but specifically in relation to their price.

The *Overall Comparison Chart* is another summary section, which presents a selection of the

data obtained for each amplifier in tabular form, to enable the would-be purchaser to easily short-list models that best meet his or her specific requirements.

We should point out that there are dangers in ignoring the detailed parts of the book and merely relying upon the summaries. If we felt that some sections of the book were unnecessary, we wouldn't have gone to the trouble and expense of writing and publishing them! A summary always leaves a lot unsaid, and if relied upon can be misleading. They are published because they are a useful way of presenting our findings accessibly, but amplifier reviewing does not readily lend itself to the 'pithy one-word characterisation', and the summaries should not be regarded as substitutes for the reviews themselves.

The JVC guide to



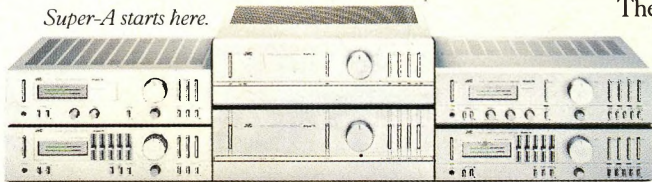
Super-A sound.

Or the undiluted truth about amplifiers.

Super-A isn't just a name we've produced because we think it sounds superior. It's the name that actually applies to the superior sound we can produce.

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At JVC's Audio Engineering Research Centre we saw the way to obtain the best of both worlds. So we went to work on a unique *variable* bias circuit.

Super-A...the 'cool' amp.

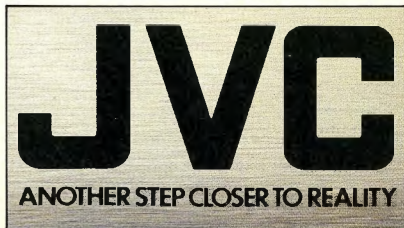
The all new Super-A amp has an active bias-control circuit to adjust the bias current as the output level varies. This prevents the power transistors from switching completely off by providing a minimum bias when there's no signal present for the transistor to amplify.

integrated amplifier on the market. The Super-A eliminates all trace of switching distortion. Indeed distortion is as low as 0.0005% at 1k Hz at rated output, because the transistors do not switch on and off.

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EDITORIAL INTRODUCTION

This is the third occasion on which Dave Watson and I have had the temerity to tackle amplification on this scale. It is still a horribly difficult job, and we are well aware of our limitations. But with the benefit of some hindsight the long term consistency appears to be quite good, so we continue to have some confidence in our findings.

There was a certain amount of controversy when Dave and I originally teamed up to produce this title in the series (at a time when few people acknowledged differences in amplifier sound quality), because his retail involvement was considered a possible basis for bias by the paranoid. (Anyone who has actually *done a Hi-Fi Choice* will know that you don't actually have time to be biased.) But for this reason we have continued to exclude Naim and Nytech, because their historical association with his shop is quite close. However the findings of this volume should completely eradicate any such fears, because a couple of years ago Dave's shop and Technics parted company. Soon afterwards he took on Sansui; such is life! (In fact I'm the one who should be feeling embarrassed, because I was taken to Japan by Technics earlier this year, so I'll just have to go again with Sony this Autumn to preserve the balance.)

To say that we are quite free of bias is of course utterly ridiculous, and certainly our basic attitudes are bound to be reflected in the book (as are any author's). However I do hope and believe that we succeed in preventing favouritism for particular products from entering into the findings. Indeed it could be that we are over-critical of the audiophile oriented products in some sort of compensation; certainly as a group they did not do quite as well as I might personally have hoped.

Following the success of the recent *Turntable and Tonearm* edition, we made a particular effort to include rather more 'top end' equipment than we have tackled in the past, on the grounds that a person who purchases a book devoted to amplifiers treats them rather more seriously than the typical rack system purchaser, and is therefore interested in the complete gamut of products available. It remains a very difficult problem to hold the £70 and the £700 amplifier in the same perspective (and perhaps it is not even valid to try).

There is the usual roster of absent friends due to model range changes (in the mass market), and an unwillingness to supply amongst some of the specialist manufacturers (or perhaps they just didn't get it together in time, or I didn't chase them hard enough). But the inclusions are pretty

comprehensive, and we certainly didn't have room for many more. We have reprinted the findings for five models from *Receivers, Tuners, and Amplifiers*, removing the tuner references, and five other important models have been fully re-tested (A&R, Meridians, NAD 3020, Revox).

One gripe at any of the manufacturers who bother to read this is that the manuals leave quite a lot to be desired. With a few notable exceptions, these seem to talk down to the purchaser in a most condescending way, along the lines: "Thank you for your good taste in buying our amplifier, this is how to put a plug on, here is the volume control and so on, now go ahead and enjoy yourselves". There is very little attempt to help the purchaser to get the best out of the product, via choice of loudspeaker cables, cartridge matching and all the interface conditions which affect the amplifier and the system performance. (Congratulations to Paul and Stan of PS Audio for their efforts in this direction.) All in all though this does seem an appalling waste of an opportunity to really help the purchaser to get the best out of a product.

There is no point in going over the same ground as the *Conclusions*, and maybe its just the 'post natal depression' of finishing one of these projects. But I cannot see that amplifier design has improved very much over the years, which is a pity. Its nice to see lots of moving-coil inputs around (saving money on expensive step up devices), and ergonomics and prices do show slight improvements. But sound quality improvements are still happening largely at the turntable/arm/cartridge and loudspeaker ends of the chain. I suppose I am also a little disappointed that we haven't yet managed to find a really good objective indicator of subjective performance. But then I have been looking for those in all categories for five years now, with only limited success! Never mind, we still have plenty of pipe dreams!

Finally I should like to express my thanks to all those who gave up their time and risked their sanity assisting with the listening tests. In no particular order or star sign: Adrian, John, Alvin, Roy, John, Alan, Mike, Ian, Julian, Norman, Paul and Ian.

Paul Messenger

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

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We call it Linear Feedback.

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We've now put theory into practice by incorporating Linear Feedback into our 80 watts per channel SU-V7 amp.

To hear its pure clarity is a positive revelation.

The perfect match

Of course, the perfect power source needs the ideal input.

May we suggest our ST-S6

quartz synthesizer tuner as the perfect match?

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Naturally you'd expect features like auto-scan tuning and random access memory for pre-tuning.

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But how about a multi



THE WHOLE TRUTH BUT THE TRUTH

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Or a 25 kHz signal instead of the usual 5 kHz to avoid noise problems?

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Technics

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In brief, HX Professional is a new recording system developed by Bang & Olufsen in co-operation with the Dolby Laboratories. It is featured in the new Beocord 8002 cassette deck and works with the deck's advanced recording control functions to give disc-quality recordings and reproduction with ALL types of tape – not just expensive metal tapes.

The Beocord 8002 Design Story, including details of HX Professional, is available on request. For your free copy write to

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Bang & Olufsen

THE DEVELOPMENT OF THE AMPLIFIER

Taking a historical perspective can give insight into the way things are today, particularly when change has been as rapid and as sweeping as hi-fi has seen over the past thirty or so years. If one were to step back thirty years, the current hi-fi user would be baffled and bewildered by the resources at his disposal, as neither the micro-groove (LP) record, FM radio, nor tape recorder were domestically established. What sources were available were strictly mono, and naturally required the services of an amplifier and loud-speaker to make themselves heard. Hi-fi in those days was very much a technical hobby, frequently appealing to the same sort of person as did amateur radio. And with no real shops as such, the chances were that apparatus was almost entirely home-built often using the components that were readily available from the government surplus stores that gathered in areas like Tottenham Court Road.

As often as not, the most famous designs of this period were just that: printed details of circuit configurations that originated from the valve manufacturers or legendary engineers such as D.N.T. Williamson. One first collected together the components and then settled down to assemble the design oneself; indeed, since much of the 'art' in valve amplifier design was vested in the construction of the output transformers, the transformer manufacturers were probably better known than those who assembled complete amplifiers. The finished units tended to be extremely heavy and bulky, and were therefore usually left in their constituent parts rather than 'integrated'. So one would frequently find separate chassis for pre-amp, power amplifier and power supply sections; as the pre-amp is the only part to which one normally requires access, the bulkier parts could be mounted out of sight and mind in a convenient cupboard.

So, in those early days hi-fi was substantially a hobbyist market, with much of the apparatus home-constructed by people who had a fair amount of technical knowledge, and who were also prepared to accept or impose standards of domestic acceptability that would be unusual in the majority of homes. Even though the amplifiers were comparatively low-powered and mono only, they were big, cumbersome and very heavy, requiring careful housing because of the plentiful heat produced. The high temperatures and attendant heating and cooling also reduced component life and reliability.

Over the years size was gradually reduced as

advances were made in transformer and circuit design. The advent of stereo in the 'fifties' was a major setback to the 'domestication' of the amplifier, because most of the circuitry and components needed to be doubled up. By this time most designs consisted of two units: the power amplifier/power supply, and the pre-amp, the latter drawing its power *via* an 'umbilical cord' from the main power amplifier. There was little point in doubling up on everything for stereo, unless one was merely adding to an existing system, so the normal practice became either to control two mono power amplifiers from a single stereo pre-amp, or alternatively use a stereo power amplifier, so that both channels could share a common power supply for economy. Keeping pre-and power amplifiers separate remained *de rigeur* for the 'serious' enthusiast, as indeed it does today. But at the popular end of the market there was a move towards total integration, which was made possible by smaller transformers, modest power outputs, and improved circuit efficiency, though not without some compromises or design difficulties.

The Transistor appears

So about twenty years ago the amplifier still used valves, but had become sufficiently compact that a stereo model would typically occupy less space than the mono equivalent of a decade earlier. The market as a whole had grown considerably, with the improvements in discs and the introduction of FM radio, so that manufactured product overtook the home-constructed type in importance.

One part of the development of hi-fi which receives little attention is that until very recently the industry carried little commercial 'clout', and was not important enough to warrant the high cost of, for example, developing purpose-designed electronic components. Most of the devices used were the crumbs from the table of larger electronics concerns, such as radio, military, or telecommunications. These would be adapted to hi-fi use by the ingenuity of the designers, but longterm developments remained somewhat dependent on the opportunities afforded by the available devices.

When the transistor was invented in 1948, it was in no way suitable for analogue or digital audio use, being fundamentally no more than a convenient electronic switch. However, switches are of great importance to the electronic industry as a whole, and its potential for reliability, longevity, simplicity of mass production, and low voltage operation, were sufficient to divert nearly

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

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

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

It's a Mitsubishi



all research away from thermionics (valves). Indeed at the end of the 'forties prototypes existed of a low voltage 'cold' valve, which might have heralded a whole new generation of thermionics, with probably far reaching effects for audio had not the transistor appeared at about the same time and usurped the development money.

It was the mid 'sixties before the transistor really became a force to be reckoned with in the hi-fi market; fifteen years on it is still scorned by many die-hard enthusiasts! It is probably fair to say that the early transistor amps were introduced rather prematurely, and did not offer the sound quality of a similar valve amp. By the end of the 'sixties they were beginning to come of age, and by the middle 'seventies had achieved a maturity that at least places them on an even footing with valves, while offering a lot of other advantages besides. The early transistor amps achieved a degree of commercial success far beyond what their audio potential deserved, primarily because of inbuilt advantages that soon made them cheaper as well as domestically more acceptable than valves.

First and foremost the transistor amp runs comparatively cool, so the extremes of temperature which the valve shares with the light bulb, and which reduces its working life compared to the transistor or fluorescent tube, were absent. While assisting reliability, this also allows greater flexibility in siting the amplifier with the reduced weight and need for ventilation, and this is very useful in a family situation. Secondly the transistor amp is more compact and cheaper to make than the equivalent valve amp, particularly when comparing power for power, mainly because output transformers need no longer be used. Consequently the Leak Stereo 30 transistorised integrated amplifier was very little larger than Leak's valve stereo pre-amp which was being manufactured at the same time, and which needed to be used with bulky power amplifiers; similarly the Quad 303, a 45 watt per channel stereo transistorised power amplifier was similar in size and lighter than each of the two 15 watt mono power amps it replaced. Thirdly, the transistor amplifier arrived about the same time that the low-output magnetic cartridge had established a firm foothold, and in the mid 'sixties the transistor amplifier caused less hum and noise problems here than the valve equivalent. Finally, the transistor was less subject to the gradual ageing process that always plagued valve designs, and by and large would not change its performance as much over a period of time.

While both manufacturers and customers rushed headlong into the transistor age, hindsight might suggest that this was a case of the deaf leading the deaf. Although it was possible to 'prove' the superiority of the transistor amplifier on paper, many designers had overlooked many implications of the sweeping changes they were making whilst embracing this whole new way of doing things. Remember the valve amplifier was the result of decades of careful, painstaking development, so it was perhaps inevitable that the new technology would have its teething problems. It must nevertheless remain something of a tribute to the persuasiveness of marketing techniques that transistors became established so quickly and with such little fuss — we were after all basking in the 'white heat of technological revolution' around that time, and had already finished 'never having had it so good'.

This is not intended as a panagraic against transistors, as I am a happy user of transistor power myself, while quite freely admitting that certain valve designs remain high on my list of personal favourites. It is intended to illustrate the unfortunate way that fashion and attendant commercial pressures tend to dominate the hi-fi markets, and can work against rather than in favour of the consumer. It is an interesting fact that on the whole the 'breakthrough' in technology usually acts *against* the best interests of the user first time around, because many of the attendant problems are only partly overcome. The second and third generations usually turn out to be far safer bets, particularly as the reduction in fashion status usually also results in a lower price!

Undoubtedly one of the reasons that the transistor gained its foothold so quickly was that it appeared to offer superior power at reduced price. This was true under test bench conditions, but it was many years before it became accepted that the 'real' conditions of music signal and loudspeaker drive gave the valve amp certain compensatory advantages, particularly when driving near the overload limit, and that the transistor amp probably needed to be twice the power of its valve equivalent in lab terms to avoid running into its potentially rather nastier overload problems.

(This unfortunate state of affairs seems likely to repeat itself in the imminent changeover to digital disc systems. These have been developed according to specifications which seemed adequate by analogue standards, but early experience suggests that the best analogue is

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

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still superior in certain important ways. History seems determined to do its usual repeating trick!)

Even though some diehard enthusiasts might disagree, from the point of view of mass market audio the transistor amp was a godsend. And even though the initial steps may have been a little faltering, the end result has been to spread hi-fi to a far wider audience at reduced cost. There is no doubt that if even a big manufacturer was to mass produce valve designs in large quantities today there would be a significant cost penalty of at least 50% compared to an 'equivalent' transistor model.

The amplifier receives a rival

At around the time that the integrated transistor amplifier was gaining a foothold, another form of integrated unit known as a receiver was also starting to appear in the UK, effectively combining an integrated amplifier with a tuner. This combination went from strength to strength commercially, because of its benefits in extra compactness and a saving of about 20% over equivalent separate tuner and amplifier combinations (costs saved on power supply, transport and case etc), despite some penalty in flexibility. The decision to go for a receiver instead of an amplifier will depend largely on how important radio is as a signal source, and this in turn may well depend on the area in which the purchaser lives: the shot in the arm of the receiver market generated by the introduction of stereo radio in the late sixties must have to some extent been dissipated by the current poor financial situation at the BBC where radio has obviously been forced to play second fiddle to TV.

The receiver has certain limitations in flexibility. First if one decides to improve either amplifier or tuner, it is necessary to change both at once. Secondly one has no control over the proportions in which the money has been spent; this equation has already been handled by the manufacturers. So if you decide you want a really powerful or high quality amplifier section, it is invariably necessary to purchase a 'state-of-the-art' tuner section to go with it, and if this is not desired the receiver may prove a false economy. Finally, while it is true that one or two specialist receiver manufacturers produce machines with amplifiers that stand up to the better separate combinations, the manufacturer who operates in both markets normally pays rather greater attention to the separate component — not a hard and fast rule, but a general indication of attitudes and priorities. Although there is very

little apparent justification, receivers do tend to get tainted by the 'jack of all trades, master of none' syndrome which, taken to its logical conclusion, makes such a mess out of music centres.

The last decade

So we arrive at the beginning of the 'seventies with hi-fi sales booming like never before (or since!), almost total transistorisation, a handful of separate pre- and power amp combinations and rather more integrated designs available, plus of course a burgeoning of receivers. The quality of the actual electronic devices continues to improve and/or get cheaper, but most of the changes that are taking place are more at the dictates of fashion and marketing than any particular desire to improve the breed.

With a strong home market, domestic manufacturers introduced a number of imaginative and refined designs which continued to stress compactness, but the market as a whole seemed to equate size with potency, and increasing compactness beyond a certain point gave rise to diminishing commercial returns. The first major trend, inspired by the steadily increasing numbers of imported products, was to make the preamplifier section (controls etc) more and more complicated. Around the same time loudspeakers were tending to become less efficient, and required increased amplifier power, so something of a power race also began.

The major market expansion occurred in the first part of the 'seventies, under a favourable climate for increased imports from Japan, which then still experienced very fortunate trading conditions, due in part to exchange and labour rates. Most of the UK companies in the hi-fi market were still comparatively small, specialising in hi-fi, while the larger UK Consumer Electronics companies, which were active in the radio and TV markets, seemed curiously reluctant to take the hi-fi market seriously. So with one or two exceptions (Goodmans/Thorn, Leak/Rank) there was little spare production capacity amongst the existing manufacturers to cope with a big increase in demand.

The Japanese electronics industry, already large from its international transistor radio successes, found that their domestic consumer was an avid purchaser of hi-fi equipment. The reasons for the Japanese home market strength have never been fully explained, although the difficulties in aspiring to home ownership must assist in fuelling the consumer economy, and a bi-annual productivity bonus scheme also assists in creating demand for pricey consumer durables.

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Whatever the reasons, the Japanese home market is estimated to be a similar size to the US market or the whole of Western Europe, so naturally the scale of operations is enormous, and enables the industry to respond quickly to specific local changes in demand anywhere in the world.

It is easy to see how the Japanese made strong inroads into the UK market in the early seventies: less perhaps on the basis of technical or sound superiority than due to a reputation for excellent reliability and a marketing professionalism which appealed to the less technical hi-fi dealer who was now appearing. It is not as immediately apparent why they have achieved *such* a dominant position at the expense of many UK manufacturers, until one recalls a characteristically crass piece of tax legislation perpetrated by Chancellor Healey in the mid seventies, as a deflationary measure in the middle of a consumer boom. The decision to raise the VAT rate on luxury goods, including electronics, to 25% was probably necessary; the decision to announce the measures and then allow a month period of grace before they came into effect was a piece of fiscal lunacy from which the market has never really recovered. During the month's 'period of grace' it is estimated that approximately twelve months of normal business was done by the harassed retailer. There was no way that the domestic manufacturers could hope to meet this twelvefold increase in demand, and some merely acquired a reputation for poor reliability in attempting to do so. Instead retailers accepted money for goods that hadn't even left the Japanese factories, and most importers emptied their European warehouses (one bringing in goods at the rate of three containers a day.) This extraordinary route to a tax increase pre-empted the best part of a year's business, and it is hardly surprising that the slump which followed almost wiped out the home market, sending many retailers to the wall and killing off several manufacturers who were insufficiently established in export markets to cushion the blow. While the importers themselves also suffered to some degree in the aftermath, the slump carried barely a ripple back to the giant Japanese manufacturing plants, because for them it was both a distant and an isolated event.

In the wake of this boom/slump the Japanese have asserted an even more dominant influence on the market. However, a number of healthy new small-scale home manufacturers have replaced those that disappeared, building upon the fragmentation that is the latest and current

market trend. By this I mean that the market has split into different camps. Some consumers are following the trend towards greater complexity that was established at the start of the seventies and which was to achieve its zenith in the quadrophonic *debâcle* of the mid-seventies (about which the least said the better). Others, perhaps in reaction against this overt consumerism, but also because it is increasingly accepted that the simpler the signal path the better the attainable quality, have opted to go the other way entirely, even to the exclusion of tone controls. This trend towards simplicity is by no means just a British phenomenon, and similar trends exist in America and Japan. Neither does it appear to be short-lived, because the approach is now being reflected in the more 'exclusive' products from the major volume manufacturers.

Coming right up to date, we have a market that at the same time offers enormous variety between its extremes, while also appearing regimentally conformist in the mass market sector (where sometimes the most obvious difference between products is the maker's name.) There has been a revival of interest in the valve amplifier, as a number of recently introduced models show. Most are as yet only power amps, and in any case have a rather specialist appeal, so we have not included them in this book.

The resources of the Japanese majors and the sheer size of the market has finally enabled companies to devote money to fundamental research for hi-fi ends, resulting in a number of new devices like Sony's and Yamaha's V-FETs, Hitachi's MOSFETs, and Trio and Matsushita's EBTs, components which will presumably be made available to other manufacturers in due course. It is also true to say that the market has never been more controversial, with some companies taking up the stance that there is no real difference between the majority of competently designed amplifiers apart from price, power and facilities, while others claim that the amplifier makes a vital contribution to the overall sound of a system. A more detailed discussion of these contrary positions will be found elsewhere in the book.

Stylistically compactness is now not only acceptable but *de rigeur* in fashion terms, and although they show no signs of ousting conventionally sized components, 'micro' components offer an alternative with no performance sacrifice. In pursuit of the slim line there is greater interest in separate components, though these are usually only sold together as part of a rack system. However the receiver is definitely on the decline and modern amplifiers often emphasise

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THE ROLE OF THE AMPLIFIER

There can be little doubt that the amplifier lies at the heart of the hi-fi system. Lose one of the other components and you probably still have a spare programme source, or a single loudspeaker or headphones through which to listen. But lose the amplifier and the system is silent. The amplifier's job is quite simply to accept signals from a variety of different programme sources, process them as required, and then amplify them sufficiently to drive loudspeakers. So far so good; this is fine as a basic definition, but as soon as one starts to try and define this in engineering terms, controversy begins. Before becoming enmeshed in this, let us look at the sort of things an amplifier is usually capable of doing, why it incorporates these facilities, and what sort of reasoning lies behind their inclusion or exclusion.

Every amplifier consists of three basic 'building blocks', namely the pre-amp, power amplifier and power supplies. These are normally combined together in the same box to make up an integrated amplifier. Some designs, either for technical or fashion reasons, separate these into separate boxes in various configurations, normally with power amplifiers and supplies in one section and the pre-amp in the other, although sometimes power amplifiers and power supplies are further separated.

The pre-amp contains the various signal inputs and their switching circuitry, required processing (eg pickup equalisation) or optional processing (eg tone controls), plus feed signals for tape recorders. Having converted the different input signals to a common and controllable one (eg volume, balance), this signal can then be passed to the power amplifier. The power amplifier's job is to multiply this signal to a sufficient level to drive the loudspeakers, and as a by-product headphones, to the required levels. The power supply or supplies are an integral part of the other components and perhaps should not be considered separately at all; their job is to supply the right amounts of electricity in the right places and at the right time.

The pre-amp: The bare necessities

There are a number of basic functions that every pre-amp section should be capable of carrying out competently. These include being able to accept and correctly process the signals from a variety of programme sources, notably record

player (ie cartridge), tuner, and tape recorder. It should also control the volume level and channel balance and provide a suitable signal to send to a tape recorder for recording a signal received on one of the other inputs. None of these functions are entirely without their problems.

The pickup cartridge input

The pickup input should be designed around the signals it receives from a cartridge. Until recently this was almost invariably a moving magnet type design with a typical output level of 1 mV/cm/sec, responding to the disc modulations in a velocity sensing manner. Understanding those last two technicalities is not really necessary; their implication is that most cartridges produced a similar output from the same record, and that it is necessary to process this output by changing its relative level at different frequencies, because of the way the disc cutting is pre-emphasised to get the information on in the first place. (If this equalisation process was not carried out, the sound would be all top, treble, and tizz, with no bass.) Happily a 'standard' weighting curve exists for this transformation, known as the RIAA equalisation curve, although there is slight controversy regarding the deep bass, and rather more concerning CBS' desire to foist a non-compatible noise reduction system upon all and sundry.

One fly in the disc input ointment has been the recent increase in popularity of the moving-coil cartridge, which normally produces a lot lower voltage output than the moving magnet type, and consequently needs special treatment. (There are a number of 'high output' m-c cartridges about, and these should work normally, but the majority need about 20dB extra gain.) Most manufacturers/importers of m-c cartridges supply step-up devices (transformers and head amps) to match them to the normal amplifier input, but these tend to cost at least £50, which is something of a deterrent. (This high final price is caused by the fact that head-amps need to be self-contained 'mini amplifiers', with their own case and power supply — often batteries.) To build the head amp into the amplifier in the first place, either as an optional extra or as an extra feature, costs very little indeed in manufacturing terms, and is increasingly found amongst the more modern models, including the majority evaluated in this book.

This is not the end of the problems for the pickup input. The very 'nature of the beast' is a mechanical miracle that has no right to work at all, and succeeds in doing so by mechanical

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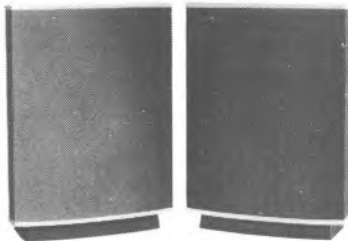
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wizardry that has placed the two major unavoidable 'resonances' outside the audio band. A resonance is, basically, a mechanical loss of control which will be reflected in the electrical output. This is a major difference between the pickup and the other types of signal with which the amplifier is required to deal; namely that neither the bandwidth, nor the behaviour outside the required bandwidth are accurately known or predictable. The pre-amp has to cope with resonances beyond the audio bandwidth in both directions, *ie* infra- and ultrasonic.

Until fairly recently, most moving magnet cartridges incorporated an automatic HF rolloff (due to an electrical filter caused by the resonant interaction of their internal inductance and resistance with the resistance and capacitance of the arm lead and pickup input). For a number of reasons including the flirtation with CD4 quadrophony and the desire to avoid 'messy' compatibility problems, the emergence of low inductance cartridge types came about, including by their very nature the moving-coil types, leaving the ultrasonic band with its tip-mass resonance 'wide open'. The significance of this remains the subject of disagreement among manufacturers and designers, although I have heard of claims that signals of a much higher level than expected and at extremely high frequencies have been measured, and if this is substantiated it may cause some concern.

The pickup input of an amplifier therefore has a number of potential troublespots: it requires heavy equalisation and much more gain than the other inputs, particularly for moving-coil cartridges; certain input parameters are not standardised, and yet can affect the performance of the system; the absolute content of the signal in terms of bandwidth and amplitude is not precisely known, and therefore could cause overload or slew-limiting problems. As the disc is both the most important signal source for the hi-fi user, and also the one most likely to cause problems, we have concentrated on this input in our examination of the amplifier.

The tape input/output

The tape recorder must be connected to the amplifier so that it can replay tapes *via* the system, but also so that it can record any of the signals being processed by the amplifier from other inputs, such as tuner or disc. The situation is made rather tricky by the fact that there are two international standards which are not really compatible with one another. One is based on the German DIN standard and is used by many

European manufacturers, while the other uses the so-called 'phono' plug and socket, and has been adopted by American and Japanese manufacturers. Both systems have advantages and disadvantages, and there is little likelihood of problems when sticking to one or the other. But it is a fact that there are very few cassette recorders using the DIN standard compared to the 'phono-oriented' Japanese models in the marketplace, and in many Japanese machines the DIN socket tends to be something of an afterthought.

The DIN socket does have some advantages over the phono in terms of its engineering, convenience and compactness, so some (predominantly British) manufacturers use DIN connectors for these benefits, but accepting the reality of the market place wire them to phono level standards. While some might condemn this practice on the grounds that standards are set to be kept, their defence that they are making the best of a pretty bad job is perhaps valid. Nevertheless this does make it extremely difficult to quote glib rules concerning absolute compatibility between types of connector, and the reader is advised to consult the individual reviews in this and our companion volumes, or rely on the integrity and guarantee of a good dealer, to ensure prospective purchases match each other properly.

As most available tape machines are best used *via* phono sockets, and most amplifiers are equipped with phono sockets or DINs masquerading as phonos, the following basic matching rules may prove useful: for 'phono' standards, signals prefer to travel from one impedance to a similar or larger impedance (up to say 100X), while the sensitivity of an input should be similar or somewhat less than the output level that it is being fed, though this output level must never exceed the input's clipping point (which proved to be greater than 10 volts for nearly all the amplifiers tested, which is more than adequate). The overall rule must be to use phono-to-phono or DIN-to-DIN except where the DIN is a 'disguised phono' (see reviews, comparison chart). Fortunately there is usually sufficient leeway built into both tape machines and amplifiers by virtue of their various gain controls that serious practical problems are rarely encountered.

The tape selector on an amplifier is usually fitted to a different switch than the main input selector in order to take advantage of off-tape monitoring, which is offered by many reel-to-reel and some of the more expensive cassette decks. This means that the pre-amp continues to handle



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input from disc or tuner, processing and sending this signal to the tape deck, while the power amp section of the amplifier (and the later stages of the pre-amp) can be switched independently between this 'source' and the tape inputs. Tape recorders which have separate record and replay heads (ie three-head machines) can replay a signal that they are recording almost simultaneously, so the user can make instant comparisons between the signal that he wishes to record and the recording that he is making, which is an extremely useful way of ensuring that no problems are being encountered.

More complex facilities for tape deck connection will be described later in the consumer introduction.

Other essential inputs

In addition to providing for disc and tape connection, a tuner input is an essential. In fact this is normally the same as the tape replay sockets, because the signal from a tuner is typically the same as that from a tape recorder (although of course no 'record' signal need be sent from the amplifier.) Most amplifiers include more than one socket of this type, to facilitate connection of such devices as television audio tuners and transistor radios (to cover wavebands not provided on the system tuner.) Duplicate tape in/out sockets also may be provided, and this enables signal processors such as graphic equalisers and noise reduction systems to be easily connected.

The Volume control

The most important control on the pre-amplifier adjusts the volume level, so it is ergonomically desirable that it is easily accessible and readily identifiable. It is also important that the volume can be adjusted over a very wide range, without significant shifts in channel balance. A curious myth seems to have spread amongst those who normally have little to do with hi-fi, to the effect that the power of an amplifier is in some way related to how far round the scale the volume control needs to be for normal listening levels; I have even encountered people who have criticised an amplifier for needing to have the volume control above halfway! If an amplifier has already reached the point of delivering full power from a typical signal when the volume control is only halfway, increasing it will only drive the system into distortion, and therefore the second half of its travel is entirely wasted; the usable part of the range becomes unnecessarily cramped, and a small movement results in an undesirably

large 'jump' in volume.

The ideal volume control should cover a range of at least 60dB evenly, so that similar sized rotational steps result in similar sized changes in volume. Many of the potentiometers used for audio volume controls can manage fine at the higher volumes, but are frequently too sensitive at the lower levels, so that a slight movement gives too large a change for accurate setting; moreover this can give problems in maintaining accurate channel balance at these low levels. It was fashionable until recently to use volume controls which mimic the action of professionally used 'attenuators', so that their operation consists of a series of steps. This often makes problems of low level volume setting rather worse, though happily the trend is now reversing.

One useful technique that is often used to extend the operating range of a potentiometer is to combine it with a switchable attenuator that offers one or two positions of muting or quieting, typically subtracting 20dB from the operating level. As well as helping to 'stretch' the low level area of control, this feature is quite handy when, for example, answering a telephone or addressing a spouse. The mute switch is therefore a useful part of a volume control, although its greatest benefit will be conferred when the volume potentiometer itself is a fairly cheap device; a really good full range control (necessarily expensive) renders it much less necessary.

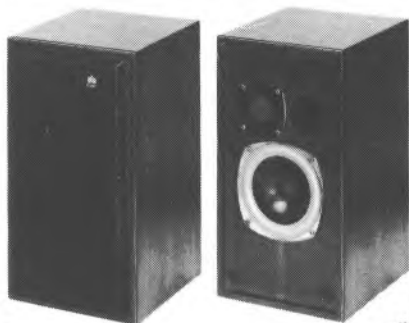
The balance control

The final essential control is the balance control, which is I suppose the fundamental distinction between mono and stereo pre-amps. This is required to adjust the channel balance, that is the relative loudness of the two channels, which can be necessary for a number of reasons. In fact the balance control is not likely to be needed very often, but is important when it is needed. Its uses include compensating (more or less) for an off-centre stereo listening seat, or making some allowance for speakers which are not the same distance from the listener; compensating for a poor output match between the two channels of a stereo cartridge or two loudspeakers with slightly different sensitivities; compensating for volume control 'mistracking', ie channel balance shifts at different volume levels.

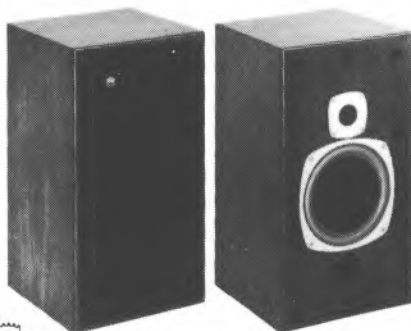
Most balance controls are able to quieten completely one or other of the channels at their extremes of travel, which can be useful when checking for system faults or for correcting potentiometer mistracking at extremely low levels. A great many balance controls are also

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fitted with a centre-indent knob, *ie* one that 'clicks' at the centre position; this is largely unnecessary unless the equipment is so sited or designed as to make visual identification difficult. (It could be argued that the balance control should be set by ear and should not be calibrated at all, as this can psychologically pressure the individual into using the centre position when it is inappropriate. But unless the pre-amp is sited near the listening seat, it can be difficult to set an uncalibrated control by ear alone.)

OTHER FEATURES AND FACILITIES:

'Mode' switching

The simple stereo/mono switch must count as the most useful of the 'inessentials', and indeed some would regard it as essential, especially for playing old mono recordings, as it reduces the background noise level (especially low frequency 'rumble' effects) without sacrificing any of the music. Other frequently provided 'mode' switch positions include left and right hand channels alone, plus a 'reverse' position which swops left and right stereo channels — a convenience only really useful if the system has been wired up with the channels reversed somewhere in the chain. Most of these 'mode' switching positions can be useful in fault checking, but the more complicated they become, the harder it can be to check for a specific fault, as the complexity of combination can become confusing.

Other inputs/outputs

In addition to those basic facilities mentioned in *The bare necessities*, and the power amp outputs that will be discussed in the power amp section, amplifier manufacturers frequently offer a number of other inputs and outputs to increase the versatility of their machinery. The value of these will depend very much on the complexity of the installation in which the amp is to be used. The switching for connecting tape recorders or extra inputs are available as accessories which can be added later if desired, so those who may be concerned about the future expansion of their system, and hence the provision of unnecessary amplifier inputs, really have very little to worry about.

A few models include a front-mounted jack socket for connecting a microphone. The only real purpose appears to be to enable the user to play DJ at a party or on tape. As this has little to do with hi-fi as we perceive it, we have paid little attention to this facility. Those who wish to use

mikes in conjunction with tape recording will find such a facility available on the tape deck; this can usually be switched to give output through amp and loudspeakers direct if required. The mike socket on an amplifier usually does offer a mono 'mixing' facility that the tape decks frequently do not (would-be DJs please note). But they by no means offer the versatile mixing facilities required by the serious home recordist, which is better satisfied by the accessory mixer units that can be obtained.

At first sight the most confusing switching must be that employed to connect and cross-connect two tape recorders. And when one considers how few people are actually likely to own two tape recorders, let alone record ('dub') from one to the other or *vice-versa*, their widespread inclusion seems rather unnecessary. I suppose the real reason is that the addition of such a feature is quite cheap, but the extra five-position function sacrifices as much in ease-of-use as it gains in versatility. Some manufacturers provide one of the tape sockets on the front panel, so that one can easily connect a friend's tape recorder into the system without creating mayhem amongst the rear wiring arrangements. This would seem an admirably sensible arrangement, because there is no doubt that cassette tapes usually replay best on the machine on which they have been recorded. So if a friend wishes to pillage your collection of rare non-copyright material, he'll probably get the best results by bringing his own recorder along for the evening.

A method of switching which allows the signal being sent to the recorder to be different from the one which is being replayed *via* the loudspeakers might be useful. This has parallels with the way a video recorder allows one to record a second channel while watching the first, and could be useful as a 'time-stretch' mechanism, enabling one to remain independent of the radio schedules while using the hi-fi as one pleases. One could therefore play records while simultaneously capturing a desired radio broadcast on tape, or monitor a long radio programme while using the hi-fi for record playing, and then find a desired extract at a later time without having to go through the whole programme (*ie* by using the fast winding and search capabilities of the recorder.) I imagine this facility might be quite attractive to those who build up a large library of recordings from the radio, although it is hardly an impossible feat to by-pass the amp and connect recorder and tuner directly to one another when the occasion demands! If one wished to listen to the radio while (probably illegally) recording

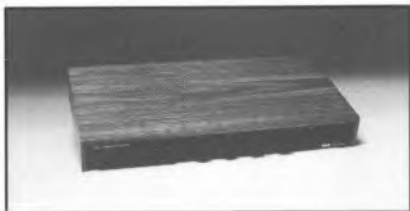
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discs, however, this switching arrangement would be essential.

The final input/output that is sometimes fitted to the more expensive integrated amplifiers is a 'break-point' between pre- and power amp sections. These usually comprise two sets of phono sockets, either physically and electrically connected by metal rods, or controlled via an adjacent switch. This allows the integrated amp to be regarded as a separate pre-/power combination in all but siting flexibility, with the possible advantage that certain accessories can be inserted between pre-and power amp stages if desired.

The items that might be inserted between the amp stages include graphic equalisers, which are very popular in the US but never seem to have captured the consumer's imagination (or ears?) in Britain. Another device that has proved popular in the US but is very much in its infancy in the UK is the 'add-on' subwoofer system, which can be driven directly from the loudspeaker terminals, but in practice usually works better if it incorporates its own power amp, and this in turn requires pre-amp feed and usually some form of electronic crossover. One system approach that requires a pre-/power split, and which shows plenty of signs of gathering momentum in Britain, is the so-called 'active' speaker system, where each drive unit in the speaker system is driven directly from a power amplifier.

The sound-shapers (tone and loudness controls, filters etc.)

One of the classic definitions for an amplifier is a 'straight wire with gain'. In my view this leaves a number of stones unturned, but nevertheless has a certain elegance as a concept, meaning that the amplifier should merely produce a magnified version of the input signal, and otherwise leave it unchanged. In fact very few hi-fi users seem content to leave things as simple as that, and most seem to demand a number of special controls to interfere with the original sound balance created by the recording engineer. (Readers will have to excuse a certain air of disdain when discussing tone controls and the like; having lived happily without them for four years or more now, I remain fairly unconvinced of their benefits.)

To return to the definition, a magnified version of the input signal implies that the amplifier magnifies all the frequencies presented to it by the same amount, and is therefore described as operating 'flat'. The various sound-shapers are designed to change this 'flatness' by emphasising

or de-emphasising some frequencies with respect to others, and this is what is meant by changing the sound 'balance'. There are a number of different types of sound shaper, and these will be discussed separately; most have some potential for adversely affecting the signal, and for this reason a number of the more expensive amplifiers around are omitting them entirely, or going to some lengths to ensure that they can be switched out of the signal path.

The heart of the matter is that any circuit used to 'bend' the frequency response of an amplifier introduces an electrical resonance, and resonances are fundamentally undesirable things that should be avoided as far as possible, because they can cause 'ringing' and phase shifts. The counter-argument is that such circuits, and indeed resonances in general, are inevitably introduced by a variety of mechanisms at different parts of the recording/playback chain, so that one or two more are neither here nor there. But at the same time two wrongs rarely make a right, and I think it is not unfair to regard the avoidance of resonances in the audio band as something worthwhile *per se*.

Most *tone controls* are designed to act over a large segment of the audio band, usually introducing a tilt centred around the middle frequencies, so that the frequencies above or below receive a fairly gentle rate of boost or cut (the rate depending on the setting of the control.) Some manufacturers like Quad for example offer slightly different modes of operation. A number of manufacturers increase the flexibility of tone controls by providing alternative 'turnover points', *ie* the frequencies at which the shape of the frequency response changes, so that the bass control may operate only over the bass region or well up into the midband if desired. A number of manufacturers also offer a 'middle' or 'presence' tone control that boosts or depresses the upper midband, usually to a fairly small degree.

But what are the reasons for fitting tone controls in the first place? A number of explanations can be given, including enabling the user to compensate to some degree for the characteristics of the listening room, helping to overcome inadequacies in the other equipment used (notably cartridges, loudspeakers and cassette decks), and attempting to compensate for a poorly balanced commercial recording. Taking these applications in turn, the treble control can help to compensate for a poor loudspeaker/room match, but its action usually extends over too wide a band to give more than crude assistance, and it is more sensible to

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ensure speaker/room matching before purchase; as far as bass compensation is concerned, the tone control is completely inadequate, and the only solution is to use a professional type (expensive) graphic equaliser that enables complex tailoring to be accomplished. Even so many people regard the adverse effects of the multiple resonances introduced by such a device as far more detrimental than the original room-induced deviation from the 'flat' state.

The tone control can help compensate for the inadequacies of ancillary equipment, and indeed it was probably introduced to enable this to be done. Nowadays however even modestly priced equipment can be found which gives a tolerably flat response, or one which is sufficiently flat to be beyond effective tone control compensation. Cartridges are best compensated by their pre-amp loading, cassette decks can give a fairly flat response at modest cost provided they are aligned and adjusted correctly and used with a properly matching tape. Perhaps the most useful application is in helping to augment the bass response of a small loudspeaker, but as before the value of the tone control must always be offset against its distortions.

A further application of the tone control might be to doctor the balance offered by the recording engineer. This is also one of its more defensible roles, but again one only has to contrast the crudity of its operation compared to the variety of complex equalisations available to the engineer on the individual constituent parts of a recording to appreciate the ultimate futility of the 'hi-fi consumer as recording engineer'. This is not to deny that some users find the ability to change a recorded balance useful, particularly on recordings made more than about fifteen years ago; my own experience on modern recordings is that it is invariably better to use a carefully set up and optimised 'flat' system.

The *loudness* (contour) switch or control often fitted to amplifiers, is of even more questionable value than tone control circuitry. The theory is that because the ear is progressively less sensitive to low and high frequencies compared to middle frequencies as volume levels are reduced, the loudness control attempts to compensate for this effect by boosting low and high frequencies by an appropriate amount, for use at low listening levels. However in my opinion the loudness effect perceived by the ear is an essential part of the hearing mechanism, and any attempt to mess around with it introduces its own forms of distortion. Because the mechanism is inbuilt, we are used to living with it, and in fact use it to help

determine absolute levels of loudness. So when we are listening quietly it is more natural to hear the bass and treble somewhat suppressed than to boost them in order to try and fool the ear into believing that it is hearing sounds at a higher level than they in fact are. It has been my personal observation that the better the hi-fi system is, the less necessary and the more obtrusive a loudness contour becomes.

The final 'sound-shaper' is the *filter*, whose operation is normally rather more discreet than tone controls and loudness contours. While a variety of different filter types are used in different electronic applications (with evocative names such as 'notch', 'comb', and 'band-pass'), from the point of view of the audio amplifier we really only have to consider two types: the treble, scratch, high, or (strictly speaking) 'low pass' filter; and the rumble, subsonic, low, or high-pass filter. As its name suggests, the filter acts to remove certain parts of the signal bandwidth, and its activities are usually restricted to the extreme ends of the audible frequency spectrum, or even beyond the audible range.

There is an old but nonetheless sound adage in audio that goes 'The wider you open the window, the more the muck flies in', and the purpose of filters that act beyond the actual audio band (*ie* infra- and ultrasonic types) is to curtail the passage of too much 'muck', which can have unpleasant repercussions on the actual audio signal. In many cases these filters are optional and operated by a front panel switch, but in other models they are tailored into the design concept of the amplifier, in order to prevent successive stages from getting each other into trouble. An advantage of the 'fixed' filter is that the designer can take it into account when considering the overall phase and slewing characteristics of the amp; if the filter is switchable, its effect upon the system phase or slew rate will depend on whether it has been selected by the user or not.

While most filters offer a fixed rate of attenuation, some enable gentle or steep slope rolloffs to be selected. Naturally the steeper the slope the less 'muck' will be able to fly through the 'window', but unfortunately at the same time the filter itself produces increasingly unpleasant side-effects. Indeed it has always seemed rather unfair that the British press has regularly castigated Japanese amplifiers for the relative ineffectiveness of their filtering in terms of the amplifier's frequency response (especially compared to the steeper rates of filtering available on many British designs), without I feel fully appreciating that the Japanese themselves prefer the

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Although fixed or variable filters are sometimes fitted to operate outside the audio bandwidth, there are many designs which offer them working within the band also. This, like the tone control, is something of a throwback to the days when equipment was less capable than it is today, and the familiar names of these filters – rumble and scratch – indicate their original purposes. However very few turntables worthy of the description hi-fi produce significant amounts of rumble these days, and the problem at low frequencies has much more to do with the LF resonance of the arm/cartridge combination than any other factor. The 'scratch' filter is a hangover from the days before the LP disc, the idea being that it helped to remove record surface noise or the exaggeration of surface noise due to the tip mass resonance of the cartridge. Here again events have rather overtaken the filter, and surprisingly few hi-fi cartridges now have an abrasive tip mass resonance within the audible regions. While the exaggeration of record surface noise remains an unpleasant phenomenon, it is more likely to be improved by a change of cartridge, arm, turntable or even pre-amp than any attempt to use filtering. Certainly the causes are still fairly obscure, and seem to involve a variety of mechanisms that are not entirely susceptible to analysis; but attacking the cause of any problem is always much more satisfactory than treating the symptoms in a way which is both inadequate and coarse.

So despite their limitations, switchable filters can be useful in some circumstances, although predominantly in attempting to cover up problems in the system. The argument for fixed filtering at the extremes of the audio band does seem rather more cogent, because under these conditions the filtering can be regarded as an integral part of the amp itself, and hopefully, problems can be avoided while the benefits accrue.

THE POWER AMPLIFIER

The power amplifier has the supposedly simple task of driving the loudspeakers with the signal it receives from the pre-amp. That this is in fact a far from simple task is evident from the existence of an international committee which is currently deriving specifications to cover the complexities and controversies that surround the 'interface' between amplifier and speaker. To examine and discuss some of the ideas involved, it is first necessary to understand a little about what electricity consists of and how it behaves. This

does not mean that I am about to launch into a jargon-ridden treatise on electronics, but an examination of the nature of electricity and its relationship with hi-fi will help establish a perspective on some of the controversies surrounding amplifier design.

Electricity is concerned with the movement of minute particles called electrons within a conductive medium, which is usually a metal. The engineering discipline of electronics is basically concerned with controlling the behaviour of electrons by manipulating the medium in order to carry out all manner of complex tasks, some of which are concerned with hi-fi reproduction and transmission. Hi-fi is trying to store and reproduce sound, and sound is a vibration in the molecules of the air, with the size (amplitude) of the vibrations corresponding to volume, and their frequency (number of vibrations per second) to the pitch of the sound. This is often accomplished by making a 'model' of these air vibrations in the form of electrical vibrations – hence the microphone converts the movement of the air into a movement of electrons *via* a diaphragm. The reason electricity and electronics are used for this purpose is merely that their technology is the most suitable; one could probably derive hi-fi systems based on mechanico-acoustics like the early 'pre-electric' gramophones, or even use fluidics, but electronics is the easiest medium in which to work.

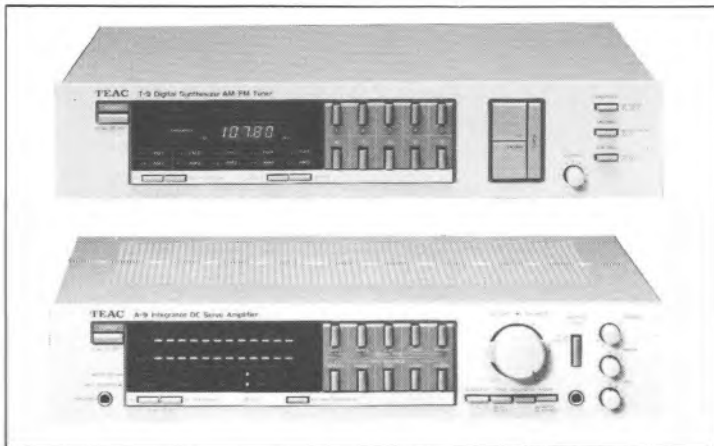
The fluid flow of normal household plumbing yields analogies that are useful in understanding some basic concepts of electricity, although the parallel should not be taken too far, as it really only refers to the direct current system (as used in cars), rather than the 'alternating' or vibrational variety used in the home and for audio. When examining the flow of water through a tap, two considerations (or 'parameters' to use a little scientific jargon) determine the rate at which the water flows. One of these is the force or pressure with which the water is being pushed, which corresponds rather neatly to the voltage in an electrical system; the other is the size of the outlet through which the water flows, and this corresponds to an electrical circuit's resistance. The actual rate at which the water is flowing (current) depends on both the pressure (voltage) and the size of the opening (resistance), and one can cut down the flow from a tap by either turning the tap off a little, or alternatively by adjusting another tap which is part of the same system, as this often shares the total pressure available. It also explains why an upstairs bath may not run water any faster than a downstairs sink despite

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having a larger tap (*ie* lower resistance): its extra 'current' capability is offset by a reduced 'voltage', pressure or head of water.

The analogy becomes rather more hazy when considering how one uses electricity. Water is drawn by turning a tap so that the water flows, impelled by the pressure at a rate which also corresponds to the size of the orifice. One 'draws' electricity by completing a circuit so that a voltage difference lies across a resistance, and this impels the current to flow, the amount depending on the voltage and the resistance according to that tried and trusted relationship Ohm's Law. The resistance is frequently a heating coil (to provide heat or light) or a motor (which adds a few complexities that are not really relevant here yet).

Under more complicated alternating circumstances, the simple concept of resistance becomes the more complex 'impedance', with the addition of two rather more abstruse types of load known as 'capacitance' and 'inductance'; these have much in common with resistance, but their behaviour depends on the alternating frequency *ie* the rate of vibration, and they have peculiar effects that are rather like storing the electricity for brief moments, in the way that a spring can store mechanical energy. This has the effect of throwing the voltage and current cycles out of phase (out of step with each other). While it is inconvenient from the point of view of simple conceptualisation that these more complex loads exist, it is perhaps just as well because much of electronics is based on tinkering with these properties!

So far we have examined electricity rather than electronics, yet the distinction is an important one, and frequently not appreciated; indeed confusion often seems to result from the fact that certain elements of hi-fi engineering derive from electrical engineering, while others are rooted in electronics. In a nutshell, electrical engineering is concerned with electricity as a form of energy – its generation and the ways in which its energy is used. In contrast electronics is to do with using the properties rather than energy of electricity in, for example, signal processing and control functions. Perhaps the most fundamental distinction between the two is that when we are dealing with electrical energy we are concerned with quantities, and hence the electrical current plays as important a role as the voltage. When dealing with electronic signal processing, current plays a minor and usually quite insignificant role, the signals being modelled by the voltage, and the circuit components kept at a high impedance to

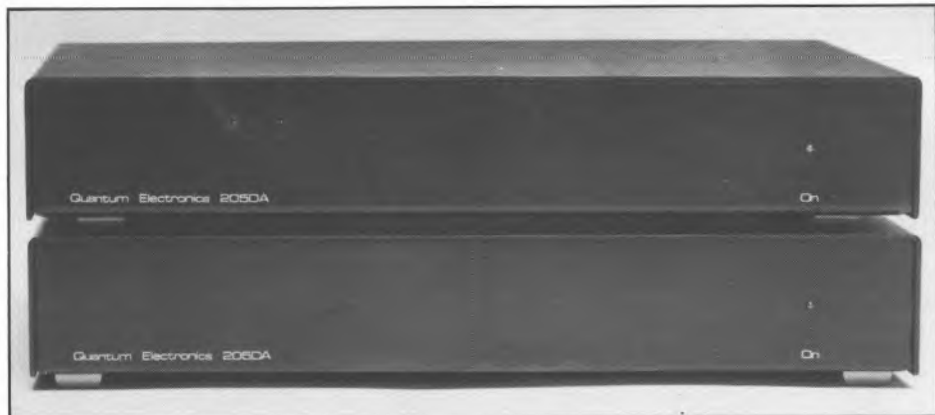
avoid the inconvenience of surges of unnecessary current. In fact large currents would prove a considerable embarrassment for delicate signal processing tasks, for the very reasons that they are used in an energy or power context, namely their ability to generate heat and magnetic fields.

If there is any single cause of the disagreement and controversy evident today in amplifier design, I am quite sure that it is due to the confusion of these two disciplines. Most discussions of amplifier behaviour seem to concern themselves primarily with the voltage signal, which is designed to correspond with the audio signal input, while in point of fact the loudspeaker is a motor which requires current to drive it (and on a rather smaller scale the pickup cartridge is a generator of comparatively low impedance which tends to produce significant current as well as voltage).

However to get back to the subject of power amplifiers, their essential characteristic is to deliver energy to the loudspeaker in order to get back an audio signal corresponding to the 'voltage model' of the audio signal that has been passed through the pre-amp. Ensuring that the output voltage corresponds to a magnified version of the input voltage without significant distortions is one part of the problem, and indeed the area that attracts most attention because it is in the 'familial' field of electronics, and voltage is much more susceptible to measurement than current. Having presented this voltage to the loudspeaker, the loudspeaker draws the appropriate current corresponding to its impedance at that instant of time, and it is here that we find some fundamentally unreconcilable disagreements between designers. The nub of the problem is deciding exactly what the impedance of the speaker is, in order to decide what the amplifier has to do to drive it accurately.

Those who have read reviews of loudspeakers in hi-fi journals (including our own) will be aware that curves are shown which depict the 'modulus of impedance' of the loudspeaker, as a function of the different frequencies it is required to handle (typically from 20Hz-20kHz). Although this 'modulus of impedance' is intended to represent the resistive load of the speaker at different frequencies, and hence the current that will be drawn to correspond to a particular voltage, it is well known that the capacitance and inductance components that make up part of this load may cause problems, due to large currents 'disguised' by the current/voltage phase-shifting mechanism mentioned earlier. Some designers take an even more extreme view, pointing out

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quite correctly that the modulus type of measurement merely averages out the impedance value over the whole cycle. This they suggest disguises the fact that at some frequencies, and under certain transient conditions common in music signals, the amount of current required to satisfy the speaker's demands (and hence keep it under control) can be considerably larger and also far less predictable than that required to meet steady state conditions.

While this debate may appear somewhat esoteric in this context, and will no doubt be resolved in the fullness of time, its implications for power amp design are far-reaching for the following reasons. To supply a certain number of volts and make available a certain number of amps costs, by and large, a fairly fixed amount of money in components, labour costs etc. Consequently most amps are designed to deliver their maximum power when driving a load of say 4-8ohms, within which the typical modulus of speaker impedance lies. If it should be technically desirable to provide an excess of current to meet this hypothesised less predictable load, it will cost considerably more money to provide the same voltage and hence loudness (though not necessarily energy) from the system, with merely the possible benefits of offering better loudspeaker control. So if this load unpredictability is established, amplifier designers will either have to make considerably more expensive amps to produce the same approximate volume, or accept compromises in sound quality due to this phenomenon. It may seem a little irresponsible to suggest that the whole concept of amplifier design may need a fairly radical rethink; but a number of specialist manufacturers have been producing 'heavy current' designs, in some cases for several years now, and with significant commercial success. And at a seminar with one of the world's leading amplifier design theoreticians, who was retained by a major international manufacturer, some very similar ideas were expressed, together with suggestions that experimental evidence was imminent. It would be irresponsible to take a firm stance at this juncture, but at the same time it would be equally irresponsible to ignore a potentially vital element in amplifier design.

Slew rate limiting

Amplifier design never seems actually to stabilise, even though many commentators and designers tend to suggest that all the problems are long solved and nicely under control, and certainly orders of magnitude less severe than the distortions which occur in other components in the

audio chain. Over the last few years the related distortion mechanisms known as Transient Intermodulation (T.I.M. or T.I.D.) and Slew Rate Limiting have both been put forward, hotly debated, and finally won a grudging acceptance that has finally found its way into commercial design. The concept of slew rate limiting is fundamentally so simple and obvious that it is surprising it was not 'discovered' earlier.

As mentioned previously, the audio signal is modelled by a complex alternating voltage, and one of the amplifier's tasks is to magnify that voltage to a sufficient level to enable the attendant current to drive loudspeakers with the original signal. This is usually accomplished by using a number of amplification stages, each of which in turn enlarges the voltage. One of the characteristics that defines the performance of transistors is known as the 'slew rate', and this is the maximum speed at which the voltage in the transistor can change. When taking into account the maximum voltage swing required (*ie* the signal level), this slew rate determines how quickly the device can switch on and off, and hence how high a frequency it can handle before limiting and distortion sets in (it has been suggested that the slew rate should be two octaves – four times – the required high frequencies).

Obviously for the same device, the smaller the voltage swing required, the higher the frequency that can be handled. If we then start with a very small very high frequency signal, such as might be developed by a moving-coil cartridge for example, and the amplification stage provides an overall gain of X10, then the transistors that provide the output from that stage must be capable of slewing ten times faster than the fastest input signal to avoid distortion. This is not so much of a problem with the fast, small transistors used in the middle of the amplifier, but the large output transistors which have to pass heavy currents to drive the loudspeakers are by their very nature comparatively 'slow', so there is a danger that the devices will not be able to keep up with themselves. Two solutions are open to the designer: the 'low-key' approach is to use carefully designed low-pass filtering between the various stages so that no stage receives a signal that is too fast for it to handle; the 'hi-tech' approach is to develop faster and faster devices at the high voltage end, and this has led to 'superfast' output devices like the V-FET, EBT, and power MOSFET. In the final analysis this approach probably has the edge, although one should not overlook the adage about the dangers

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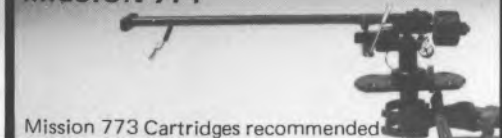
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of opening the window too wide and allowing too much muck through; sometimes careful bandwidth control can give the best compromise.

I don't propose to try and explain TID fully in similarly simple terms, because it would take rather longer and not really serve any useful purpose. In essence though TID can be regarded as somewhat similar to SID, applied to complete circuits rather than just devices. Most amplifiers rely on a mechanism, called feedback, which compensates for distortion producing 'non-linearities' in the devices. However it takes a finite time for this feedback to operate, depending on the circuit design, and in this case the circuit can 'fail to catch up with itself' when trying to handle the highest frequencies, so that the output becomes un-corrected distortions.

Output switching

This is another area where there is some measure of controversy amongst designers, with some claiming that speaker switches in the signal path between power amplifier stages and loudspeakers are undesirable either on performance or reliability grounds. Certainly there is some reason to regard switches that carry comparatively heavy currents representing delicate transient musical information with a measure of suspicion, although the majority of amps use them anyway. However the fact that the more expensive and exotic models, and those from specialist 'enthusiast' manufacturers, tend to eschew them suggests perhaps that there is no smoke without fire, and that there is at least the possibility of sound quality benefits where switches are *not* used.

The reciprocal argument would claim that the provision of a headphone socket and the need for this to mute the speakers already introduces speaker switching, but then the exotic models tend not to provide headphone switching either! While the debate remains unresolved, I do believe there is some room for re-thinking how speaker and headphone switching is carried out, and with a little more care in the engineering it should be possible to have one's cake and eat it too. One neat solution is fitted to the A&R A60 amp, which provides three terminals per channel on the back; one of these is connected 'directly' while a parallel one connects via the headphone socket, and the third 'return' also connects direct. The user then has the option of a 'straight-through' connection, or via the headphone socket with its built-in muting.

I personally would like to see all amps with at least one 'straight-through' speaker connection

socket, and then perhaps two switchable positions for those wishing to use auxiliary speakers in other rooms; these switched sockets could also offer the headphone option, and could perhaps be arranged to give either/or rather than either/or/both, to avoid the possibility of damage if the 'main' speakers are left connected. Alternatively perhaps the best approach to headphone drive is to provide a special output circuit designed specifically for this function.

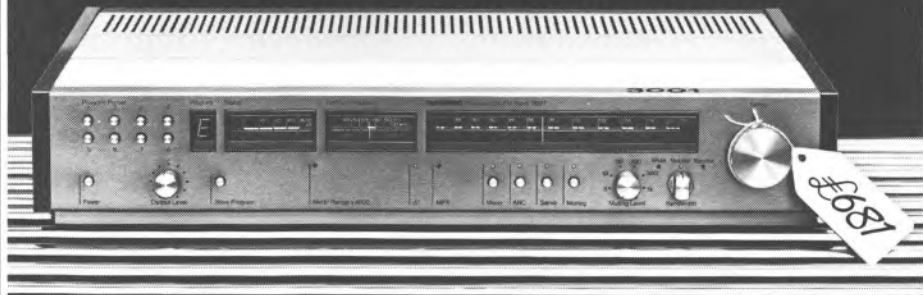
The whole area of interfacing between amplifiers and loudspeakers is sufficiently riddled with doubts, controversies and unknowns that the connection of more than one set of speakers for serious listening must be open to question. The problems of loudspeaker drive are complicated to say the least, but the fact remains that an amplifier is primarily designed for one set in terms of its 'conventional' power rating and impedance matching, and even its ability to do this adequately is challenged by the existence of multi-amplification systems (where a separate power amplifier is used for each loudspeaker drive unit).

Headphone driving poses few of the problems found with loudspeakers, if only because a far smaller amount of energy is required, the headphone only needing to energise the ear canal rather than an entire room. The majority of headphones should work without any difficulty from a normal headphone socket, which should be designed to give a fairly good match for the various types encountered as well as a measure of protection against their being overdriven and destroyed by the comparatively high-powered amplifier. Some of the more exotic designs, typically those using electrostatic or electret principles of operation, are designed for direct connection to loudspeaker terminals via special adaptor boxes which also ensure this matching/protection function. Those amplifiers which are not provided with headphone sockets can use them via an external adaptor/switch box, but the same comments and reservations about switching in the speaker signal path mentioned above will of course apply.

Power indicators

A number of amplifiers are fitted with large meters which are supposed to indicate the power being delivered by the power amps. Different mechanisms are used to display this, but the standard so-called 'VU'-type swinging needle meter type is usually marginally worse than useless, because its reaction time is invariably too slow to respond accurately to the

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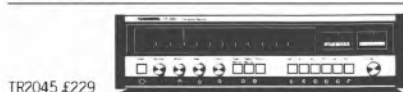
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transient peaks which are the important part of the music signal. Some methods of metering, either using very fast and expensive needle types or some sort of electronic light emitting device, are of limited usefulness, although there are none that I know of that actually register power. They are in fact all devices which measure the voltage that is being delivered to the loudspeakers. They are then calibrated in watts (the measure of power) as a result of the designer's flight of fancy that the loudspeaker load that they will be driving is precisely eight ohms at all frequencies (which in point of fact it never is).

So-called 'power meters' will not therefore give information about the power being delivered by the amp; they will give information about the voltage being presented at the output terminals, provided they are fast enough. This can still be useful, because if an amplifier is called upon to deliver more voltage than is within its design capabilities it goes into a state known as 'clipping'. This can cause a variety of ill effects ranging from simple distortion to more serious 'latch-up' losses of signal while it, so to speak, recovers its breath. There is also the possibility of loss of control and/or instability. So clipping can be indicated by decent power meters (although one or two simple light emitting diodes - LEDs - are in fact quite sufficient), so such meters do have their uses. Incidentally if you find that you wish to run your amp into its clipping region quite often, there are only two solutions open: buy a more powerful amp, or use more efficient or sensitive loudspeakers.

THE POWER SUPPLIES

Amplifier power supplies have recently come under close scrutiny from designers, some of whom have suggested that they comprise the most important single part of any design. Indeed one could go so far as to describe an amplifier as a power supply connected to a loudspeaker, with the signal applied by controlling this supply in the manner of a tap controlling the flow of water. A variety of different design approaches exist, and some of these have been touted as 'inherently desirable' by advertising copywriters. But like most things audio, the 'feature' is less important than the appropriateness of its application; there is no single 'right way', merely a variety of available techniques, whose effectiveness is probably pretty closely related to their price.

The problem with power supplies is that when you remove power from them, you reduce their ability to deliver more power. A slight drop in

capability may not matter in a household domestic electricity supply, where one is only interested in drawing 'crude' power from the system. But audio power corresponds to an extremely complex and subtle musical signal, so any such lack of capability will show up as a form of distortion in the signal. A power supply that is fairly impervious to such undesirable effects is often referred to as 'stiff'.

It is therefore quite likely that two separate supplies will be better than one, all things being equal, because the demands on one will be unaffected by the demands on the other. However in practice all things are by no means equal, and a number of considerations need to be taken into account. The most important is that two supplies will inevitably cost twice as much as one, if each is to match the capability of the single one. In practice 'twin-powered' amps tend to use two somewhat smaller supplies, which is perhaps fair enough as they only have to power one loudspeaker and hence provide on average half as much energy. However music consists of peaks rather than averages, and the smaller supply will necessarily be less capable of providing voltage or current peaks than a bigger shared supply.

So the twin power supply approach that is commonly encountered, where each supply is relatively smaller, may offer certain advantages in reducing interference between channels, but is also likely to reduce the peak power capability of the amplifier, a corresponding disadvantage. A similar result to 'twinning' may be obtained by 'regulating', which involves controlling the output of the power supply by electronic means. This again effectively gives separate power supplies, although only one transformer is used, but again the peak capabilities are lower than with a similar unregulated supply, and so a larger supply will be needed to obtain equivalent peak performances. To this cost penalty must also be added the cost of the regulating circuitry.

Quite clearly there is 'no such thing as a free lunch'. If one were to try and define the power supply's functions, this would probably be to provide the required current and voltage at every stage of the amplification, in such a manner that all points of supply remain independent, inasmuch as they do not influence each other. The big question mark remains over that word 'required', and here we come back to the points made earlier concerning possible unknowns in pre-amp current handling and loudspeaker transient current requirements. Those designers who emphasise both the subjective performance of

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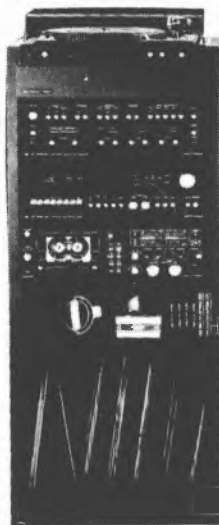
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their amplifiers and the importance of their power supplies tend to try to increase the independence of the different stages, their current handling capability, their internal control, and the speed at which they can supply both voltage and current.

For example, the Meridian 103 modular system splits the amp into three basic units, one is a pre-amp with built-in supply, the second is a stereo power amp without power supplies, and third a power supply section. The user can choose between operating with this single power supply module for a power of 35 watts per channel, or having two separate (and incidentally identical) power supplies to give 45 watts per channel and claimed subjective improvements; this configuration also permits the purchaser to begin with one supply and upgrade without obsolescence at a later date. Likewise the Naim 160 and 250 power amps are claimed to offer virtually identical power amplifier circuitry, yet one costs twice the price of the other because of their power supply differences, the 160 having a single unregulated supply while the 250 uses a larger transformer and no fewer than four regulated supplies.

REVIEWING AMPS: THE PITFALLS

There is probably no audio component more difficult to evaluate meaningfully than the amplifier, for a number of very good reasons. Many of these have been touched on in the preceding sections which examined the constituent parts in some detail, but this is an opportunity to tie them together. Two quite opposite schools of thought currently exist amongst the experts in the field. The problems boil down to the simple question of choosing the criteria that are relevant for design or evaluation, and here the reader will have to make some effort to establish *his* criteria, rather than merely taking the reviewer – or his critic's – words for it.

These opposing stances are so dissimilar and strongly held that there can be no consensus approach to deciding what makes an amplifier, broadly speaking, good, bad or indifferent. One point of view would not be inaccurately described as 'objectivist', and claims that any reasonably designed amp that is operated within its limits (of power capability into the accompanying loudspeaker impedance) will sound indistinguishable from any other, provided sufficient care is taken to match levels and ensure that there are no frequency response anomalies.

Close to this extreme position are many others who consider that as the measured distortions introduced by amplifiers are so much lower than

those produced by other elements in the chain, notably cartridges and loudspeakers, any marginal differences between models will be irrelevant. The implication is that the only valid criteria for a sensible approach to purchasing an amplifier are its power capability in relation to price, one's requirements and loudspeakers, and the features and facilities that are needed, provided that the design does not show any obvious weaknesses on technical measurement.

The alternative so-called 'subjectivist' stance proposes that amps are really by no means perfect, and that their performance exerts a powerful influence on the overall sound quality of a system. It is also implied that our present measuring techniques are unsuccessful at revealing important audible differences. If one accepts this point of view, the criteria of power capability and facilities should be extended to include listening tests. Furthermore it is also suggested that comparable power ratings may not yield similar maximum tolerable loudness levels, and that a 'loudness capability' is a more valid or useful criterion than measured power.

The essential difference between these points of view is that one places importance on listening tests, while the other regards their results as figments of either the imagination or inadequate test procedures. While the co-authors of this book are both firmly convinced that the amplifier does indeed make a vital contribution to sound quality, our researches before the project got under way indicated that current methods of subjective assessment, at least when dealing with large numbers of products, are far from reliable. Moreover objective measurement techniques cannot be relied upon to give results which correlate with claims for sound quality either. Consequently any findings related to sound quality must be regarded as tentative rather than definitive.

Despite this measure of uncertainty we are quite convinced that listening tests must be carried out, and the results reported. Even though the 'subjectivists' have not succeeded in proving the reliability of their results, the fact remains that a sizeable percentage of those involved in hi-fi – probably the majority – would regard themselves as more or less in this camp. So while the easy way out would be to omit more than cursory subjective testing, and produce a book based merely on simple (and perhaps meaningless) objective tests, this would have rendered the project worthless in the eyes of a significant segment of audio opinion. To take the opposite course and rely heavily upon listening



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tests of dubious reliability in order to make value judgements would be equally indefensible.

From this vantage point, perched uncomfortably upon the horns of a dilemma, it is possible to see a way to wriggle out of this situation by means of careful qualification and a degree of necessary reserve. Therefore an amp which offers a competitive package of power and facilities will not be debarred from commendation on the basis of poor results in the listening tests, though the review will naturally exhort the reader to confirm or deny our findings for himself. Similarly, good and consistent listening test results will be sufficient justification for commending an amplifier that might not otherwise qualify, for example on the basis of price/power or poor measured distortion.

Our advice to the buyer must be to try to confirm or deny our subjective results for himself, or at any rate try to establish for himself the importance of sound quality in amplifiers. Those who line up with the 'objectivists' will nevertheless find the reviews useful in providing facility/power/price data to assist them in making a choice, and can cheerfully ignore our 'subjective impressions'! Hopefully those like ourselves who consider that amplifier differences are significant will find our subjective findings correspond to some degree with their own, and consequently our attempts in this direction will be of some value.

The listening tests

Over the past few years a number of projects have been undertaken by this and other magazines in the hopes of establishing reliable subjective test procedures for amplifiers. Overall the results have not shown great consistency, though the indications in the most recent instances have been more encouraging than heretofore. There remain many pitfalls though, particularly when dealing with a large number of products in projects such as this.

To try and avoid unreliability as much as possible, we decided to carry out several quite separate listening tests under different circumstances on all of the amps, while trying to ensure that the conditions for listeners were as relaxed as possible. The 'blind' listening included a number of repeats to help give an indication of reliability. One could continue to make listening tests more and more elaborate in the hopes of making them more reliable and meaningful. Even so there appears to be no guarantee that the results could be replicated independently elsewhere under different circumstances, which is

the real criterion for a 'scientific' test. Nevertheless we feel that we have at least done our damndest to avoid generating unreliable results, while remaining aware that this is an area where nothing is strictly provable.


In my own experience, the only really reliable method of subjective amp assessment remains to live with the model for at least a few days under relaxed home conditions, and even this can give results that may not be truly universally applicable (in other words they may only work in the context of the particular system). Under such 'home' circumstances I have myself spent over £1500 on my personal amplification system; while this may not prove anything (apart from certifiable tendencies in some people's estimation), it does indicate a personal commitment to the subjective importance of the amplifier in a hi-fi system. Unfortunately it is impossible to carry out this extensive 'home-use' evaluation on the large range of products that are accommodated in a *Choice* project – if this was attempted the results would not only still be somewhat system-dependent, but many of the models would probably have become obsolete in the meantime!

The measurements

The measurements taken on an amplifier fall roughly into two types: those that are taken in order to determine the basic physical and electrical parameters of the amplifier, such as its size and input sensitivities; and those that are taken in order to get information on how well the amplifier performs, such as distortion and noise measurements. The former are vital in order to establish whether the amplifier is likely to match electrically other items of equipment, the room decor, the available shelf space, the impedance of the speakers being used, etc, etc. The second group is intended to give information on how well the amp performs rather than merely what it performs, and implies that we have some knowledge of what constitutes a worthwhile lab performance. (In point of fact many so-called performance measurements have developed not so much because they represent desirable amplifier functions, but more because the machinery existed to carry out the test!)

When embarking on this project we examined closely the tests that were normally carried out by manufacturers and reviewers in order to build up a programme. Although we would have liked to include some fairly new techniques in the hopes of achieving close reliable subjective/objective correlations, this was not always

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practical for a variety of reasons: some can be challenged on the grounds that they are not representative of 'use' conditions; some risk damaging the amplifier through stressing it too hard, and the last thing we wanted were a lot of 'dead' amps; some require rather more development of technique and/or apparatus than was possible in the time available. However this still left us with an enormous number of possible measurements to take on each amplifier, all of which qualified for possible inclusion either on grounds of tradition, hoped for correlation, or to reveal potential trouble spots.

There are of course an infinite number of measurements that one could take on a single amplifier. The big question, for which no-one has provided a totally satisfactory answer, is which measurements are the important ones. If one accepts the point of view that the differences between amps are insignificant, then measurements are merely required to show that the sample is performing adequately and to define the parameters necessary for basing one's selection on price/power/facilities/matching. The fact that even a 'poor' amplifier will produce harmonic distortion, frequency response and crosstalk measurements that are 'better' than those given by the best speakers and cartridges continues to argue that perhaps most amplifier measurements are irrelevant.

If one takes the stance that amplifiers do play an important role in sound quality, then which measurements indicate the sound quality performance?. The simple answer is that we don't know! All we can hope to do is to take a lot of measurements of different kinds and look for patterns developing between the amplifiers, rather than absolute values that can be labelled 'good' or 'bad'. There is even some evidence which suggests that improving certain aspects of measured performance without due consideration for the total design may actually worsen the listening results. In the early days of transistor amp design, for example, the tendency was to increase the amount of feedback to a level far higher than that which has been used in valve designs. It is now generally accepted that although this enhanced the measured performance using simple steady state techniques, it also tended to introduce undesirable dynamic distortions, which were less easily measured but which were certainly audible. In fact the necessary low feedback in valve designs may be one reason why they have maintained their popularity amongst a minority, despite their inherent technical limitations and extra costs – it

is that much more difficult to mis-engineer the feedback loop!

The net result of the above was that some amps which produced better harmonic distortion results than others actually sounded worse. Although we do not wish to imply that this is a reliable 'inverse' indicator either, it does rub home the fact that measurements are really only worthwhile as indicators if they follow some pattern which relates to the listening experience.

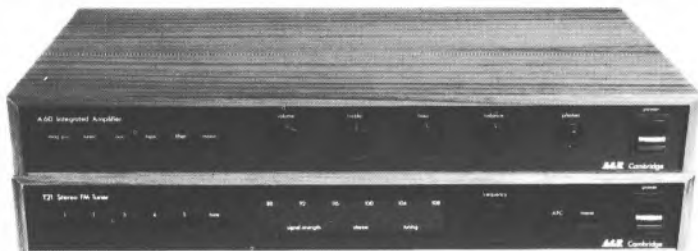
On the basis that absolute measurement values on amplifiers rarely bear any direct relationship to sound quality, we started by measuring a deliberately excessive number of different parameters to look for those that seemed to offer the best correlations, in addition to including those which have almost by habit become 'standard'! We should point out that a further process of editing has been applied to the results published, because printing interminable lists of figures is baffling for any but the most technical reader, and ultimately self-defeating; we see little point in publishing data merely to prove that we have taken it! Let us now examine the different measurements that were taken, discussing the meaning and interpretation of the results.

Power output

The power of an amp is traditionally expressed in watts, which is the unit of electrical power derived by multiplying together the volts and amps supplied across and through a specified load.

All electrical power systems work by setting up a voltage across a load, and this itself determines the current required: with ordinary power systems like the mains or car battery (and ignoring AC voltage complexities), the voltage supplied is set at 240 and 12 respectively, so ¼amp at 240 volts will give 60 watts, whereas 5 amps will be necessary at 12 volts to give 60 watts ($\frac{1}{4} \times 240 = 5 \times 12 = 60$). If the voltage is fixed, then the power is determined by choosing the load to allow the right amount of current to flow. This can be worked out by means of Ohm's Law, which states that the current (I, amps) multiplied by the load (R, ohms) equals the voltage (V, volts). So the load that gives 60 watts via ¼ amp from the mains will have a resistance of 960 ohms, but with the 12 volt battery it will be 2.4 ohms. Getting back to the audio situation, the amplifier sets up a voltage that corresponds to the required loudness and the signal content, and the loudspeaker then specifies the required current according to its load.

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We require the amplifier to work right across the audio spectrum from the deepest bass at 20Hz to the highest treble at 20kHz. While it is true that most of the energy will be required at the middle frequencies, there are some indications that a restricted power delivery capability at the frequency extremes can be a slight weakness. As our quotations of power are made as far as possible at the level at which 0.1% distortion is reached, a reduced power reading may merely correspond to an increase in distortion. The 'standard' load used to represent loudspeakers is 8 ohms, so we have measured the maximum power with both channels driven simultaneously into 8 ohms at a suitable mid-band frequency (1kHz), and repeated the measurement at 20Hz and 20kHz to check for any possible limitations.

We then measured the power with only one channel driven. If the amp can produce more power when driving only one channel, this implies that the power delivery when both channels are driven is being limited to some extent by the capabilities of the power supply 'running out of steam' and not fully meeting the demands placed upon it. In other words the power supply could with advantage be 'stiffened'.

In addition to measuring the channels separately with an 8 ohm load, we have also investigated their ability to drive into lower impedances. The theoretically 'ideal' amplifier would maintain its voltage and double its current when the load is halved, thus producing double the 8 ohm power output into 4 ohms and a further doubling into 2 ohms. However, to do this is expensive and usually also means restricting the power that can be delivered into 8 ohms, as the amp has to be 'balanced' with reduced voltage and increased current capability.

A minority of designers consider that it is necessary to sacrifice loudness for this enhanced ability to drive complex loads, their claim being that it is vital to prevent the loudspeaker from being starved of current. The majority would say that this is largely unnecessary overdesigning, and is potentially commercial suicide! The debate continues, and the proof of the pudding must remain in the listening experience. But we have as far as possible measured the amplifiers' abilities to drive these low impedances in order to give an indication of the designer's priorities and also the ability of the amp to drive some of the 'nastier' speaker types around.

The final power test is a measure of the transient power of the amp, to see what it can develop in a short 'burst', which is probably more

representative of music peaks than the steady state sinewaves used for the other power tests. A high 'burst' capability should indicate an amp that goes quite gently into distortion when it is driven hard. It can also however indicate a degree of 'looseness' or lack of power supply control which can impair detail.

Inputs

We have measured a large number of parameters concerned with the inputs of the amplifiers so that the reader can check matching with the inputs and outputs of other components that may already be owned or be contemplated for future purchase. Details concerning checking the matching of sensitivities and impedances is given in the earlier section describing the different pre-amp inputs in detail; note that the input capacitance of the disc input can significantly affect the sound from moving magnet cartridges.

Outputs

Our figures relating to the outputs from the amp that feed tape decks and headphones are designed to try and indicate typical use conditions. The precise conditions are specified in the technical introduction, but for the tape outputs the intention has been to measure the signal when loaded by a typical tape deck impedance of the appropriate standard, and when driven at typical signal levels from disc and auxiliary inputs.

Any power amp is more than capable of driving headphones, as these require relatively little energy compared to loudspeakers – so little in fact that most models can be driven from a tape deck pre-amp with little difficulty. The main problem when driving headphones from power amps is avoiding destroying their delicate moving parts with too much power. For this reason the headphone socket is fitted with an attenuator, and this serves the extra purpose of allowing the amplifier to drive the headphone in its normal working range. If driven directly from the speaker terminals, the volume control will need to be kept retarded, and this can allow the residual noise in the potentially powerful amplifier output stage to become obtrusive; an attenuator minimises this problem. To ensure that the headphone socket is suitable for driving the wide variety of impedances types found amongst commercial designs, we have measured the socket voltage that is supplied across two typical representative impedances (8 ohms, 2.2

kohms) using a 'standard representative' input signal.

Noise

While we have measured this parameter with one of the most recent standard methods, there is little doubt in my mind that noise has a fairly limited effect upon the listening experience, because no domestic program source yet available can produce noise figures that are anywhere near as good as most amplifiers; furthermore most sources have a far more restricted 'real' dynamic range capability than even their noise figures indicate. Admittedly some very low inherent noise figures are promised for the 'digital disc' formats that are appearing in prototype form from a number of manufacturers, but this does little to change my feelings (prejudices?) that by and large random noise is the least offensive form of distortion, and insignificant compared to other problems generated in systems when the music is actually playing—after all there is little point in listening to the background noise on its own!

Damping factor

The damping factor is the ratio of the internal impedance of the amplifier output to the impedance of the loudspeaker (which is traditionally taken as 8 ohms). The theory is that the amplifier acts as a brake on the movement of the loudspeaker cone by acting as a near short circuit when seen from the speaker. (Try for yourself the difference in pushing a reflexloaded loudspeaker bass cone with and without a wire connecting the two speaker terminals together).

In practice there seems little point in increasing this ratio beyond 40 (some consider 15 is ample), and it is likely that the dominant factor will be the resistance of the speaker leads in any case. (Note though, that the latest trend is to reduce this effect by including speaker wires in the feedback system; this will be referred to in greater detail in the relevant individual reviews.)

The output impedance of the amplifier is in fact an artificial effect caused by the feedback loop within the amplifier, and we have measured it at three frequencies to see where and whether there is any significant variation. A significant drop in damping factor at HF can be an indication that the internal bandwidth of the amplifier is limited, and this may result in unpleasant distortion effects (TID etc) if fed from a wide-bandwidth source such as a moving-coil cartridge.

DC offset

The DC offset is a measure of the DC voltage measured at the amplifier's outputs. This is an undesirable side-effect that has come about since most amplifiers abandoned capacitor coupling in favour of direct coupling a few years ago. It will produce a slight forward or backward permanent offset in the speaker cone, which could be a possible source of distortion and will also heat the voice coil unnecessarily. It is a convenient indicator to show how well the amplifier has been set up when it left the factory. The DC offset should be as small as possible and similar in both channels.

Power bandwidth

This is an indication of the highest and lowest frequencies at which the amp can deliver reasonable amounts of power at low levels of distortion. It is difficult to interpret, as although there are indications that a narrow bandwidth has certain undesirable attributes, there is also evidence that too wide a bandwidth may give rise to equally harmful effects of a different kind (the wider you open the window etc.) It is probably desirable for this bandwidth to cover the audio band from 20Hz to 20kHz, but extension much beyond this is likely to be unnecessary, and bandwidths extending significantly above 50kHz may give rise to problems.

Total Harmonic Distortion

Rather than quote a figure for this parameter, we have examined the content of the distortion in order to make a value judgement.

Harmonic distortion is one of the key traditional parameters of amplifier design, which is one reason why most designers make sure that their products show little of it! However its effect are known to be fairly innocuous, because music signals contain large proportions of harmonics naturally. In addition, cartridges and loudspeakers both produce quite large amounts of harmonic distortion, more than sufficient to mask that produced by virtually any amplifier. The addition of harmonics to a single note will change its 'timbre' slightly, but unless the amplifier is producing large amounts of high-order harmonics (11ths, 13ths etc), the distortion is unlikely to be detectable. The examination of harmonic distortion is frankly more use in understanding the internal behaviour of the amp than in producing a meaningful result which will correlate with subjective listening tests.

Intermodulation Distortion

Intermodulation distortions are generally considered to be far more offensive than their harmonic brethren. Whereas the harmonic distortion merely gives extra amounts of frequencies which are present in the music anyway, marginally changing their relationship but nothing else, intermodulation distortions are the products of two (or more) frequencies, and give the frequencies that were not present in the original at all, known as sum and difference components. For instance the combination of frequencies at 19kHz and 20kHz (quite likely to be produced as a result of the tip mass resonance of a typical cartridge and poor disc surfaces) will produce an unrelated difference signal at 1 kHz, where the ear is quite sensitive.

Hum performance

Once again we decided the best way to describe the hum performance of an amp was via a value judgement, after a careful examination of the hum spectrum. Hum is, I suppose, related to noise, but acts at particular frequencies, which therefore stand out when it is present, and the results are far more objectionable than the gentle 'swishing' of random noise. The cause of hum is breakthrough from the mains alternating frequency of 50Hz (60Hz in the US), but its effects become more objectionable when higher harmonics which are more clearly audible are generated (eg 150, 200, 300Hz).

Crosstalk and Separation

Crosstalk or separation is a measure of the breakthrough from one channel of a stereo amplifier to the other. Traditionally it has been held that there is likely to be no problem provided it exceeds a modest 40dB, which is more than most pickup cartridges can manage. However crosstalk is a form of distortion, and if it lies only 40dB below the other channel signal it is rather higher than other forms of amplifier distortion. Crosstalk may also provide an indication of the interdependence of the power supplies.

Crossover distortion

Nearly all commercial amplifiers operate in what is known as class B or class AB mode. This refers to the way in which the output signal is passed through two sets of transistors, one of which handles the 'top' half of the wave cycle, and the other the 'bottom' half. As the signal is passed from one to the other, one set is switched off and the other on, and this will cause a slight 'ripple' distortion effect known as crossover distortion.

We have examined the crossover components in each amp on an oscilloscope, and comments are made where they suggest a potential source of trouble.

CHOOSING AND USING AN AMP

How does one set about choosing an amp from the hundred or more models that are available these days? At first sight the prospect is daunting, but providing one doesn't simply panic and pick up the first pretty one to catch the eye, it's not difficult to cut the list down to size. The first thing is to decide on a list of priorities, start getting down to a shortlist, and finally do a little listening for yourself to make sure you like the sound.

For most people the first criterion will be price. But having decided on a price, bear in mind that a little less money spent on the amp could leave a little more for the record deck, and you may prefer the overall result; alternatively a more expensive amp with cheaper speakers may be more to your liking. So go for a price bracket, but keep flexible, and try to listen to the cheaper and more expensive options at least to find out what you are gaining or losing.

Price is however not the only criterion; for many people the big question will be 'how powerful?' This is virtually impossible to answer in general terms, and provided one is reasonably careful, it is also probably true to say that there is no such thing as too much power!

Many people are nervous about matching amplifier power with speaker power handling, and consequently stick slavishly to manufacturer's recommendations without perhaps realising the slim premises on which they are based. The ability of an amplifier to damage a loudspeaker depends on so many more things than just its power rating, not all of which can be predicted, and there are really no worthwhile rules. It depends on the type of program (electronic synthesisertype music being the most dangerous), the ability of the amp to keep control of itself particularly when driven hard, and the cleanliness of the program source. It was salutary to note during the work for *Choice: Loudspeakers* that a 500 watt amp was used for some of the time; although it was possible to make some of the speakers protest audibly, none were permanently damaged, and it was surprising how many quite modest models accepted the full power rating on peaks. Although this was partly due to the very clean signals used, it also tended to show how the extra headroom and consequent extra control of a big amp helped matters. One shop with a large dem room has often remarked

CONSUMER INTRODUCTION

to me how the cheap low-powered amps tend to blow up their speakers far more readily than the high powered monsters, due to the bad effects that can occur when a smallish amp is persistently overdriven.

So if too much power is unlikely to be a problem, what is the minimum one can get away with? Again one factor in the equation will be how well the amp behaves when it is near its limit. But the most important considerations will be how loud one likes to play music, how large the listening room is, and how sensitive one's loudspeakers are. The first will depend on personal taste, and the second on circumstances, but we may as well consider an average room of say 80 cubic metres, while the third can have the most marked effect of all. Amongst the loudspeakers in one of our surveys there was a difference of rather more than 10:1 in the amplifier power needed to achieve the same level of loudness! So if you have very sensitive speakers, you should be able to get loud levels in a normal sized room using only a few watts of amplifier power, while the less sensitive designs may need as many as 40 watts to achieve a similar level; this in turn means that the less efficient speakers will be working an amp rather harder, and will leave less in hand to cope with peaks (which can be much higher than the average power levels in music). 50 watts or so is likely to leave sufficient in hand for the 'average' situation, but if the speakers used are fairly sensitive, 20 watts may be ample. If you find even more powerful amplifiers of 100 watts or more beginning to strain and giving insufficient 'headroom', it is time to consider using more sensitive speakers; this will usually be a cheaper way of getting a higher loudness capability. Once again there is no substitute for listening to a combination for yourself to determine whether it is loud enough or tolerable at its higher levels; sheer numbers of 8 ohm watts do not give a reliable indication of whether a combination will sound good at high levels.

Another criterion for choosing an amp will be the provision of the right facilities. However it is not really necessary to place a plethora of 'just in case' inputs as a high priority, because these can always be added later if such a case arises. It is however quite important to make sure that the inputs that are provided are going to match your other equipment adequately, and the outputs for tape, headphones, and most importantly loudspeakers likewise. For loudspeakers, the amplifier should be able to deliver plenty of power at the speaker's *minimum* impedance

value (if not below this), particularly if this minimum lies in the midrange.

Physical appearance is often one of the most important criteria for the purchaser. This may be prejudice, but I sometimes wonder whether the 'satin-chrome monster' that gleams amongst its brethren on the shop shelf is very well suited to blend in with the lounge decor, or is merely gleaming in order to make sure that it is noticed in the shop? I may be old-fashioned, but have always felt that discretion was the better part of styling, particularly with something that one has to live with day in and day out. It is perhaps rather sad that the average customer gets little alternative to chrome in the majority of ranges, although at least some manufacturers now offer a matt black alternative. Happily the smaller British manufacturers offer a wide variety of different styles and finishes; indeed the chances are that any two British amps will be more different from each other than the styling differences encountered amongst the entire range of Japanese hi-fi!

The final, and in our view the overriding criterion must be sound quality. We have done our best to give advice on this aspect of an amplifier's performance, but this is a tricky field. We do feel that no hi-fi product should be purchased without prior demonstration, and that the customer should ideally be afforded the opportunity of a home demonstration with the chance to compare one or two alternatives in the context of his own system (don't expect big discounts with this sort of service, however, or you'll end up with a bankrupt dealer!)

A good dealer should be able to demonstrate an appropriate improvement if he tries to sell you an expensive amplifier instead of a cheap one. If a dealer is a good one, his standard of demonstration should be high, and the overall sound quality should be good; another old adage 'if it sounds wrong it is wrong' is also worth keeping in mind. Above all have a little faith in your own powers of discrimination; if a dealer can sway you by the standard of his demonstration rather than the smoothness of his patter, then the chances are he does have something to offer.

In conclusion a few 'don'ts' when using an amplifier. Don't economise on speaker cable by grafting together miscellaneous lengths of left-over bell wire with sticky tape; use mains cable of at least 5 amp, and preferably 13 amp capability, without any joins. Make sure this is securely fastened at each end and that the two wires cannot accidentally touch. Don't unplug inputs or outputs while the amp is switched on - this is just

CONSUMER INTRODUCTION

asking for trouble; if you have been playing around with the inputs or outputs for any reason, then switch on afterwards at a low volume setting and increase this slowly while making sure nothing is wrong. Don't overdrive the amp for long periods; overdriving is usually easily detectable by an increase in distortion, and if you keep it up for a long time you may well damage the amp or the speakers.

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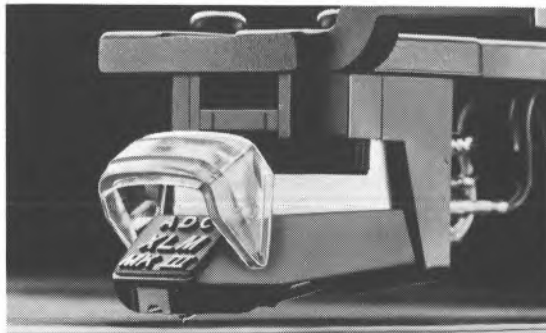
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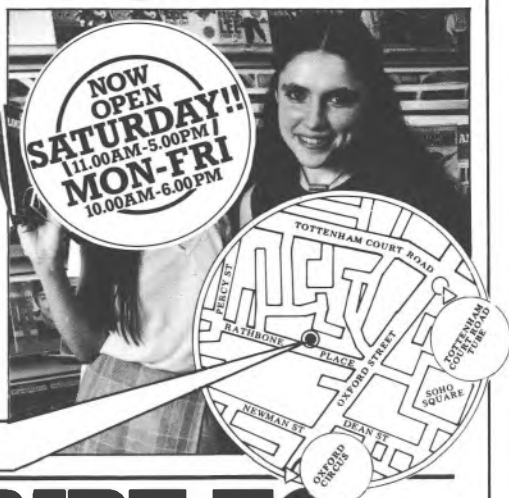
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TECHNICAL INTRODUCTION

The Technical Introduction is intended to explain in some detail the techniques used for the various measurements and some of the reasoning behind them. Much of the philosophy upon which the reviews have been based is already discussed in the *Consumer Introduction*, and will not be reiterated unnecessarily.

Each of the units under test have an implied common goal: to amplify any signal presented to any of the inputs by the gain setting of the volume control. Each particular unit's ability will be affected by many factors, some imposed by the its inherent performance, some by the external loads and sources, and some by any interface inconsistencies between the parts.

To assess any amplifier's abilities, it needs to be pushed to its physical and electronic limits in an effort to determine the performance extremities. This may seem a slightly unfair approach to testing a unit out, but in practice it is the only way to assess capabilities properly. In the lab we can vary at will any or all of the external influences on the amplifier. In the domestic 'use' situation we have very little control, and either input sources or output loads are substantially unpredictable.

No-one has yet shown conclusively how severely an amplifier is tested by the input and output demands, so we need to try and establish the performance limitations, and attempt to determine how these will influence the behaviour of the unit in a domestic environment.

In some circles it has been commonly believed for some years now that all amplifiers 'sound' the same at the same volume settings (output amplitude), provided that they are operated within their limitations (overload etc). In principle we do not agree with this, because it seems clear to us that an amplifier very rarely has the chance to operate under 'ideal' conditions. Almost all amplifiers have different transmission characteristics which influence the sound quality: our problem is finding out how to expose these.

Power

Amplifiers perform differently into different loads, and the power measurements are designed to show up technical points in the designs which may have some relevance to the final musical performance, and which will suggest what load impedances may be tolerated without distress.

One of the most difficult things to define precisely is the power output of an amplifier, and sometimes as many techniques as there are amplifiers appear to exist! As far as possible all our measurements were taken at distortion levels of 0.1%, which more closely approximates the

threshold of clipping than the 1% point that has frequently been used in the past. This does tend to result in a more severe test at the frequency extremes, where distortion tends to be greater, so amplifiers that show an apparent power drop at these frequencies (20Hz and 20kHz) *ref* the available power at 1kHz may merely be indicating an increase in the relative distortion. In a few stated instances it was necessary to relax the distortion criteria in order to get a sensible measurement, and this has been noted where appropriate.

Before carrying out power measurements, the unit is allowed to warm up to normal operating temperature. But when the power measurements are being made, the local temperatures internally may be expected to increase somewhat. This in turn tends to increase distortion slightly, hence reducing the power output for our specification 0.1%. It can be seen that there must be a margin of unpredictability which cannot be closely controlled here.

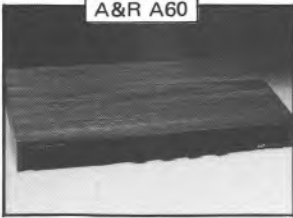
The 'prime' measurement of the amplifier's output power is considered to be the power developed across a heavy duty 8ohm resistor with both channels driven to 0.1% distortion at 1kHz, supplemented by similar measurements taken at 20Hz and 20kHz. Distortion residuals were examined on a 'scope to check for cross-over products, hum and instability. A further series of measurements were taken with one channel only being driven and with different loads, to examine first the extent to which the power supply is affecting the power delivery of the amplifier, and second to give an indication of the voltage and current relationship of the power output. The assessment of the power supply capability is not an exact one, as it can depend on other elements of the design, but the 'normal' single power supply amplifier which shows a large variation between single and dual channel drive clearly shows that each channel can be 'starved' to some extent when the other channel is driven to the limit; this will certainly affect the quality when the amplifier is driven hard, and possibly at all levels.

The decision to examine the amplifiers into a 2ohm as well as 4ohm loading was made in order to show the way in which the amplifier's power was delivered. Theoretically the amplifier should behave as a constant voltage supply, though for practical reasons it is designed to do this over specific load ratings. The 'theoretical' amplifier would therefore double its current and hence power each time the load impedance is halved, thereby requiring infinite current into a short

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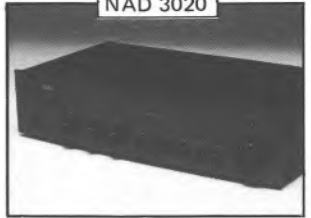
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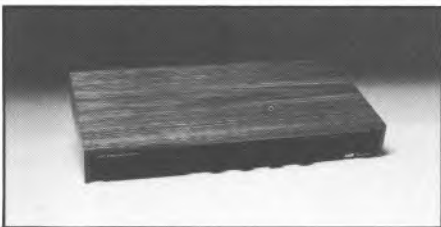
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circuit! While some designers claim this is an important end in itself for reasons of transient control, this is not yet proven and remains a minority opinion (perhaps partly because of the practical problems involved!) The normal and most cost effective approach is to assume that the speaker presents the amplifier with a fairly stable load corresponding to its impedance modulus, and then design the amplifier to produce its maximum power into this impedance area, while limiting the current available into lower impedances so as to avoid getting out of the safe operating area of the transistors and risking device failure.

Unfortunately even the 'static' impedance measure of loudspeakers gives quite a wide variation between models, and the amplifier designer has to decide what sort of load the amp is to be optimised to handle. By examining delivery into 8, 4 and 2 ohms, some indication of the amplifier's sensitivity to different impedances and the sort of impedance into which the amplifier is happiest working can be determined, so that a good combination can be chosen.

A rather more complicated power test was also undertaken in an attempt to get some understanding of the *transient* abilities of the amplifiers, *ie* the capability of producing large amounts of power in the short term, such as might be required for a music signal. Slow-acting limitations on the power amplifier will not operate under these conditions, and some indications of the design and operation of the protection circuitry can sometimes be deduced.

The test is carried out by passing a continuous 1 kHz signal through a gating system, which has been adjusted to pass a single cycle at a repetitive rate. This is fed into any line input, and the maximum peak-to-peak voltage developed across various load impedances is noted. The peak-to-peak voltages are converted to RMS, and from this the 'single cycle' power can be calculated.

Although we have retained 'watts' presentation on the grounds of general familiarity(?), we have added a conversion to dBV (voltage ratios) ref 2.83V on this occasion, and this represents the voltage developed across a load. If an amplifier behaves as an ideal 'voltage source', with unlimited current available, then this voltage will stay the same whatever the load. But the need to use practical electronic devices and keep them protected usually involves some form of current limiting. So that at some point when the load is being reduced, the amplifier starts to behave more like a 'current source', *ie* current becomes constant and the voltage starts to drop instead,

which is reflected in the results.

We would normally expect a high powered and expensive amplifier to have sufficiently rugged output transistors and a generous enough power supply to produce and handle considerable current, and so stay somewhere near the 'voltage source' ideal and cope with any load that it might encounter. One could perhaps draw an analogy with a very powerful car which may have poor chassis design, preventing the power being applied properly particularly under adverse circumstances (bumpy surfaces, corners etc).

The complete matrix of power measurements, when viewed as a whole, give a reasonably good idea of the power and delivery capabilities of the amplifiers.

The traditional method of presenting power uses 'watts' as the units, and in fact these are calculated by the formula which relates power with the measured voltage and the known load. However our hearing behaves in a logarithmic fashion, so it may be more realistic to show power measurements which are expressed on a logarithmic scale, such as dB levels above 1 watt.

$$ie \text{ dB level} = 10 \log \frac{P_2}{P_1}$$

where P2 is the power level to be expressed, P1=1 watt *ref*.

Alternatively the voltage developed across a load may be presented in dB *ref* 2.83V=0dB (2.83V=1 watt/8 ohms).

$$ie \text{ dB(V) level} = 20 \log \frac{V_2}{V_1}$$

where V2 is voltage level on load, V1=2.83V *ref*.

Most people will easily hear 3dB changes in power levels, as this represents a change by a factor of 2, *ie* a 3dB power increase over 100 watts is 200 watts. This is quite a large power change in engineering terms, so it can be seen that the log scale can cover a very large range in quite convenient steps, which relate reasonably well to the way we hear.

Noise

Following some of the recent IHF recommendations for standard test procedures a system of *reference levels* was adopted for noise measurements, and also in determining relative output levels. The noise levels are related to 2.83V across 8 ohms (equivalent to 1 watt), which represents 0dB, and are measured with the volume control in such a position as to produce this when driven from 5mV disc and 500mV input levels (and, where appropriate, 500uV *via* m-c disc input).

TECHNICAL INTRODUCTION

The source is removed to be replaced by a typical source input impedance relevant to the input in question, and the resulting noise developed across the load is measured with 'A' weighting in dB below *ref*.

In addition the noise developed with zero volume is also noted under the same basic conditions, to check out the power amplifier's contribution. This is of course nominally referred to the 1 watt level, though frequently manufacturers quote a figure related to the maximum power available. One merely compares the manufacturer's figure to the zero volume figure plus the maximum output developed by the amplifier (the dBV figure represents this).

Hum

Similar methods were used to measure hum, but this time the 'A' weighting was replaced by a narrow band filter of 10Hz width centred on 50Hz, 100Hz and 150Hz. Similar input loading was adopted. Rather than present further lists of figures the hum was summarised in a value judgement characterisation which relates to the average performance of the group as a whole, and any further qualifications deemed necessary are mentioned in the review text.

Inputs

Input (and output) impedances were measured using the Wayne Kerr 642 precision bridge and a digital impedance meter (EPI). Sensitivities were related to the continuous power outputs already established (both channels driven) and, with the volume control set to maximum, a 1 kHz signal from an appropriate source impedance was increased in level until the rated power was achieved. The disc inputs were further checked at 20Hz and 20kHz, and a sweep check made on the RIAA equalisation curve. The inverse RIAA network used for this sweep has a maximum deviation of 0.01 dB above 100Hz, -0.1 dB below 100Hz.

Checking of overload points was also carried out at the three disc sensitivity frequencies by reducing the volume control setting and increasing the input signal until a sudden onset of distortion indicating pre-amp overload was noted; the figure was converted to dBs *ref* sensitivity, and the figure for 1kHz has been published (others being mentioned if appropriate). Some random checking of high level inputs revealed that all were impervious to overload from signals up to 10V, so no further time was spent checking these clearly more than adequate margins.

Outputs

Output levels were related to the reference levels adopted for the noise testing, as it was felt that this would provide a sensible indication of typical domestic use conditions. The tape outputs were loaded by a 'worst case' 10kohms/1000pF for 'phono' sockets and those DIN sockets that were clearly designed to match 'phono' standards. DIN standard sockets were checked into 100kohm. Where checked, pre-amplifier outputs were loaded by 22kohm, representing a 'typical' power amplifier input impedance.

The headphone output was similarly related to this reference level, and the socket was loaded by two resistance values to represent the extremes found amongst commercial designs; this should give a fairly good idea of how the amplifier will drive different impedance 'phones when referred to a speaker terminal output of 1 watt (2.83V/8ohms).

Damping factor, DC offset

The damping factor was calculated by measuring the output voltage on a digital voltmeter both on and off load when driven to approximately 20 watt at 40Hz. The same equipment was used to check the DC offset values (taken and quoted if appropriate).

Harmonic distortion

THD plus noise is the rather more precise term which we are using in place of THD; the change has come about largely because harmonic distortion levels tend to be very low in many designs, and are frequently obscured by residual noise in the amplifier or measuring system. Spot measurements were taken with the ST 1700, with the residual monitored on a 'scope, at full power, 10 watts and 1 watt at 1 kHz and 20kHz. The figures have not been quoted, but a value judgement characterisation relating to the average of the test group has been derived, and any specific features considered relevant are pointed out in the text.

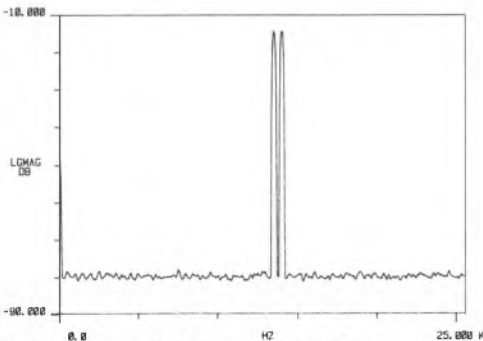
Intermodulation distortion

Music signals are very much more complicated than test signals, though they do not lend themselves to analysis. The intermodulation test attempts to go a little way towards simulating music conditions by examining the interaction of two tones. In music of course there are many tones and harmonics, continuously stopping, starting, and changing, so the IM test is really rather 'kind'.

Two separate tones of the same amplitude, quite close together in frequency, are passed through the amplifier, with the results recorded spectrally. The frequencies used were 13.5 and 14kHz, at an amplitude of 1 watt equivalent. The published spectrograms have a vertical resolution of 90dB (+10 - -80dB), covering a linearly presented frequency range of 0-25kHz.

It was not until we had finished all the lab work and broken down the test setup that we realised a limitation, related to the display resolution, and hence the discrimination of the spectrum analysis when used across such a wide frequency range. It is easy enough to be wise after the event, it is less easy to re-test 50+ amplifiers which are now at the other end of the country. So regrettably we were unable to do 'fine resolution' work on the complete test group. But we have carried out extra tests on a small sample of the units to show something of what we missed. This is discussed and illustrated in the *Conclusions* section of the project. A spectrogram of the two tone signal is shown here, plotted directly from the B&K 2010 signal generator without an intermediate amplifier.

It can be seen that quite a lot of the amplifiers do not show distinct intermodulation sidebands corresponding to sum and difference products, but rather show a significant apparent rise in noise, which we have dubbed a 'noise modulation effect', either side of the test signals. It appears that this is at least partly a result of the insufficient display discrimination referred to earlier, but that the rise in noise is probably indicative of some 'hidden' intermodulation products. For further information please refer to the *Conclusions*.



IM spectrum of B&K generator alone

Bandwidth

With the B&K 2010 as signal source and measuring amplifier, a sweep was made at -3dB ref the max

power at 1kHz to determine the total pass bandwidth of the amplifier, concentrating on the disc input, but also checking the other inputs. This can prove something of a stern test for the amplifier, by generating a lot of localised heat at the transistors, particularly when the bandwidth is rather wide.

Any evidence of waveform triangulation within this bandwidth was noted, as this is indicative of slew limiting, a form of distortion that is generally considered to be undesirable. Slew problems can be observed by this means but they are not easy to pin down to a precise cause without examining the amplifier internally stage by stage, and may be introduced in power amplifiers, pre-amps or internal interfaces within the amplifiers. We have commented on slew limiting in the review text where relevant.

Crosstalk

Both channels were driven to an output of 1 watt, and then the input to one channel was removed and replaced by a 1 kohm source; the output from this channel was then recorded while the other was swept from 20Hz to 20kHz via the moving magnet disc input (via inverse RIAA).

Listening tests

Amplifier listening tests are a difficult and controversial area, which has a rather poor track record in terms of the reliability of results. We remain quite confident that our results have some meaning and are worthwhile, but it is necessary to add some rider clauses explaining various constraints and limitations, and the reasons behind the techniques and choices made.

The main technique which we use to check the reliability of our findings is to carry out four complete listening tests, and attempt to correlate the results in terms of descriptive comments and consistency of value judgement. Two of these tests are done completely 'blind' in order to avoid any bias from prior knowledge, or prejudice for or against any machines, while two other tests are carried out 'hands on', as an essential part of getting the 'feel' of the products at different volume levels etc.

Perhaps the most difficult problem is choosing the ancillary equipment for the tests, because this is bound to affect the findings somewhat, and it is almost impossible to be quite sure exactly how the more subtle compatibility interactions may influence value judgements.

The first standpoint (which is itself somewhat controversial) was to use disc sources exclusively.

TECHNICAL INTRODUCTION

This is because we firmly believe the LP disc is THE prime source for hi-fi in the home, is repeatable (unlike an FM broadcast), and has its own special problems which the amplifier has to sort out.

In order to avoid gross frequency response aberrations arising from disc/pre-amplifier interactions, most of the tests had to be carried out using cartridges which were relatively immune to capacitance loading variation. This is largely immaterial with moving-coil types, but needs some care with moving magnet cartridges. In the event we used the load-independent Technics *EPC205CIII*, plus the ADC *VLM Illimp* and *ZLM imp* models (which are more affected by load variations but usually only to the extent of a mildly falling treble at higher capacitances). Moving-coils were predominantly the Linn *Asak* and *Asak T*.

On grounds of personal preference and dynamic range the *Sondek LP12* turntable was used, with *Ittok*, *Basik* and Breuer *Dynamic* tonearms, according to the cartridge being used. It could be argued that a cheaper more typical turntable would perhaps give more representative results with the cheaper amplifiers, though our feeling is that it would merely give them a harder time (and the panelists likewise). There remains the dilemma that a poorer less well controlled signal source may not only give an amplifier a more difficult job, but it will also mar discrimination by its own inherent limitations.

The toughest decision of all is which loudspeakers one should use. There is no such thing as a speaker which does everything well. Most of the better sounding designs can be attacked on grounds of having a 'difficult' and hence possibly unfair impedance characteristic, and all designs have readily identifiable strengths and weaknesses. In the end we investigated the Quad *ESL63*, the Rogers *510*, and Mission *770*, but settled for Linn *Isobarik* and *Kan* and Spendor *SA3* designs. We could doubtless spend a page or three debating this in more detail, but the important trade-offs include balancing bandwidth, dynamic range, sensitivity/impedance, stereo abilities, and room suitability. Some care needs to be taken with loudspeakers like the *Isobarik* to ensure that their low impedance does not cause any of the amplifiers any trouble. But we can point out that provided a little care is taken to keep the overall levels low (made possible by the reasonably high sensitivity of the design), apparently unpromising models like the *A&R A60* and *NAD 3020* can be seen not to suffer in the least, and indeed perform well.

The big Spendor *SA3* has both a high sensitivity and high impedance, so no apparent problems here. But in a recent amplifier test in *Hi-Fi News* (Colloms), it was found that the Threshold amplifier did not audition well with a loudspeaker design which combined the bass and midrange in one reflex loaded drive unit, yet it did fine with separate bass and midrange drivers in a sealed box design. This difference was perhaps due to an excessively extended LF bandwidth causing midrange intermodulation in the former loudspeaker, under such conditions the 'bandlimited' *isobarik* is likely to give less problems than the *SA3*.

Such arguments can be extended to any loudspeaker design, and none is without its own peculiarities. In the end it is important to choose something with which the panel is happy, to avoid unnecessary fatigue and any irrational desire to hurl the speakers from the balcony at the end of the day. We have invariably found that although the loudspeaker influences the overall character of the sound of course, it does not tend to affect the relative performance of the different amplifiers too much. Rather it may change the degree with which different things upset the panelists, and to some extent how some aspects of performance are masked and others emphasised.

Discs were used throughout, as mentioned previously, and the only criteria for the selection of test pieces were that everybody liked the sound of them, and that they gave a reasonable spread of different types of music. This in turn implied that they were all analogue recordings, because none of us like the sound of digitally recorded music, and that they were 'normal' rather than 'audiophile' pressings for the same reason (ie half-speed masters were excluded because they sound worse than normal cuts in our experience).

We made a particular effort to include some 'real' stereo classical recordings, made with simple microphone techniques, because these at least have some basis in reality. And it is perhaps no coincidence that our personal preferences in classical recordings still go back to the early 'sixties, in the days before multi-track recordings. At the same time, recognising that music is not all classical, each listening session included rock type program which tends to place quite different demands upon the reproducing chain.

The listening tests included extracts from the following items:

Paganini violin concerto 1, Perlman RPO, EMI.

TECHNICAL INTRODUCTION

Elvis Costello, New Lace Shoes, from Trust.
Mahler Symphony No 2, Solti LSO, Decca.
Mahler Symphony No 5, Barbirolli NPO, EMI.
The Kinks, Misfits, from Misfits.
B52s, Lava, from Party Mix.
Siouxie and the Banshees, Christine, from
Kaleidoscope.
Mendelssohn, Scottish Symphony, Maag LSO,
Decca.
Van Morrison, Madam George, from Astral Weeks.

Recommended

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Akai AMU 11

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Presentation, facilities etc

This is a very low cost design from a brand new Akai range. It is amongst the slimmest units on the market, and is finished to a very high standard. The fascia has a slightly sculptured look which on first sight gives it an 'exclusive' air; closer inspection reveals it as a plastic moulding rather than a metal plate, though not necessarily any the worse for that! The styling is dominated by 'swinging needle' meters, unusual in these days of flashing lights. Though they have something of a nostalgic appeal, there is no doubt that they are usually inferior to inertialess LED types. But then we have yet to see any convincing justification for the fitting of metering to amplifiers in any case.

The single large knob controls volume, with a concentric ring fitted for adjusting balance while the two small knobs alter tonal balance. Sadly there is no centre indent to help verify that the tone controls are set flat, let alone a bypass or cancel switch. The larger pushbuttons select disc, tuner, aux and connect power, while the smaller buttons give loudness, mono/stereo, and tape monitoring. The back panel uses phono sockets throughout, though DIN duplication is provided for tape.

Lab performance

The lab performance of this unit unfortunately serves merely to reflect its very low price, with THD fairly high at all frequencies despite the modest power output. Twenty watts or so a channel sounds very little, but is in fact quite adequate for the majority of domestic situations provided very high levels are not required, and with the warning that the most insensitive speaker models should be avoided. However the

delivery pattern was not particularly encouraging, suggesting that the power supply is something of a limiting factor, with very little level available into low impedances and quite a large percentage difference between single and dual channel drive. The slight restriction in power delivery at frequency extremes is indicative of an early rise in distortion here.

Bandwidths show a sensible attempt to control low frequencies on the disc input, but no such caution as far as high frequencies are concerned. The disc RIAA equalisation is rather too inaccurate, and this will certainly introduce audible coloration, while a lack of close component QC is perhaps emphasised by the nominal 47k Ω input impedance measuring out at 56k Ω . The capacitance figure of 127 pF is fine for matching purposes, and no compatibility problems seem likely to occur on any of the inputs and outputs. Noise figures were adequate enough, if a little below average, but hum was also below average, the crosstalk was barely adequate (being only -30dB at 5kHz and down to -20dB at 15kHz), while the IM distortion spectrum shows a significant difference product at 500Hz. All in all this is not a particularly inspiring performance.

Listening impressions

It is difficult to make a meaningful appraisal of this amplifier *via* the disc input, because results are almost bound to be heavily influenced by the RIAA equalisation error. All too common were comments of 'no bass, too much treble', and slightly less polite descriptions amounting to much the same thing. The sound quality was placed well below average, with criticism of some treble 'splash', a generally rather muddled sound

particularly in loud passages, and a bass that was qualitatively as well as quantitatively found wanting.

Conclusions

In our view the compromises evident in this design are too severe to regard it as a real hi-fi amplifier. Granted the price is competitive, and the appearance attractive, but there must come some point where hi-fi criteria no longer really apply and one is entering an 'audio' product market, whatever the presentation or marketing approach. And this is the category into which we feel the AMU 11 fits more comfortably.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 19/23/21 Watts
 o/p level ref 2.83V=0dB 12.8/13.7/13.2dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 28/35/30 Watts
 o/p level ref 2.83V=0dB 14.5/12.5/8.8dB
 Single cycle power 1kHz, 8/4/2 ohms. 36/55/56 Watts
 o/p level ref 2.83V=0dB 15.6/14.4/11.5dB
 Dynamic headroom (IHF) 0.7dB

Bandwidth (-3dB below half power)

Disc in - power out 19Hz - 100kHz
 Disc in - tape out 18Hz - 136kHz
 Aux in - power out 5Hz - 54kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.8	56k	127
Tuner/Aux.....	Phono	140	76k	
Tape 1.....	Phono	140	91k	
Tape 1.....	DIN	140	91k	

Disc overload MM..... 35dB

Outputs (5.0mV disc input)

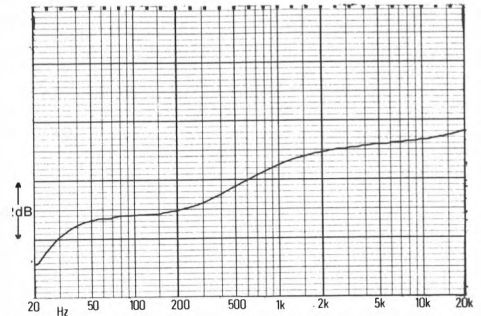
	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	260	24
Tape 1.....	DIN	28	77k
Headphones (8 ohms).....	Jack	120	
(2 kohms).....		2.7V	

Noise (ref 1 Watt, 8 ohms)

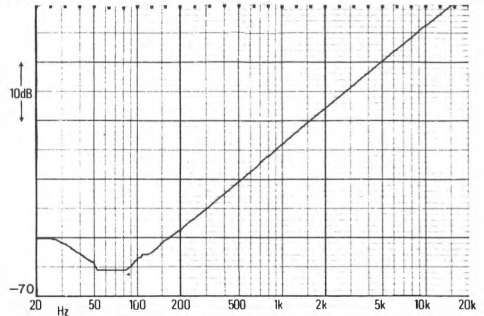
Zero volume -83dB
 Aux ref volume -76dB
 MM disc ref volume -74dB

Other

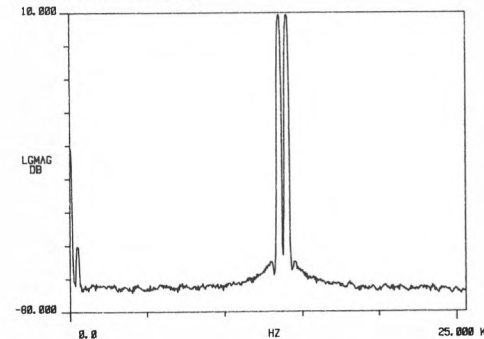
Damping factor 38
 THD performance average
 Hum performance below average
 Dimensions (W x D x H) 17¼(44) x 13(33) x 3(8) ins (cms)
 Weight 12lbs
 Typical purchase price £60



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Akai AMU 33

Akai UK Ltd., Unit 12, Silver Jubilee Way, Haslemere Heathrow Estate, Parkway, Hounslow, Middx. Tel 01-897 7171



Presentation, facilities etc

Not quite the bottom of Akai's expensive range, the AMU33 is still firmly in the budget amplifier market. The standard of external finish is very good indeed, though the overhang of the sharp-cornered fascia suggests that it is primarily designed for rack/console mounting. This is a fairly simple design in terms of the facilities offered, though it would appear to be quite versatile enough, and the general lack of clutter can only make it easier to use.

The large rotary knob controls volume, and has the stepping action that was *de rigueur* a couple of years ago, but which now seems to have fallen out of fashion (it was always more of an inconvenience than a benefit). The main styling feature is a large 'power' meter, accompanied by a range change switch (so you can keep it flashing away when you're playing the music quietly). Two smallish rotary controls adjust tone, while balance is on a concentric ring with the volume. A row of identical illuminating push-buttons switch the inputs, with tape monitoring and cross-dubbing, stereo/mono and loudness facilities. The rear panel has phono sockets exclusively, including two pairs for inserting an equaliser or some such device between pre- and power amplifier sections.

Lab performance

We measured a respectable 50 watts a channel (near enough) from this modestly priced model, although there is some restriction on delivery into 4 and 2ohms. However speaker matching should not be any problem, as facility for one pair of speakers only is provided. The difference between single and dual channel drive is quite

significant, suggesting some limitations in the power supply, but the power was well maintained at the frequency extremes, with distortion staying low throughout.

The important disc bandwidth shows quite sensible control at high and low frequencies, but the RIAA is not quite as flat as we would have liked, and is probably out enough to cause slight tonal coloration. The disc input is sensibly low at 130pF, facilitating cartridge matching. The remaining inputs and outputs are reasonably typical and suggest no compatibility problems with other equipment. Though harmonic distortion was excellent and noise figures pretty good, hum and crosstalk were both below average, likewise the IM sidebands, though in the latter case the 'noise modulation effect' is quite slight. Considering the price of the unit, it is commendably free of significant technical limitations, while offering some room for improvement nevertheless in a number of areas.

Listening impressions

The listening tests did not give particularly encouraging results for this model, though it was by no means strongly criticised like its smaller brother. The problem seemed to be that the amplifier worked fairly well when quiet, with nice separation and fairly good bass, but started to deteriorate significantly when working harder, the high frequencies becoming unpleasantly aggressive, the sound becoming more confused, and the bass rather 'light'. The overall rating was a little below average.

Conclusions

This is a neat well-finished amplifier with sound

enough technical performance and adequate power at a very modest price. Unfortunately it did not get good reaction in the listening tests, the main difficulty for the panelists being the sound quality at higher levels (where in fact many other designs also received criticism). It is in fact quite difficult to dismiss what is in many ways a well-balanced design, but we must take our subjective findings into account, while inviting potential purchasers to refute them for themselves!

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 49/49/48 Watts
 o/p level ref 2.83V=0dB 16.9/16.9/16.8dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 57/86/88 Watts
 o/p level ref 2.83V=0dB 17.6/16.3/13.5dB
 Single cycle power 1kHz, 8/4/2 ohms 72/124/138 Watts
 o/p level ref 2.83V=0dB 18.6/17.9/15.4dB
Bandwidth (-3dB below half power)
 Disc in - power out 10Hz - 60kHz
 Disc in - tape out 13Hz - 200kHz
 Aux in - power out 3Hz - 50kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	3.8	48k	130
Tuner/Aux.....	Phono	180	90k	
Tape 1.....	Phono	180	100k	
Tape 2.....	Phono	180	100k	
Power amp.....	Phono	1.1V	32k	

Disc overload MM..... 35dB

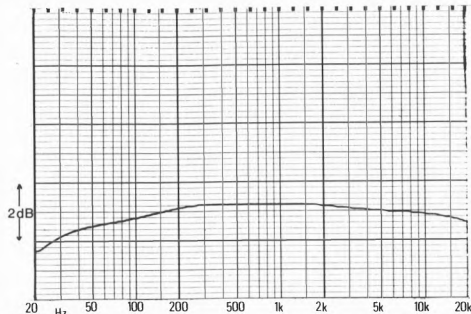
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	200	1.3k
Tape 2.....	Phono	200	1.3k
Headphones (8 ohms).....		50	
(2 kohms).....		1.3V	

Noise (ref 1 Watt, 8 ohms)

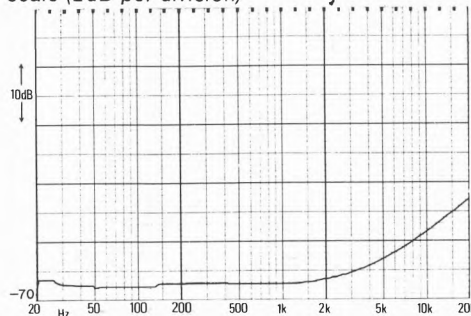
Zero volume -86dB
 Aux ref volume -78dB
 MM disc ref volume -78dB

Other

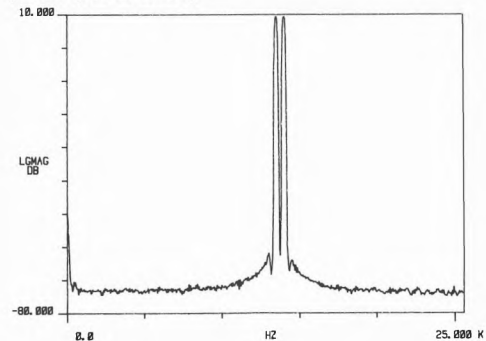
Damping factor 50
 THD performance excellent
 Hum performance below average
 Dimensions(W x D x H) 17½(44) x 13(33) x 4(10) ins(cms)
 Weight 18lbs
 Typical purchase price £110



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz. 0-25kHz linear; vert. range 90dB)

Amcron SA2/DL2

HHB Sales, Unit F, New Crescent Works, Nicoll Road, London NW10 9AX. Tel 01-961 3295



Presentation, facilities etc

It is difficult to do justice to this extremely elaborate system within the space allotted for a *Choice* review. In addition to the huge pre-and power amplifiers (the latter massively constructed so that the former feels a trifle flimsy by comparison), there is a smaller pre-amp power supply, which demands console mounting, plus two little 'outboard' disc input modules, one for moving magnet and one for moving-coil matching, also powered from the pre-amp supply. Interconnect cables and a wooden console case were supplied, the former being rather unusual combinations which should not be lost!

The pre-amp is really much closer to a professional mixer than a hi-fi component, and has the capability for external computer control, as all the main functions are electronically operated. A row of phono inputs are all at line levels, and matched by a row of jack socket outputs: this allows control and mixing of up to nine separate inputs and two main outputs, with additional mono, inverted, stereo, tape, processor, and buffer outputs. Three tone controls per channel act more like equalisers, though the Q is not particularly high, and each may be centred on one of three different frequencies. Four positions of high and low pass filtering have a fairly steep 18dB/oct attenuation, and a variable loudness contour is the main central rotary control. Volume and balance are digitally switched over 63.5dB in 0.5dB steps, using six pushbuttons and two large LED displays; alternatively this can be set once and for all, and loudness (with compensation) used instead. The three dual-concentric rotaries on the mixer section permit considerable flexibility in stereo image jiggery-pokery. A number of

similar pushbuttons control tape recorder routing and defeat for tone and filters, while jack sockets power headphones (2) and allow front access for a tape recorder.

The power amplifier can be used stereo or 'bridged mono' (over a kilowatt into 4ohms here), and has a permanently operating fan for cooling. Independent volume control rotaries for each channel and an on/off switch are on the front, with a 42dB range LED display of some subtlety. Difficult to distinguish switches on the back panel give stereo/mono, 'low frequency protect' and 'delay', the latter protecting against switching transients, and the 'low frequency protect' against sub-10Hz signals. The elaborate protection circuitry uses analogue computations based upon the safe operating areas (SOA) of the output devices, in order to get the most from these transistors while still keeping a watchful eye on them.

Lab performance

Power output at around 280 watts per channel is very high, showing only a slight difference between single/dual channel, as two separate high voltage supplies are used. Surprising that we measured any difference between channels single/dual channel, as two separate high voltage supplies are used.

Bandwidths are rather on the wide side through-out, unnecessarily so we feel, and considering that each of the phono modules cost more than the average price of the amplifiers in this project we might have expected flatter RIAA equalisation. However their technical performance is rather good, though construction might have been neater and 'fine tune' capacitance on mm would

have been appreciated instead of the 49/98kohm option offered. Crosstalk was reasonable, but could have been better with the type of volume control used had it not been for the mixer/blender circuitry. Distortion performance was good, and the IM spectrum showed no separately distinguishable components but a fair amount of the 'noise modulation effect', while the hum performance was only average. Construction of the power amplifier was excellent, but the preamp did not seem to be quite as well built or laid out, and its case marked rather easily, while the wooden console unit was also a little flimsy.

Listening impressions

One is forced to enter into an emotional relationship with the pre-amp and the manuals in order to get this set-up to work, and the attendant frustration perhaps prejudiced 'hands on' listeners somewhat against the system. Here results were a little above average, whereas 'blind' scoring was significantly higher still, well above average, and amongst the best in the project. This does go some way towards justifying the exorbitant price, and is a creditable result for such a powerful amplifier. Balance was a little on the bright side, but bass and dynamics were good, with a notable lack of 'stress'. Interestingly, the bass was described as 'very odd' at first, until the 'wee switch' on the back giving 'low frequency protection' was discovered and switched off, whereupon things improved markedly.

Conclusions

Despite some scepticism when first confronted by this beast, we have to admit that it went a long way towards delivering the goods, at any rate as far as the power amplifier was concerned (a slightly cheaper professional version is also available, without the complex level indicator circuitry). The pre-amp was rather less to our taste, seeming to compromise things rather with extravagant complexities, while not offering some of the more useful facilities like variable capacitance on the mm disc module or variable impedance on the m-c module. Furthermore the volume control is difficult to use: could Crown not have given us a shaft-encoded single large rotary? Though flexible in many ways the pre-amp scores poorly on ease of operation. Overall we don't feel able to recommend this combination for normal domestic hi-fi use, particularly at its very high price and with the noise of the cooling fan to contend with. But for specialised applications where price is no disincentive it may well be worth considering. The power amplifier looks a strong proposition in its own right, and is much more competitive on price.

GENERAL DATA

Power stage

Both channels 20Hz/1 kHz/20kHz	277/289/280 Watts
8 ohms, 0.1% dist	24.4/24.6/24.5dB
o/p level ref 2.83V=0dB	
Single channel 8/4/2 ohms	295/494/733 Watts
1 kHz, 0.1% dist	24.7/23.9/22.7 dB
o/p level ref 2.83V=0dB	
Single cycle power 1kHz, 8/4/2 ohms	351/665/840 Watts
o/p level ref 2.83V=0dB	25.4/25.2/23.2dB
Dynamic headroom (IHF)	0.4dB

Bandwidth (-3dB below half power)

Disc in - power out	2.5Hz - 113kHz
Disc in - pre out	2Hz - 200kHz
Disc in - tape out	2Hz - 103kHz
Aux in - power out	DC Hz - 106kHz
Power amp only	DC Hz - 111kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	0.7 - 9*	48/97k	30
Disc MC	Phono	.07 - .7*	100	
Tuner/Aux	Phono	235	85k	
Tape (1, 2, 3)	Phono	235	85k	
Power amp	Phono	2.4V	25k	

Disc overload MM	33dB
Disc overload MC	34dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape (1, 2, 3)	Jack	500	500
Headphones (8 ohms)	Jack	220	
(2 kohms)		220	

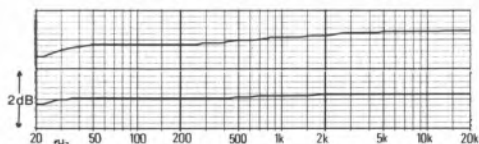
Noise (ref 1 Watt, 8 ohms)

Zero volume	-90dB
Aux ref volume	-88dB
MM disc ref volume	-86dB
MC disc ref volume	-86dB

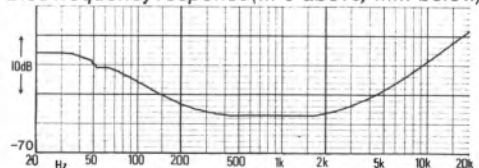
Other

Damping factor	785
THD performance	good
Hum performance	average
Dimensions (W x D x H)	large and complex
Weight	very heavy
Typical purchase price	£3000

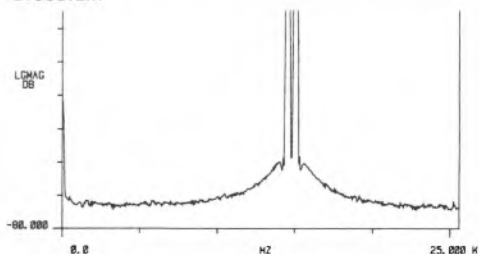
*Continuously variable.



Disc frequency response (m-c above, mm below)



Crosstalk

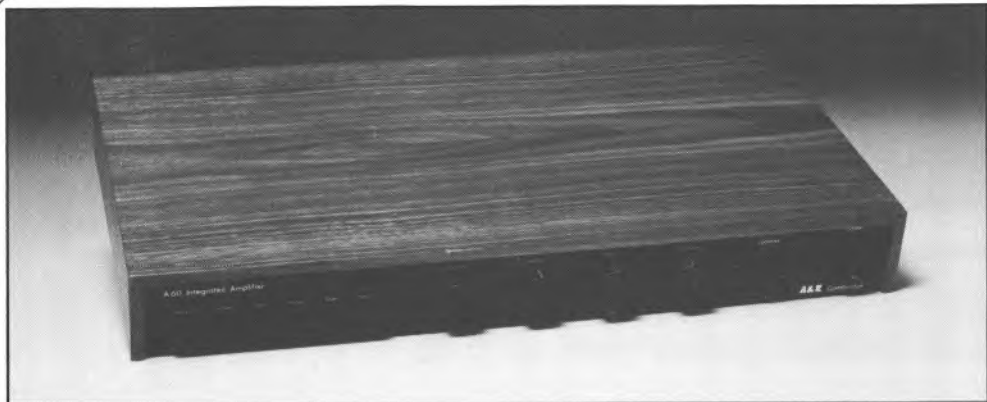


Intermodulation distortion spectrum

BEST BUY

A&R A60

A&R Cambridge Ltd., Denny End Industrial Centre, Waterbeach, Cambridge CB5 9PB. Tel (0223) 861550



Presentation, facilities etc

Such is the mayfly existence of most hi-fi equipment, this is now an old favourite, coming round for its third assessment by this *Choice* team. Yet I recall it is only five years ago that I was saying rude things to the designer about the original prototype (and he was saying rude things about my ears!) Individualistic in a number of ways, the A60 is unusually well domesticated with its attractive walnut sleeve and discreet fascia styling. It is perhaps a trifle wide for its height, looking better when stacked with the matching tuner, while the lack of differentiation between the knobs and buttons does not make it the easiest unit to use.

The four identical knobs control volume, balance, bass and treble, and there is no centre indent or tone defeat switch to ensure the latter are operating 'flat'. The six pushbuttons select the inputs, mono/stereo, and (unspecified but the manual says high) filter (bass roll-off is a fixed part of the design). A large rocker switch operates on/off, beside which a headphone socket can be used with or without speaker muting. The back panel has DIN sockets throughout (adaptors available), though in fact tape conveniently masquerades as a phono and aux as a DIN input/output set. Three speaker terminals are provided for each channel, giving the option of connecting speakers direct with no switches in the high level signal path, or of routing the signal via the headphone socket's mute facility. A head amplifier is available which plugs into the disc input, taking its power from the amplifier. All disc inputs offer flexibility in cartridge loading.

Lab performance

Power is fairly restricted, though adequate for

most domestic applications nevertheless, and a significant improvement on our earlier findings (probably attributable to improved distortion performance). Delivery into low impedances is fairly restricted, somewhat more so under steady state conditions than when we last tested the unit, so a little care needs to be taken to avoid the lowest impedance loudspeakers. THD has been improved, though it only rates average compared to the latest Japanese designs.

Bandwidths are deliberately tightly controlled, with the nicely tailored bass roll-off acting quite quickly below 50 Hz, while the RIAA is reasonably flat. Crosstalk has been dramatically improved over our earlier samples, and is now better than -35dB everywhere and better than -70dB at low frequencies. The IM distortion spectrum shows one noticeable sideband, though the 'noise modulation effect' is noticeably better than in many other designs. Noise figures are slightly below average, hum is very good (another significant improvement), and inputs and outputs are very versatile. In fact apart from any philosophical objections to the band-limiting employed, and the slightly limited power delivery (one of which helps protect the other we feel), there are really no grounds for technical criticism of this model.

Listening impressions

Once again the listening impressions gave unusually positive reactions to this amplifier, tending further to confirm the findings of the two previous occasions. The fundamental reason appears to lie in the fact that the amplifier always seems to stay in control even when working quite hard, and as a result sounds more coherent than many

more pretentious models. The praise is not unqualified, however, and the high frequencies are again singled out as this amplifier's weakest attribute, as these can sound 'untidy' and a little over-emphasised. But on balance results are fine for the price, with praise of stereo, dynamics, tonal balance and 'focus', with more information than usual. The Integrated Amplifier of its title is rather apt.

Conclusions

Showing only a modest (and recent) price increase over the years, the A60 continues to improve technically and audibly, and sets a high standard as a well-balanced and well-domesticated package at a competitive price. A&R have also now had a chance to establish a good reputation for reliability and after sales backup, so it was a trifle frustrating that their new pre/power combination had only just reached its final prototype stage around the same time as this book!

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 41/44/39 Watts
 o/p level ref 2.83V=0dB..... 16/16.4/15.9dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist..... 52/48/18 Watts
 o/p level ref 2.83V=0dB..... 17.1/13.8/6.6dB
 Single cycle power 1kHz, 8/4/2 ohms..... 64/95/25 Watts
 o/p level ref 2.83V=0dB..... 18.1/16.8/8dB
 Dynamic headroom (IHF)..... 0.34dB

Bandwidth (-3dB below half power)

Disc in - power out 20Hz - 50kHz
 Disc in - tape out 19Hz - 160kHz
 Aux in - power out 6Hz - 40kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	DIN	2.0	48k	120
Disc MC.....	Phono	85/100uV	*	
Tuner/Aux.....	DIN	100	49k	
Tape.....	DIN	100	47k	

Disc overload MM..... 36dB

Disc overload MC..... 36dB

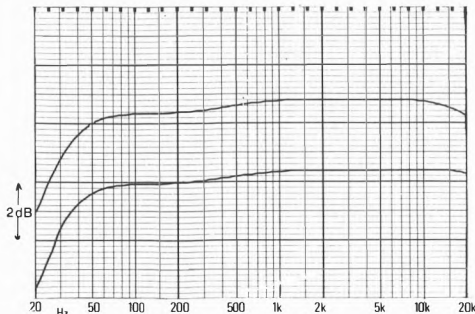
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape.....	DIN	150	5k
Aux.....	DIN	115	104k
Headphones (8 ohms).....		64	
(2 kohms).....		1.0V	

Noise (ref 1 Watt, 8 ohms)

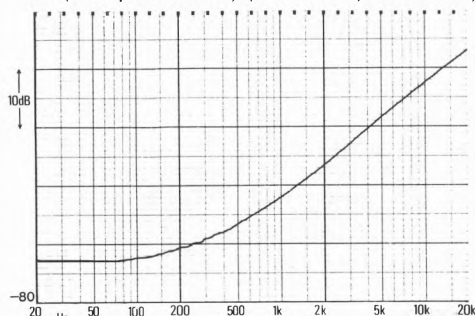
Zero volume -85dB
 Aux ref volume -83dB
 MM disc ref volume -78dB
 MC disc ref volume..... -75dB

Other

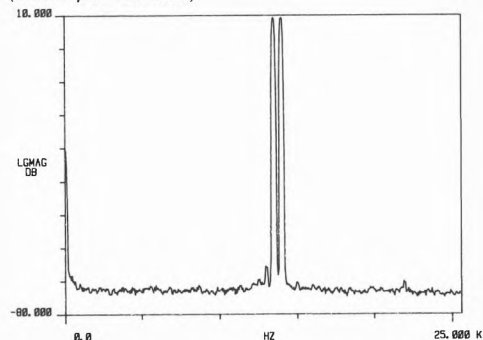
Damping factor 62
 THD performance..... very good
 Hum performance..... excellent
 Dimensions(W x D x H) 18(45) x 2½(6) x 10(26) ins(cms)
 Weight 10lbs
 Typical purchase price £190



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Aurex SC-M12/SY-C12

(revised and reprinted)

Toshiba (UK) Ltd., Toshiba House, Frimley Road, Frimley, Camberley, Surrey GU15 5JJ. Tel: (0276) 62222



This review has been adapted from that which appeared as a tuner/amplifier combination, shown in the photograph. Some care should be taken in comparing value judgements with those for the latest tests.

Presentation, facilities, etc.

This is effectively the middle combination in the Aurex/Toshiba micro-component range. Higher priced and more sophisticated components also exist in a similar format, allowing a variety of permutations, and including tuners and cassette decks. The elegant ultra-compact styling and 'jewellery' finish invariably draws favourable comment.

The pre-amplifier has phono socketry through-out apart from a mixable mike jack on the front panel; concentric volume and balance, traditional tone controls, switchable loudness and tape monitoring for two machines complete the list. The power amplifier includes a headphone socket and permits switching between two sets of speakers. Although fairly basic in terms of facilities, the simplicity prevents clutter and will satisfy most people. In our opinion this delightful-looking combination deserves better than relegation to the bedroom or second-system role that some marketing people have implied should be its place.

Lab performance

The fairly modest power output came quite expensive, showing modest single/dual channel difference, but restricted availability into low impedances. Disc input bandwidth was fairly well controlled, but had rather high capacitance for

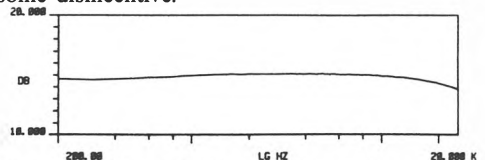
matching some cartridge/arm combinations, while frequency response showed some variation from flat, though disc overload margin was exceptional. Other inputs/outputs seemed fine, while IM distortion was below average and hum and damping factor well below average.

Subjective impressions

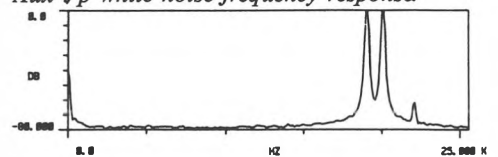
Sound quality was encouraging, with comfortably above average results, liked for good detail, information and integrity, but with criticism of bright (but nice) high frequencies and some 'untidiness'.

Conclusions

This model does perhaps merit consideration for applications where its styling and compactness holds particular appeal. Listening tests give quite positive results, though power is a little restricted for the price. The disc input capacitance remains some disincentive.



Aux i/p white noise frequency response.



IM distortion.

GENERAL

Power
 Bandwidth (-3dB ref max power, disc)..... 12Hz-46kHz
 Both channels 20Hz/1 kHz/20kHz (8 ohms, 0.1% dist) ... 32/35/33 Watts
 Single channel 8/4/2 ohms (1kHz, 0.1% dist) 40/39/33 Watts
 Burst power 1kHz, 8/4/2 ohms 45/59/42 Watts

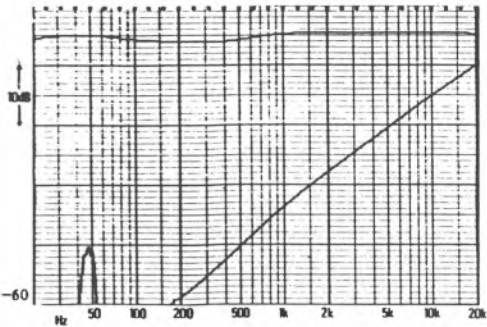
Inputs	<i>Type</i>	<i>Sens (mV)</i>	<i>Imp (ohms)</i>	<i>Cap</i>
Disc MM	Phono	1.8	46k	300pF
Disc MC	—	—	—	—
Tuner/aux	Phono	130	35k	—
Tape	Phono	120	39k	—

Disc overload 1kHz..... 45dB

Outputs (5mV disc)	<i>Type</i>	<i>Level (mV)</i>	<i>Imp (ohms)</i>
Tape	Phono	215	5k
Headphones (8 ohms)	Jack	75	—

Noise (ref 1 Watt, 8 ohms)
 Zero volume..... -81dB
 Aux ref volume..... -75dB
 Disc ref volume..... -77dB

Other
 Damping factor..... 24
 THD performance..... good
 IMD performance..... below average
 Hum performance..... well below average
 Typical retail price..... £246



Disc v/p frequency response/crosstalk.



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Bryston 2B/3B

KJ Leisuresound, Bridle Path, Watford, Herts. WD2 4BZ. Tel Watford 33011



Presentation, facilities etc

These mean-looking power amplifiers from Canada are being imported by the well known London dealer KJ Leisuresound, but are also available to other dealers. At present the importers are concentrating upon the power amplifiers, so this review combines two of these, and naturally the results will depend somewhat upon the choice of a partnering pre-amplifier. (Pre-amp performance probably accounts for rather more than 50% of the subjective characteristics of an amplifier, in our estimation, while the interface between pre-and power, with bandwidth matching and the like, can easily be another 25%).

Both units are uncompromisingly matt black, with sharp edges and protruding heatsinks (3B) and fascias that virtually demand console mounting. Both have an unusual heavy duty coiled cable (a la telephone handset), which may be convenient but does risk the induction of hum into other components, so some care may be needed in siting. Massive construction suggests that these amplifiers are built to last. LED indicators are used for clipping on each channel and to indicate 'power on', though strangely the 2B does not have an on/off switch. Each has rugged speaker terminals on the rear, and a switch for

mono 'bridged' operation (we did not test this option). The 3B is equipped with power supply fusing. The accompanying literature shows that Bryston have tackled many of the aspects which are believed to affect power amplifier performance, notably in offering high slew rates and output stages and protection which should be unaffected by loudspeaker impedance characteristics.

Lab performance

The 2B gave over 60 watts per channel into 8ohms, with the channel independence ensured by the twin supply, and with generally good delivery into low impedances. This was slightly constrained into 2ohms, steady state, but well maintained for the 'single cycle' transient test, though the difference between these is fairly large. Bandwidths were rather wide, though not excessively so for a power amplifier, and the input sensitivity and impedance should be an easy match for many pre-amplifiers. Harmonic distortion and crosstalk were well down into the noise floor of the amplifier, and although there is some evidence of IM sidebands, the 'noise modulation effect' is notably absent. Hum was only average, and the 'air cored inductor' effect of the mains lead needs watching, and should be

kept away from pre-amps and signal leads. The connectors were rather close together for convenience, and it was difficult to tighten the speaker terminals properly.

The 3B gave a similarly high standard of technical performance, with a power rating approximately double that of the 2B, at 130 watts per channel, and with a more or less identical delivery pattern. In nearly every respect the same comments apply, though the hum here was very good, while the IM spectrum showed no specifically identifiable sidebands but a fair amount of the 'noise modulation effect'.

Listening impressions

Listening tests were predominately carried out with Naim Audio pre-amplification, which inevitably played a part in the results, which were consistently well above average, particularly for the 3B. The bass was considered to be a little 'fat' and 'heavy', and the 2B tended to sound a little 'harsher' than the better balanced 3B. Dynamics

and imagery were pretty good, with some detail clouding but a generally good sense of rhythm. The 3B tended to stay under control a little better than the smaller 2B. Overall it must be said that it is impossible to evaluate a power amplifier in isolation, but there were indications that the Brystons were pretty good performers, well up to the standard of the better models in this report. We had a distinct preference for the 3B over the 2B, even though their characters were quite similar.

Conclusions

Of the two, the 3B would appear to be the most interesting proposition, with plenty of 'high quality' power available in every respect, at a not unreasonable price. Choice of a partnering pre-amplifier will of course be important, but the power amplifiers appear to have some promise, with rugged construction and a good technical performance.

GENERAL DATA

Power stage
 Both channels 20Hz/1 kHz/20kHz
 8 ohms, 0.1% dist..... 63/68/65 Watts
 o/p level ref 2.83V=0dB..... 18/18.4/18.1dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist..... 68/106/117 Watts
 o/p level ref 2.83V=0dB..... 18.4/17/14.6dB
 Single cycle power 1kHz, 8/4/2 ohms..... 86/132/217 Watts
 o/p level ref 2.83V=0dB..... 19.3/18.2/17.3dB
 Dynamic headroom (IHF)..... 0.36dB
Bandwidth (-3dB below half power)
 Power amp only..... DC Hz - 92kHz
Inputs

Type	Sens (mV)	Imp (ohms)	Cap (pF)
Power amp..... Phono	700	48k	

Noise (ref 1 Watt, 8 ohms)
 Zero volume..... -89dB
Other
 Damping factor..... 641
 THD performance..... excellent
 Hum performance..... average
 Dimensions(W x D x H)..... 19(48) x 11(28) x 3.5(9) ins(cms)
 Weight..... 17lbs
 Typical purchase price..... £299

Bryston 2B

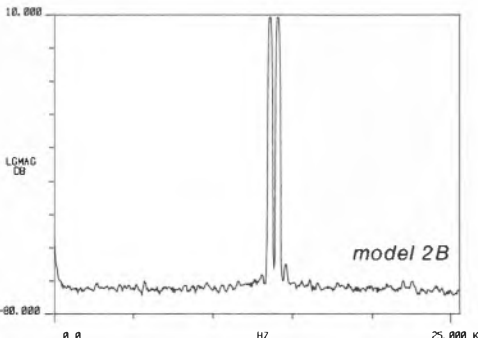
GENERAL DATA

Power stage
 Both channels 20Hz/1 kHz/20kHz
 8 ohms, 0.1% dist..... 130/139/131 Watts
 o/p level ref 2.83V=0dB..... 21/21.4/21dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist..... 140/239/197 Watts
 o/p level ref 2.83V=0dB..... 21.4/20.8/16.9dB
 Single cycle power 1kHz, 8/4/2 ohms ... 163/300/528 Watts
 o/p level ref 2.83V=0dB..... 22.1/21.7/21.2dB
 Dynamic headroom (IHF)..... 0.1dB
Bandwidth (-3dB below half power)
 Power amp only..... DC Hz - 82kHz
Inputs

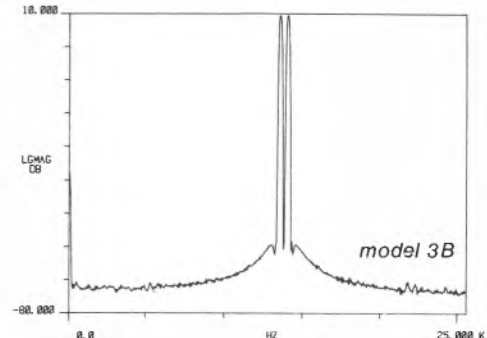
Type	Sens (mV)	Imp (ohms)	Cap (pF)
Power amp..... Phono	850	48k	

Noise (ref 1 Watt, 8 ohms)
 Zero volume..... -90dB
Other
 Damping factor..... 504
 THD performance..... excellent
 Hum performance..... excellent
 Dimensions(W x D x H)..... 19(48) x 9(23) x 5.5(14) ins(cms)
 Weight..... 32lbs
 Typical purchase price..... £399

Bryston 3B



Intermodulation distortion spectrum (horiz. 0-25kHz linear; vert. range 90dB)

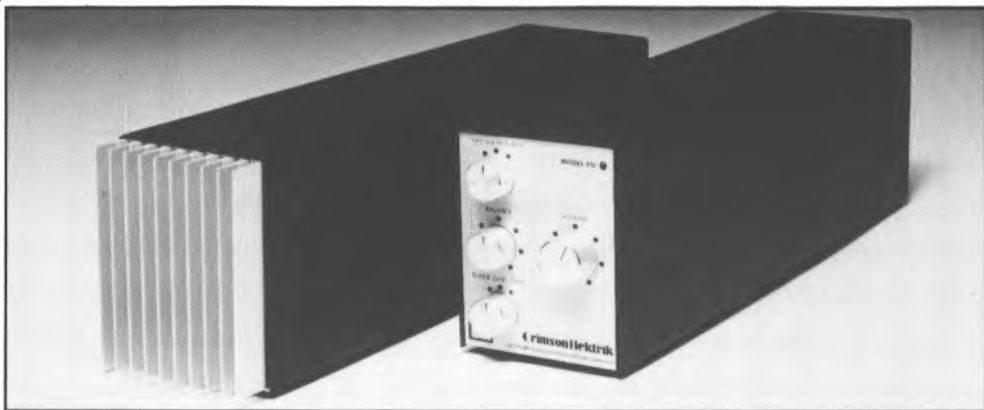


Intermodulation distortion spectrum (horiz. 0-25kHz linear; vert. range 90dB)

RECOMMENDED

Crimson 510/520

Crimson Elektrik, 9 Claymill Road, Leicester. Tel (0533) 761920



Presentation, facilities etc

Crimson is quite a new company to amplifier manufacturing, with its roots in the design and preparation of low cost powerful designs for the kit market. The 510/520 is a complete break with these traditions, and is a highly unusual design in several ways. The pre- and power amplifier modules are deep (but so is a record player), and narrow, so that they take up very little space. The standard of finish is a bit 'cottage industry', though it is quite acceptable in a rather low profile way, and some might regard it as refreshingly simple and down to earth. Some care is necessary in siting to avoid hum.

The 'tubes' have a black crackle finish on the wrapped metal covers, with one end finished in silver the other in red. The silver end is the bit you look at, with the pre-amplifier sporting an LED 'on' indicator light (important, see later), and four rotary knobs, the larger one controls volume, the others balance, input selection, and on/off/tape monitor. The 'crimson' end of the pre-amp has phono sockets throughout, plus a jack socket for those using the rechargeable battery pack. Yes the pre-amp runs off batteries, 2 PP9s or rechargeable equivalent, partly for cost but mainly for technical reasons. The pre-amp may be modified internally for either moving magnet or moving-coil operation, add-on modules giving capacitance matching for the former and sensitivity/impedance for the latter. Battery life (£2.20 a set) is estimated at 3 months+ of 2-3 hrs/night, and the rechargeable batteries plus charger cost about £45. The power amplifier has an 'on' indicator LED on the silver front heatsink, though the on/off switch is inconveniently sited on the rear, with phono sockets 'in' and 4mm sockets 'out'.

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Lab performance

Power output is quite modest, though nonetheless adequate for most domestic uses, and is reasonably maintained into low impedance, though the very lowest impedance speakers should perhaps be avoided. A rather large difference between single and dual channel drive indicates some power supply limitations.

Bandwidths show generally good control, particularly at low frequencies. The RIAA LF roll-off is nicely tailored, though there is a 1 dB rise in the treble. Disc input matching is effectively infinitely flexible via the module system, and as supplied the m-c input was probably more sensitive than necessary. THD was effectively masked by the noise of the system, which was a little below average, and little perturbation can be seen on the IM spectrum, with noticeably less of the 'noise modulation effect' which we found with some amplifiers. Crosstalk was poorer than average, though adequate nonetheless, and the hum performance was a little disappointing considering the pre-amp battery operation. The manual warns that the units should not be sited side by side, with which we agree. Mains transformer mechanical hum was modulated by the demands made on the power amplifier. Overall then results are unspectacular but show some promise; this is a flexible design with still a little room for improvement.

Listening impressions

Very positive results were obtained in the listening tests, with the units consistently receiving well above average praise, largely because the sound was felt to be much more controlled than with most designs. It stood out clearly on the blind tests, with praise for coherence, control,

dynamics, stereo and neutrality, though it was also considered a trifle 'bright' and qualitatively the bass might have been 'tauter'. It was considered to maintain its character rather well when driven loud. "A good 'un", as someone summed it up.

Conclusions

This is a new design with its fair share of 'wrinkles' which offer some room for further development and improvement. And by its very nature it is something of an enthusiasts device, with operation not entirely convenient. But the fine subjective balance for the price demands recommendation, though the slightly quirky nature of the models are sufficient to keep it from best buy status this time around.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 41/43/42 Watts
 o/p level ref 2.83V=0dB. 16/16.3/16.3dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist. 54/79/93 Watts
 o/p level ref 2.83V=0dB. 17.3/16.0/13.7dB
 Single cycle power 1 kHz, 8/4/2 ohms. 74/128/189 Watts
 o/p level ref 2.83V=0dB. 18.7/18/16.8dB
 Dynamic headroom (IHF) 0.7dB

Bandwidth (-3dB below half power)

Disc in - power out 20Hz - 58kHz
 Disc in - pre out 20Hz - 103kHz
 Disc in - tape out 5Hz - 142kHz
 Aux in - power out 20Hz - 61kHz
 Power amp only DC Hz - 65kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.3	45k	47
Disc MC	Phono	0.04	86	
Tuner/Aux	Phono	52	47k	
Tape	Phono	52	47k	

Disc overload MM 38dB
 Disc overload MC 38dB

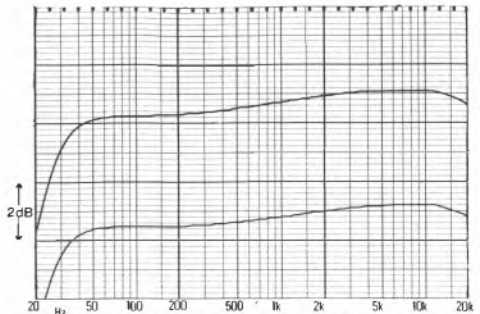
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape	Phono	100	1.7

Noise (ref 1 Watt, 8 ohms)

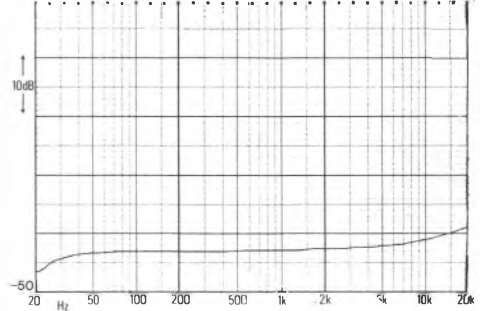
Zero volume -77dB
 Aux ref volume -76dB
 MM disc ref volume -76dB
 MC disc ref volume -73dB

Other

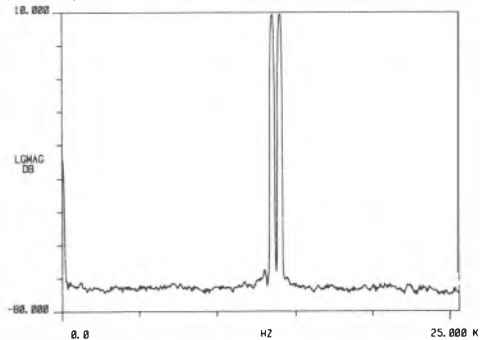
Damping factor 31
 THD performance good
 Hum performance below average
 Dimensions (W x D x H) ... 2 x [3.3(8.5) x 15 (38) x 4.3(11)] ins (cms)
 Weight 15lbs
 Typical purchase price £228



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear, vert. range 90dB)

Denon PM510

Eumig UK Ltd., 14 Priestley Way, London NW2 7TN. Tel 01-450 8070



Presentation, facilities etc

Though it would win no prizes for originality, this amplifier looks pleasant enough with its brushed aluminium fascia and knobs. The continuously varying volume control is conveniently large and falls easily to hand, while the remaining functions are sensibly laid out in a manner which emphasises their importance. Unusually for a reasonably cheap model a moving-coil cartridge option is provided; upon reflection one recalls Denon's expertise and long experience in producing such cartridges, so it is quite logical.

The smaller knobs control balance, bass, treble, tape monitoring and dubbing, while switches select the inputs and power (LED indicated), either of two pairs of speakers, subsonic filtering, and loudness. Phono socketry is used throughout, with DIN duplication for Tape 2. All in all the ergonomics are fine, and this semi-slimline model is virtually devoid of any startling features.

Lab performance

The power output is reasonably generous for an amplifier in this price class, and power delivery shows good consistency between single and dual channel drive. Power was well maintained into 4ohms though somewhat more curtailed into 2ohms: choosing matching loudspeakers is unlikely to offer any problems, and the omission of a 'both' position on the speaker selector would seem a sensible move, reducing the likelihood of causing the power stage any distress.

The important disc input bandwidth is extended to 100kHz according to the manual, though our measurements indicate an internal interface problem at around 35kHz. The others would appear to have been left wide open, which is

rather unnecessary and doesn't make life any easier. The inputs in general would appear to be fine, though the moving magnet input capacitance of 280 pF is rather too high for optimum matching with some such cartridges. (Most m-m models will be OK up to a total of 350pF, though this only leaves 70pF for the pickup leads if certain models are to be used.) The moving-coil input is a little on the insensitive side for the lowest output models though it would appear to be fine for Denon's own. Apart from the hum level which only rated as average all the other performance parameters we assessed were fine. The crosstalk is respectable, with the usual slight curtailment at high frequencies, and the disc frequency responses are generally smooth, showing a very mild upward slope towards high frequencies.

Listening impressions

The results for this model were generally positive, though not entirely consistent, and overall it was better received than its more powerful and expensive twin, the 540. Most listeners found it reasonably well controlled and detailed, quite clear and with good stereo and separation, though there was a fair amount of criticism of a tendency to 'shrillness' when playing at higher levels. One listener in particular on more than one occasion was upset by 'thickening' and 'heaviness' in the upper bass particularly, and was generally less well disposed overall. Even taking account of this dissenter, the overall results were a little better than average, which is quite creditable for an amplifier in this class.

Conclusions

This is a well balanced model which gave sensibly

good results on most measurements, and was also quite well received in the listening tests, though it was not felt to be quite as pleasant when driven fairly hard. The only real note of caution concerns the moving magnet input capacitance, which is fine for models such as Ortofon, Shure, Grado, and Technics, for example, but may give less than optimum results with certain others. The blend of facilities, and in particular the provision for moving-coil cartridges was felt to be good, and the price for what is offered seems reasonable.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist..... 59/64/62 Watts
 o/p level ref 2.83V=0dB..... 17.7/18/17.9dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist..... 65/104/113 Watts
 o/p level ref 2.83V=0dB..... 18.1/17.1/14.5dB

Bandwidth (-3dB below half power)

Disc in - power out..... 6Hz - 35kHz
 Disc in - tape out..... DC Hz - 100kHz
 Aux in - power out..... 6Hz - 100kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.6	50k	280
Disc MC.....	Phono	0.270	100	
Tuner/Aux.....	Phono	160	70k	
Tape 1 & 2.....	Phono	160	70k	
Tape 2.....	DIN	160	70k	

Disc overload MM..... 35dB
 Disc overload MC..... 35dB

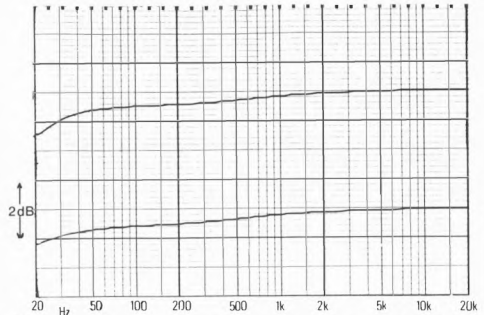
Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1 & 2.....	Phono	300	395
Tape 2.....	DIN	45	470k

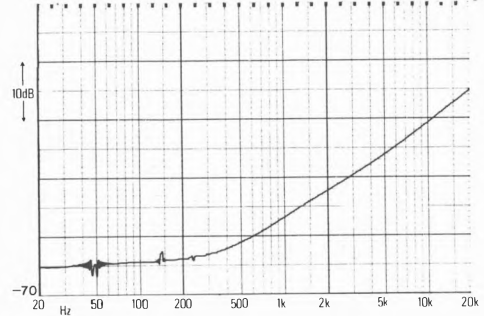
Headphones (8 ohms)..... 100
 (2 kohms)..... 2.5V

Noise (ref 1 Watt, 8 ohms)
 Zero volume..... -91dB
 Aux ref volume..... -84dB
 MM disc ref volume..... -83dB
 MC disc ref volume..... -75dB

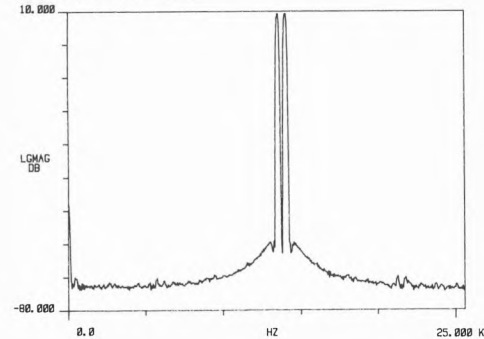
Other
 Damping factor..... 50
 THD performance..... excellent
 Hum performance..... average
 Dimensions (W x D x H) ... 17(43) x 15½(39) x 4¼(11) ins(cms)
 Weight..... 19lbs
 Typical purchase price..... £144



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



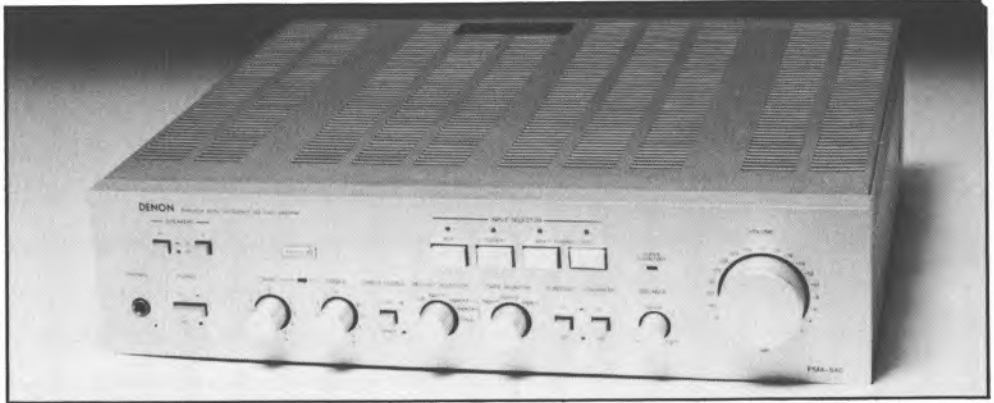
Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz. 0-25kHz linear; vert. range 90dB)

Denon PM540

Eumig UK Ltd., 14 Priestley Way, London NW2 7TN. Tel 01-450 8070



Facilities, presentation etc

This model shows very few differences from the 510 reviewed at the same time, and comprises a semi-slimline case finished in matt silver, and including most of the more usual facilities. Finish is to a very good standard, though the well ventilated top cover rattled somewhat when tapped. The volume control is sensibly placed and easily distinguished, with a pleasant smooth action happily free of the once fashionable 'stepping'.

Rotary controls alter balance and tone and switch tape monitoring and dubbing, while illuminated indicator pushbuttons select the remaining inputs. Further pushbuttons control either or both speaker selection, tone defeat, power, subsonic filter and loudness. Spurious indicator lights inform us of the 'Direct A' circuitry employed in the design, and of the presence of a 'super equaliser' (of dubious merit) operating on the disc input; more useful is an indicator informing whether or not the tone controls are active (the position of a pushbutton switch can be difficult to assess from some angles). Phono sockets are employed throughout, with DIN duplication on Tape 2.

Lab performance

The similarities with its smaller and cheaper brother the 510 are as apparent in the measured results as they are in the physical appearance, although the power rating is significantly more substantial. Once again good delivery is maintained into 4ohm loads but with some curtailment when attempting 2ohms, so only the most difficult speaker loads are likely to give any difficulty. The

back panel wisely warns against the use of sub-8ohm models if two pairs are to be used simultaneously. The single channel maximum shows a significantly larger increase over dual channel drive than that found with the smaller model, indicating that the power supply is marginally less well controlled.

Our measured bandwidths are rather on the wide side, noticeably more so than for the 510, though the internal EHF matching problem seemed less severe. Once again the moving magnet disc input capacitance is a little on the high side for the best match with a few available models. The mc input is a little less sensitive than usual though well matched to Denon models. And again the hum performance is the worst of the measured performance parameters. The disc frequency response and crosstalk show slight improvements over the cheaper model, and offer no grounds for criticism. Apart from the aforementioned minor points on the disc inputs, no problems are to be expected in matching the inputs and outputs to ancillary equipment.

Listening impressions

Unfortunately the results for the 540 were not terribly encouraging overall, and did not match those achieved by the cheaper 510. However there were some indications that the moving-coil input might be rather more satisfactory than the moving magnet circuit. Criticism was levelled at the frequency extremes and in particular the bass, which was not thought to be well controlled, while some complaints were also made of treble 'tizz'. The midrange character was quite liked, but there was no particular praise for the stereo

imagery. Overall results were below average, though attained a somewhat inconsistent 'average' via the moving-coil input.

Conclusions

This is an attractive if somewhat undistinguished amplifier which gave a generally favourable laboratory performance. Listening test results were inferior to those of its less powerful stablemate: one is tempted to wonder whether this may result from the wider bandwidths and/or 'looser' power supply indicated in the measurements. Though by no means a bad amplifier, it failed to raise our enthusiasm.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 95/97/95 Watts
 o/p level ref 2.83V=0dB 19.8/19.9/19.8dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 113/155/134 Watts
 o/p level ref 2.83V=0dB 20.5/18.9/15.2dB
 Single cycle power 1kHz, 8/4/2 ohms ... 138/210/240 Watts
 o/p level ref 2.83V=0dB 21.4/20.2/17.8dB
 Dynamic headroom (IHF) 0.5dB

Bandwidth (-3dB below half power)

Disc in - power out 3Hz - 63kHz
 Disc In - tape out DC Hz - 121kHz
 Aux in - power out 3Hz - 115kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.5	50k	230
Disc MC	Phono	0.260	100	
Tuner/Aux	Phono	150	67k	
Tape 1 & 2	Phono	150	67k	
Tape 2	DIN	150	67k	

Disc overload MM 34dB
 Disc overload MC 34dB

Outputs (5.0mV disc input)

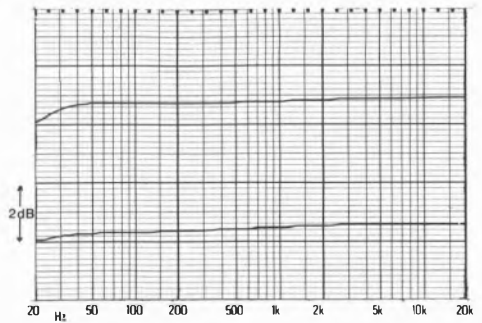
	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	300	450
Tape 2	DIN	45	500k
Headphones (8 ohms)		100	
(2 kohms)		2.6V	

Noise (ref 1 Watt, 8 ohms)

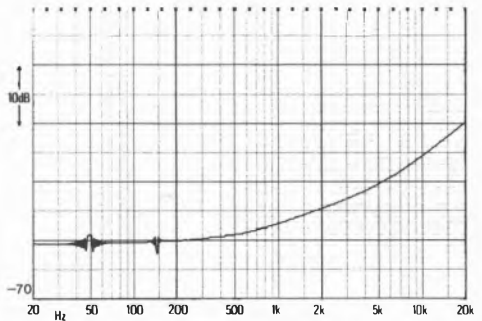
Zero volume -90dB
 Aux ref volume -82dB
 MM disc ref volume -81dB
 MC disc ref volume -73dB

Other

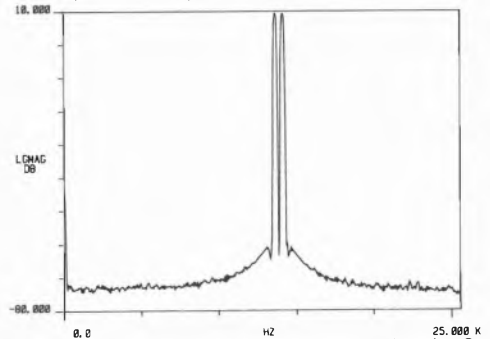
Damping factor 78
 THD performance excellent
 Hum performance below average
 Dimensions (W x D x H) ... 17(44) x 15½(39) x 4½(11½) ins (cms)
 Weight 21 lbs
 Typical purchase price £190



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Denyo AU3000M

Uher Ltd., 24 Market Place, London NW11. Tel 01-455 1771



Presentation, facilities etc

The Denyo got something of a reputation a while back as providing some real competition for the impressive NAD 3020, so although this is not a new model, it seemed a good idea to check it out in any case. The 'full-sized' presentation does give the unit a slightly old-fashioned look in this diet-conscious age, as do the swinging needle 'power' meters. (There is absolutely no need for such devices anyway as far as we can see, and swinging needles are more mendacious than inertialess light types.)

The control layout is pleasantly straightforward, though the large volume knob has a strongish detent action. Five smaller rotary controls adjust balance, bass, treble, input selection and speaker selection, while toggle switches (much nicer than fiddly pushbuttons) give high and low filters, mono/stereo and tape monitoring. The rear panel phono sockets are DIN duplicated on tape, while the speaker terminals are rather primitive screw types mounted quite close together, so it could be only too easy to get a short circuit particularly if sensibly heavy cable is used. (This is a phenomenon that has destroyed the output transistors of many a music centre, though we imagine the Denyo is protected against such abuse.) Overall a neat enough amplifier, reassuringly heavy but with a slightly old-fashioned bulky appearance and evidence of some construction economies. The front panel overhangs the case, giving rather sharp protruding corners.

Lab performance

Considering the very low price of the model, the power output is remarkably healthy, though we had to relax our 0.1% criteria to 0.2% to get the

same results when the amplifier was warm, so some attention paid to temperature stability might be worthwhile. Again, measurements of THD+noise became poorer when the amplifier became warm. The power delivery shows reasonably good maintenance into 4ohms, but is somewhat more curtailed into 2ohms, so some care should be taken to avoid the lowest impedance types if planning to use two pairs of speakers loudly and simultaneously.

The bandwidths show sensible control via the disc input, but the frequency response leaves a great deal to be desired. Frankly the 3dB 'bump' takes this product out of the hi-fi category in our opinion, and will invariably strongly dominate comments made upon the sound quality. The input capacitance at 220pF is also a trifle high for optimum matching with a few models if the turntable is not chosen carefully. Other inputs and outputs are fine, but the low price of the unit is reflected in the below average results for hum, IMD, noise, crosstalk and disc overload, the IM spectrum showing both a significant difference component and 'noise modulation effect'. All in all not the most encouraging pattern.

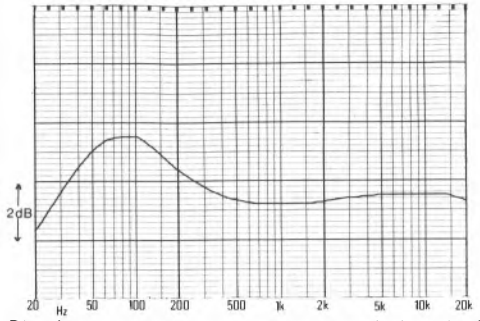
Listening impressions

Though results were not entirely consistent, the consensus rating was significantly below average, with the bass 'bump' dominating the character of the sound, giving an initially lively powerful effect which quite quickly palled. Under some circumstances this 'loudness' character does work subjectively, giving the sound pleasant 'bounce'. But trying to hear beyond it one becomes aware that the overall sound is nothing special, with a certain amount of 'muddle' and rather untidy high

frequencies. Not a subtle nor an accurate amplifier, but one which can be curiously satisfying up to a point.

Conclusions

An interesting if slightly dated design, the Denyo offers quite a lot of amplifier for the money, but the technical performance has sufficient weakness to suggest that it is more of an audio than a hi-fi product. The limitations lie primarily in the RIAA equalisation, which gives a sometimes enticing but ultimately not very satisfying sound quality.



Disc frequency response, note expanded vertical scale (2dB per division)

GENERAL DATA

Power stage

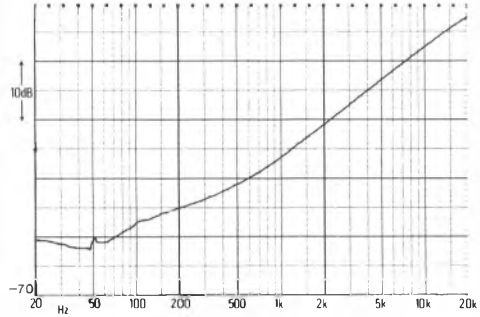
Both channels 20Hz/1 kHz/20kHz
 8 ohms, 0.1% dist. 34/39/39 Watts
 c/p level ref 2.83V=0dB. 15.3/15.9/15.9dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist. 48/60/54 Watts
 c/p level ref 2.83V=0dB. 16.9/14.8/11.3dB
 Single cycle power 1 kHz, 8/4/2 ohms. 58/88/81 Watts
 o/p level ref 2.83V=0dB. 17.6/16.4/13.1dB
 Dynamic headroom (IHF) 0.2dB
Bandwidth (-3dB below half power)
 Disc in - power out. 9 Hz - 50kHz
 Disc in - tape out. 28 Hz - 100kHz
 Aux in - power out. 5 Hz - 50kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.	Phono	2.35	45k	220
Tuner/Aux.	Phono	170	35k	
Tape.	Phono	170	39k	
Tape.	DIN	170	39k	

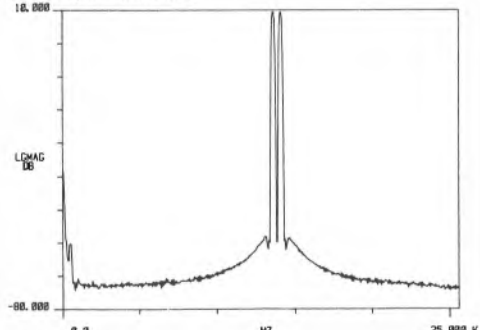
Disc overload MM.	Level (mV)	Imp (ohms)	
Disc overload MM.	26dB		
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape.	Phono	300	2k
Tape.	DIN	20	87k

Noise (ref 1 Watt, 8 ohms)
 Zero volume. -81 dB
 Aux ref volume -75dB
 MM disc ref volume -74dB

Other
 Damping factor 49
 THD performance. average
 Hum performance. below average
 Dimensions (W x D x H) 17(43) x 9½(24) x 5½(14) ins(cms)
 Weight 16lbs
 Typical purchase price. £75



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Eagle A8500

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



Presentation, facilities etc

This is an attractively satin-finished full-sized unit with a nicely sculptured fascia dividing the front panel horizontally. The major styling feature is a rather garish power meter display. This unit is manufactured in Korea, and it is a credit to the standard of finish to say it looks as if it could have emanated from a Japanese factory. Only a couple of years ago it was quite easy to tell the difference between Japanese and other Far-Eastern products, and this gap has now narrowed dramatically.

On the top section a large detent action volume control sits between a rotary input selector and loudness and mono/stereo pushbuttons. Beyond the 'power' meters is another rotary switch selecting loudspeakers. Below the input selector two toggle switches organise tape monitoring and cross-dubbing, while a small balance knob sits under the volume control. Two more rotaries adjust tone and are accompanied by defeat and high filter toggle switches, matching the power switch at the end. The back panel has rather small spring grip speaker terminals, separately fused outputs and mains, and predominantly phono sockets DIN duplicated on tape 2. All in all, this is a conventional enough amplifier, nicely presented if perhaps a trifle old-fashioned looking.

Lab performance

Power output is more than adequate, though showing some restriction at low frequencies under our specification, a difference between single and dual channel drive which is quite marked, and some restriction into low impedances. However our figures for the latter are perhaps a little misleading, as the current limiting operated

asymmetrically, and in practice the fuse protection would act long before this. The single cycle transient test shows less limitation, suggesting that speaker choice is quite uncritical, though as usual some caution needs to be exercised if planning to drive two sets together.

The bandwidths show a reasonable degree of curtailment, particularly at the low frequencies on disc. The frequency responses confirm this, though the tailoring at the low frequency end could have been more elegant. The input capacitance is a sensible 127 pF, allowing any cartridge types to be matched. Noise and harmonic distortion figures were particularly good, likewise the crosstalk trace, while hum performance was also fine. The IM spectrum showed a small difference component and a significant amount of the 'noise modulation effect'. The inputs and outputs seem generally pretty well chosen, though the output into high impedance 'phones was less than usual (not such a bad thing in fact). To summarise, the technical performance was sound but unremarkable, giving little cause for criticism.

Listening impressions

This amplifier received a rather mixed batch of results on audition, and these varied from average to well below average, so the overall reaction could not be described as positive. The amplifier gave the impression of being very powerful, suggesting quite positive dynamic qualities, but tonal colorations were also described, detail appeared to sound 'muddled' at low and mid frequencies, while the treble was frequently described as 'aggressive' and 'shrill', and stereo as ill-defined. It would appear from the agree-

ment in the comments that the amplifier subjectively does not sound too well controlled, although it does have certain promising attributes. The variation in value judgement depends largely on the importance the panelists placed upon the control/dynamics dichotomy.

Conclusions

This amplifier is not a bad performer technically, but subjectively it attracted some adverse comment, and overall it does not appear to offer anything special when compared to similarly priced rivals in the marketplace.

GENERAL DATA

Power stage

Both channels 20Hz/1 kHz/20kHz
 8 ohms, 0.1% dist 47/58/57 Watts
 o/p level ref 2.83V=0dB 16.7/17.6/17.5dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist 69/87/44 Watts
 o/p level ref 2.83V=0dB 18.4/16.4/10.5dB
 Single cycle power 1 kHz, 8/4/2 ohms ... 84/98/100 Watts
 o/p level ref 2.83V=0dB 19.3/17/14dB
 Dynamic headroom (IHF) 0.32dB

Bandwidth (-3dB below half power)

Disc in - power out 22Hz - 100kHz
 Disc in - tape out 5Hz - 90kHz
 Aux in - power out 9Hz - 109kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.8	55k	127
Tuner/Aux.....	Phono	172	49k	
Tape 1 & 2.....	Phono	172	80k	
Tape 2.....	DIN	172	80k	

Disc overload MM..... 37dB

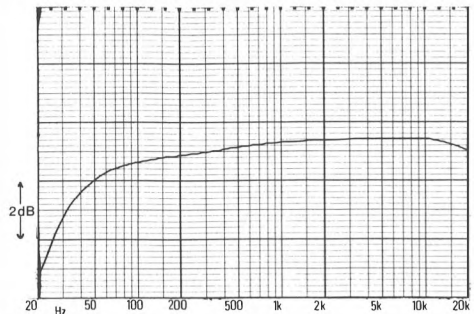
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1 & 2.....	Phono	2k	550
Tape 2.....	DIN	46	20k
Headphones (8 ohms).....		55	
(2 kohms).....		150	

Noise (ref 1 Watt, 8 ohms)

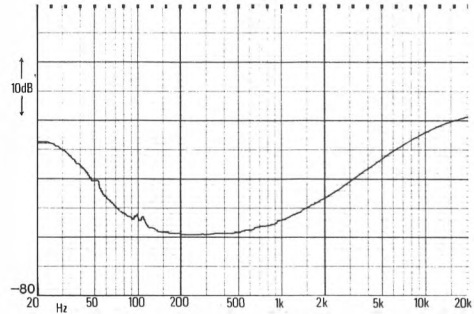
Zero volume -90dB
 Aux ref volume -84dB
 MM disc ref volume -82dB

Other

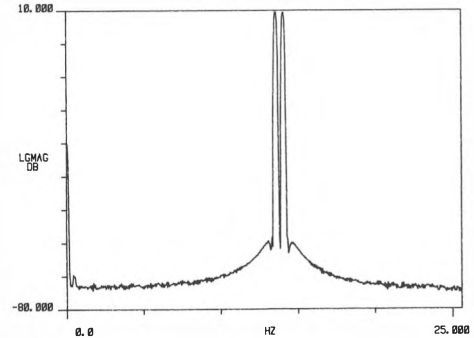
Damping factor 76
 THD performance excellent
 Hum performance above average
 Dimensions(W x D x H) ... 17¼(44) x 13½(34) x 5(13) ins(cms)
 Weight 22lbs
 Typical purchase price £120



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

The Electro (25w & 'bridged')

Norse Ecosse Electronics, Glenrothes, Scotland



Presentation, facilities etc

'The Electro' has an illustrious reputation as a limited power output power amplifier of the highest quality. Originally known as the Electro-companiet, it is a Scandinavian design reputedly based heavily upon the ideas of Matti Otala, an engineer of international reputation who has done much original and frequently controversial work on audio amplifier design. Production was originally started in Norway, but was transferred to Scotland a couple of years ago, under the aegis of Norse Ecosse Electronics.

Both units feel very 'solid' in construction, the power amplifier case being partly constructed from substantial heatsink fins. The pre-amp also feels quite heavy, so one is surprised to find that it draws power from the power amplifier. Finish is matt black throughout and quite tastefully restrained with high enough standards even if not aspiring to Japanese 'camera finish'. The pre-amplifier is 'minimal' in the audiophile tradition, and hence easy to use, with a single concentric volume/balance control and two input selection switches. The rear panel uses phono sockets throughout for signal (the power umbilical uses a DIN socket), and moving magnet/moving-coil switching is provided here. The very substantial power amplifier has a plain front panel, and the back panel has a fused pre-amp power supply outlet and a large on/off toggle switch, which is quite easy to find 'by feel' despite its inconvenient location. Speaker terminals are nicely spaced to avoid short circuits with heavy cable. This unit gets quite hot at all operating levels due to its high A-bias, so adequate ventilation is necessary. An alternative arrangement using two power amplifiers in 'bridged' mode gives a substantial increase in power, from 25 to 85 watts.

Lab performance

The standard stereo model has comparatively low power delivery, below 30 watts, but the quality of delivery is quite good, showing no difference whatever between single and dual channel drive, and a drive pattern that is quite well maintained into 4ohms, if curtailed somewhat into 2ohms. No particular care needs to be taken when choosing matching loudspeakers.

In the bridged mode using two power amplifiers as mono devices, output is trebled into 8ohms, though delivery is not quite as well maintained into lower impedances, so such loudspeakers should perhaps be avoided in this application.

The bandwidths tend to be unnecessarily wide in our opinion, showing little attempt at curtailment at either end of the audio band except *via* the m-c input. Disc input capacitance for mm is sensibly chosen. Inputs and outputs are a little unusual, with the tape input impedance rather low, but sensitivity is higher than usual to compensate, so problems are unlikely. The power amplifier input impedance is lower than usual at 900ohms (with the pre-amp correspondingly so at 3.5ohms), so this does mean some care needs to be taken if using an alternative pre-amp, choosing one with a low output impedance to avoid mis-match effects.

Frequency responses were quite flat, crosstalk fine, but noise was not as good as many other designs, and in fact gave poorer results when measured in the bridged mode. This is probably because the pre-amp had become quite warm when testing was carried out, after standing near the power amplifiers. Both hum and harmonic distortion were somewhat below average, though the latter tended to be dominated by the noise. In many respects the technical performance was

reasonable, but does reflect the comparatively early origins of this design when compared to the latest models from Japan.

Listening impressions

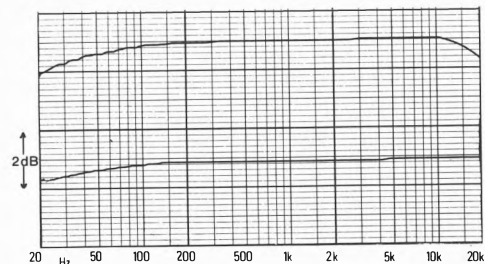
As a single stereo amplifier, the Electro was quite well received, though it was felt that the moving-coil input was disappointing compared with the mm input, and this held the overall ratings back a little. Careful appraisal of the results and a little informal 'hands on' testing suggested that the power amplifier is definitely amongst the very best, the pre-amp is reasonably good *via* moving magnet, but a little disappointing *via* moving-coil. The sheer quality of the power amplifier encourages one to increase the volume and easily get rather close to the limited power capabilities.

The sound was described as quite easy to listen to, not aggressive and quite lively, if a little lacking in high frequency detail (? noise effect) and rather 'strong' in the bass.

The unit was also liked well enough in bridged format, though the sound quality was not considered quite as good as the stereo version. Once again control, dynamics and stereo received praise, but the detail did not seem as subtle and the sound tended to be a little 'shrill' and 'scratchy', and also a trifle 'plummy' in the bass range.

Conclusions

It is difficult to place overall value judgements upon a low powered amplifier at these prices, but the sound quality was rather promising, being a little limited by the pre-amplifier in our estimation. Technical performance was not outstanding, but there is no particular cause for alarm, though care needs to be taken if substituting pre-amplifiers. The option of doubling up the power amplifier when funds and needs arise is quite enticing, but the sound quality here did not seem quite the equal of the low powered version. Although the specification indicates low power, the sound quality by no means reflected this, and the power amplifier quality meant that it was often happier than more powerful models at fairly loud levels.



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)

GENERAL DATA

Power stage **25w**

Both channels 20Hz/1kHz/20kHz

8 ohms, 0.1% dist. 27/29/27 Watts

o/p level ref 2.83V=0dB. 14.4/14.6/14.4dB

Single channel 8/4/2 ohms

1 kHz, 0.1% dist. 29/48/56 Watts

o/p level ref 2.83V=0dB. 14.6/13.8/11.5dB

Single cycle power 1kHz, 8/4/2 ohms. 30/48/77 Watts

o/p level ref 2.83V=0dB. 14.8/13.8/12.8dB

Bandwidth (-3 dB below half power)

Disc in - power out. 2 Hz - 94kHz

Disc in - pre out. DC Hz - 100kHz

Disc in - tape out. DC Hz - 134kHz

Aux in - power out. DC Hz - 210kHz

Power amp only. DC Hz - 220kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	1.5	48k	176
Disc MC	Phono	0.06	99	
Tuner/Aux	Phono	78	9k	
Tape	Phono	78	9k	
Power amp	Phono	400	875	

Disc overload MM. 41 dB

Disc overload MC. 40dB

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape	Phono	250	1k

Noise (ref 1 Watt, 8 ohms)

Zero volume. -75dB

Aux ref volume. -75dB

MM disc ref volume. -73dB

MC disc ref volume. -71dB

Other

Damping factor. 69

THD performance. below average

Hum performance. average

Dimensions (W x D x H). 15(38) x 8(21) x 3½(9)

+ 14½(37) x 13(33) x 4½(11) ins(cms)

Weight. 31 lbs

Typical purchase price. £575

Power stage **'bridged'**

Both channels 20Hz/1kHz/20kHz

8 ohms, 0.1% dist. 88/90/82 Watts

o/p level ref 2.83V=0dB. 19.4/19.5/19.2dB

Single channel 8/4/2 ohms

1 kHz, 0.1% dist. 90/116/72 Watts

o/p level ref 2.83V=0dB. 19.5/17.6/12.6dB

Single cycle power 1kHz, 8/4/2 ohms. 100/145/169 Watts

o/p level ref 2.83V=0dB. 20/18.6/16.3dB

Other

Damping factor. 53

THD performance. below average

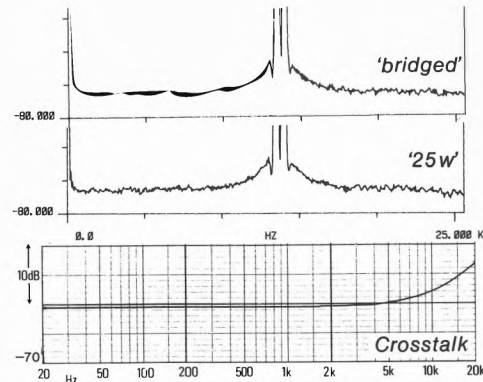
Hum performance. average

Dimensions (W x D x H). 15(38) x 8(21) x 3½(9)

+ 2[14½(37) x 13(33) x 4½(11)] ins(cms)

Weight. 54 lbs

Typical purchase price. £880



Elite Townshend

Elite Electronics Ltd, 32 Mayo Road, Walton-on-Thames, Surrey. Tel (09322) 46850



Presentation, facilities etc

The Elite amplification system is manufactured in the UK under the design and direction of expatriate Antipodean Max Townshend. It is a modular system which perhaps owes a little in concept to the Meridian, but in execution it is quite different though similarly elegant and ingenious. The tested system uses four modules, separating the two power amplifiers from their power supply unit, but as we were going to press we heard that an alternative version with fully integrated power amplifier will be available at a saving of £70 (less metalwork and connecting sockets). A possible advantage of the completely separated approach is that the power amplifiers can be used next to the loudspeakers with short speaker leads and long interconnect cables.

The pre-amplifier must be one of the neatest and most versatile around. With its power supply built into the mains cable, it measures only 1¼ inches wide and 4 inches high. The single knob on the front controls volume, while three miniature toggle switches control the inputs. Two tiny pushbuttons for low filter and power plus an indicator light complete the front panel, and slightly less white graphic enthusiasm would have made this look less cluttered. The wedge section at the back gives easy access from above, allowing a small balance control to be sited at the top, along with two more toggle switches to adjust disc input loading - 30/100/470ohms on moving-coil and 50/150/270pF on moving magnets. A final pushbutton adjusts the pre-amplifier output. The other units are substantially featureless, though solidly constructed and with the attractive 'wedge' styling. Note-worthy however are the biggest loudspeaker terminals we have ever seen!

Lab performance

Considering the very high price of the units, the measured results were a trifle disappointing. Power output is more than adequate at 95 watts or so, and shows some evidence of good control, with no difference between single and dual channel drive and little extra short-term capability. But it is also rather restricted into low impedances, so low impedance loudspeakers are best avoided.

Bandwidths are quite well controlled, though the tape output is less so, rising 3dB above 20kHz. The mm disc input capacitance variations measured approximately 100pF higher than the values stated, probably because of an inherent contribution from the layout, but they are still quite useful values nevertheless. Unfortunately the RIAA response is not as flat as we would have liked, with the presence band showing a 1dB boost with respect to the bass and treble, and this is likely to be subjectively audible as extra 'forwardness' and 'clarity'. The mm input sensitivity is lower than usual, but the noise figure is quite good. The moving-coil input did have rather poor noise figures, while the overload margin of 31.6dB had dropped to 23dB at 20kHz; sensitivity here was normal. Distortion performance was not perhaps as good as one might expect for the price, while noise and hum were also only average (good everywhere apart from 100Hz), and some IM sidebands may be identified though the 'noise modulation effect' is fairly slight.

Listening impressions

Inconsistency seemed to be the order of the day in our findings on this amplifier. Some people found the overall balance a little 'bright' and 'brash', probably due to the frequency response. The gentle roll-offs at the extremes offended

some listeners, while others welcomed the 'lack of aggression'. Some care needs to be taken in siting to avoid hum effects, which also may have affected auditioning consistency. Some listeners praised the dynamics and control, though others found these rather less satisfactory when volume was increased.

Conclusions

It is difficult to summarise this system, because neither the technical nor the subjective results were particularly positive, and the price is high. Yet the design is clever and neat, and the listening tests were not consistent and quite good on occasions. Clearly we cannot recommend as value for money, but suggest that those interested in the concept should try to audition it for themselves.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 90/93/88 Watts
 o/p level ref 2.83V=0dB 19.5/19.7/19.4dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 93/125/25 Watts
 o/p level ref 2.83V=0dB 19.7/18/7.9dB
 Single cycle power 1kHz, 8/4/2 ohms ... 95/145/49 Watts
 o/p level ref 2.83V=0dB 19.8/18.6/10.9dB
 Dynamic headroom (IHF) 0.1dB

Bandwidth (-3dB below half power)

Disc in - power out 5 Hz - 38 kHz
 Disc in - pre out DC Hz - 62kHz
 Disc in - tape out 2Hz - 200kHz
 Aux in - power out 3Hz - 33kHz
 Power amp only 3Hz - 40kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	5	46k	168/269/ 396

Disc MC.....	Phono	0.28	44/98/390	
Tuner/Aux.....	Phono	170	26k	
Tape.....	Phono	170	26k	
Power amp.....	Phono	1.0V	20k	

Disc overload MM 32dB
 Disc overload MC 32dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape.....	Phono	170	1.2k

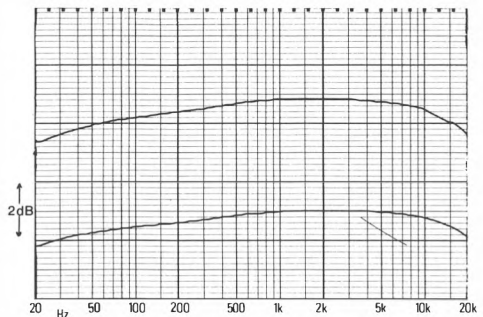
Noise (ref 1 Watt, 8 ohms)

Zero volume 77dB
 Aux ref volume 77dB
 MM disc ref volume 76dB
 MC disc ref volume 68dB

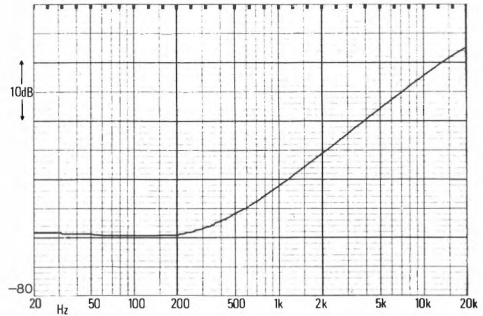
Other

Damping factor 58
 THD performance average
 Hum performance average
 Dimensions (W x D x H)

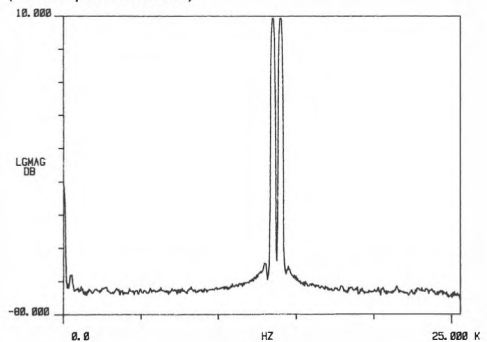
typically approx 15½(39) x 13(33) x 4¼(11) ins(cms)
 Weight 33lbs
 Typical purchase price £860



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Exposure (III)/IV/VII

Exposure Electronics, Richardson Road, Hove, Sussex BN3 5RB. Tel (0273) 777912



Presentation, facilities etc

Though Exposure are a very small company, they have been around for a number of years and their amplifier has attracted quite a bit of attention for a claimed good subjective performance. Their background in professional equipment manufacture (mixers etc) is reflected in the styling, which gives the unit a pleasantly 'different' appearance. The power amplifier is physically quite large, and is available in three configurations: single power supply (£250+VAT), single supply + pre-amp supply (£300+VAT) (as tested), and dual power supply (without pre-supply) (£400+VAT). When originally submitted, the *model III* pre-amp was in production, but this was replaced during the project by the *model VII*, and we have tried to accommodate this change within the review. The *VII* is available in two configurations, for use with a single (built in or external) power supply (£200+VAT), or with dual power supply circuitry (£250+VAT). Pre-amp power supply units are £150 +VAT each, and are rather more elaborate than those built into the single supply power amplifier. Active filter units are also available for multi-amp systems. Confusing, isn't it? Most of our work was done with the integral power amplifier pre-amp supply feeding the *VII*.

The matt black case finish is attractively highlighted with dark orange legends. Phono socketry is used throughout apart from the pre-amp power supply connections which use dice-configuration 5-pin DIN. The pre-amp has two larger knobs for input selection and 'master gain', while two smaller knobs give separate gain for each channel, an arrangement which enables the user virtually to tailor the volume control law to his personal requirements. The pre-amp has the

option of moving-coil or moving magnet cartridge matching *via* a switch on the rear.

Lab performance

Power output is quite reasonable at 80+ watts per channel, and for our single supply version showed a significant but not excessive difference between single and dual channel drive. Delivery looks promising into low impedances, but the fusing prevented us from taking measurements into 2ohms, so the full pattern is difficult to assess, and no fuse-blowing was encountered in use on music programme.

Bandwidths are tightly curtailed, with those for the pre-amp properly lying inside those for the power amplifier alone. The RIAA curve is reasonably flat, albeit with some room for improvement, and shows sensible curtailment of low frequencies. The new pre-amplifier shows a number of improvements over the *III*, for which we had already taken measurements, notably in the flatness of the disc input, a 10+dB improvement in crosstalk, and a (much needed) significant improvement in noise figures. Noise is still not good, presumably partly due to the semi-passive disc input EQ circuitry. But the figures are now unlikely to be seriously intrusive for most listeners we feel, though some may still find them inadequate. Note also that the mm input sensitivity is rather lower than usual, and that the disc overload margin is also somewhat below average. Hum and harmonic distortion only rated average, while the IM spectrum shows a significant difference component, but relatively slight 'noise modulation effect'. Overall the technical performance is rather a mixed bag, which shows some promise, but also some areas of concern.

Listening impressions

Rather mixed results were nevertheless overall reasonably enthusiastic about the sound of this amplifier, with some listeners rating it highly, and others complaining a little about noise. The V/I pre-amp is clearly an improvement on its predecessor, but the power amplifier is still perhaps the strongest part of this combination, and is probably amongst the best liked in the tests. The results were clearly above average, but were insufficiently consistent to warrant enthusiastic endorsement. Some listeners received this system very well, highly rating the dynamics, bass control, and treble delicacy, despite the limitations imposed by the noise floor.

Conclusions

In the basic form which we evaluated this combination gave quite promising but somewhat inconsistent listening results. It is not too expensive in the context of specialist 'audiophile' products, and although it is not entirely free of problems, it would appear to offer a pretty good subjective performance for the price. The power amplifier is particularly interesting, while the pre-amp shows significant improvements over its predecessor.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 81/87/85 Watts
 o/p level ref 2.83V=0dB 19.1/19.4/19.3dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 98/150/— Watts
 o/p level ref 2.83V=0dB 20/18.8/—dB
 Single cycle power 1kHz, 8/4/2 ohms... 115/190/— Watts
 o/p level ref 2.83V=0dB 20.6/20/—dB
 Dynamic headroom (IHF) 0.3dB

Bandwidth (-3dB below half power)

Disc in - power out 4Hz - 43kHz
 Disc in - pre out 3Hz - 31kHz
 Disc in - tape out 3Hz - 113kHz
 Aux in - power out 4Hz - 28kHz
 Power amp only 2Hz - 60kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	7.5	46k	60
Disc MC.....	Phono	0.29	469	
Tuner/Aux.....	Phono	400	139k	
Tape 1.....	Phono	400	139k	
Tape 2.....	Phono	400	139k	
Power amp.....	Phono	1.9V	18k	

Disc overload MC 30dB

Outputs (5.0mV disc input)

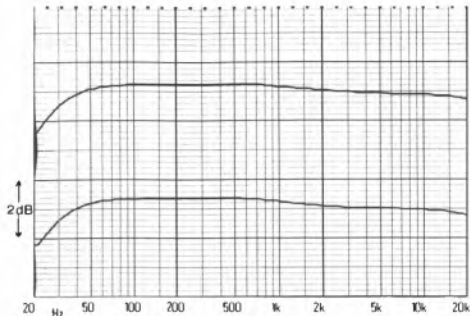
	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	700	100
Tape 2.....	Phono	700	100
Pre- out.....	Phono		

Noise (ref 1 Watt, 8 ohms)

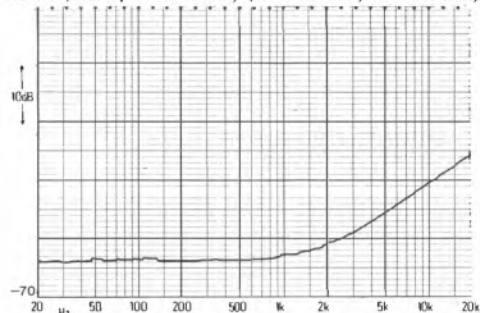
Zero volume -73dB
 Aux ref volume -69dB
 MM disc ref volume 65dB
 MC disc ref volume 67dB

Other

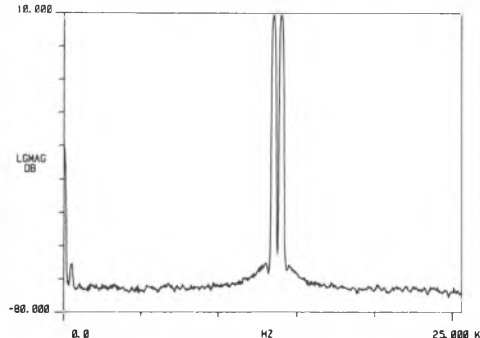
Damping factor 51
 THD performance average
 Hum performance average
 Dimensions (W x D x H) 18(46) x 12½(31) x 5(13) ins(cms)
 Weight power amp 27 lbs
 Typical purchase price £340 + £230



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Harman Kardon HK750

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



Presentation, facilities etc

This attractive and compact amplifier is a product of American design and Japanese manufacture. The legend on the front emphasises H-K's philosophical commitment to an 'ultrawideband DC amplifier', a stance which they have held consistently for many years. While acknowledging their right to their point of view, we must point out that this goes against our experience in practice. To try to put *our* point succinctly, in an ideal world where there is little room for improvement, wide bandwidth would probably be a good thing. But with amplifiers' struggling to fulfil even the basic requirements of coping with a pickup cartridge and driving a loudspeaker, we feel that they need all the help they can get, and controlling the bandwidth seems to be one way of giving them an easier time.

However to get away from philosophy for a moment, the 750 is handsomely finished in matt silver with brightwork highlights. The large knob smoothly controls volume, while little ones adjust balance and tone. Pushbars select inputs with light indicators, a second group operates subsonic and high filtering, the ambiguously labelled 'mode' (presumed to mean mono) and loudness, while others switch power and loudspeakers. Some tiny rather fiddly buttons (4) switch tape monitoring and dubbing, while an extra one handles tone defeat. Phono connectors are used throughout.

Lab performance

Measuring about 60 watts per channel, the 750 has more than enough 'urge' for almost all domestic circumstances, though the slight limitations at the frequency extremes is indicative of slightly below average distortion measurements.

The delivery is better maintained than most into low impedances, particularly under transient 'single cycle' conditions, so loudspeaker matching is really no problem. The difference between single and dual channel drive is quite large, indicative perhaps of slight limitations within the power supply.

As discussed above, bandwidths are deliberately wide open. The disc input has one of the flattest RIAA equalisation curves we encountered, and the capacitance is low enough to enable optimum matching with all cartridges. It is perhaps a pity that the second disc input was not provided with a moving-coil option, as this will to some degree limit its appeal on the UK market. The IM spectrum shows slight sidebands, but the 'noise modulation effect' is encouragingly low. Inputs and outputs have been well chosen throughout, and there are no other areas of technical weakness on this design. We did encounter a failure with one sample, though the second sample to which the measurements relate showed good correspondance with those that we had taken for the earlier one.

Listening impressions

Listening tests gave a rather mixed bag of results with no particular consistency. With the *Isobarik* loudspeakers the sound was considered quite smooth with quite good bass definition and a slightly recessed midrange, though it tended to get a little 'bright' when loud, rating a comfortable average here. With the SA3s a very negative reaction was produced, with descriptions of 'plummy' bass and 'messy' midrange, particularly on more complex material. In a recent test by Martin Colloms in *Hi-Fi News* he found that a DC-

coupled amplifier gave much better results with a sealed box enclosure (*à la Isobarik*) than a reflex (*à la SA3*), so perhaps thls may be an explanation (*viz* bandlimiting by loudspeaker!)

Conclusions

Though a generally very competently engineered amplifier, the H-K is expensive considering the strange listening test results and for the power available. It has distinct promise, but the choice of facilities might have been better for the UK, and we feel it ought to be auditioned in a system context before purchase.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 57/64/61 Watts
 o/p level ref 2.83V=0dB. 17.5/18/17.8dB
 Single channel 8/4/2 ohms

1 kHz, 0.1% dist. 72/100/123 Watts
 o/p level ref 2.83V=0dB. 18.6/17/14.9dB
 Single cycle power 1kHz, 8/4/2 ohms... 85.6/153/225 Watts
 o/p level ref 2.83V=0dB. 19.3/18.9/17.5dB
 Dynamic headroom (IHF) 0.5dB

Bandwidth (-3dB below half power)

Disc in - power out DC Hz - >200kHz
 Disc in - tape out. DC Hz - >200kHz
 Aux in - power out. DC Hz - >200kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM1 & 2...	Phono	2.8	42k	150
Tuner/Aux	Phono	150	31k	
Tape 1.....	Phono	150	31k	
Tape 2.....	Phono	150	31k	

Disc overload MM..... 37dB

Outputs (5.0mV disc input)

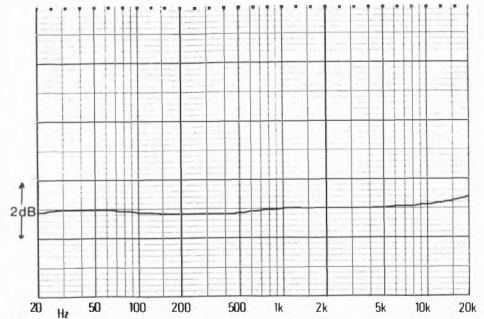
	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	260	1.5k
Tape 2.....	Phono	260	1.5k
Headphones (8 ohms).....		30	
(2 kohms).....		1.5V	

Noise (ref 1 Watt, 8 ohms)

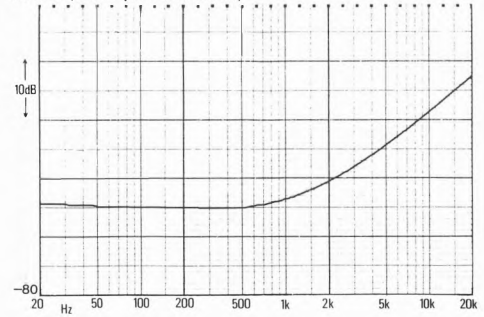
Zero volume..... -83dB
 Aux ref volume -79dB
 MM disc ref volume -78dB

Other

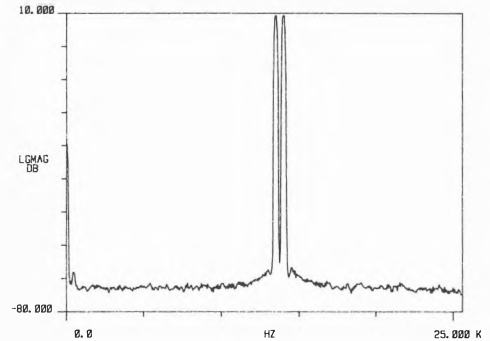
Damping factor 84
 THD performance average
 Hum performance average
 Dimensions(W x D x H) 15(38) x 14(35) x 3½(9) ins(cms)
 Weight 18 lbs
 Typical purchase price £195



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz. 0-25kHz linear; vert. range 90dB)

Hitachi HM/CA 7500II

Hitachi Sales UK Ltd., Hitachi House, Station Road, Hayes, Middx. UB3 4DR. Tel 01-848 8787



Presentation, facilities etc

This attractive and beautifully finished combination belies its comparatively modest price, which is much less than its Mark 1 predecessor. Both generations have majored on the use of Hitachi-developed 'power mosfets' in their power output stages. These semi-conductor devices have been specially developed for audio applications, and are notably 'fast'; a handful of other manufacturers also use them, though perhaps fewer than might have been expected considering their claimed advantages.

The elaborate pre-amplifier, discreetly finished in contrasting browns, is perhaps a little overburdened with tiny pushbuttons, but the main functions are easily distinguished. The largest knob controls volume with a detent action: this is calibrated in dB, and the low level settings show rather large steps, though the total range is assisted by a -20dB mute switch hidden amongst the pushbutton array. Beside the volume is a small balance knob, and a rotary switch which adjusts 'fine detail' disc input parameters. The main input switching is done by a row of accessible pushbars while the little buttons switch loudness, mute, subsonic filter, stereo/mono, tape inputs and monitoring. Two other rotaries adjust tone, with three associated pushbuttons to change turnover frequency and provide defeat. Nor is the power amplifier devoid of features, the front panel consisting of two of the largest illuminated swinging needle meters one is likely to encounter—the 'goldfish bowl' styling technique—adjustable for range and for speaker impedance. Switching is provided for two pairs of speakers, and there is also the option of direct and capacitor coupling

via the inputs (probably worth using capacitor coupling with reflex type speakers). Again with the optional output, the pre-amplifier uses phono sockets throughout.

Lab performance

Considering the weight of the power amplifier, output is comparatively modest at 100 watts per channel, but commendably shows no interference effects between the two channels reflected through the power supplies. However the power delivery was quite severely restricted into low impedances, with relay protection on 2ohms steady state. The relay did not operate on the single cycle test, and here the current limiting can be clearly seen. In effect this means that speakers need to be chosen with some care to take proper advantage of the 8ohm power available, and great care should be taken in selection if two pairs are to be used together.

The bandwidths have been left wide open at high frequencies, which we feel is a pity, though some rolloff at LF is apparent. In fact relay protection operated at 50 watts, 137kHz, so some inbuilt roll-off would have been appropriate before this. RIAA equalisation, crosstalk and THD were very good, the latter below the equally good noise threshold. Some specific IM sidebands are just visible, though this is partly because there was very little of the 'noise modulation effect'. Inputs and outputs look fine, with disc input capacitance sensible, though we would have preferred to have seen capacitance rather than impedance variations offered, while the m-c impedance at 10ohms is a little low for some models in our estimation.

Listening impressions

The 7500II combination scored a straight and consistent above average rating. Criticisms were made of a number of aspects of the sound, though they were fairly mild. Most centred around a degree of 'boom and tizz', which was fairly unobjectionable at low levels, but became less acceptable as more power was demanded. Focus, stereo and detail were all quite good, but although the amplifier sounded powerful, it lacked 'life' and definition in the bass, giving a rather 'over-heavy' sound. 'Sanitary urge' and 'squeaky clean' were two phrases which seemed to summarise the comment well. The volume control was not much liked in use, and results for mm cartridges seemed a little better than those for m-cs.

Conclusions

This is an attractive amplifier in many ways, with fine presentation and generally sound technical performance. But it is also quite expensive for the power offered and for its delivery pattern, which needs some care in speaker matching. Although the listening impressions were fairly positive and consistent, they were unexceptional for the price.

GENERAL DATA

Power stage

Both channels 20Hz/1 kHz/20kHz

8 ohms, 0.1% dist. 98/104/103 Watts
 c/p level ref 2.83V=0dB. 19.9/20.1/20.1 dB

Single channel 8/4/2 ohms

1 kHz, 0.1% dist. 104/103/- Watts
 c/p level ref 2.83V=0dB. 20.2/17.1/-dB

Single cycle power 1 kHz, 8/4/2 ohms. 126/105/52 Watts
 c/p level ref 2.83V=0dB. 21/17.2/11 dB

Dynamic headroom (IHF) 0.5dB

Bandwidth (-3dB below half power)

Disc in - power out 3Hz - 137kHz

Disc in - pre out 3Hz - 93kHz

Disc in - tape out 3Hz - 137kHz

Aux in - power out DC Hz - 115kHz

Power amp only DC or 5Hz - 183kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.8	21/50/100	156
Disc MC.....	Phono	2.8/0.105	10	
Tuner/Aux.....	Phono	150	45k	
Tape 1.....	Phono	150	43k	
Tape 2.....	Phono	150	43k	
Power amp.....	Phono	1.0V	48k	

Disc overload MM..... 39dB

Disc overload MC..... 40dB

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	265	580
Tape 2.....	Phono	265	580
Headphones (8 ohms).....		70	
Pre-out (max vol).....		1.8V	800

Noise (ref 1 Watt, 8 ohms)

Zero volume..... 97dB

Aux ref volume..... 86dB

MM disc ref volume..... 82dB

MC disc ref volume..... 77dB

Other

Damping factor 69

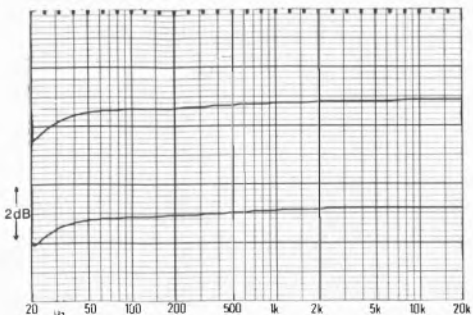
THD performance excellent

Hum performance good

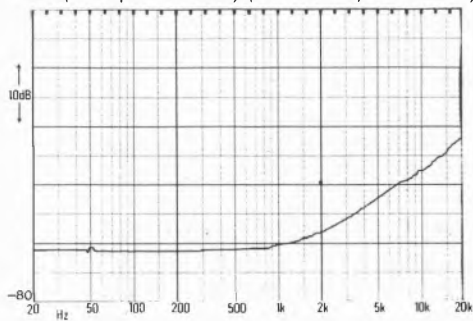
Dimensions(W x D x H).... 17(43½) x 12½(32) x 10(25) ins(cms)

Weight 40lbs

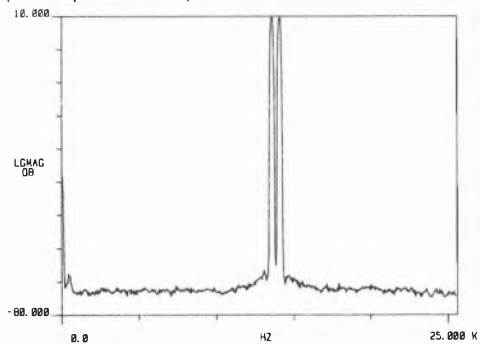
Typical purchase price £390



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

BEST BUY

JVC AX1

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



Presentation, facilities etc

Definitely for those who like the shiny silver look, the AX1 is beautifully finished but has a rather sharp protruding fascia, and is presumably intended first and foremost for console/rack mounting. Like the Technics models the fascia is divided horizontally, with the most useful functions (plus obligatory (?) 'power' meters) in the larger top section. Four long bars switch power, disc, aux and tuner inputs and a large smooth knob controls volume.

The lower section has rotary controls for balance, bass and treble, plus sensibly arranged tape monitoring, mode, loudness, speaker switching and a headphone socket. Phono socketry on the back panel is supplemented by one DIN duplicate tape connector. Construction does show some signs of economy, but this is only to be expected at the price. In all this is a smartly finished amplifier with all the necessary basic facilities, nicely laid out and easy to use.

Lab performance

Power output is fairly modest, though adequate for most purposes nonetheless. Moreover it shows a good delivery pattern, with no restriction due to distortion rising at the frequency extremes, healthy outputs into 4 and 2ohm loading, and a significant but by no means excessive difference between single and dual channel drive. Once again there is evidence of cost effective engineering rather than ill-balanced 'spec chasing', and it is unlikely that there will be any problem in choosing matching loudspeakers.

Bandwidths are reasonably sensible through the amplifier, and the RIAA curve is smooth with slight rolloffs at the extremes, which is usually a

good recipe for a low cost design. One anomaly which we noted was a 5dB rise in output to tape from disc between 10kHz and 100kHz: this is clearly wrong, though it is difficult to assess just what problems it may cause in practice. We are inclined to think that it is probably harmless, though the wrong high output moving-coil cartridge and the wrong tape recorder might result in interference with the bias oscillator. The IM distortion spectrum showed some low level sidebands, but the 'noise modulation effect' was less serious than in many other cases. Inputs and outputs are all sensibly chosen, with the disc input capacitance a nice and low 110pF (easily increased with external adaptors if required). Noise figures were excellent, and the fact that distortion is around this threshold is further evidence of good design.

Listening impressions

This amplifier did consistently well in the listening tests, comfortably rating above average overall. The bass was considered very good for a budget amplifier, just a trifle 'loose' but quite convincing nonetheless. The sound did perhaps lack finesse, sounding a little 'loud' and 'untidy', but it was generally quite well integrated with good stereo/depth, plenty going on and a quite exciting sound. The question that will inevitably be asked is whether or not it is a 'NAD-beater'. The answer as far as we are concerned must be no, but then neither is the NAD an AX1 beater either. They did similarly well overall, with the AX1 being perhaps a little more lively and untidy, yet quite neutral, while the 3020 benefited from marginally better integration and control at high frequencies, yet sounded a little more 'coloured'. Certainly this amplifier looks like a worthy rival.

Conclusions

Its nice to find a budget amp where the compromises appear to have been very well chosen, where the listening tests give positive results, and where resources do not seem to have been wasted excessively on gimmicks and in pursuit of unbalanced specification parameters.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 37/37/36 Watts
 o/p level ref 2.83V=0dB 15.7/15.7/15.5dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist 41/65/108 Watts
 o/p level ref 2.83V=0dB 16.2/15.1/14.3dB
 Single cycle power 1kHz, 8/4/2 ohms 51/95/138 Watts
 o/p level ref 2.83V=0dB 17/16.8/15.4dB
 Dynamic headroom (IHF) 0.7dB

Bandwidth (-3dB below half power)

Disc in - power out 8Hz - 71kHz
 Disc in - tape out 4Hz - >200kHz
 Aux in - power out 7Hz - 50kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.8	49k	110
Tuner/Aux	Phono	160	62k	
Tape 1 & 2	Phono	160	73k	
Tape 1	DIN	160	73k	

Disc overload MM 35dB

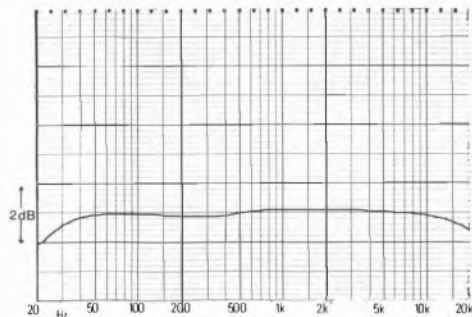
Outputs (50mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	290	510
Tape 1	DIN	30	66k
Headphones (8 ohms)		100	
(2 kohms)		2.6V	

Noise (ref 1 Watt, 8 ohms)

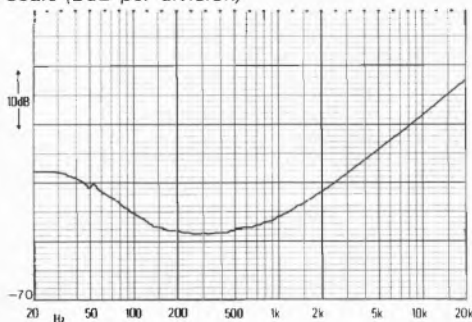
Zero volume -87 dB
 Aux ref volume -80dB
 MM disc ref volume -80dB

Other

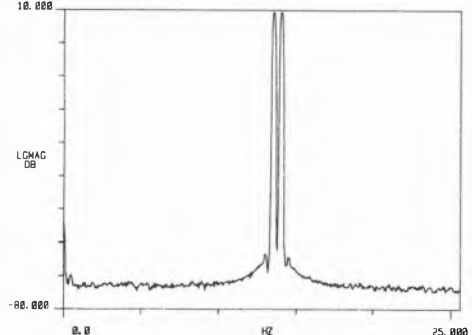
Damping factor 43
 THD performance very good
 Hum performance average
 Dimensions(W x D x H) 16½(42) x 13(33) x 4¾(12) ins(cms)
 Weight 13lbs
 Typical purchase price £72



Disc frequency response, note expanded vertical scale (2dB per division)



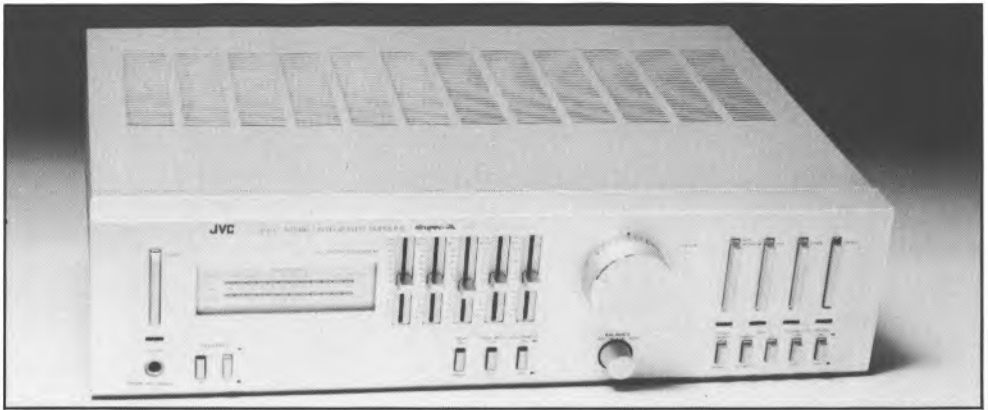
Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear, vert. range 90dB)

JVC AX4

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



Presentation, facilities etc

Like the other JVC models, this is something of a celebration in satin silver. The provision of a five-band graphic equaliser and power meters make the fascia rather 'busy' looking, but the controls seem quite logically grouped, while the standard of finish is extremely high.

The large smooth volume control is easily distinguished, and to its right are the four main pushbars with light indicators which control the inputs. A row of smaller buttons below switch mm/m-c, subsonic filter, tape 1/2, dubbing, and mono/stereo. Under the equaliser are defeat, loudness and 'record out' switches, the latter enabling the user to pre-equalise a tape recording, which can be useful in helping to 'rescue' an unpromisingly balanced recording. The remaining functions include light type 'power' meters, and speaker and power switching. Phono sockets on the back panel are supplemented by DIN on tape 1. In all this is a complicated looking amplifier which is nicely finished and laid out, so that it stays convenient to use.

Lab performance

Power output is quite adequate into 8ohms, though delivery is quite severely restricted into low impedances, which suggests that speakers should be as near to 8ohms as possible, and we feel it would be unwise to use two pairs simultaneously for fear of clipping. The delivery pattern also showed a quite significant difference between single and dual channel drive, indicating some room for improvement in the power supply perhaps.

Bandwidths show some curtailment at low frequencies, but 'wide open' high frequencies,

and the RIAA curves can be seen to have a very flat response with nicely tailored LF. The disc input capacitance is unfortunately high at 337pF, which will restrict the choice of mm cartridges to those suited to high capacitance (eg Shure, Ortofon), and those uncritical of loading (eg Grado, Technics). In other respects the inputs and outputs should be fine.

Harmonic distortion was almost completely masked by noise, which itself gave good measurements. Hum performance was only average, and a smallish difference component can be seen on the IM spectrum, together with a fair degree of 'noise modulation effect'. Overall then the lab performance is quite creditable, though the power delivery leaves a fair amount to be desired, and the disc input capacitance remains a source of compatibility concern.

Listening impressions

Depressingly inconsistent results on this occasion leave us confused about the sound quality of this model, and exasperated at the vicissitudes of listening tests (the lunch interval before one presentation may well have been the cause!) Common observations included complaint directed against an 'ill-defined' bass, and a slightly 'thin' balance. But the results were too inconsistent to give much reliable guidance, so we can really only report some uncertainties here.

Conclusions

This amplifier was not very distinguished technically, with a rather restricted power delivery into any impedance below 8ohms, and rather too much disc input capacitance for easy cartridge matching. Listening tests were not consistent

enough for any confident appraisal here, so although the design is pleasant enough, and offers plentiful facilities for the price, we are unable to summon any particular enthusiasm.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 73/78/77 Watts
 o/p level ref 2.83V=0dB 18.6/18.9/18.9dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 90.5/63/30 Watts
 o/p level ref 2.83V=0dB 19.6/15/8.8dB
 Single cycle power 1kHz, 8/4/2 ohms ... 110/61/30 Watts
 o/p level ref 2.83V=0dB 20.4/14.8/8.8dB

Dynamic headroom (IHF) 0.4dB
Bandwidth (-3dB below half power)

Disc in - power out 5Hz - 152kHz
 Disc in - tape out 12Hz - 220kHz
 Aux in - power out 2Hz - 115kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.8	46k	337
Disc MC.....	Phono	0.215	100	
Tuner/Aux.....	Phono	190	46k	
Tape 1 & 2.....	Phono	190	46k	
Tape 1.....	DIN	190	55k	

Disc overload MM 38dB
 Disc overload MC 38dB

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1 & 2.....	Phono	290	800
Tape 1.....	DIN	38	70k

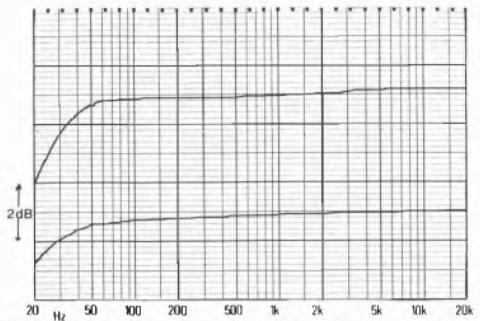
Headphones (8 ohms) 70
 (2 kohms) 2.5V

Noise (ref 1 Watt, 8 ohms)

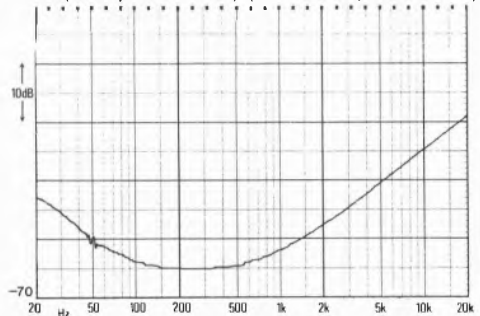
Zero volume -91dB
 Aux ref volume -82dB
 MM disc ref volume -80dB
 MC disc ref volume -75dB

Other

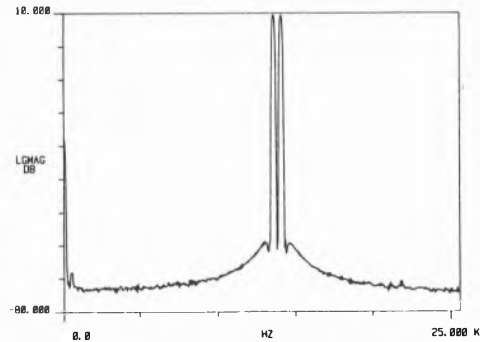
Damping factor 64
 THD performance very good
 Hum performance average
 Dimensions (W x D x H) ... 18(45) x 14(35) x 5(12) ins(cms)
 Weight 21 lbs
 Typical purchase price £166



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear, vert. range 90dB)

JVC AX9

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



Presentation, facilities etc

This large and exquisitely finished shiny artefact must be one of the best looking integrated amplifiers to come out of Japan, providing one doesn't have an aversion to large expanses of satin-chrome. The fascia is divided horizontally, with the major functions exposed and accessible along the wide top section, while less often used functions and controls are concealed under a full-width hinged section. The overall effect is impressive, though necessarily bulky.

The major controls are a large smooth action volume control, and large pushbars switching power, muting, and four main inputs. Under the subpanel things get pretty complicated, with a mass of similar pushbuttons. From the left, four of these switch loudspeakers, subsonic filter and tone defeat, then there are bass and treble tone controls. Four phono sockets allow the easy temporary connection of a tape recorder, and then there is a small rotary balance control. The final (daunting) row of 8 buttons uses no less than six to route tape recorders, which could surely have been better organised, with the final two selecting mm/m-c matching and phono 1/2. The back panel is predominately phono sockets, with DIN duplication on tape 1 (the one not duplicated on the front panel). A three position switch selects 'mm cartridge load' between 100/47k/100 kohms, the former naturally more suitable for high output moving-coils than mm types.

Lab performance

Superficially power delivery reflects the mass, price and bulk of this model, but closer examination reveals a number of weaknesses. The 120 or so watts per channel (8ohms, both channels

driven) increases quite significantly under single channel drive, which is a pity, and shows quite severe restrictions in the levels delivered into 4ohms and 2 ohms. The single cycle power figures followed this very closely, because the amplifier did not go into clipping cleanly, rather showing many harmonics and a tendency to oscillate at high frequencies. All this suggests that speaker selection needs to be made with some care, and caution should be used when driving more than one pair at a time.

Bandwidths are very wide, which in our experience is unnecessary and merely provides opportunity for trouble to occur. The disc input has impressively flat frequency responses, and sensible input capacitance. The option of 100ohms loading might be nice with some of the high output moving-coils, though by and large we would have preferred variable capacitance switching for finely tuning the HF response of mm cartridges. There is no cause for concern in the other technical areas, inputs and outputs presenting typical matching values. Noise figures and crosstalk are very good indeed, and harmonic distortion was usually below the noise. Hum also gave above average performance, though the 'noise modulation effect' on the IM spectrum is quite pronounced, and a difference component is visible.

Listening impressions

Considering the pretensions of this model, listening test results must be considered a little disappointing, the overall rating being quite consistently average, somewhat below that achieved by the humble AX1! Criticism was consistently made of the treble being 'bright' and

rather 'hard', and mention was also made of some midrange 'muddling', with general agreement that the sound was somewhat fatiguing despite a good feeling of power. The description 'chromium plated sound' from one critic seemed quite apt and representative.

Conclusions

This amplifier is superficially an attractive prospect, with apparently high power delivery and plenty of facilities at a reasonable price, nicely laid out in terms of the main operating functions. Beneath the surface power delivery was a little ill-balanced, with unfortunate behaviour in clipping, while the subjective performance only rated average, so all-in-all it doesn't really fulfil the promise of its beguiling exterior.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz

8 ohms, 0.1% dist 122/119/116 Watts

o/p level ref 2.83V=0dB 20.9/20.7/20.6dB

Single channel 8/4/2 ohms

1kHz, 0.1% dist 133/106/57 Watts

o/p level ref 2.83V=0dB 21.2/17/11.6dB

Single cycle power 1kHz, 8/4/2 ohms 138/110/60 Watts

o/p level ref 2.83V=0dB 21.4/17.4/11.7dB

Dynamic headroom (IHF) 0.16dB

Bandwidth (-3dB below half power)

Disc in - power out 2 Hz - 217 kHz

Disc in - tape out 4 Hz - 230kHz

Aux in - power out DC Hz - 200kHz

Inputs Type Sens (mV) Imp (ohms) Cap (pF)

Disc MM Phono 2.5 100/50k/99k 160

Disc MC Phono 0.2 100

Tuner/Aux Phono 200 57k

Tape 1 & 2 Phono 200 66k

Tape 1 DIN 200 66k

Disc overload MM 42dB

Disc overload MC 42dB

Outputs (5.0mV disc input) Type Level (mV) Imp (ohms)

Tape 1 & 2 Phono 380 319

Tape 1 DIN 48 76k

Headphones (8 ohms) Not taken

(2 kohms) Not taken

Noise (ref 1 Watt, 8 ohms)

Zero volume -92dB

Aux ref volume -85dB

MM disc ref volume -82dB

MC disc ref volume -77dB

Other

Damping factor 96

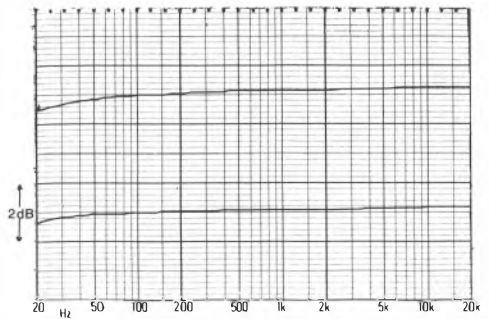
THD performance very good

Hum performance above average

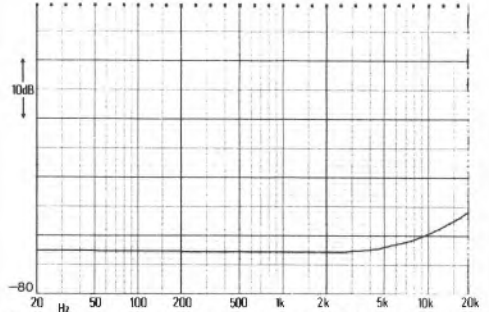
Dimensions (W x D x H) 18(45) x 16½(42) x 6½(16) ins/cms

Weight 36lbs

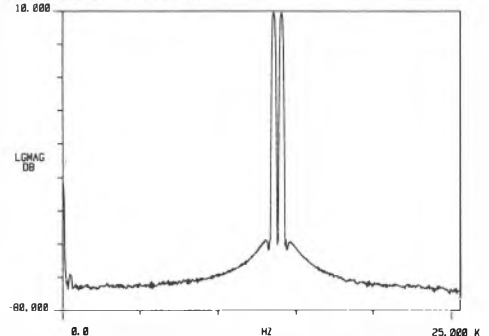
Typical purchase price £500 (incl cartridge valued at £100)



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear, vert. range 90dB)



Presentation, facilities etc

This integrated amplifier from a specialist UK manufacturer is conventional enough in overall format, yet for this reviewer at least it offers a rare combination of function, beauty and good taste in styling and design. The finish is to the sort of standard which one has come to expect only from Japanese manufacturers, while the integration of the heatsinking with the overall shape gives a pleasing octagonal fascia, and a style perhaps reminiscent of the pre-war Art Deco movement. Despite its large size, the semi-matt blue/grey gunmetal finish with white lettering should ensure that it does not stick out like a sore thumb amidst normal household decor.

Functions are deliberately kept fairly limited, though not to the degree of asceticism encountered in some audiophile-oriented products. Pushbuttons with LED indicators select power, mono/stereo and low filter, while two rotary switches handle the signal inputs and tape dubbing functions. An LED beside the volume and balance controls indicates if the amplifier is driven into clipping. Presumably in the interests of sound quality, tone controls, speakerswitching, and headphone sockets have been omitted, while an inordinate amount of care has gone into providing optimum matching for both moving-coil and moving magnet cartridge types. All (phono) socketry is fitted within a section set into the rear of the unit, accessible from above, so no rear overhang need be provided and wiring alterations can be made *in situ* (given sufficient illumination).

Lab performance

Despite the comparatively high weight of the unit, the absolute power delivery is not very large. The fact that it is very well maintained into

4ohm as well as 8ohm loads, and shows close correspondence between single and dual channel drive, suggests that the power supply is both generous and well-controlled. However the protection would seem to have been set conservatively, as delivery into the 2ohm load is rather restricted, so speakers with an impedance dropping below 4ohms are best avoided. The bandwidths measured and shown on the disc input curve are sensibly controlled, and the crosstalk sweep shows good values across most of the audio band.

The disc input impedance/sensitivity options were too complex to fit comfortably into our data table, and our measurements accorded quite closely with the manufacturer's specification: the moving magnet input offered 25/34/49/104 kohm with 40/89/147/197/263/310/420 pF options, while the moving-coil had 100/250/500/650 microV sensitivities and 38/43/54/64/78/100/197/382 ohm impedances, adjusted via presets next to the sockets on the rear panel. Though the quoted 1kHz overload margins were fine, one could nit-pick a little with the figure of 13dB which we measured at 20kHz on the m-c input.

Noise levels were very good on the disc inputs, though a little below those achieved by other amplifiers on the other inputs. The intermodulation test showed no identifiable sidebands, though there was some increase in the noise floor either side of the test signals. Overall the lab results are very good, with little cause for concern and evidence of a number of sensible choices made during the design stage.

Listening impressions

The response of listeners to this amplifier was neither particularly consistent nor overly en-

thusiastic. The overall rating was a little above average, and the most positive attribute seemed to be unusual neutrality, or lack of coloration, particularly in the midband. Criticisms were however directed towards the treble quality and to the sound quality when driven loud. Overall the sound was liked at lower levels, and the moving-coil stage appeared to be up to scratch, but the subjective impressions did not seem to accord with the power and dynamics which a unit of this weight and price might have been expected to produce.

Conclusions

This amplifier has a great deal going for it, with its very flexible disc inputs, beautiful presentation, fine technical performance, and very neutral sound quality. However it is expensive for the power offered, and was not particularly favoured when driven loud. It clearly has a place in the market when value for money is not a prime consideration, but it does show signs of over-engineering which perhaps mitigates against its competitiveness somewhat, whilst ensuring that the product has a reassuring solidity which creates confidence in the purchaser.

GENERAL DATA

Power stage

Both channels 20Hz/1 kHz/20kHz

8 ohms, 0.1% dist. : 71/72/65 Watts

a/p level ref 2.83V=0dB 18.5/18.6/18.1dB

Single channel 8/4/2 ohms

1kHz, 0.1% dist. 76/135/62 Watts

a/p level ref 2.83V=0dB 18.7/18.3/11.9dB

Single cycle power 1kHz, 8/4/2 ohms 88/153/— Watts

a/p level ref 2.83V=0dB 19.4/18.9/—dB

Dynamic headroom (IHF) 0.54dB

Bandwidth (−3dB below half power)

Disc in – power out. 7 Hz – 36kHz

Disc in – pre out. 6 Hz – 71 kHz

Disc in – tape out. 10Hz – 81 kHz

Aux in – power out. 5Hz – 55kHz

Power amp only. 3Hz – 63kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.	Phono	*	*	*
Disc MC.	Phono	*	*	*
Tuner/Aux.	Phono	100	64k	
Tape 1.	Phono	100	64k	
Tape 2.	Phono	100	64k	

Disc overload MM. 39dB

Disc overload MC. 29dB

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1.	Phono	190	550
Tape 2.	Phono	190	550
Headphones (8 ohms)	N/A		
(2 kohms)	N/A		

Headphones (8 ohms) N/A

(2 kohms) N/A

Noise (ref 1 Watt, 8 ohms)

Zero volume. 83dB

Aux ref volume. 80dB

MM disc ref volume. 79dB

MC disc ref volume. 79dB

Other

Damping factor. 416

THD performance. excellent

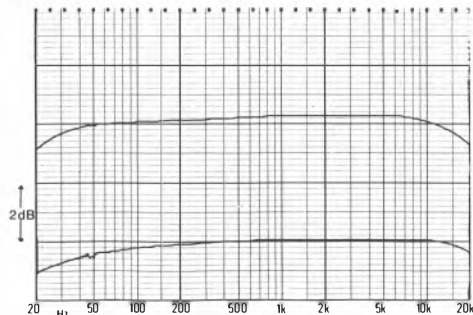
Hum performance. above average

Dimensions (W x D x H) ... 17½(44½) x 14(36) x 5(13) ins(cms)

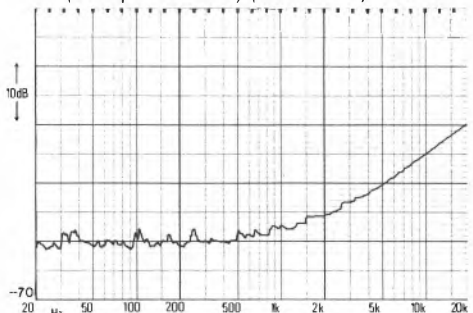
Weight. 40lbs

Typical purchase price. £750

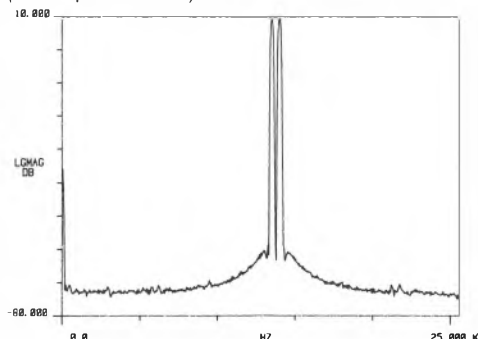
*Very flexible, see text.



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



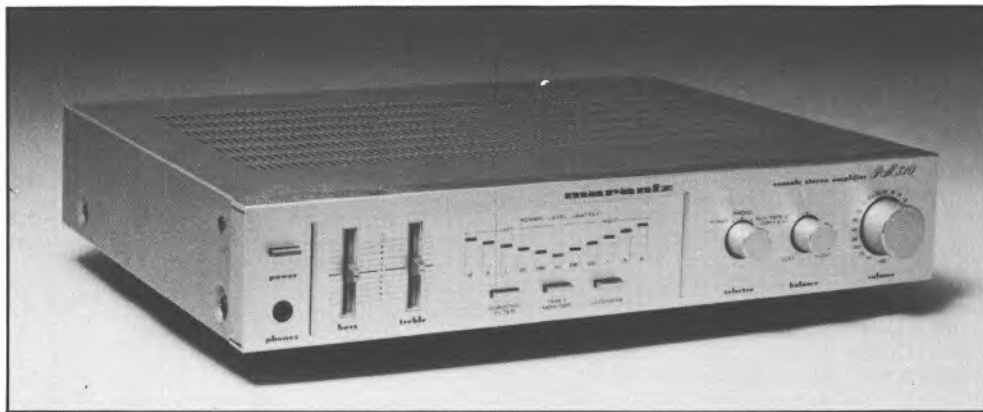
Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz. 0–25kHz linear; vert. range 90dB)

Marantz PM310

Marantz UK Ltd., 15/16 Saxon Way Ind. Estate, Moor Lane, Harmondsworth, Middx UB7 0LW. Tel 01-897 6633



Presentation, facilities etc

This pretty little slimline lightweight is one of the cheapest amplifiers in the project, but its standard of finish in no way indicates this. The fascia is a little unusual in being gold coloured, something of a Marantz tradition which seems to be stronger this year than last. Because it is very much a 'budget' amplifier, facilities are quite restricted, and there is a pleasing lack of clutter, Marantz have had less opportunity than usual to overburden us with stylistic and typeface excesses.

It does seem strange that 'power' meters are still with us even when cost-cutting to get to the lowest possible price, yet a simple group of LEDs provides the central styling feature, with attendant pushbuttons for loudness, subsonic filter and tape monitor. To the left, two vertical sliders control tone, while on the right hand side are three rotaries, comprising a largish detent action volume control and input selectors. The back panel is similarly simple, with one set of speaker terminals and five pairs of phono inputs. Though basic, the facilities are positively lavish compared with some audiophile products, yet the layout is logical and straightforward, so the amplifier is refreshingly easy to use.

Lab performance

30 watts per channel output is not particularly generous by current standards, but in fact it is quite rare to need much more power than this under typical domestic circumstances, particularly if reasonably sensitive speakers are chosen (such as Marantz's own, for example). Distortion measured below average, though not severely so, and this serves to restrict our power measurement at the frequency extremes a little. Delivery

is reasonably maintained into 4ohms, but quite restricted into 2ohms, so the lowest impedance speakers are best avoided, although the absence of second speaker outlets will help avoid problems. A significant power difference can be noted between single and dual channel output, so the power supply is a little on the 'loose' side.

Bandwidths are quite nicely controlled, but the RIAA equalisation is not very accurate and will colour the sound somewhat. A further point to watch is the slightly high disc input capacitance, which added to the turntable combination could well make it difficult to match some cartridges optimally; however with a little care there should not be any serious problems. Hum breakthrough was poorer than average, and some sidebands can be identified on the IM spectrum, while the 'noise modulation effect' is also quite pronounced here. In general the technical performance parameters are somewhat below average (except for crosstalk which is very good), but there are no particularly serious anomalies, and the overall balance would appear to have been quite carefully worked out to make the best of limited resources.

Listening impressions

Not surprisingly the 310 came in for a fair amount of criticism, but at the same time the amplifier was considered to have acquitted itself quite reasonably when examined as a whole, and had an overall rating only marginally below average. The sound was a little coloured and rather muddled, and these characteristics were much more noticeable when working it hard. But the overall sound was quite well balanced, if short on detail, and aggressive tendencies were mercifully

slight. All in all we felt that an A for effort turned a potential C into a respectable enough B—!

Conclusions

It is easy enough to become over-critical when dealing with amplifiers at the very cheap end of the market, where technical limitations become fairly obvious. But the Marantz does manage a surprisingly competent overall performance despite rather unpromising ingredients. Its not really hi-fi, more top-end audio, so we feel disinclined to recommend it formally, and an extra £20 is worth spending on something a little better. But if you must have a £65 amplifier, this is almost certainly the one.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 27/31/29 Watts
 o/p level ref 2.83V=0dB 14.3/14.9/14.6dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 38/49/18 Watts
 o/p level ref 2.83V=0dB 16/13.9/6.5dB
 Single cycle power 1kHz, 8/4/2 ohms 49/69/16 Watts
 o/p level ref 2.83V=0dB 16.9/15.4/6dB
 Dynamic headroom (IHF) 0.7dB

Bandwidth (-3dB below half power)

Disc in - power out 11Hz - 51kHz
 Disc in - tape out 8Hz - 80kHz
 Aux in - power out 5Hz - 56kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.8	46k	230
Tuner/Aux.....	Phono	180	60k	
Tape.....	Phono	180	60k	

Disc overload MM..... 35dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape.....	Phono	300	278
Headphones (8 ohms).....		70	
(2 kohms).....		2.5V	

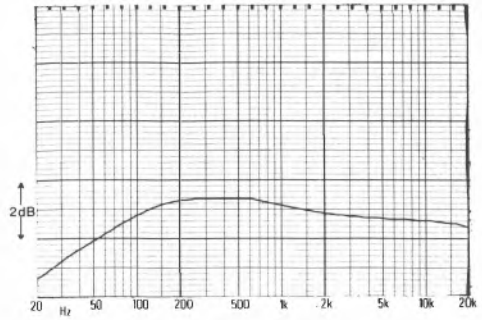
Headphones (8 ohms)..... 70
 (2 kohms)..... 2.5V

Noise (ref 1 Watt, 8 ohms)

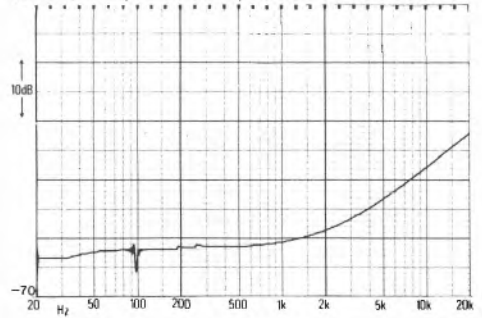
Zero volume -84dB
 Aux ref volume -82dB
 MM disc ref volume -74dB

Other

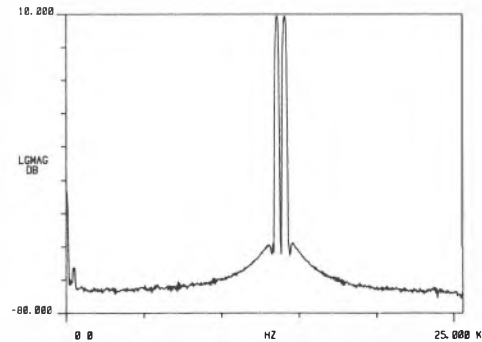
Damping factor 44
 THD performance average
 Hum performance below average
 Dimensions (W x D x H) 16½(42) x 13(33) x 3¼(8) ins (cms)
 Weight 1.1 lbs
 Typical purchase price £65



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Marantz PM550DC

Marantz UK Ltd., 15/16 Saxon Way Ind. Estate, Moor Lane, Harmondsworth, Middx. UB7 0LW. Tel 01-897 6633



Presentation, facilities etc

This model lies around the middle of the large Marantz range, so it is free of the tightest cost constraints of the lowest priced models, but is nevertheless in a very competitive sector of the market. Styling is peculiarly Marantz, that is with gold rather than silver finish, rather an abundance of bits and pieces enlivened by a profusion of typefaces.

Slightly slimmer than some, this is nevertheless very much a full-sized model, with the fascia separating the controls via a raised section on which the less essential functions are located. The volume control is a little larger than the other three knobs around it, and has a mild detent action. The other rotaries control balance, input selector (including moving-coil cartridge option), and a 'record send' selector incorporating cross-dubbing. At the other end of the fascia the tone controls are replaced by an elaborate five position graphic equaliser, the controls centred on 50/200/800/3.2k/12.8k Hz. An 'EQ out' jack socket gives the useful facility of feeding a tape recorder directly. 'Power' LEDs are elaborately mounted under a transparent cover. Pushbuttons switch two pairs of loudspeakers, give equaliser defeat, subsonic and high filters, loudness, stereo/mono and tape monitoring. The rear panel is exclusively phono sockets.

Lab performance

Power output is not unreasonable, but the delivery pattern gives us some cause for concern. The restriction at 20Hz is due to an early rise in the measured distortion, but the delivery into low impedances is also quite limited, both into 4 and 2 ohm loads on steady state measure. This implies

that some care should be taken in avoiding low impedance loudspeakers, and calls into question a little the provision to drive more than one pair simultaneously. It would have been better to have given an either/or option, and this amplifier should not be used to drive two sets of speakers together at a party. However the power measurements we obtained do show some discrepancy with the specification (this in turn depends a little on how the measurements were taken), and does make us wonder whether our sample might have been misaligned, in say the protection circuitry, and our findings and their inferences may not be entirely representative.

Bandwidths show little attempt at curtailment, and noise was a little on the high side, particularly via the moving-coil input. However distortion was pretty low, usually below the noise of the amplifier. Disc input capacitance is rather too high for optimum matching with a number of moving magnet models, assuming a typical contribution from the turntable. Our figure is rather higher than Marantz spec. here, but even their 220pF value could be inconvenient. The alternative mm input uses the same basic circuitry while bypassing the head amp stage, so presumably similar conditions apply, though we did not measure this (our fault). The other inputs and outputs are usefully typical, and there is no cause for concern on the other technical measurements, though the 'noise modulation effect' on the IM spectrum is fairly pronounced.

Listening impressions

The results for the 550 were pretty fair considering its place in the market, yet were also rather unspectacular, giving a straight average

throughout. The consensus seemed to be that it was commendably unaggressive, without obvious vices, but at the same time tended to make the music rather boring to listen to. Some general criticisms were made against the bass quality, which was considered a little 'loose', but the general balance was quite well favoured. One listener in particular consistently marked this model down, and the adjective 'thick' turned up several times in descriptions.

Conclusions

This has turned out to be very much a middle of the road amplifier at a middle of the road price. Facilities are quite useful, particularly the m-c option and EQ out for recording enthusiasts. But there are a few technical quirks, possibly due to quality control slip-ups on our sample, and the listening tests gave unspectacular results. So this model does not stand out in quite the way our other Marantz models do in their respective classes.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist..... 62/72/71 Watts
 o/p level ref 2.83V=0dB..... 17.9/18.5/18.5dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist..... 82/60/21 Watts
 o/p level ref 2.83V=0dB..... 19.1/14.8/7.3dB
 Single cycle power 1kHz, 8/4/2 ohms..... 102/180/27 Watts
 o/p level ref 2.83V=0dB..... 20/19.5/8.3dB
 Dynamic headroom (IHF)..... 0.6dB

Bandwidth (-3dB below half power)

Disc in - power out..... 5Hz - 103kHz
 Disc in - tape out..... 6Hz - 110kHz
 Aux in - power out..... 4Hz - 92kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	3.3	48k	335
Disc MC.....	Phono	0.34	108	
Tuner/Aux.....	Phono	180	76k	
Tape 1.....	Phono	180	80k	
Tape 2.....	Phono	180	80k	

Disc overload MM..... 39dB
 Disc overload MC..... 39dB

Outputs (5.0mV disc input)

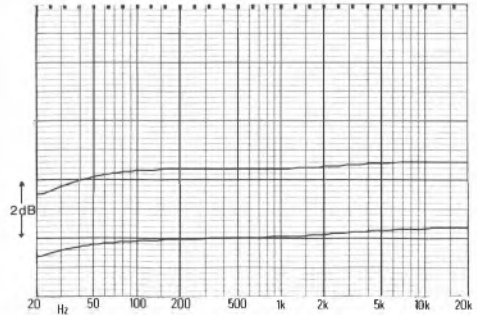
	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	270	470
Tape 2.....	Phono	270	470
Headphones (8 ohms).....		67	
(2 kohms).....		2.5V	

Noise (ref 1 Watt, 8 ohms)

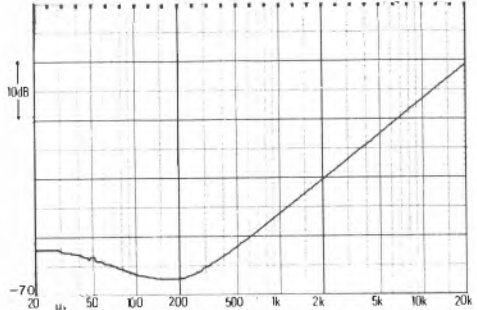
Zero volume..... -82dB
 Aux ref volume..... -80dB
 MM disc ref volume..... -77dB
 MC disc ref volume..... -66dB

Other

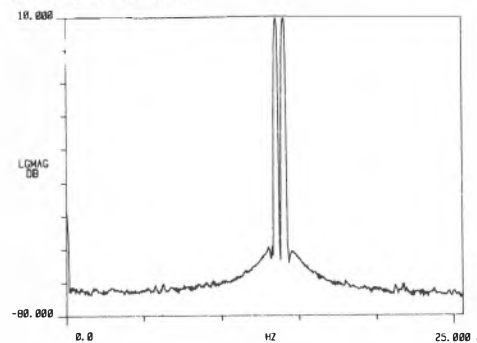
Damping factor..... 51
 THD performance..... good
 Hum performance..... excellent
 Dimensions (W x D x H)..... 16½(42) x 14(36) x 5(12) inst cms
 Weight..... 17lbs
 Typical purchase price..... £150



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

RECOMMENDED

Marantz PM5

Marantz UK Ltd., 15/16 Saxon Way Ind. Estate, Moor Lane, Harmondsworth, Middx. UB7 0LW. Tel 01-897 6633



Presentation, facilities etc

Originally marketed as part of the Marantz Esotec brand, the PM5 is joining the top of the regular range now, with a welcome £100 price reduction. This large integrated model has a gold-coloured fascia which stands proud of the case proper, for console mounting, and is decorated with a large range of features. One quite unusual facility is that the power amplifier may be switched to operate either in Class A or in Class B modes: in theory Class A is considered to be superior because it eliminates 'crossover distortion' which may be caused when switching from one output transistor to another, though in practice any benefit is far from proven, and also 'wastes' power as heat.

The copious facilities include tone controls which operate independently on each channel, elaborately scaled light-type 'power' meters, a five-position mode selection switch, selection for two sets of speakers plus a headphone socket, and monitoring and dubbing for two tape recorders. Provision is made for both moving-coil and moving magnet cartridge types, and front panel switches also operate a loudness function, a subsonic 'rumble' filter, and a tone control bypass switch, the latter rather obscurely labelled 'straight DC'. The layout of the front panel knobs and switches has a pleasing symmetry, though this does not assist in finding the volume control easily, nor is it complemented by the inevitable Marantz confusion of logo typefaces scattered hither and thither. All inputs and outputs are on phono sockets. When in use, particularly in Class A mode, the unit naturally gets quite warm, so some care needs to be taken to ensure adequate ventilation.

Lab performance

The significant heat output from this model was noted, causing a continuous 'ticking' from the heat pipe which is used to cool the transistors. Power delivery comfortably exceeded the 80/20 specification, though why the power meters are scaled to 200/50 watts/8ohms remains obscure. A significant though not excessive difference between single and dual channel drive power outputs may be seen in Class B mode, but the power delivery into low impedances was generally well maintained, so choice of accompanying loudspeakers should not be critical.

Bandwidths show sensible curtailment at the frequency extremes, but the disc input frequency responses do show a mild low frequency 'bump' of about 1 dB, sufficient to be audible and introduce a measure of tonal coloration, though unlikely to be considered offensive. More worrying perhaps is our measured input capacitance of 370 pF on the moving magnet input: although it could be argued that this can help control ultrasonic spurious from modern wide-bandwidth cartridges, the fact remains that it will also have an undesirable effect upon the high frequency audio band response of a significant number of models, particularly with the typical extra 150 pF provided by the turntable's pickup leads. The discrepancy between our finding and the 150 pF measured for a similar amplifier (Colloms: *Hi-Fi News* May 1981) remains unexplained. In other respects the inputs and outputs show well chosen values that should cause no compatibility problems.

The other measured technical performance parameters were to a competent standard, with the crosstalk better than 50 dB across most of the

audio band, noise figures a little below average, while the intermodulation spectrum shows no specifically identifiable sidebands, though there is a rise in noise related to the test signals.

Listening impressions

The listening tests gave generally positive results, with the overall ranking well above average, albeit with occasional dissent. Most criticisms were directed at a rather 'bright' treble, and little difference was noted between Class A and B operation. Some informal auditioning was also undertaken with the related MA5 mono power amplifiers, which showed a slight improvement, and also a slight change between modes when driven from a high quality component pre-amp.

Conclusions

This was definitely considered amongst the more lively, dynamic and informative integrated amplifiers, and gave a well balanced subjective performance for the price. Some reservations nevertheless remain concerning the moving magnet input capacitance and the perhaps unnecessarily elaborate arrangements (cooling etc) needed to provide the Class A option.

GENERAL DATA

Power stage Class B

Both channels 20Hz/1 kHz/20kHz
 8 ohms, 0.1% dist. 99.4/100/98 Watts
 o/p level ref 2.83V=0dB 20/20/20dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 113/182/237 Watts
 o/p level ref 2.83V=0dB. 20.5/19.6/17.7dB
 Single cycle power 1kHz, 8/4/2 ohms 156/276/380 Watts
 o/p level ref 2.83V=0dB. 21.9/21.4/19.8dB
 Dynamic headroom (IHF) 1.05dB

Power stage Class A

Both channels 20Hz/1 kHz/20kHz
 8 ohms, 0.1% dist. 25/25/25 Watts
 o/p level ref 2.83V=0dB 14/14/14dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 26/44/65 Watts
 o/p level ref 2.83V=0dB. 14.1/13.4/12.1dB
 Single cycle power 1kHz, 8/4/2 ohms. 29/48/81 Watts
 o/p level ref 2.83V=0dB. 14.6/13.8/13dB
 Dynamic headroom (IHF) 0.24dB

Bandwidth (-3dB below half power)
 Disc in - power out. 5Hz - 51kHz
 Disc in - pre out. 4Hz - 52kHz
 Disc in - tape out. 4Hz - 175kHz
 Aux in - power out. 3Hz - 46kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.5	54k	370
Disc MC	Phono	0.25	74	
Tuner/Aux	Phono	180	39k	
Tape 1 & 2	Phono	180	39k	

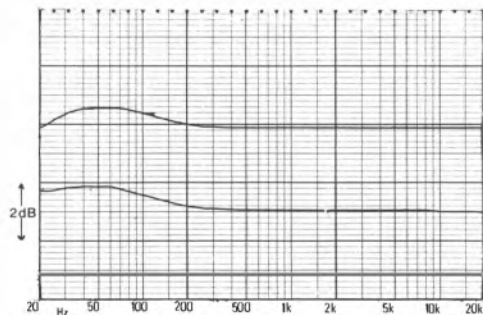
Disc overload MM. 39dB
 Disc overload MC. 38dB

Outputs (5.0mV disc input)

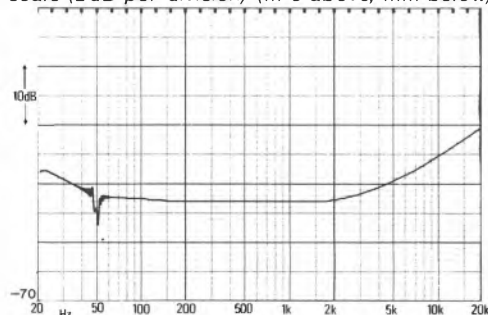
	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	325	600
Headphones (8 ohms)		70	
(2 kohms)		2.5V	

Noise (ref 1 Watt, 8 ohms)
 Zero volume -82dB
 Aux ref volume -78dB
 MM disc ref volume -78dB
 MC disc ref volume -74dB

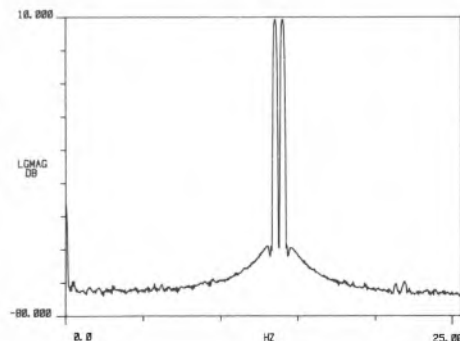
Other
 Damping factor. 77 (Class A, 64)
 THD performance excellent
 Hum performance average
 Dimensions (W x D x H) ... 16½(42) x 14½(37) x 6(15) ins(cms)
 Weight 28 lbs
 Typical purchase price £400



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz. 0-25kHz linear, vert. range 90dB)

Meridian 101/103/103D

Boothroyd Stuart Ltd., 13 Clifton Road, Huntingdon, Cambs. PE18 7EJ. Tel (0480) 57339



Presentation, facilities etc

This is the third time we have examined the Meridian amplification system in *Choice*, as on each occasion there have been detail changes which required re-appraisal. On this occasion though we have decided to combine the 103 and 103D review, because the products are very similar, sharing three modules. The module system is what distinguishes the Meridians externally and internally from most products, and gives them an aesthetic edge which few even approach.

The system is made up from three or four (D type) small identically sized modules which are discreetly finished in a textured olive green/brown. The pre-amp majors on external simplicity, with the single knob operating on/off for the pre-amp and the system *via* mains outlets, plus volume and balance arranged concentrically. Three toggle switches select inputs and mono/stereo mode. The pre-amp has its own power supply, while the input circuitry is contained on 'plug in' sealed plastic modules, permitting great flexibility in cartridge loading and future upgrading. A recent introduction for pre-amp internals is a 'double module' specifically for moving-coil matching, and our tests have concentrated on this version. Besides the pre-amp, the 103 has a power amplifier and its power supply, while the D version uses two supplies instead of one. DIN circuitry is used throughout, which is a trifle inconvenient on the disc input even though there is some technical justification. High quality adaptors are available, and for reasons of compatibility the tape signals are matched to typical phono standards. Interconnection is initially confusing, and takes a little effort to get tidy, but once set up the system is very simple to use.

Lab performance

Power output is not particularly large, but should be sufficient for most applications. Interestingly it shows a substantial improvement over the figures taken a year previously (approximately 10%). The single supply 103 has a delivery which is quite well maintained into low impedances, but shows a substantial single/dual channel drive difference and a large increase on the 'single cycle' test, which indicates rather 'loose' control. The dual supply 103D shows a significant increase in power and a generally more controlled delivery pattern. Naturally there is no difference between single and dual channel drive, but the overall pattern is still generally 'tidier', and is again competent into low impedances.

Bandwidths show close control on all inputs, which is sound practice in our view, though the RIAA equalisation only meets $\pm 0.5\text{dB}$, and shows a trend which will almost certainly be audible as slightly exaggerated 'presence' and 'brightness'. Distortion was below average, and several significant sidebands are visible on the IM spectrum. With the 103 hum was also below average, though excellent on the 103D with its extra power supply. Crosstalk and noise figures were both very good, the former representing a significant improvement. Inputs and outputs seem reasonably compatible (to phono standards), and benefit from the flexibility of the module system.

Listening impressions

Listening tests gave slightly disappointing results compared with previous findings for these models, perhaps due to a rather higher overall standard shown by the test group. Overall the 103 rated only average, with the 103D a little above average.

The sound of the 103D was described as pleasant and easy to listen to, with good stereo and control at low levels, albeit slightly 'forward' and coloured in the midrange and with a tendency to lose subtlety and some bass control when working at louder levels. The 103 still sounded respectable, but sounded more 'muddled' and 'coloured'.

Conclusions

Though this is an attractive system in a number of ways, it is also expensive for both the technical and the subjective performance which we found. On the technical side it still shows some of the weaknesses we have commented on before, though there are areas of improvement, while subjectively it does not seem to have benefited significantly from the module changes which have been made to the pre-amp. Notwithstanding this, it is still a respectable performer, and in our eyes amongst the most beautiful around, easy to use, and with unusual capability for future upgrading.

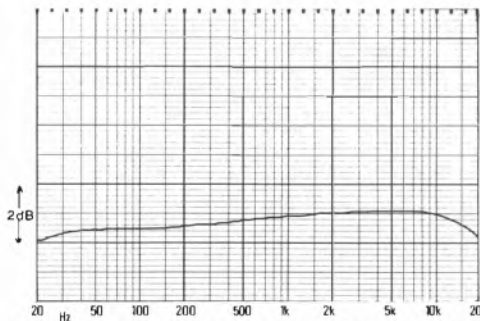
GENERAL DATA

101/103

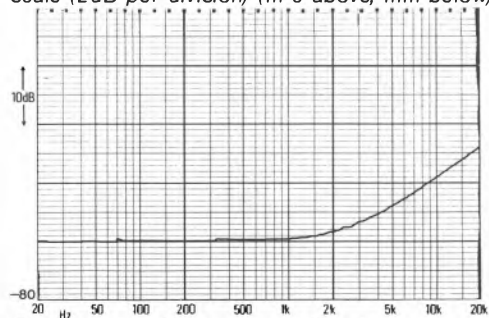
Power stage			
Both channels 20Hz/1kHz/20kHz			
8 ohms, 0.1% dist	41/47/48 Watts		
o/p level ref 2.83V=0dB	16.1/16.9/16.9dB		
Single channel 8/4/2 ohms			
1kHz, 0.1% dist	58/83/105 Watts		
o/p level ref 2.83V=0dB	17.6/16.4/2dB		
Single cycle power 1kHz, 8/4/2 ohms			
o/p level ref 2.83V=0dB	70/128/121 Watts		
Dynamic headroom (IHF)	18.5/18/14.8dB		
Bandwidth (-3dB below half power)			
Disc in - power out	5Hz - 36kHz		
Disc in - pre out	3Hz - 45kHz		
Disc in - tape out	2Hz - 50kHz		
Aux in - power out	4Hz - 36kHz		
Power amp only	3Hz - 60kHz		
Inputs			
Disc MM	DIN	Sens (mV)	Imp (ohms) Cap (pF)
Disc MC	DIN	0.1	46
Tuner/Aux	DIN	150	100k
Tape	DIN	150	19k
Power amp	DIN	1.3V	9k
Disc overload MC			37dB
Outputs (500uV disc input)			
Tape	DIN	100	6k
Noise (ref 1 Watt, 8 ohms)			
Zero volume			-80dB
Aux ref volume			-80dB
MC disc ref volume			-80dB
Other			
Damping factor			58
THD performance			below average
Hum performance			below average
Dimensions (W x D x H)			3 x [5½(14) x 2(5) x 12(30)] ins(cms)
Weight			15lbs
Typical purchase price			£430

Power stage 101/103D

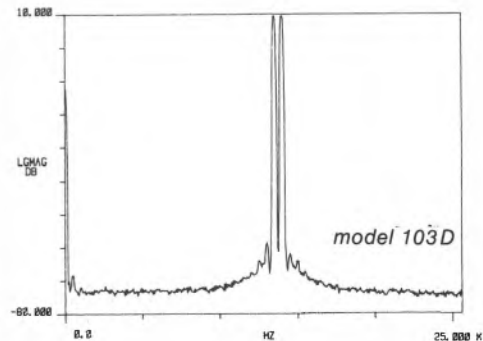
Both channels 20Hz/1kHz/20kHz			
8 ohms, 0.1% dist	54/57/55 Watts		
o/p level ref 2.83V=0dB	17.3/17.6/17.4dB		
Single channel 8/4/2 ohms			
1kHz, 0.1% dist	58/87/99 Watts		
o/p level ref 2.83V=0dB	17.6/16.4/13.9dB		
Single cycle power 1kHz, 8/4/2 ohms			
o/p level ref 2.83V=0dB	70/124/115 Watts		
Dynamic headroom (IHF)	18.5/18/14.6dB		
Other			
Damping factor			58
THD performance			below average
Hum performance			excellent
Dimensions (W x D x H)			4 x [(5½(14) x 2(5) x 12(30)] ins(cms)
Weight			22lbs
Typical purchase price			£550



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear, vert. range 90dB)

Meridian 101/105

Boothroyd Stuart Ltd., 13 Clifton Road, Huntingdon, Cambs. PE18 7EJ. Tel (0480) 57339



Presentation, facilities etc

Sharing the pre-amplifier from the cheaper Meridian combinations, the 101/105 uses 'double module' mono power amplifiers, one for each channel. Internally a modular construction is used, so that any changes or improvements to the design may be incorporated conveniently. The system is unusually compact and visually discreet, with a matt, textured, olive green/brown finish.

Facilities are strictly limited, though the modular construction does permit considerable long-term flexibility. The pre-amp has a single rotary knob which controls volume, balance (arranged concentrically) and also does duty as the on/off switch for pre- and power amplifiers (via mains outlets at the rear). Three toggle switches complete the line up, handling mono/stereo mode switching and input selection/tape monitoring. Though facilities are strictly limited, this does aid the simplicity of operation, and many users seem to find that most of the features fitted to 'mainstream' products are rarely - if ever - used from one year to the next. Inputs and outputs use DIN sockets, which is a little inconvenient particularly for the disc input, though good quality adaptors are available. To improve general compatibility the 'line' inputs and outputs are designed to work with phono ancillaries.

Lab performance

Power output is generous, with an improvement of about 10% over our previous findings. Moreover the delivery pattern is encouraging into low impedances, so no special consideration need be taken when choosing loudspeakers. Naturally there is no interchannel interference with this

design, though the substantial increase noted under single cycle transient conditions does perhaps indicate some power supply 'looseness'.

Bandwidths are closely controlled throughout, with the disc input sensibly within that of the power amplifier, so that unwanted signals should be suppressed before they can cause any harm. The disc frequency response shows a larger error than we like falling inside $\pm 0.5\text{dB}$, but suggesting a reason for the Meridian's reputation for a 'bright' 'forward' sound. Crosstalk measures very well, showing a substantial improvement over our previous findings. Noise figures are pretty good as well, though hum and harmonic distortion were only average, and the IM spectrum shows a significant sideband, though it is free of the 'noise modulation effect', and gives a significantly better result than the 103 power amplifier.

Listening impressions

Results were slightly mixed with this model, whose combination of attributes and limitations appeared to confuse the panelists somewhat. Overall results were comfortably though not exceptionally above average. Favourable comments were directed towards the 'punchy' 'lively' reproduction of transients, which made the amplifier exciting to listen to, while stereo, ambience and 'weight' were all favourably commented upon. However there were also comments of occasional 'hardness', some 'muddle' and 'muddiness' on complex passages, and a rather 'lumpy' tendency in the bass, with the amplifier tending to sound a little 'untidy', despite good detail with plenty going on. Overall the feeling remains that inside the 105 is a rather better amplifier waiting to get out. It has notable

strengths, which carry a strong appeal for some listeners, but others find its weaknesses rather less acceptable, and the recent pre-amp changes do not seem to have resulted in any dramatic improvements.

Conclusions

Ergonomically and aesthetically this must be a very attractive package, but it is expensive, and the listening tests were perhaps not positive enough to fully justify the price. Technical performance was competent rather than spectacular, though power delivery was generally very good. We suspect that the 105 would benefit from pre-amp improvements, and are not very confident that the recent changes in pre-amp modules have been particularly beneficial. Worth consideration, but prior audition is essential.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 111/117/111 Watts
 o/p level ref 2.83V=0dB. 20.5/20.7/20.5dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 117/174/222 Watts
 o/p level ref 2.83V=0dB. 20.7/19/17.5dB
 Single cycle power 1kHz, 8/4/2 ohms ... 162/294/361 Watts
 o/p level ref 2.83V=0dB. 22/21.7/19.6dB
 Dynamic headroom (IHF) 1.1dB

Bandwidth (-3dB below half power)

Disc in - power out. 6Hz - 35kHz
 Disc in - pre out. 3Hz - 45kHz
 Disc in - tape out. 2Hz - 50kHz
 Aux in - power out. 4Hz - 33kHz
 Power amp only. 3Hz - 57kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.	DIN	Various modules available		
Disc MC.	DIN	0.10	46	
Tuner/Aux.	DIN	150	100k	
Tape.	DIN	150	19k	
Power amp.	DIN	1.05V	10k	

Disc overload MC 37dB

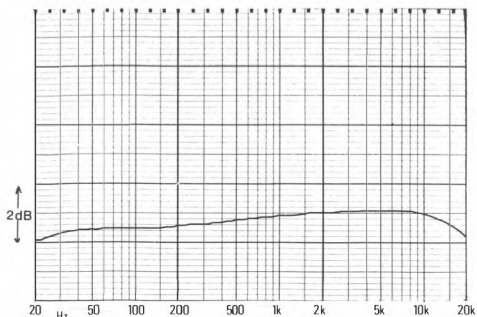
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape.	DIN	100	6k

Noise (ref 1 Watt, 8 ohms)

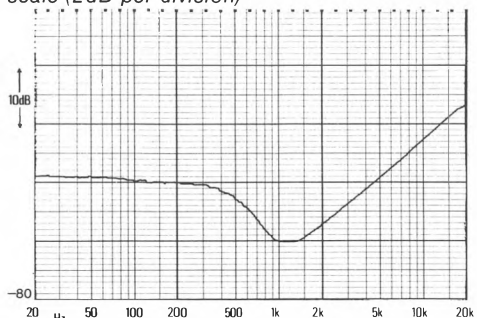
Zero volume. -93dB
 Aux ref volume. -80dB
 MC disc ref volume. -80dB

Other

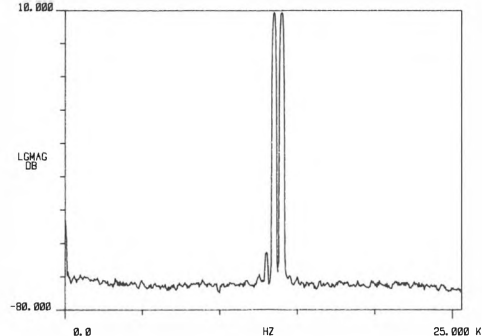
Damping factor 78
 THD performance. average
 Hum performance. average
 Dimensions (W x D x H)
 1 single, 2 double x [5½(14) x 2(5) x 12(30)] ins(cms)
 Weight 31 lbs
 Typical purchase price £700



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

BEST BUY

NAD 3020

Hi-Fi Markets, Unit 3, Colonial Way, Watford, Herts. Tel (0923) 27737



Presentation, facilities etc

Launched with considerable publicity two years ago, the 3020 quickly became regarded as THE budget amplifier, sending rival importers searching frantically for 'NAD-beaters', and being the biggest single reason for the rapid growth and success of the 'Hi-Fi Markets' franchised dealer network. We just missed it for the last *Amplifiers Choice* (and I was not a little embarrassed by the cheeky 'best buy' advertisement that they sneaked into that issue). But it was included with its matching tuner in 1980's *Receivers, Tuners and Amplifiers*, and is definitely important enough to warrant complete solo reassessment for this edition.

Because of its position in the marketplace, rumours tend to fly thick and fast, and question marks have been raised over its reliability. It is very difficult to establish facts in such cases, but my collaborator David Watson, whose shop has sold several hundred, reckons that it is no different to typical Japanese products in terms of percentage returns, and rather better than more audiophile-oriented products.

To get back to the product itself, it is a simple and fairly conventional integrated amplifier, which would win no awards for its aesthetics, but which at least has the good taste not to glint enticingly in every ray of sunshine. Finished with a sort of olive camouflage fascia, the black knobs look rather cheap and plasticky (though I can't see that it matters much anyway), and the controls are reasonably simple and logically grouped. Features are (thankfully?) fairly basic, the only 'frills' being a 5 LED 'power' indicator, audio muting and loudness switching, plus tone control and a headphone socket. On the rear, socketry is phono, with the tape DIN duplicated. Provision is

made for a single set of speakers, and pre-out/in and 'Lab in' sockets are provided, as well as a special switchable 'soft clipping' circuit.

Lab performance

Power is naturally not generously available, but will still be found quite adequate for most normal domestic applications (I still personally feel that there is a place in the market waiting for a really good low cost 5 watt amplifier!) The distortion rises a little early at low frequencies, and the limitations of the power supply are shown in the nearly 25% difference between single and dual channel capabilities. But power is maintained quite well into low impedances, and represents a significant improvement on the earlier sample we tested with its tuner in 1980. When activated the soft clipping circuitry reduces the undistorted power available by 50%, but ensures that over-driving remains audibly relatively unobjectionable, so it could be useful for the occasional party.

Sensible bandlimiting is in evidence *via* the disc, auxiliary and power amplifier inputs, which are probably the most important in any case, though the disc frequency response might have been a little flatter. Crosstalk was generally fine, worsening somewhat towards the high frequencies. Inputs and outputs all have sensibly compatible sensitivities etc. The intermodulation distortion was generally good, with some increase in noise around the test signals, but less than with many other designs.

Listening impressions

The 3020 continued to score above average marks quite consistently on listening tests, with some listeners rating it very highly indeed. The

extreme bass and treble character did not always appeal, but nearly everybody commented upon the high standard of integration and the realistic impression of dynamics. Clearly the NAD continues to set an enviable subjective standard at its modest price.

Conclusions

Our latest sample shows some improvement over that tested previously, so even though the price has crept up slightly, NAD have not let their standards slip. Subjectively we find an above average amplifier sold at an almost ridiculously low price. It is clear that there are some closer rivals than before amongst the latest ranges from other manufacturers, and we have always felt that the NAD's performance has tended to become elevated above its station by the media: *ie* that at higher prices the better examples do sound better (such as the (lamented) Sansui 217 and A&R A60, for example). Notwithstanding this, the 3020 remains a sterling achievement which has stood the test of time well, and is thankfully still available.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 28/35/34 Watts
 o/p level ref 2.83V=0dB 14.5/15.4/15.3dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist 44/72/98 Watts
 o/p level ref 2.83V=0dB 16.4/15.6/14dB
 Single cycle power 1 kHz, 8/4/2 ohms 52/95/150 Watts
 o/p level ref 2.83V=0dB 17.2/16.8/15.8dB
 Dynamic headroom (IHF) 0.18dB

Bandwidth (-3dB below half power)

Disc in - power out 16Hz - 41 kHz
 Disc in - pre out 12Hz - 132kHz
 Disc in - tape out 4Hz - 143kHz
 Aux in - power out 16Hz - 39kHz
 Power amp only (normal) 15Hz - 40kHz
 (lab) 6Hz - 122kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	3	47k	121
Tuner/Aux.....	Phono	220	33k	
Tape.....	Phono	220	36k	
Tape.....	DIN	220	36k	
Power amp N/L		1250	15/30k	

Disc overload MM 38dB

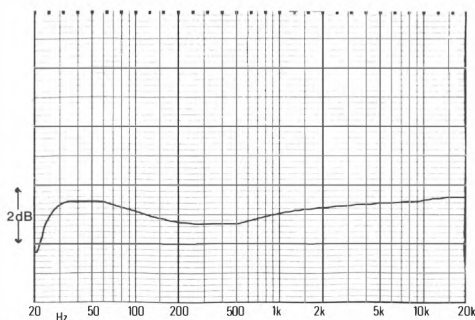
Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape.....	Phono	280	1.6k
Tape.....	DIN	56	68k
Headphones (8 ohms).....	Jack	100	
(2 kohms).....		2.6V	
Pre-out(5mV discmax vol).....	Phono	1.9V	

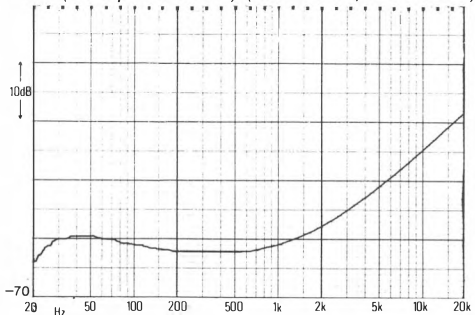
Noise (ref 1 Watt, 8 ohms)
 Zero volume..... -91dB
 Aux ref volume -87dB
 MM disc ref volume -80dB

Other

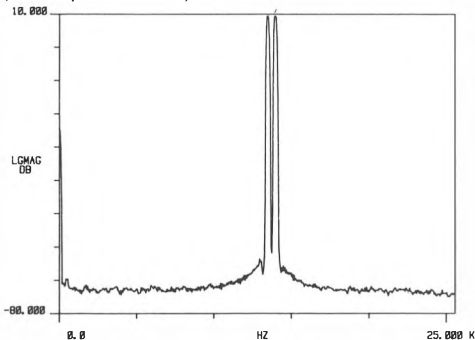
Damping factor 42
 THD performance excellent
 Hum performance average
 Dimensions (W x D x H) 16½(42) x 10(26) x 4(10) ins(cms)
 Weight 12lbs
 Typical purchase price £90



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

NAD 3140

Hi-Fi Markets, Unit 3, Colonial Way, Watford, Herts. Tel (0923) 27737



Presentation, facilities etc

The 3140 is clearly an attempt by NAD to translate the success of their 3020 model further upmarket into a higher price bracket. Physical appearance is similar to the 3020, though there are a number of extra facilities and illuminated 'power' meters, so this model looks much less stark (alternatively, much more fussy) than its baby brother.

The main knob adjusts volume, and has a concentric balance ring control which had a rather sloppy 'feel' about the centre indent. Five identical but sensibly distributed switches select loudness, low level listening, mono, infra-sonic (filter), and power, while six identical rotaries switch the inputs and the signal sent to tape recorders independently, the tone controls, the speaker connections, plus a special function called 'speaker EQ' which is designed to compensate tonally for low frequency rolloff of small sealed-box loudspeakers.

The back panel is unusually busy, using phono sockets predominately but offering DIN alternative on Tape 1. A switch selects 100/200/320pF options on one of the disc inputs (both mm, no m-c input being provided). Pushbutton switches activate SLC (speaker lead compensation), soft clipping, and a bridged mode to convert the amplifier to high power mono operation. Separate pre-out/power-in and 'lab in' sockets are provided, with different bandwidth limiting characteristics.

Lab performance

This is quite a powerful amplifier, much more so than its 40 watt rating might imply. Delivery is reasonably well maintained into 4ohms, though somewhat curtailed into 2ohms, so speaker

matching is unlikely to be a problem unless one is planning to drive two pairs simultaneously and hard. A rather large difference can be seen between single and dual channel drive, suggesting that the power supply is a little 'loose'.

Bandwidths show sensibly tight control throughout, and distortion measured well, though deteriorating somewhat towards high frequencies. Noise measurements were somewhat below average, as was hum, and the disc input equalisations might have been more accurately tailored at the low frequency end. The flexibility of the various inputs is good, with the variable capacitance showing accurate calibration and well chosen values. From the point of view of the UK market the absence of a moving-coil input would seem a pity. Though the IM distortion spectrum shows some low level sidebands, the 'noise modulation effect' was less severe than with many other designs. We did not investigate the SLC feature closely, and the brochure is not particularly explicit upon the mode of operation. But in essence it is designed to take account of the effects produced by long runs and/or thin cables, both of which should be avoided in any case. So it is likely to be most useful when running auxiliary loudspeakers in another room some distance away.

Listening impressions

Unfortunately the 3140 did not repeat the 3020's impressive and quite consistent high rankings in the listening tests. It was not so much that it did particularly badly, more that it seemed rather undistinguished, rating slightly below average overall. At low levels comments were pretty favourable, describing the sound as quite 'open'

and controlled, with reasonable dynamics and stereo, and with no unpleasant aggressive characteristics, if a trifle 'soft' overall. When driven louder the criticisms were fairly strong, describing 'muddling' and loss of 'weight', resulting in a much less 'integrated' sound.

Conclusions

The 3140 is an interesting product in many ways, with a number of quite unusual features which show some careful thought. In terms of the measured performance and power outputs it is respectable value for money. But the listening tests gave far less encouraging results than for the much cheaper 3020, the additional facilities are by no means essential and the chance to build in a head amp has not been taken, so our enthusiasm remains rather lukewarm.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 70/73/73 Watts
 o/p level ref 2.83V=0dB 18.5/18.6/18.6dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist 91/132/126 Watts
 o/p level ref 2.83V=0dB 19.6/18/15dB
 Single cycle power 1kHz, 8/4/2 ohms 100/162/248 Watts
 o/p level ref 2.83V=0dB 20/19/17.9dB
 Dynamic headroom (IHF) 0.18dB

Bandwidth (-3dB below half power)

Disc in - power out 11 Hz - 42kHz
 Disc in - pre out 14 Hz - 90kHz
 Disc in - tape out DC Hz - 90kHz
 Aux in - power out 14 Hz - 42kHz
 Power amp only (normal) 11 Hz - 39kHz
 (lab) 5 Hz - 100kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM 1	Phono	1.2	50k	110
Disc MM 2	Phono	3.8	50k	117/210/ 339
Tuner/Aux	Phono	250	56k	
Tape 1 & 2	Phono	250	56k	
Tape 2	DIN	250	56k	
Power (normal)	Phono	1.25V	18k	
amp (lab)	Phono	1.4V	38k	

Disc overload MM 35dB

Outputs (5.0mV disc 1 input)	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	780	2.8k
Tape 2	DIN	250	74k
Headphones (8 ohms)		48	
(2 kohms)		2.4V	
Pre-out (5m disc in max vol)		5.5V	156

Noise (ref 1 Watt, 8 ohms) -75dB

Aux ref volume -69dB

MM disc ref volume -69dB

Other

Damping factor 104

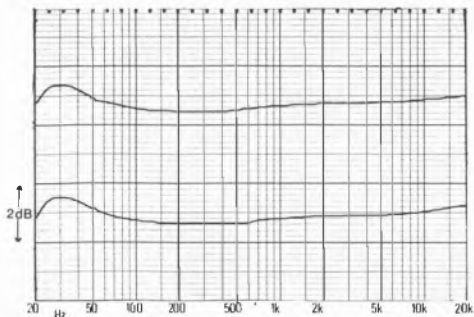
THD performance above average

Hum performance below average

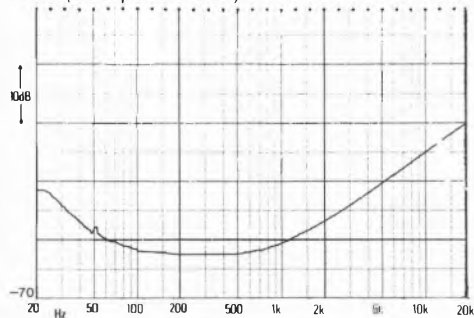
Dimensions (Wx Dx H) 16½(42) x 12½(32) x 4¼(11) ins (cms)

Weight 20lbs

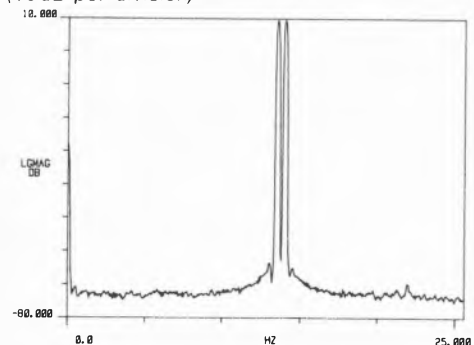
Typical purchase price £160



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Onkyo A25

Audiotrend Ltd., Bridle Path, Watford, Herts. WD2 4BZ. Tel Watford 33010



Presentation, facilities etc

As a package, the A25 must be one of the neatest in the book. Finish is to the expected high Japanese standards, though there are a couple of sharp corners around the fascia. This compact design is surprisingly heavy, indicating that it is more powerful than its dimensions suggest. The overall presentation is enhanced by a hinged flap covering the less essential controls, leaving the basic visible layout simple and quite easy to use.

The exposed section of the front panel has a main volume control with fairly strong detent action, and pushbuttons for power and input selection (disc, tuner and tape/aux). There are also two 'swinging needle' 'power' meters of slightly nostalgic appearance, and indicator lights to differentiate between m-c and mm cartridge and A and B speaker selection. Under the panel three pushbuttons select loudness, tape 2 monitoring, and m-c/mm selection, small fiddly rotaries control balance and tone, while a larger one switches either/or/and between two pairs of speakers. The rear panel uses phono sockets exclusively.

Lab performance

Power output is quite generous at 50 watts per channel, considering the size and price of the unit. Delivery remains quite capable into 4ohms, with the level into 2ohms tailing off somewhat. The instruction on the back panel 'total impedance more than 4ohms' is accurate enough, but could be misleading for the non-technical user, whose memory contains the mathematical data $2+2=4$ indelibly engraved. For the benefit of these $8+8=4$ in impedance/parallel terms, so some care needs to be taken if planning to use

two speakers together, though for a single pair there should not be any problems. The delivery pattern does show quite a large difference between single and dual channel drive, suggesting that the power supply is one of the limiting factors.

No attempt appears to have been made to control the bandwidths, and our technical evaluation found that the amplifier did not react too kindly to very high frequencies, tending to triangulate the incoming wavefront above 65kHz, so a much earlier rolloff, say above 35kHz, might have been more sensible. The distortion was good, normally buried below the noise threshold of the amplifier, though in fact the noise performance was a little below average.

The disc inputs have their fair share of problems, with the RIAA equalisation sufficiently far from flat to cause colorations, and with the moving magnet input capacitance a trifle on the high side at 220pF, so that a little care needs to be taken to choose a turntable to match some of the cartridges around. The moving-coil input is a little noisy and insensitive, and the hum performance around 50Hz is not particularly good, so the higher output types (ie Denon rather than Ortofon) are best used here, though the RIAA error is on m-c is a further disincentive in any case. Overall the Onkyo is not a bad amplifier, but has sufficient technical 'wrinkles' to impair confidence a little.

Listening impressions

Listening test results were not terribly encouraging, with the unit quite consistently scoring a below average rating overall, partly no doubt due to the effects of the RIAA error. Certainly the 'bright and bass light' character was noted, and it

was felt that this might prove fatiguing in the long term. Besides this the character was not particularly unpleasant, nor was it in any way distinguished, nor described particularly consistently by the panel members. The nearest thing to consensus described a somewhat muddled sound which was not very dynamic or exciting.

Conclusions

This is undoubtedly a pretty little amplifier which offers a moving-coil option at a very competitive price, and has quite a high power output to boot. But to be frank it was undistinguished in the listening tests and showed sufficient technical oddities to mar our confidence a little. So while it is not a bad design and has its own appeal, it has not really done well enough to merit recommendation, though if the sound quality appeals it represents a competitive enough package.

GENERAL DATA

Power stage

Both channels 20Hz/1 kHz/20kHz
 8 ohms, 0.1% dist. 48/52/51 Watts
 o/p level ref 2.83V=0dB. 16.9/17.2/17dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist. 61/85/83 Watts
 o/p level ref 2.83V=0dB. 17.8/16.3/13.2dB
 Single cycle power 1kHz, 8/4/2 ohms. 72/112/132 Watts
 o/p level ref 2.83V=0dB. 18.6/17.5/15.2dB
 Dynamic headroom (IHF) 0.48dB

Bandwidth (-3dB below half power)

Disc in - power out. 7 Hz - 93kHz
 Disc in - tape out. 10Hz - >200kHz
 Aux in - power out. 4Hz - 72kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.	Phono	3.5	43k	220
Disc MC.	Phono	0.31	330	
Tuner/Aux.	Phono	190	64k	
Tape 1.	Phono	190	64k	
Tape 2.	Phono	190	64k	

Disc overload MM. 39dB
 Disc overload MC. 36dB

Outputs (5.0mV disc input)

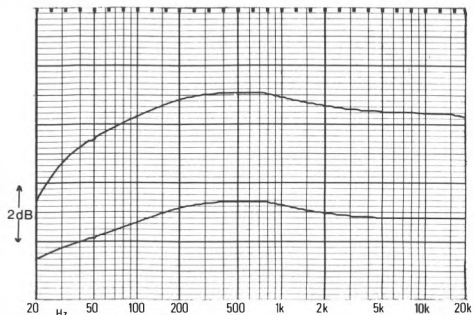
	Type	Level (mV)	Imp (ohms)
Tape 1.	Phono	240	980
Tape 2.	Phono	240	980
Headphones (8 ohms)		65	
(2 kohms)		2.4V	

Noise (ref 1 Watt, 8 ohms)

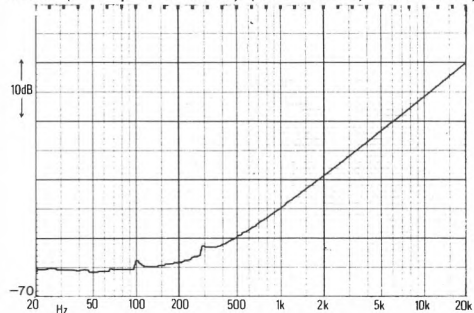
Zero volume. -88dB
 Aux ref volume. -87dB
 MM disc ref volume. -77dB
 MC disc ref volume. -77dB

Other

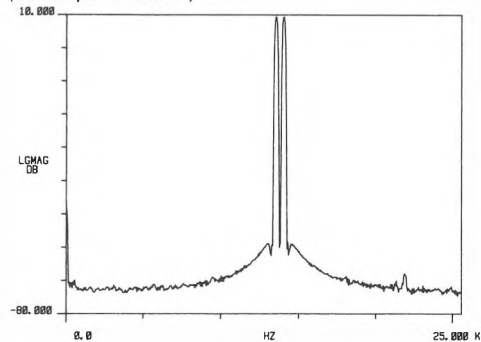
Damping factor 67
 THD performance excellent
 Hum performance below average
 Dimensions (W x D x H) 16½(42) x 11(28) x 3.2(8) ins (cms)
 Weight 14lbs
 Typical purchase price £110



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

PS Audio 2/III/LCC

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



Presentation, facilities etc

Viewing with the Crimson as the wierdest set-up in the project, the PS is a true audiophile product in the American tradition, characterised by sharp edges, minimal standards of finish, and a concentration on the important basics. We originally received two little lightweight pre-amplifier boxes (and were surprised to find mains leads on each), and a power amplifier similar in overall shape to the 'classic' Quad 303.

The two pre-amps are respectively a 'linear control centre' and 'PS III phono pre-amplifier'. The control centre is a simple input selector with volume and balance, while the phono pre-amplifier accepts moving magnet and moving-coil types (the switch being adroitly hidden on the underside near the back panel). Switching adjusts mm impedance and capacitance (22/47kohm, 50/150/300pF). Moving-coil users can spend a little more money and purchase the 'moving-coil amplifier' as well, though we have not tested this variation in any detail. Some care needs to be taken when siting the units to avoid hum. The power amplifier has facilities for operating as a higher power mono device in 'bridged' mode (160w/8ohms, 180 watts, 4ohms).

Lab performance

Power delivery is rather low for such an expensive unit, though adequate for most domestic situations nonetheless, and delivery was well maintained into low impedances, so there is no problem in using any loudspeaker models. However the difference between single and dual channel drive is rather large (20+%), so perhaps the power supply has room for improvement, though PS make an interesting point on this in

their literature. Rather than the more common UK technique of powering the pre-amp from the power amplifier to avoid hum, the PS uses the alternative of tiny transformers with correspondingly small fields; hum performance was rather below average nevertheless.

Bandwidths show reasonable curtailment at the extremes, and the RIAA equalisation was very flat. However overload margins reduced somewhat at high frequencies, to 23dB mm and 14dB m-c and noise figures on the disc inputs were not very good (due perhaps to part passive equalisation). There were also signs of HF instability above the -3dB points. Odd results were initially obtained on the disc input stage until we discovered that the toggle switches controlling input resistance and capacitance had been wired wrongly. Things behaved properly once corrected, but a brickbat nevertheless to PSQC.

The amplifier showed rather higher distortion levels than most of the models tested, especially at high frequencies, while crossover distortion was also encountered, and appears to be an inherent part of the design rather than an alignment problem. Crosstalk was very good indeed, but the IM spectrum shows a small difference component as well as noticeable 'noise modulation effect'. Inputs and outputs indicate no compatibility problems, and although our measured values for disc input impedance and capacitance varied a little from the labelling on the switches, they are nevertheless sensible and useful values.

Listening impressions

If the technical tests were inauspicious for an

amplifier in this price class, the listening tests should give Paul and Stan a little more cause for satisfaction. Though not consistent, results were well above average on occasions, rating a strong above average rating overall. The amplifier sounded clear, detailed and 'confident', with generally good coherence, coping quite well with rhythm, although it was felt to sound rather less good when working at louder levels and on more complex forms of music (*ie* classical orchestral was less convincing than solo instruments). Other occasional criticisms were of a touch of 'tizz' and a tendency for the bass to 'hang on' to notes.

Conclusions

If you take an audiophile-priced product (*ie* one not made by the thousand on Osaka production lines), and then ship it halfway across the world, it is difficult to preserve value for money. In the US this is a 'budget enthusiast' model, but it becomes quite high priced in the UK. So we have some qualms about the value for money aspects, and some quibbles about the technical performance. But we found the sound interesting and sometimes quite impressive, so the PS goes some way towards justifying its existence despite its oddities (which include finish, presentation and UK price).

GENERAL DATA

Power stage

Both channels 20Hz/1 kHz/20kHz
 8 ohms, 0.1% dist 40/40/40 Watts
 c/p level ref 2.83V=0dB 15.9/15.9/15.9dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 51/82.8/128 Watts
 c/p level ref 2.83V=0dB 17/16.1/15dB
 Single cycle power 1kHz, 8/4/2 ohms ... 53/95/150 Watts
 c/p level ref 2.83V=0dB 17.2/16.7/15.7dB
 Dynamic headroom (IHF) 0.1dB

Bandwidth (-3 dB below half power)

Disc in - power out 3Hz - 63kHz
 Disc in - pre out 3Hz - 80kHz
 Aux in - power out 3Hz - 62kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.2	10k/47k	65/215/340

Disc MC.....	Phono	0.17	10	
Tuner/Aux.....	Phono	360	8k	
Tape 1.....	Phono	360	8k	
Tape 2.....	Phono	360	8k	

Disc overload MM..... 34dB

Disc overload MC..... 32dB

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	600	870
Tape 2.....	Phono	600	870
Pre-amp out.....	Phono	1.8V	150

Noise (ref 1 Watt, 8 ohms)

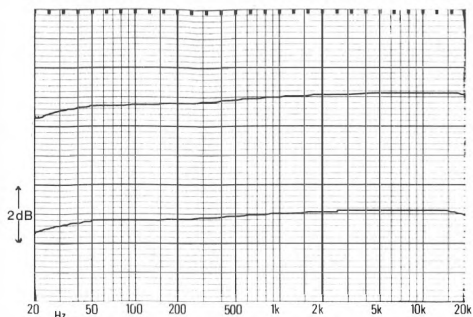
Zero volume -87dB
 Aux ref volume -87dB
 MM disc ref volume -74dB
 MC disc ref volume -66dB

Other

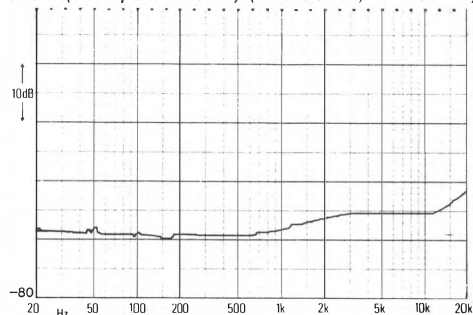
Damping factor 137
 THD performance below average
 Hum performance below average
 Dimensions (W x D x H) complex: 2 [9(23) x 9(23) x 3(8)]
 + 6½(17) x 12(31) x 6(15) ins(cms)

Weight 17lbs

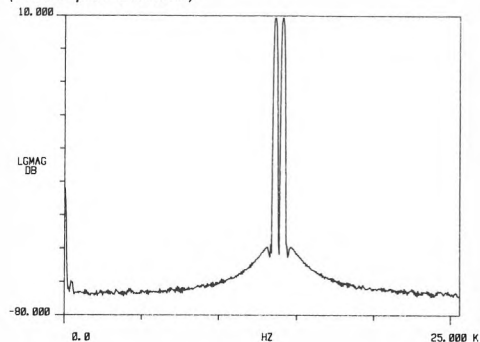
Typical purchase price £670



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz. 0-25kHz linear; vert. range 90dB)

Pioneer A7

Pioneer UK Ltd., Pioneer House, The Ridgeway, Iver, Bucks. SL0 9JL. Tel (0753) 652222/7



Presentation, facilities etc

Pioneer's variation on making a complicated amplifier reasonably straightforward to use at least has a touch of originality, though the permanent 'underground map' (follow *green* lights to Victoria) may not be to everybody's taste. The right hand gold coloured third has a giant *macho* volume control plus -20dB muting button, and then a flush row of large pushbutton input selectors: these look smart with their engraved lettering but are not too easy to read; they are however supplemented by illuminated ideograms on the block diagram beside them, but these of course are difficult to understand (can anybody write down the one for 'aux'?).

The left hand third is again gold finished, with two protruding knobs which control tone. Lower the flap (and slide it out of the way underneath if you wish) and (hey presto!) two more knobs and eight tiny buttons appear. The former operate balance and the signal sent to the tape recorders with cross-dubbing facility, while the buttons switch mono/stereo, m-m/m-c disc, tone defeat, loudness, subsonic filter, speakers A and B. Though confusingly labelled, their operation is displayed on the map, preventing ambiguity. The map section is not really for those who dislike light shows, with illuminated power meters on top of all the rest. But it is not too difficult to understand, and does help prevent getting everything wrong in its own interactive little way (some videorecorders of my acquaintance might benefit from this example).

Lab performance

Power output is more than adequate, though not perhaps as generous as we have come to expect

from the Japanese for this price. Delivery is quite well maintained into 4ohms, but is somewhat restricted into 2ohms. The back panel recommends 6ohm speakers, and minimum 12ohm models when two are being used together (I know of no 12ohm models on the market); this is really being over-conservative, but speakers below 4ohms are probably best avoided. The difference between single and dual channel drive is significant, though by no means unusual.

Bandwidths appear to have been controlled quite sensibly, and the distortion was really 'state of the art', almost completely masked by the (good) low level of noise produced. Two niggles relate to the disc inputs: the m-m capacitance is perhaps a trifle high at 210pF – not enough to completely rule out cartridges if sensibly low values of arm lead capacitance are obtained: the m-c overload margin deteriorated somewhat at high frequencies. It was noticeable how distortion and noise were improved when the 'line straight' tone-defeat switching was engaged, so its just as well this switch was provided along with all the other gubbins. In other respects the amplifier is pretty good, with sensibly compatible interfacing, a little extra noise than desirable via m-c, no distinct IM sidebands although the 'noise modulation effect' can be seen around the test signals, and slightly below average hum performance.

Listening impressions

Overall the results for this amplifier were reasonably consistent and rated it slightly above average. The areas of criticism were mainly the extreme treble and bass, the former sounding a little 'jangly' with definition somewhat obscured, and the latter lacking real power and authority, though

neither criticism was particularly severe. The midband was nicely controlled and open, with quite good stereo and depth, while the total sound was smooth if not particularly dynamic, and overall this amplifier seems to have managed quite a neat set of compromises.

Conclusions

Though not offering the power/price ratio of some of the competition, this is a generally very competently engineered amplifier which rated quite well on the listening tests, offering a smooth if not spectacularly exciting sound, and happily free of many of the fatiguing effects criticised in other designs. Ergonomics are fine, though the styling is perhaps more of an acquired taste.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 78/85.8/82.5 Watts
 c/p level ref 2.83V=0dB 18.9/19.3/19.2dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 97/150/131 Watts
 o/p level ref 2.83V=0dB 19.9/18.7/15.1dB
 Single cycle power 1kHz, 8/4/2 ohms 116/200/138 Watts
 o/p level ref 2.83V=0dB 20.6/20/15.3dB
 Dynamic headroom (IHF) 0.3dB

Bandwidth (-3dB below half power)

Disc in - power out 5Hz - 86kHz
 Disc in - tape out 5Hz - 43kHz
 Aux in - power out 2.5Hz - 64kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.5	51k	213
Disc MC.....	Phono	0.25	100	
Tune/Aux.....	Phono	150	47k	
Tape 1.....	Phono	150	47k	
Tape 2.....	Phono	150	47k	

Disc overload MM 37dB
 Disc overload MC 37dB

Outputs (5.0mV disc input)

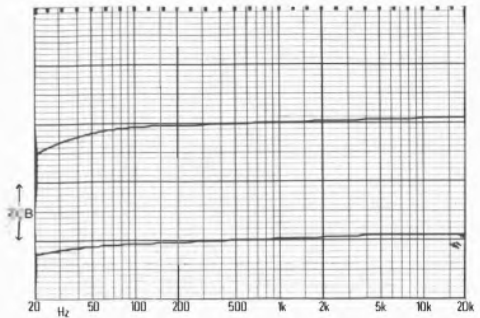
	Type	Level (mV)	Imp (ohms)
Tape.....	Phono	250	3k
Tape.....	Phono	250	3k
Headphones (8 ohms)		50	
(2 kohms).....		2.0V	

Noise (ref 1 Watt, 8 ohms)

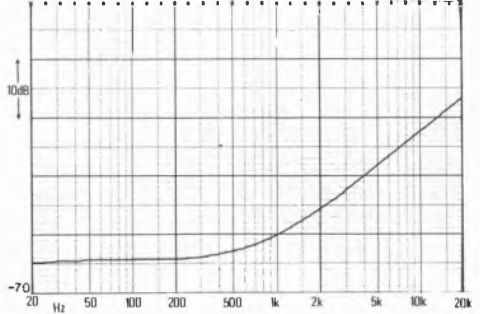
Zero volume -90dB
 Aux ref volume -82dB
 MM disc ref volume -81dB
 MC disc volume -75dB

Other

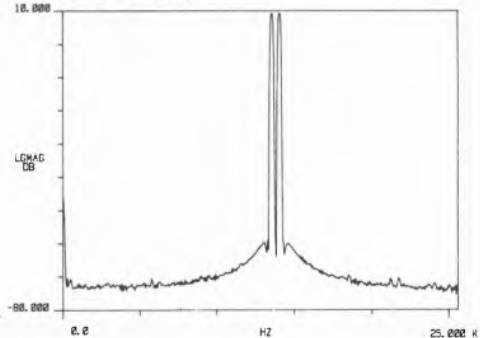
Damping factor 91
 THD performance excellent
 Hum performance below average
 Dimensions (W x D x H) 16½(42) x 16½(42) x 5(12) ins(cms)
 Weight 26lbs
 Typical purchase price £270



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

RECOMMENDED

Pioneer A8

Pioneer UK Ltd., Pioneer House, The Ridgeway, Iver, Bucks. SL0 9JL. Tel (0753) 652222/7



Presentation, facilities etc

This middle model of Pioneer's 'big three' is difficult to distinguish from the cheaper A7. The fascia is divided into three full height sections finished in gold, black plus lights, and gold respectively. The right hand section is dominated by a huge volume control with an attendant muting button. A neatly indented row of large pushbuttons select the inputs: these are attractively engraved but not easy to read, while the light show next door only identifies them in hieroglyphics.

A hinged and retractable panel covers the left hand section, with just the tone control knobs peeking through (why?) When retracted a confusion of nine little buttons is revealed, to switch mm/m-c disc, speakers A and B, 'line straight' tone bypass, mono/stereo, subsonic filter, loudness, high/low mm and m-c loading, the latter giving 200/400pF mm options and 33/100ohm m-c alternatives.

Two extra rotary controls adjust balance and sort out tape recorder switching, allowing any input to be recorded independently of the main signal playing, and organising cross-dubbing. In the centre the 'light show' gives a graphic and hard-to-ignore display of the signal routing through the amplifier. This does help to overcome ambiguities in the switch labelling, but the absence of any dimming/off switch and the use of three lurid colours makes this a difficult item of equipment to ignore. Adding further muscle to the display is a vertical 'power' meter, while the main power switch is tucked away almost as an afterthought, black on black with only a red blip to attract attention.

Lab measurements

Power delivery follows a similar pattern to the A7, offering about 1dB of extra level. Delivery was quite well maintained into 4 ohms, though somewhat curtailed into 2ohms, so a little caution is necessary when choosing loudspeakers particularly if wanting to use two pairs together and loudly, though the 'minimum 12ohms' instructions under these conditions on the back panel is quite impractical. Single/dual channel drive difference is on the large side.

The bandwidths show a measure of control, though with a certain randomness, and no LF rolloff has been incorporated. Although the intention was presumably to improve upon the A7, as it turned out the measurements were marginally poorer overall, though pretty good nonetheless. Once again distortion was vanishingly small, while the IM test shows some 'noise modulation effect', but no distinct sidebands to speak of. The tone control circuits should be switched out unless really (?) necessary, since they adversely affect the distortion and noise performance. The provision of alternative disc input capacitances is usually useful, but the values we measured are 10% higher than specification, and the 200/400pF spec would have been much more useful as 100/300pF in any case. So despite these alternatives some care needs to be taken with turntable and cartridge selection, though mismatches are likely to be minor. We cannot see the 450pF+ setting proving to be much benefit at all, unless it helps control the input bandwidth at high frequencies.

Listening impressions

Listening test results were not entirely consistent,

but the overall rating was comfortably above average in spite of this, and some listeners responded quite positively towards this amplifier. The extreme bass seemed unusually well controlled, and was quite powerful with reasonable detail and definition. A slight preference was made for moving magnet over moving-coil inputs, and there were occasional touches of 'brashness', but by and large the dynamics were quite liked and the amplifier did not seem to become too distressed when driven loud.

Conclusions

This appears to be a soundly engineered amplifier with few if any criticisms, albeit with fairly conservative power ratings for the price. Listening tests gave encouraging though not entirely consistent results, and the technical niggles were few and slight. Ergonomics are quite good, but the Star Trek presentation might not suit everybody.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 102/108/99 Watts
 o/p level ref 2.83V=0dB. 20.1/20.4/20dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 124/198/149 Watts
 o/p level ref 2.83V=0dB. 21/19.9/15.7dB
 Single cycle power 1kHz, 8/4/2 ohms ... 143/231/156 Watts
 o/p level ref 2.83V=0dB. 21.6/20.6/15.9dB
 Dynamic headroom (IHF) 0.46dB

Bandwidth (-3dB below half power)

Disc in - power out DC Hz - 75kHz
 Disc in - tape out 5Hz - 40kHz
 Aux in - power out DC Hz - 90kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.3	50k	220/450
Disc MC.....	Phono	0.25	33/100	
Tuner/Aux....	Phono	150		
Tape.....	Phono	150		
Tape.....	Phono	150		

Disc overload MM 39dB
 Disc overload MC 39dB

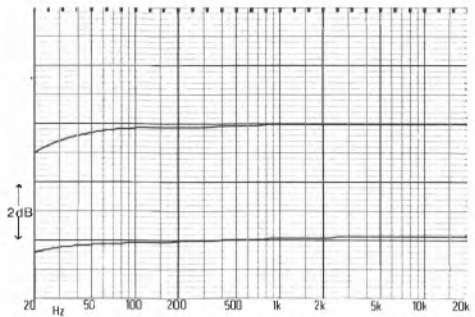
Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	235	3k
Tape 2.....	Phono	235	3k
Headphones (8 ohms)		65	
(2 kohms)		2.5V	

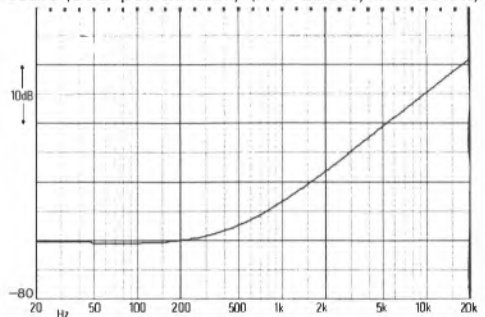
Noise (ref 1 Watt, 8 ohms)
 Zero volume -89dB
 Aux ref volume -81dB
 MM disc ref volume -80dB
 MC disc ref volume -77dB

Other

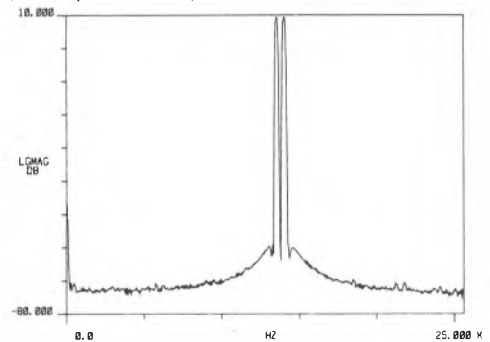
Damping factor 74
 THD performance excellent
 Hum performance good
 Dimensions (W x D x H) ... 16½(42) x 16½(42) x 5(12) ins(cms)
 Weight 29lbs
 Typical purchase price £330



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



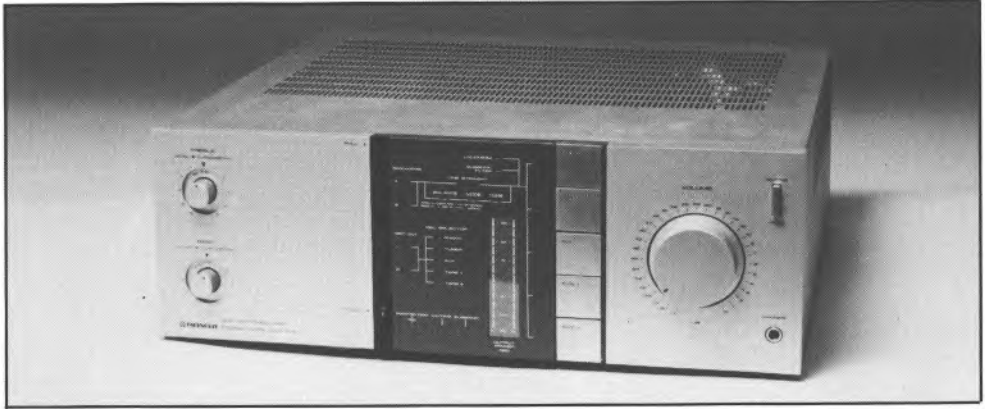
Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Pioneer A9

Pioneer UK Ltd, Pioneer House, The Ridgeway, Iver, Bucks. SL0 9JL. Tel (0753) 652222/7



Presentation, facilities etc

Biggest of Pioneer's upmarket threesome, the A9 has much in common with its two slightly smaller brothers. The gold and black/Christmas-tree fascia is divided into three segments, the right hand one dominated by a giant volume control with attendant muting switch. To the left of these is a row of neatly indented push switch sections controlling the main inputs. Their legends look expensively engraved, but are not easy to read, so they are supplemented by illuminated hieroglyphics: these are not easy to understand.

The left hand section has a hinged panel, only the tone controls (why the tone controls?) being visible with it up. When lowered, two extra rotaries and no less than twelve tiny pushbuttons are revealed. The rotaries control balance and tape recorder switching (independent record routing and cross-dubbing), while the buttons select mono/stereo, tone defeat, speakers A and B, loudness, subsonic filter, mm/mc, 33/100 ohm on mc, and 100/200/300/400pF options on mm. The central 'Space Invaders' panel has the virtue of helping one avoid some of the ambiguities of the function labelling, but its three colours are rather garish and bright. One might have hoped that Pioneer could have incorporated a delay switch which cancelled the display, say ten seconds after each function change, for those who find a light show accompanying their music distracting. In addition to input/routing information, a (larger) 'power' meter is fitted, and an indicator which detects subsonics and advises when the filter should be inserted: surely this task could have been dealt with automatically?

Lab performance

This unit has plenty of power potential, but delivery into low impedances was constrained by asymmetrical clipping. Using a practical rather than lab load the effect may well not be noticed, as it is probably due to current limiting and only occurs at high levels. In fact the back panel implies that this power amplifier is less load sensitive than the other Pioneers, so speaker selection is unlikely to be as critical as our results might indicate, though again some care may be needed if using two pairs together at high levels. Like the others there is a significant but not extreme difference between single and dual channel drive.

The measured bandwidths show sensible control at high frequencies, but no built in rolloff at the LF end. The distortion results and noise results were truly excellent, likewise RIAA accuracy and crosstalk, while the IM spectrum showed no specific sidebands but some 'noise modulation effect'. Disc overload margins were excellent, but unfortunately the mm input capacitance measured consistently 100pF higher than the labelling indicates: this is regrettable because the minimum now becomes 200pF, which is a bit marginal for optimum matching with some cartridge/turntable combinations. The unit becomes quite warm even when working at low levels, due presumably to the high level of A biasing in this non-switching design. Overall this amplifier would have given an exemplary all round performance but for the asymmetrical clipping and mm input capacitance, both of which suggest slight QC deficiencies, unfortunate in an amplifier at this price level.

Listening impressions

Like its kindred this model was quite well received in the listening tests, again rating a comfortable above average with reasonable consistency. In fact there was probably not a lot to choose between the three Pioneers. Although they were not the same, they had general similarities with different aspects attracting varying degrees of criticism. Once again this design was felt to be 'open' 'clear' and detailed, with reasonably good dynamics, extended and powerful bass, perhaps a shade 'full', and a tendency to treble 'fizz' when driven hard. Most aggressive tendencies were kept adequately under control, though the stereo was not particularly well focused.

Conclusions

This is an expensive amp that scored quite well on listening and did very well technically apart from slight quality control problems. Despite its fairly high price it did not outperform its cheaper brethren significantly, though like them it represents a good overall compromise. The aesthetics owe more to the Pinball Wizard than to good taste.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 142/147/142 Watts
 o/p level ref 2.83V=0dB 21.5/21.7/21.5dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 167/166/88 Watts
 o/p level ref 2.83V=0dB 22.2/19.2/13dB
 Single cycle power 1kHz, 8/4/2 ohms 175/157/86 Watts
 o/p level ref 2.83V=0dB 22.4/18.9/13.3dB
 Dynamic headroom (IHF) 0.2dB
Bandwidth (-3dB below half power)

Disc in - power out DC Hz - 40kHz
 Disc in - tape out DC Hz - 50kHz
 Aux in - power out DC Hz - 80kHz
Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.5	51k	201/297/ 396/500

Disc MC.....	Phono	0.1	33/100
Tuner/Aux.....	Phono	156	50k
Tape 1.....	Phono	156	50k
Tape 2.....	Phono	156	50k

Disc overload MM..... 41dB
 Disc overload MC..... 41dB

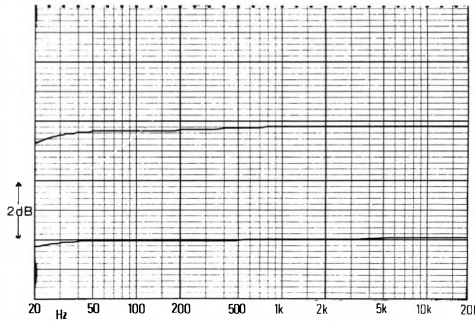
Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	250	2.6
Tape 2.....	Phono	250	2.6k
Headphones (8 ohms)....		70	
(2 kohms).....		2.5V	

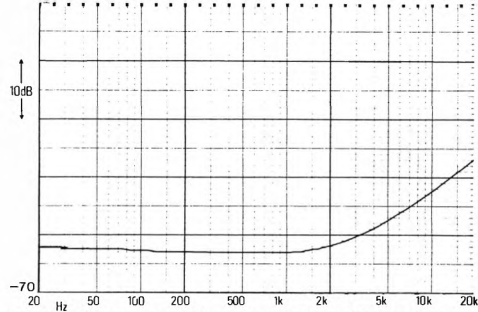
Noise (ref 1 Watt, 8 ohms)
 Zero volume -91dB
 Aux ref volume -86dB
 MM disc ref volume -82dB
 MC disc ref volume -78dB

Other

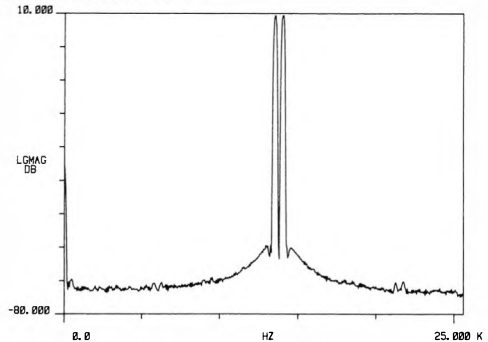
Damping factor 105
 THD performance excellent
 Hum performance excellent
 Dimensions (W x D x H) ... 16½(42) x 16½(42) x 5(12) ins(cms)
 Weight 34lbs
 Typical purchase price £450



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Quantum series

Quantum Electronics, 8 Albion Street, Leicester. Tel (0533) 546198



Presentation, facilities etc

Just as we were wrapping this project up, a complete quorum of Quanta arrived, somewhat unexpectedly. One we could have handled, three was a bit too much for the resident camel, and matters were made worse by an intermittent fault in the pre-amp, which cleared itself after fraying a few nerves and upsetting the lab testing. Time was too short to obtain an alternative sample under the circumstances, so we decided to do the best we could, treat them as a single group review, and get as much data as possible, with any necessary qualifications in the review.

Quantum have emerged from the electronic kit market as amplifier manufacturers proper fairly recently, and in many ways their products still bear the hallmark of this extremely cost-conscious market, with their low-cost metal case construction. In fact the finish is pretty good, even though the design externals appear to have been left to happen by themselves with the accent on economy rather than aesthetics. So although they may not be as elegant as a Meridian or an Elite, they cost a whole lot less, and the 'hair shirt' austerity look approach has always had its place amongst value-conscious audiophiles. Three power amplifier systems were supplied for use with a common 102 pre-amp, the two stereo models, 202D and 207D, providing power for the pre-amp via a DIN umbilical, while the mono 205DAs offer still more power but operate via a 402 pre-amp supply. The pre-amp is superficially very basic, with two knobs for volume and balance and two pushbuttons for inputs and tape monitoring; internally there is a fair amount of flexibility via different disc input cards switchable line sensitivities and an LF filter. Disc inputs are

phonos, and the other sockets DIN but operating to phono standards. The stereo power amplifiers have only banana (4mm) sockets, while the 205DA has proper binding posts. All in all this is an intelligent attempt to provide an audiophile-oriented modular amplification system without frills at a modest cost. Even though it does appear a little crude, some considerable thought has gone into the design, even as far as rounding the metal case corners so they don't have the propensity to causing actual bodily harm in the way that some American units do.

Lab performance

Power delivery showed a strong family resemblance throughout, with power outputs measuring at about 45, 80 and 130 watts respectively. There is plenty of reserve to drive low impedances, but some suggestion of rather 'loose' power supply control. Bandwidths were sensibly restrained, with the pre-amp envelope correctly lying within the power amplifiers'. Inputs and outputs should pose no compatibility problems and are usefully flexible. The RIAA response was not as flat as we would have liked, with a 1 dB bass 'bump' and a treble rise that is likely to be audible. Harmonic distortion was generally reasonable, but the IM spectrum did show some sidebands (205), albeit with only modest 'noise modulation'. Crosstalk at -45dB was rather poor, and was limited by the pre-amp. Hum and noise both gave acceptable but rather average results. Overall the results show some promise, but are also a little flawed.

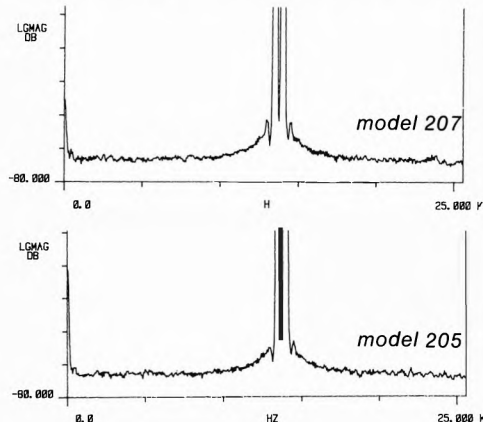
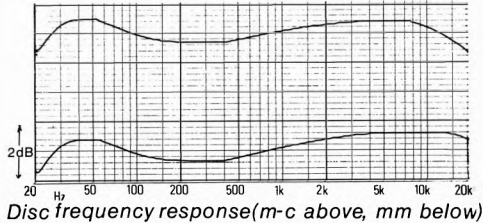
Listening impressions

The problems mentioned earlier interfered with a

proper multiple appraisal of these products, but as far as we can establish the 102/207D is the most promising combination, and would appear to rate firmly above average, being quite easy to listen to with generally good integration across the band, good midrange, reasonable bass and treble control, and good detail. Somewhat behind this came the 205DA(X2)/102/402, which was less consistently liked at the frequency extremes, while behind this the cheapest 102/202 rated a little below average, lacking some control and delicacy and tending to sound a little coloured in the midband.

Conclusions

We remain a little cautious about the Quantums, because we didn't have sufficient time for our usual full analysis. That which we did manage shows both strengths and weaknesses, and as a route to low cost audiophilia we feel they merit close attention. The 102/207D came within an ace of recommendation, and appears to offer the best overall package, with a good combination of power and sound quality for the price. There remains certain areas which could be 'tidied up', but the range shows quite a lot of promise, and is potentially good value for money as well.



GENERAL DATA

Bandwidth (-3dB below half power)				
Disc in - power out			10Hz - 49kHz	
Disc in - tape out			11Hz - 160kHz	
Aux in - power out			3Hz - 50kHz	
Power amp only			2Hz - 50kHz	
Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	3.8	48k	127
Disc MC	Phono	0.12	32 (var)	
Tuner/Aux	DIN	170/900	37k (var)	
Tape	DIN	170/900	37k	
Disc overload MM				36 dB
Disc overload MC				35 dB
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)	
Tape	DIN	185	1.7k	

Power stage 202D/102

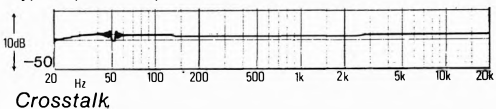
Both channels 20Hz/1kHz/20kHz	
8 ohms, 0.1% dist	47/50/46 Watts
o/p level ref 2.83V=0dB	16.7/16.9/16.6dB
Single channel 8/4/2 ohms	
1kHz, 0.1% dist	58/86/97 Watts
o/p level ref 2.83V=0dB	17.6/16.4/13.8dB
Single cycle power 1kHz, 8/4/2 ohms	81/136/182 Watts
o/p level ref 2.83V=0dB	19/18.3/16.6dB
Noise (ref 1 Watt, 8 ohms)	
Zero volume	-95dB
Other	
Damping factor	51
THD performance	average
Hum performance	average
Typical purchase price	£240

GENERAL DATA

Power stage 207 DA/102	
Both channels 20Hz/1kHz/20kHz	
8 ohms, 0.1% dist	81/88/77 Watts
o/p level ref 2.83V=0dB	19/19.5/18.9dB
Single channel 8/4/2 ohms	
1kHz, 0.1% dist	101/150/179 Watts
o/p level ref 2.83V=0dB	20/8.7/16.5dB
Single cycle power 1kHz, 8/4/2 ohms	126/220/333 Watts
o/p level ref 2.83V=0dB	21/20/19dB
Dynamic headroom (IHF)	0.16dB
Noise (ref 1 Watt, 8 ohms)	
Zero volume	-83dB
Aux ref volume	-82dB
MM disc ref volume	-72dB
MC disc ref volume	-70dB
Other	
Damping factor	90
THD performance	good
IMD performance	below average
Hum performance	below average
Dimensions (W x D x H)	complex
Typical purchase price	£300

Power stage 205D/102

Both channels 20Hz/1kHz/20kHz	
8 ohms, 0.1% dist	128/145/132 Watts
o/p level ref 2.83V=0dB	21/21.6/21.2dB
Single channel 8/4/2 ohms	
1kHz, 0.1% dist	145/208/242 Watts
o/p level ref 2.83V=0dB	21.6/20.2/17.8dB
Single cycle power 1kHz, 8/4/2 ohms	210/378/506 Watts
c/p level ref 2.83V=0dB	23.2/22.8/21dB
Noise (ref 1 Watt, 8 ohms)	
Zero volume	-90dB
Aux ref volume	-82dB
MM disc ref volume	-72dB
MC disc ref volume	-70dB
Other	
Damping factor	48
THD performance	average
Typical purchase price	£470



Reference Master

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



Presentation, facilities etc

This is a neat integrated amplifier of British manufacture, marketed by Reference Products of Oxford. Simply finished in black with white and silver pointing and lettering, it is attractively discreet, and scalloped knobs give it a touch of individuality. Five of these comprise the total complement of front panel controls, and although this gives reasonable symmetry, no attempt has been made to physically separate or distinguish the volume control, so this is not the simplest of designs for the uninitiated to use.

The power knob, operating a simple switch, has been set slightly apart from the others, which comprise balance, volume, tape monitor switching and input selection. The rear panel has phono socket tape inputs/outputs throughout, with 4mm sockets for loudspeakers. Heatsinks are mounted on the rear, though the unit is not deep enough to cause any ventilation problems when sited beside a record player. Overall it is a neat enough unit, which is in some ways reminiscent of those manufactured by JE Sugden in terms of overall shape, size and layout.

Lab performance

Considering the reasonably high price of this model, power output at about 40 watts per channel is rather modest, although the lack of any significant difference between single and dual channel drive is a good sign. However the delivery into low impedances is quite severely restricted under both steady state and single cycle conditions, so care should be taken to avoid low impedance loudspeakers. Furthermore it was found that harmonic distortion rose significantly as impedance was reduced, and

also showed significant variation between the channels, with the results quoted corresponding to the better figures obtained.

Bandwidths show sensible close control, though the input capacitance on disc is too high at 300pF for optimum matching with a number of cartridges around, even if one takes care to use a turntable with low capacitance wiring. The RIAA equalisation shows well-tailored high and low roll-offs, but unfortunately it is marred by a distinct and rather abrupt 1dB step in the important midband area, which can be expected to audibly affect the character of the sound. It also seems a little surprising that an amplifier in this price class is not equipped with a moving-coil input. Crosstalk was very good indeed, as was noise, but the other performance parameters were below average, the IM distortion spectrum showing both a significant difference component as well as quite a pronounced 'noise modulation effect'.

Headphone drive was accomplished by unusual means, the signal being taken directly from the pre-amp output, while insertion of a 1/4 inch jack in the socket causes the loudspeakers to be disconnected by relay. It is better to use high impedance 'phones, since the source impedance of 217ohms connected to 8ohm phones can result in the pre-amp being overdriven fairly easily.

Listening impressions

The frequency response anomaly seems to have been accurately identified by the listeners, as there was constant complaint of upper-mid emphasis with attendant coloration, plus a rather lacking bass and extreme treble, giving a clear

but 'dulled' sound lacking bass definition and 'drive'. It was generally tidy sounding, tending to sound rather 'bland' and 'lifeless', though it did begin to sound a little 'edgy' when volume was increased above normal listening levels. Overall it was not an offensive sounding amplifier, nor was it one that excited the interest of the panel, and the response problem probably contributed to the negative comments despite its mild degree, perhaps because of its rather abrupt nature.

Conclusions

Though this is not a poor design, neither is it a particularly inspiring one, and it is expensive for the power offered and subjective performance which we obtained. Furthermore it needs some care in matching to cartridge and speakers, and does not have a particularly versatile pre-amplifier.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 34/40/36 Watts
 o/p level ref 2.83V=0dB 15.3/16/15.5dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist. 41/33/15 Watts
 o/p level ref 2.83V=0dB 16/12/5.8dB
 Single cycle power 1kHz, 8/4/2 ohms 47/40/20 Watts
 o/p level ref 2.83V=0dB 16.7/13/7dB
 Dynamic headroom (IHF) 0.17dB

Bandwidth (-3dB below half power)

Disc in - power out 16Hz - 37kHz
 Disc in - tape out 11Hz - 28kHz
 Aux in - power out 11Hz - 31kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.5	51k	300
Tuner/Aux.....	Phono	130	203k	
Tape 1.....	Phono	130	180k	
Tape 2.....	Phono	130	180k	

Disc overload MM..... 36dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	200	1k
Tape 2.....	Phono	200	1k
Headphones (8 ohms).....		15 - 24*	
(2 kohms).....		250mV - 3V*	

Noise (ref 1 Watt, 8 ohms)

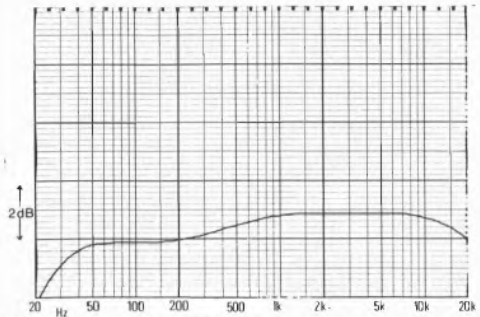
Zero volume..... 83dB
 Aux ref volume..... 83dB
 MM disc ref volume..... 80dB

Other

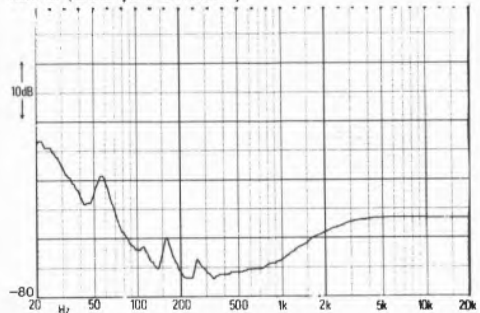
Damping factor 43
 THD performance below average
 Hum performance below average
 Dimensions (W x D x H) ... 17(43) x 12(30) x 5(13) ins(cms)
 Weight 24lbs
 Typical purchase price £295
 *Special circuit for 'phones (driven from pre-amp output buffer).

Note

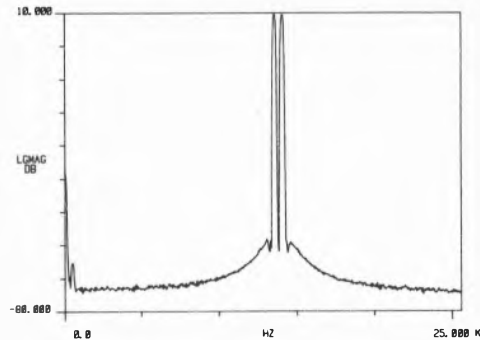
As we went to press we were informed of a welcome price reduction to £200 for this model.



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Revox B750 II

FWO Bauch Ltd., 49 Theobald Street, Borehamwood, Herts. WD2 4RZ. Tel 01-953 0091



Presentation, facilities etc

In 1980's Receivers book we recommended the Revox, mainly because we were very impressed by the tuner section with which it was fitted. Now we have another opportunity to place the amplifier under close scrutiny. It is a big solid beast (though not without a rattle to its top plate), attractively presented in a dark blue/grey suede type finish. Ergonomically it is not particularly clever, as the layout of the knobs seems to have been selected for overall symmetry rather than to find one or another particularly easily.

The four large knobs control volume, bass, treble, and presence (upper midrange) tone. The smaller rotaries control balance, and switch mode, inputs, and loudspeaker options. Four toggle switches operate power, loudness, low and high filters, while pushbuttons cover tone defeat, -20dB muting, tape monitoring and cross-dubbing. Two headphone sockets and a large 'on' light preserve the overall styling package. A slim hinged section at the top of the fascia opens to reveal a pre/power break switch, disc sensitivity control, variable impedance on disc (25/50/100 kohm), and a convenient 'record out' jack socket. The socket panel at the rear is recessed slightly, which enables the amplifier to sit flush against a wall but does make access a little trickier. Phono sockets are used predominantly, with DIN duplication on tape 2, and unusually a set of DIN speaker output sockets supplementing the sprung bare wire retainers.

Lab performance

The amplifier has changed little since our last examination some two years ago, most of the

results showing quite good consistency. However one aspect which we criticised which has been improved is the power delivery into low impedances, and this is now respectable into 4ohms steady state, and rather good into both 4 and 2ohms under single cycle transient conditions. The difference between single and dual channel drive is also commendably slight, indicative of good power supply engineering.

The bandwidths show sensible control at low frequencies, although one could perhaps quibble a little and suggest that the filtering does start at a rather high frequency and could have been better tailored. However the anomaly of disc/power out being wider than the power amplifier bandwidth alone needs a little further examination, and we found that the rising trend at high frequencies noted on the RIAA curve continues to +5dB at 80kHz, which is unlikely to auger well for performance with the wide bandwidth cartridges necessary for fair comparative auditioning. The capacitance is a little on the high side for some models, and although the variable impedance gives some tailoring capability, its effects tend to be more crude and less accurate on today's better cartridges than those obtained with variable capacitance loading. The inputs and outputs were well chosen, but the other technical performance parameters tended to give average or below average results (crosstalk was good however). This may not matter much, as there is more to an amplifier than is revealed in our measurements, but it does perhaps indicate that the design is not quite the last word. Sidebands can be seen on the IM spectrum, though it should be noted that the 'noise modulation effect' is notably absent.

Listening impressions

The Revox is a difficult model to rank. Though the comments showed quite good consistency, the value judgements based upon them showed more variation. The most obvious characteristic was a degree of 'brightness' that some thought potentially fatiguing, while others found it gave an attractive (artificial?) clarity. Though a trifle bass light, the amplifier sounded powerful and generally well-controlled, 'clean' and clear, with good stereo. The overall ranking of average was an attempt to reconcile a promising design which gave an odd, slightly unbalanced result. It is possible that some of the points of criticism might have been less obvious with the more controlled source bandwidth of the cartridges used in Revox's own players.

Conclusions

Though this amplifier has a number of strengths, results suggest that there is room for improvement particularly at the disc input, and although it might be well suited to a Revox system, it was not entirely subjectively happy in a 'universal' context. The results of this completely fresh re-appraisal show a gratifying consistency with our findings of two years previously.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 96/105/99 Watts
 o/p level ref 2.83V=0dB 19.8/20.2/19.9dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 110/156/25.9 Watts
 o/p level ref 2.83V=0dB 20.4/17.9/8.1dB
 Single cycle power 1kHz, 8/4/2 ohms ... 105/190/297 Watts
 o/p level ref 2.83V=0dB 20/19.7/18.7dB

Dynamic headroom (IHF) 0.04dB

Bandwidth (-3dB below half power)

Disc in - power out 19Hz - 103kHz
 Disc in - pre out 18Hz - 150kHz
 Disc in - tape out 23Hz - 90kHz
 Aux in - power out 8Hz - 91kHz
 Power amp only 4Hz - 90kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	1.1 - 7	38 - 43	228
Disc MM2/Aux	Phono	180	47k	
Tuner/Aux	Phono	180	108k	
Tape 1	Phono	180	108k	
Tape 2	DIN	180	108k	

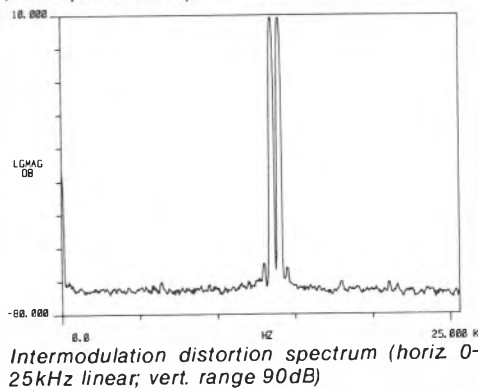
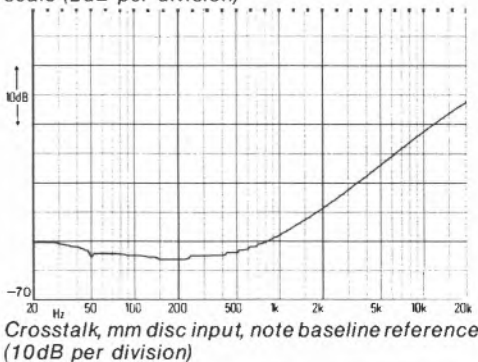
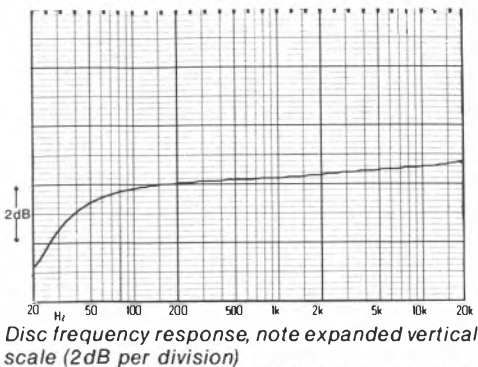
Disc overload MM 36dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1	Phono	130	2k
Tape 2	DIN	70	200k
Headphones (8 ohms)		200	
(2 kohms)		2.65V	

Noise (ref 1 Watt, 8 ohms)
 Zero volume -84dB
 Aux ref volume -82dB
 MM disc ref volume -79dB

Other

Damping factor 89
 THD performance average
 Hum performance below average
 Dimensions (W x D x H) ... 18(45) x 14(35) x 6(15) ins(cms)
 Weight 28lbs
 Typical purchase price £500



Rogers A75 Series 3/T75 Series 2

(revised and reprinted)

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



This review has been adapted from that which appeared as a tuner/amplifier combination, shown in the photograph. Some care should be taken in comparing value judgements with those for the latest tests.

Presentation, facilities, etc.

The Rogers designs have changed little in external appearance over the years, which implies that they should retain their value well. The case is narrower than most, though fairly high, and the line of the black fascia is broken by a grille effect at the top and bottom, offset by wooden endplates; the unit has a particularly substantial 'feel'.

The amplifier offers the fairly standard range of facilities, with phono inputs DIN-duplicated for tape on front and rear, and with variable sensitivity on the disc input. The high frequency filter is unusually elaborate, offering a choice of two turnover frequencies and variable slope; this offers scope for precise fine tuning of the high frequency response. This discreet if somewhat severe looking unit is quite compact, needing less shelf space than most, and feels reassuringly 'solid'.

Lab performance

Though on the expensive side for the power offered, delivery is reasonably well maintained into low impedances, but shows the usual marked difference between single and dual channel drive. Disc input bandwidth was rather excessive, though with sensible LF rolloff, while the frequency response showed a lower midrange suckout that is likely to be audible; the impedance and capacitance was complex, and resisted our measurement. In general performance parameters were fine, but

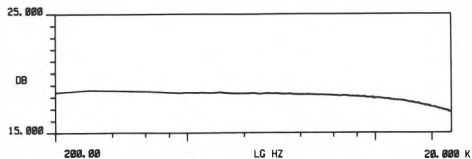
hum performance was considered below average.

Subjective impressions

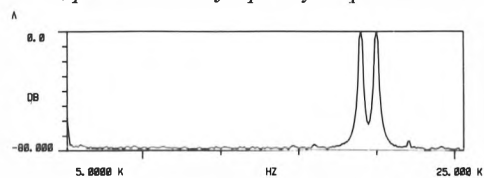
Scoring average overall, this amplifier's listening test reception was clearly affected by the frequency response, with consistent criticism of undue brightness, and further observations of lack of bass definition and power, plus some muddling, while at the same time having good overall clarity and definition.

Conclusions

Overall this is a competent design without any significant weaknesses, though a few mild opportunities for improvement. The listening test results may have been influenced by the frequency response characteristic, but are insufficient to ensure recommendation at the fairly high price.



Aux i/p white noise frequency response.



IM distortion.

GENERAL

Power

Bandwidth (-3dB ref max power, disc) 16Hz-159kHz
 Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist) ... 41/42/42 Watts
 Single channel 8/4/2 ohms (1kHz, 0.1% dist) 53/73/73 Watts
 Burst power 1kHz, 8/4/2 ohms 66/109/89 Watts

Inputs	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM	Phono	Var	—	—
Disc MC	—	—	—	—
Tuner/aux	Phono	130	50k	—
Tape	Phono	130	50k	—
Tape	DIN	120	50k	—

Disc overload 1kHz 35dB

Outputs (5mV disc)	Type	Level (mV)	Imp (ohms)
Tape	Phono	225	100
Tape	DIN	120	81k
Headphones (8 ohms)	Jack	120	—

Noise (ref 1 Watt, 8 ohms) -76dB

Zero volume -76dB

Aux ref volume -75dB

Disc ref volume -76dB

Other

Damping factor 70

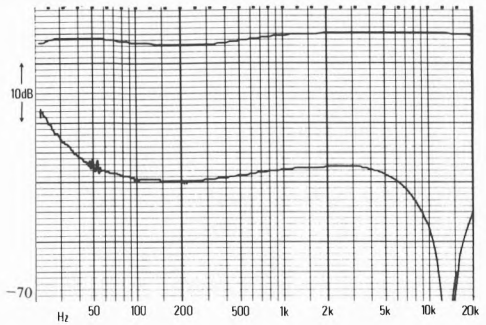
THD performance good

IMD performance average

Hum performance well below average

Total size (W x D x H) 14¾(36) x 12(31) x 4¾(12) in(cm)

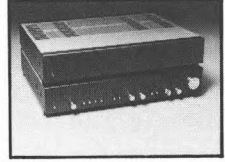
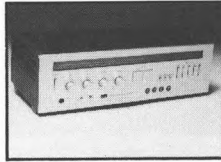
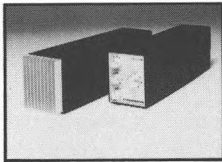
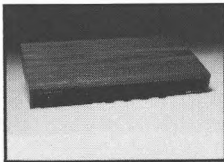
Typical retail price £220



Disc i/p frequency response/crosstalk.

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



This review has been adapted from that which appeared as a tuner/amplifier combination, shown in the photograph. Some care should be taken in comparing value judgements with those for the latest tests.

Presentation, facilities, etc.

This more recent and more powerful *A100* amplifier is practically identical to the cheaper model, with the austere but discreet black fascia broken by a 'grille' effect, and attractive wooden endplates. Though fairly high, the unit is narrower than most, and will use correspondingly less shelf space.

The amplifier front panel has switching for the rear (phono) inputs and a DIN auxiliary input on the front. Tone controls are conventional, but the HF filtering is unusually sophisticated, with choice of two operating frequencies and variable slope. Two sets of speakers and headphones may be connected, and the rear panel also has European-style mains sockets, and switches for 'fine-tuning' the disc input loading. The overall effect is attractively smart, yet restrained, sturdy and fairly compact.

Lab performance

Quite expensive for the power output offered, delivery was well maintained into low impedances, but with the usual single/dual channel difference. Disc input bandwidth followed the new IEC recommendations for bass rolloff, and was a little over-extended at HF (though much better than the '75). Disc input capacitance was usefully variable, and other inputs/outputs should pose no problems. Once again performance parameters were average or better, with hum performance well below average, but a significantly flatter frequency re-

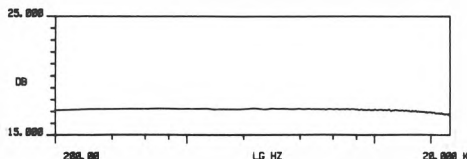
sponse than the '75 on disc was measured.

Subjective impressions

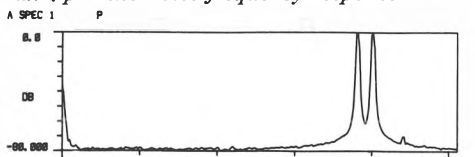
Described as significantly more 'authoritative' than the '75, the *A100* was rated significantly above average overall, with particularly favourable comments at lowish powers, describing nice balance with plenty of detail, good bass performance and good overall control, though it was a trifle 'bright' with tendencies to harshness nearer full power.

Conclusions

Although on the expensive side, this amplifier has evidence of a general competency of design, with few if any weak spots. The added confidence of respectable listening test results implies that this model merits serious consideration even in the context of the higher standards of this latest *Amplifier* project.



Aux i/p white noise frequency response.



IM distortion.

AMPLIFIER

Power

Bandwidth (-3dB ref max power, disc)..... 20Hz-85kHz
 Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist) . . . 53/53/53 Watts
 Single channel 8/4/2 ohms (1kHz, 0.1% dist) . . . 63/91/100 Watts
 Burst power 1kHz, 8/4/2 ohms 75/116/107 Watts

Inputs	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM	Phono	1.8	49 k	Var
Disc MC	—	—	—	—
Tuner/aux.	Phono	110	50k	—
Tape	Phono	110	50k	—
Tape	DIN	110	50k	—

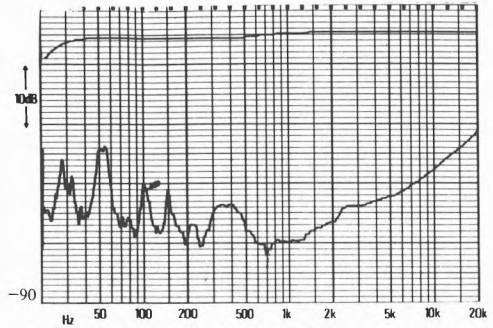
Disc overload 1kHz..... 38dB

Outputs (5mV disc)	Type	Level (mV)	Imp (ohms)
Tape	Phono	280	460
Tape	DIN	150	82k
Headphones (8 ohms)	Jack	120	—


Noise (ref 1 Watt, 8 ohms).....
 Zero volume..... -75dB
 Aux ref volume..... -73dB
 Disc ref volume..... -74dB

Other

Damping factor..... 82
 THD performance..... good
 IMD performance..... average
 Hum performance..... well below average
 Total size (W x D x H)..... 14¼(36) x 12(31) x 4¾(12) in(cm)
 Typical retail price..... £320



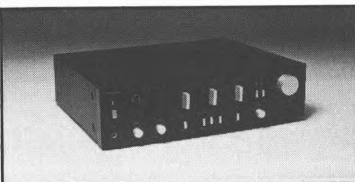
Disc i/p frequency response/crosstalk.



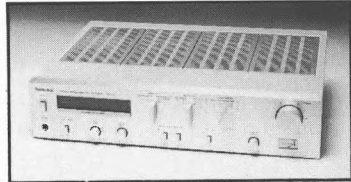
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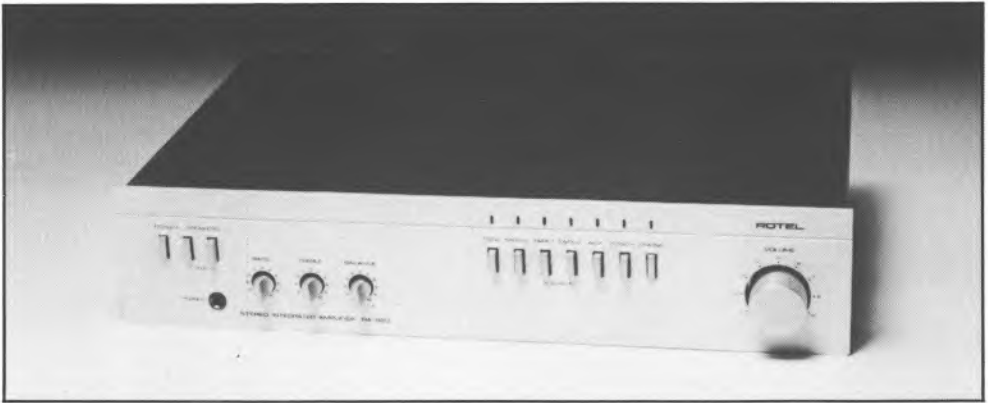
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Rotel RA520 (prototype)

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



Presentation, facilities etc

When we included the RA520 in our testing for this issue, we realised that some of the work would be done on a prototype, but hoped to have an example of final production for checks and comparisons before publication. As it happens we did receive a second sample much closer to final production, but our findings must remain very circumspect at this stage, as the design may not have yet been finalised, and we were unable to take measurements on the second sample.

A pleasantly uncluttered fascia features a silver detent action volume control, and contrasting black knobs for balance and tone. A row of light indicated pushbuttons switch the various inputs, mono/stereo, and tone defeat, while switching between two pairs of speakers and power is at the other end. Finish on our second sample was reasonable enough, though it is difficult to know whether this will be representative in any case. The unit is styled with an overhanging front fascia with rather sharp corners, so it is presumably intended primarily for rack/console use. Phono sockets are in the majority on the rear, though one of the tape sockets is to DIN standards. Speaker terminals are rather insubstantial spring loaded types, with fuses available externally (under a cover).

Lab performance

Although our findings here may be of limited benefit to the consumer, it was nonetheless interesting to investigate a prototype, and see the development stages through which every product must pass, but which is usually done behind closed doors. Considering the modest price, the power output at 36 watts is not

ungenerous, and delivery is quite well maintained into low impedances, even as low as 2ohms, so there should be no practical limitation on the choice of loudspeakers. A difference of about 10% can be noted between single and dual channel drive, though this is by no means excessive.

Bandwidths show pretty close control throughout, and although the RIAA equalisation may look a little unusual, it is probably the most sensible approach for the designer of a low-cost amplifier. In fact the low frequency end might have benefited from slightly tighter tailoring to further protect the power supply from stress in use. The disc input capacitance is unusually low, so there will be no problem in matching any available cartridges, and external adaptors can assist those that require higher capacitance to give a flat response. The high frequency roll-off is perhaps just as well, because we found that the disc input overload margin had reduced to 11dB at 20kHz. Noise and hum were both slightly problematic on the first prototype, with the former increasing as the volume control was reduced (this has been changed we understand). Harmonic distortion was reasonable but worsened somewhat into low impedances, while a significant difference product and 'noise modulation effect' can be seen on the IM spectrum.

Listening impressions

The original prototype 520 did not fare well in the listening tests, scoring well below average with criticisms of 'loose' control at the frequency extremes. It also became rather muddled on complex material and when the sound became at all loud. Stereo and 'focusing' were poor, though

there was some praise of 'dynamics' and 'liveliness'. The second sample was assessed informally in comparison, and was felt to offer a real improvement in terms of integration, but also a tendency to sound 'forced' and 'coloured' in the midband when loud. Certainly it was preferred to the original, but the overall improvement was not considered sufficient to make the sound particularly distinguished. However we believe that things are not quite finalised yet, and we understand Rotel are hoping to effect further improvements before stocks are in the market place.

Conclusions

This product has certain promise technically, and would appear to be heading in the right general direction subjectively. But we did not have the opportunity to check a full production sample, as we had originally hoped to do, so we cannot come to any firm conclusions. All we can do is point out that the design does hold some promise.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 32/36/36 Watts
 c/p level ref 2.83V=0dB 15.1/15.6/15.6dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 41/65/87 Watts
 c/p level ref 2.83V=0dB 16.2/15.1/13.4dB
 Single cycle power 1kHz, 8/4/2 ohms ... 45/85/138 Watts
 c/p level ref 2.83V=0dB 16.6/16/15.4dB
 Dynamic headroom (IHF) 0.13dB

Bandwidth (-3dB below half power)

Disc in - power out 22Hz - 24kHz
 Disc in - tape out 4Hz - 155kHz
 Aux in - power out 4Hz - 32kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	1.7	50	22
Tuner/Aux.....	Phono	220	5.5k	
Tape 1.....	Phono	inop.	47k	
Tape 1.....	DIN	inop.	54k	

Disc overload MM..... 34dB*

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	70	47
Tape 1.....	DIN	15	87k

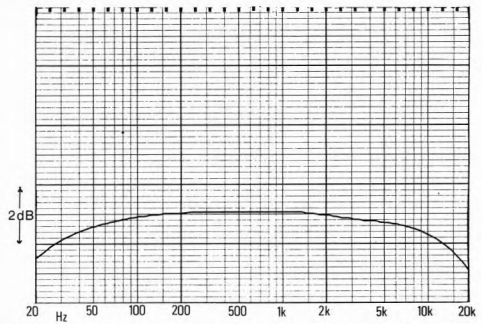
Noise (ref 1 Watt, 8 ohms)

Zero volume -73dB
 Aux ref volume -83dB
 MM disc ref volume -76dB

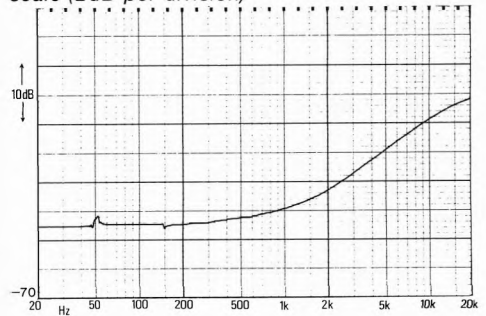
Other

Damping factor 41
 THD performance average
 Hum performance below average
 Dimensions (W x D x H) ... 16½(42) x 12(30½) x 3½(9) ins (cms)
 Weight 15 lbs
 Typical purchase price £90

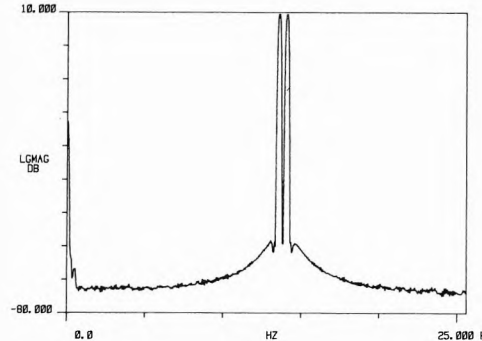
*Reduces to 11dB at 20kHz.



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Rotel RB/RC 1010

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



Presentation, facilities etc

The RB and RC 1010 combination comprise a relatively low cost pre-/power combination which could presumably feature in an upmarket rack system. Construction is neat enough, if not exactly lavish and with rather sharp edges to the fascias, and the dark grey finish is pleasantly neutral.

The pre-amplifier has quite a number of facilities, notable and unusual amongst them being a headphone socket, which therefore operates independently of the power amplifier, hence avoiding at least one set of switches at the output. The large central knob is a smooth action volume control; balance is provided but no tone controls. (Rotel market an equaliser in matching trim for those who value such a facility, and 'tone send' switch and sockets are provided for inter-connection.) Three large pushbuttons select main inputs, with three additional rotaries to route tape recorders and adjust the disc inputs, input linked indicator lights help to avoid confusion. Four rather fiddly little pushbuttons give muting, subsonic filter, loudness, and mode, the latter entirely ambiguously labelled. The disc inputs offer three impedance options on m-m and also moving-coil matching. The power amplifier is no 'black box' either, with its illuminated 'power' indicator, sensitivity switch for same, speaker switching, plus output levels for each channel independently.

Lab performance

There is plenty of power available from this unit, and the delivery thereof is well maintained into 4ohms, though fairly restricted into 2ohms, so low impedance models are reasonably OK pro-

vided one doesn't try to drive two such pairs simultaneously at high levels. The output level with both channels driven is somewhat lower than the single channel maximum, but not dramatically so.

No particular attempt appears to have been made to control the bandwidths at either end of the spectrum, though at least the matching between them is the right way round. Rather disturbing is the high figure measured for m-m disc input capacitance, which will only really be optimally useable with a very few cartridges assuming the normal contribution from the turntable. Even Shure and Ortofon models will be rather heavily loaded, while the best solution might be to go for load-tolerant types like Technics, Grado and high output moving-coil models. Even the provision of variable impedance switching cannot really compensate for the effect this high capacitance will have upon the frequency responses of most moving magnet designs, though to be fair one school of thought suggests that high input capacitance is desirable *per se* in helping to control (ie rolloff) high frequencies. By and large most of the technical performance parameters were pretty good, with distortion generally at the noise level. The m-c disc noise is poorer than some, and the overload margin here reduces from 37dB to 19dB at high frequencies. Some sidebands can be seen on the IM test spectrum, but in this instance the 'noise modulation effect' is notably absent.

Listening impressions

A dirty contact amongst the disc input circuitry plagued our listening tests. Nevertheless with perseverance results were obtained, though they

were neither particularly positive nor entirely consistent, indicating an overall rating of average. As often seems to be the case the sound was quite liked when playing softly, but was felt to deteriorate significantly when any real power was being demanded, with control at the frequency extremes suffering. The midrange was described as rather 'forward', but clean and with plenty going on, though not particularly exciting dynamically.

Conclusions

By most conventional standards there is quite a lot of amplifier for the money here, but our listening tests were not especially encouraging, and the m-m disc input capacitance is rather high for good general compatibility, so our enthusiasm remains a little muted, while acknowledging respectable enough value for money.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 140/145/145 Watts
 o/p level ref 2.83V=0dB 21.5/21.6/21.6dB
 Single channel 8/4/2 ohms
 1 kHz, 0.1% dist 165/272/158 Watts
 o/p level ref 2.83V=0dB 22.2/21.3/15.9dB
 Single cycle power 1 kHz, 8/4/2 ohms ... 192/344/297 Watts
 o/p level ref 2.83V=0dB 22.8/22.4/18.7dB
 Dynamic headroom (IHF) 0.43dB

Bandwidth (-3dB below half power)

Disc in - power out 4Hz - 129kHz
 Disc in - pre out 3Hz - 192kHz
 Disc in - tape out 6Hz - 220kHz
 Aux in - power out 3Hz - 175kHz
 Power amp only 3Hz - 235kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.3	47k	400
Disc MC.....	Phono	0.14	100	
Tuner/Aux.....	Phono	145.0	40k	
Tape 1.....	Phono	145.0	40k	
Tape 2.....	Phono	145.0	40k	
Power amp.....	Phono	1.0V	18k	

Disc overload MM..... 40dB
 Disc overload MC..... 37dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	290	450
Tape 2.....	Phono	290	450

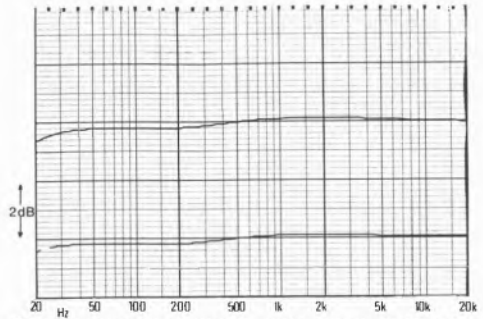
Headphones (8 ohms) 25 independent
 (2 kohms) 85 of power amplifier

Noise (ref 1 Watt, 8 ohms)

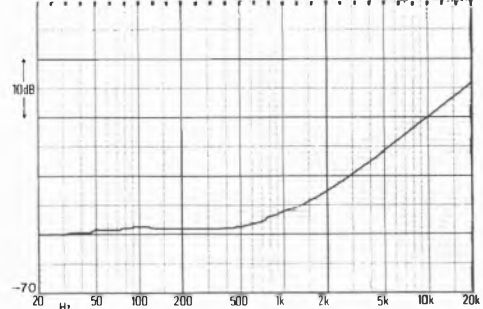
Zero volume -85dB
 Aux ref volume -83dB
 MM disc ref volume -83dB
 MC disc ref volume -71dB

Other

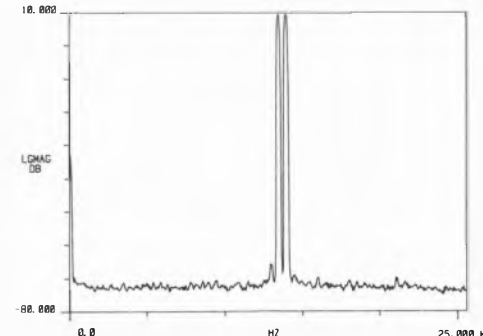
Damping factor 128
 THD performance excellent
 Hum performance average
 Dimensions (W x D x H) 17(43) x 12½(32) x 8(23) ins (cms)
 Weight 36 lbs
 Typical purchase price £300



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Sansui A5

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



Presentation, facilities etc

Two distinct ranges of electronics are currently available from Sansui, since the advent of their budget 'super compo' series a couple of years ago, aimed primarily at the fast-growing rack system market. The A5 is the cheapest of these, and certainly does not have the pretensions towards high fidelity of their more expensive models. But our experiences with Sansui amplifiers have generally been rather positive over the years, and we are always on the look out for the most 'likely' budget amplifiers, so its inclusion seemed well worthwhile.

Finished in black on our sample (silver also available), the A5 betrays its humble aspirations more by a lack of weight than any paucity of facilities, indicator lights or quality of external finish. (Smart plastics mouldings are partly responsible.) The full width transparent window in the fascia makes one wonder whether a tuner or receiver has arrived by mistake, but turns out merely to indicate the 'power' level and identify the selected input. The main selector knob is unfortunately identical to the volume control, and is supplemented by two pushbars for the single tape input, one offering monitoring and the other usefully enabling the tuner signal to be fed to the recorder irrespective of the source being heard *via* the amplifier at the time. Rotary controls operate bass, treble and balance, while (tiny and rather fiddly) pushbuttons switch high filter, loudness, and either/or/off loudspeakers. Although only one pair may be operated at a time, the back panel instructions strongly warn against using speakers of less than 8ohms; if adhered to strictly this would limit the user's choice dramati-

cally. Phono sockets only are provided on the back panel.

Lab performance

Despite the impedance warning, our measurements indicate that this model performs reasonably capably into 4ohms, with more severe curtailment into 2ohms, so speaker choice is not too critical (though higher impedance models are to be preferred), and the omission of the capability to drive two pairs simultaneously appears sensible. Overall power is somewhat restricted, showing a distortion increase at the frequency extremes before it is reached in the midband, while the 25% difference between single and dual channel drive is certainly indicative of some inadequacies in the power supply. The bandwidths show some attempt at curtailment, which is probably sensible in view of the limited power available, though in our view it would have been more usefully applied at high frequencies to the disc rather than the auxiliary input.

Input and output parameters are reasonably normal, though the tape output impedance is a little higher than usual, and the disc input capacitance is also a little on the high side for optimum matching with a number of popular cartridges. Most of the other aspects of performance tend to rate below average, but none sufficiently so to cause any real misgivings, and although the intermodulation test spectrum shows distinct sidebands (at adequately low levels), there is little suggestion of an increase in the noise floor either side of the test signals.

Listening impressions

The listening tests unfortunately gave consistently negative reactions to this model, some panelists taking a most uncompromising stance. The sound was described as muddled throughout, obscuring detail and dynamics, though not in a particularly offensive way, *ie* it wasn't so much what the amp did but what it didn't do that attracted criticism. The balance was considered rather 'bright' and 'clangy' tonally, with a 'softened' and restrained bass, little 'focus' and indifferent stereo imagery.

Conclusions

The modest technical performance and disappointing auditioning lead us to believe that perhaps Sansui should have sacrificed some of the facilities and external finish rather than the internals to maintain a presence in this important market slot. It is not so much that the product is bad, rather the inescapable conclusion that its not really much to do with hi-fi.

GENERAL DATA

Power stage

Both channels 20Hz/1 kHz/20kHz

8 ohms, 0.1% dist. 26/33/30 Watts

o/p level ref 2.83V=0dB. 14.2/15.1/14.8dB

Single channel 8/4/2 ohms

1 kHz, 0.1% dist. 44/50/40 Watts

o/p level ref 2.83V=0dB. 16.4/14/10dB

Single cycle power 1 kHz, 8/4/2 ohms. 51/81/70 Watts

o/p level ref 2.83V=0dB. 17/16/12.5dB

Dynamic headroom (IHF) 0.28dB

Bandwidth (-3dB below half power)

Disc in - power out. 8 Hz - 75kHz

Disc in - tape out 8 Hz - 90kHz

Aux in - power out 8 Hz - 35kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.	Phono	2.6	50k	240
Tuner/Aux.	Phono	150	70k	
Tape.	Phono	150	70k	

Disc overload MM. 36dB

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape.	Phono	190	4.7k
Headphones (8 ohms)		100	
(2 kohms)		2.7V	

Noise (ref 1 Watt, 8 ohms)

Zero volume. -85dB

Aux ref volume -77 dB

MM disc ref volume -73dB

Other

Damping factor 85

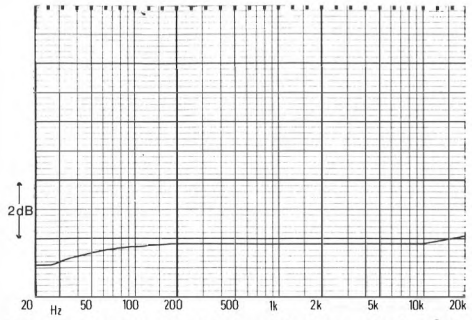
THD performance below average

Hum performance below average

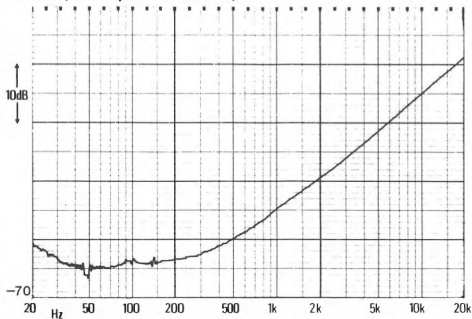
Dimensions(W x D x H) 17 (43) x 10(26) x 5.2(13) ins(cms)

Weight 10lbs

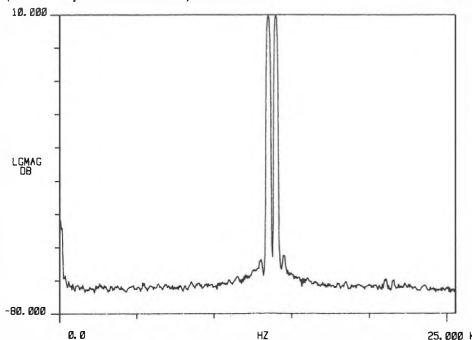
Typical purchase price. £78



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Sansui A7

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



Presentation, facilities etc

This is the middle model in Sansui's range of budget amplifiers, which are conceived as part of their rack system 'super compo' range. All three models share plastics mouldings for the case, which keeps the weight down and the standard of finish high. The review sample was finished with a silver fascia and knobs, but an all-black option is also available.

Although modestly priced, finish is well up to the expected high Japanese standard and there is a plentiful range of facilities. A full-width transparent window reminiscent of a tuner or receiver covers brightly illuminated 'power' meters and input indicator lamps. The large volume control and input selector are identical, which is a pity ergonomically, while plenty of other features keep the front panel quite busy. Rotary controls operate tone, balance and a variable loudness function, plus mike mixing level (front panel stereo jack). Switches control the selection and cross-connection of two tape recorders, permitting a deck to record from a tuner while the amplifier is playing from an alternative source. Rather small pushbuttons permit either/on/off speaker selection and high filter. The second tape recorder sockets are mounted on the front panel, which is practical alternative avoiding wiring inconvenience if the second machine is not a permanent part of the installation. Socketry is phono throughout.

Lab performance

A lot of power is available for the money, but the delivery pattern is not particularly 'tidy', and perhaps some should have been sacrificed to avoid the distortion rise at high frequencies

which we noted. Power delivery is reasonably well maintained into 4ohms, but more seriously curtailed into 2ohms, so speaker matching is less critical than the rear panel warning (8ohms or more) implies, though the avoidance of 'both' speaker drive option is quite sensible. The power supply is clearly not very 'stiff', as the difference between single and dual channel drive is rather marked.

The bandwidths *via* the disc input show reasonable control, more so than with the cheaper A5, but the tape output might benefit from some attention as it distorts above 50kHz. Inputs and outputs are generally reasonable, though the tape output impedance is a little higher than usual. The highish 320pF disc input capacitance does give rise to some concern, as it will certainly impair the designed frequency response of quite a number of available cartridges, so selection should be made with some care. Shure and Ortofon models are likely to be fine, likewise load-insensitive cartridges like high-output moving-coils, Technics and Grado models. The other performance characteristics gave below average results, though none seriously so, yet we wonder perhaps whether too many of the subtler aspects of performance have been compromised slightly in the quest for specification power.

Listening impressions

The general consensus placed this amplifier significantly below average on the listening tests, and with a reasonable degree of consistency. Most frequent criticisms were directed at a general lack of integration, a certain lack of control at the frequency extremes, and an un-

acceptable degree of muddle when the music was complex, plus a loss of stereo information. Results were rather better under blind conditions, with criticisms less severe but along the same general lines, and still showing substantially negative attitudes towards the sounds produced.

Conclusions

Rather in the manner of the A5 we have the feeling that a little too much effort has been directed towards the provision of extensive facilities and a high external standard of finish, and in this instance a high specification power output. Overall we feel that too much of the overall balance which tends to result in good sound quality has been sacrificed to these ends.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 48/58/54 Watts
 o/p level ref 2.83V=0dB. 16.7/17.6/17.2dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 72/100/98 Watts
 o/p level ref 2.83V=0dB. 18.5/17/13.9dB
 Single cycle power 1kHz, 8/4/2 ohms. 94/162/162 Watts
 o/p level ref 2.83V=0dB. 19.7/19/16dB
 Dynamic headroom (IHF) 0.96dB

Bandwidth (-3dB below half power)

Disc in - power out. 7 Hz - 46kHz
 Disc in - tape out 7 Hz - 59kHz
 Aux in - power out. DC Hz - 75kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.	Phono	2.6	47k	320
Tuner/Aux.	Phono	150	64k	
Tape 1.	Phono	150	64k	
Tape 2.	Phono	150	64k	

Disc overload MM. 36dB

Outputs (5.0mV disc input)

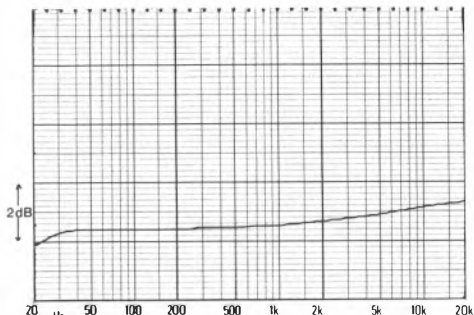
	Type	Level (mV)	Imp (ohms)
Tape 1.	Phono	180	5k
Tape 2.	Phono	180	5k
Headphones (8 ohms)		100	
(2 kohms)		2.6V	

Noise (ref 1 Watt, 8 ohms)

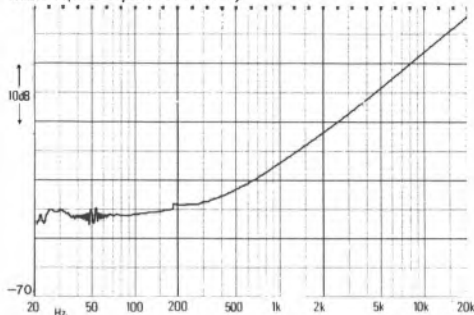
Zero volume. -81dB
 Aux ref volume. -78dB
 MM disc ref volume. -77dB

Other

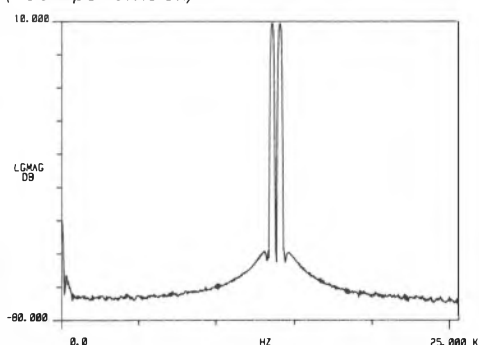
Damping factor. 53
 THD performance. below average
 Hum performance. below average
 Dimensions(W x D x H). 17(43) x 9½(24) x 5½(14) ins(cms)
 Weight. 13lbs
 Typical purchase price. £105



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

RECOMMENDED

Sansui A9

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



Presentation, facilities etc

This is the top model of the 'super compo' threesome, and consequently is the most elaborate in terms of features and facilities. The same basic chassis has been used, as well as the 'window' along the full length of the fascia, though both the large rotary controls have been replaced by pushbuttons. Input selection has light indication and is now entirely controlled by pushbuttons/bars. The real extra is rather more useful perhaps than the mike input/blend fitted to the A7, and gives the option of moving-coil or moving magnet cartridge matching. Once again tape dubbing may be switched and recordings made from a tuner input when the amplifier is playing from any source.

The rotary controls operate tone, balance and variable loudness, while control over volume has been delegated to two large pushbuttons necessarily augmented by a light indicator bar. How this can be anything but a fatuous gimmick on any item not actually needing digitised controls for remote operation escapes us. Not only does one lose control of the rate at which volume may be changed and is unable to set the volume before connecting power, but the simple single analogue control must be replaced by two buttons and a visual indicator. Other pushbuttons of rather fiddly dimensions control either/or/off loudspeakers and a high filter. Phono sockets are used throughout, with the tape 2 set duplicated on the front panel, a useful way of temporarily connecting a second machine without entangling the 'spaghetti' at the back of the installation.

Lab performance

Power output is again generous for the price,

showing some similar characteristics to other A-series models, being reasonably well maintained into 4ohm loads and even able to deal quite respectably with 2ohms particularly in the short term. Our specification for power being measured at the level of 0.1% distortion has restricted our reading at high frequencies to an unfortunate degree, showing that the distortion begins to rise quite early on. There is still a significant difference between single and dual channel drive, though this is not as pronounced as in the cheaper models in the series.

Bandwidths show some attempt at control, but the RIAA equalisation at high frequencies is not correct and can lead to over-driving within the amplifier and give rise to slew rate limiting problems. The amplifier is just at the threshold of this. Disc input capacitance is rather high, which will restrict the range of cartridges which can be optimally loaded. Shure and Ortofon models, plus those insensitive to loading like moving-coil, Grado and Technics models, are likely to give the best match. Tape output impedances are rather high, though practical problems are most unlikely. Although the IM distortion test gave good results, hum breakthrough and THD+ noise *via* disc were well below average.

Listening impressions

This amp received a somewhat mixed reception on the listening tests, though it was certainly better received than its cheaper brethren, and on occasion attracted quite favourable comment. Results were not entirely consistent, and the m-c input did not give such good results (bandwidth matching?). The midrange was well liked if a little 'forward', and the dynamics were considered

reasonable. Extreme bass and treble received criticism for lack of control, likewise the overall performance when the volume level was increased. But the sound as a whole was slightly above average, which is quite respectable for an amplifier in its price class.

Conclusions

Lots of power and facilities for the money, and clearly a better power supply and listening test results than its cheaper stablemates suggest that this model has quite a lot going for it. But there are a number of areas of technical reservation, particularly on the disc input and its high frequency capability, so pre-auditioning in a system context is vital if this amplifier is considered.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 86/88/20 Watts
 o/p level ref 2.83V=0dB 19.3/19.4/13dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 105/156/162 Watts
 o/p level ref 2.83V=0dB 20/18.9/16dB
 Single cycle power 1kHz, 8/4/2 ohms ... 126/220/272 Watts
 o/p level ref 2.83V=0dB 21/20.4/18.3dB
 Dynamic headroom (IHF) 0.5dB

Bandwidth (-3dB below half power)

Disc in - power out 7 Hz - 63kHz
 Disc in - tape out 6 Hz - 52kHz
 Aux in - power out DC Hz - 61kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.5	49k	330
Disc MC.....	Phono	0.16	9	
Tuner/Aux.....	Phono	156	60k	
Tape 1.....	Phono	156	60k	
Tape 2.....	Phono	156	60k	

Disc overload MM 38dB
 Disc overload MC 36dB

Outputs (5.0mV disc input)

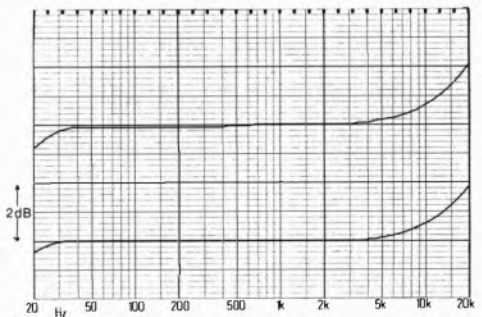
	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	200	4.9k
Tape 2.....	Phono	800	4.9k
Headphones (8 ohms).....		100	
(2 kohms).....		2.5V	

Noise (ref 1 Watt, 8 ohms)

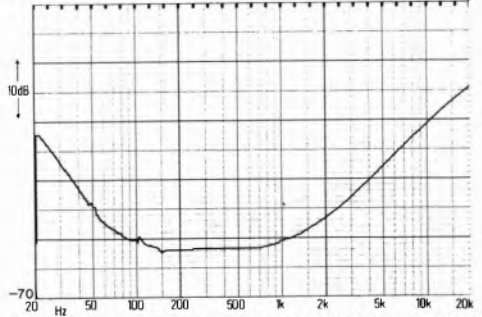
Zero volume -77dB
 Aux ref volume -73dB
 MM disc ref volume -72dB
 MC disc ref volume -71dB

Other

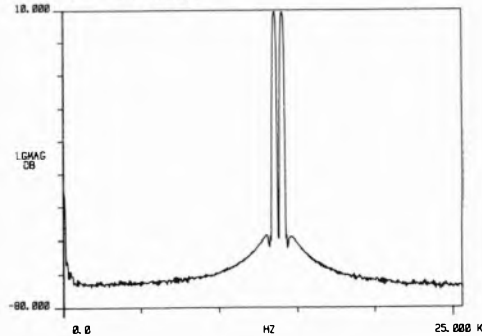
Damping factor 48
 THD performance below average
 Hum performance below average
 Dimensions (W x D x H) ... 17(43) x 10(25) x 5 1/4(13 1/2) ins (cms)
 Weight 16lbs
 Typical purchase price £135



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Sansui AU-D5

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



Presentation, facilities etc

The cheapest of the three *AU* series which were tested for this new edition, the *D5* is really a middleweight rather than a lightweight in Sansui's hi-fi range, leaving the gaps left by the departure of the popular *217* and *317* models still to be filled. Available in silver or black, the *D5* seems much more substantially constructed than the *A*-series. The front panel is a little cluttered, with vertical and horizontal groupings, but the volume control is easily distinguished.

Inputs are selected with illuminated display by pushbuttons, and rotary controls independently select the source fed to a tape recorder, and also control cross-dubbing, mode selection and balance. Other rotary controls grouped together offer no fewer than four tone controls, 'super bass' and 'presence' complementing the traditional bass and treble; a defeat switch is also provided. The left hand section of the amplifier is dominated by rather garish red/blue illuminated 'power' meters, switching being provided to change the range and switch off the display, though the illuminated scale remains permanently lit when the unit is on. A loudness button, smaller than the others and left untrimmed in nude plastic sits almost as an afterthought beside the volume control, while either/or/both speaker switching is situated near the power switch and protection indicator light.

Lab performance

The power behaviour of this model was surprisingly close to the cheaper *A9*, though it nevertheless gives a healthy output for the price. Distortion measured very well on this model, however, so there is no high frequency limitation like that

found on the cheaper design. Power was reasonably well maintained into 4ohms, but the relay protection operated too early for us to take any 2ohm readings even on single cycle, so a little care perhaps needs to be exercised when choosing loudspeakers, especially if two pairs are to be used continuously together at high levels. The difference between single and dual channel drive was respectable at about 10%, again mirroring the *A9*.

The bandwidths permitted are very wide, unnecessarily and riskily so in our opinion, though the moving-coil input rolls off at the bass rather too early even by our conservative standards! The m-c input also gave significantly more hum and noise than the m-m input, which is a further disincentive to taking it seriously. The inputs and outputs appear to have been carefully selected for general compatibility, and unlike the *A*-series the m-m disc input capacitance is a more modest value permitting greater flexibility of cartridge choice. Crosstalk in particular was rather better than most of the competition, and all the other performance parameters were fine, though hum was perhaps a little less good than it might have been.

Listening impressions

Overall the rating for this amplifier was a little below average, with quite consistent criticism of its performance via the moving-coil input, and of an inability to maintain its respectable low level quality when being driven loud. The bass register was felt to be a little vague, lacking definition and some control, while the midrange and treble were a little forward, compressing and muddling stereo information and depth and emphasising

surface noise a little. The general consensus seemed to be that the amplifier had a reasonable potential, but didn't quite get enough things right for a balanced subjective performance.

Conclusions

Though many aspects of this amplifier's performance were sound, there were a few anomalies notably on the moving-coil input, and the listening tests consistently criticised this and the performance when loud. Though it is not overpriced, the cheaper A9 was generally preferred (though not without its own quibbles), so the AU-D5 would not appear to rank as a class leader.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 85/90/85 Watts
 o/p level ref 2.83V=0dB 19.3/19.6/19.3dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 100/148/Relay Watts
 o/p level ref 2.83V=0dB 20/18.7/Relay dB
 Single cycle power 1kHz, 8/4/2 ohms ... 107/190/Relay Watts
 o/p level ref 2.83V=0dB 20/20/Relay dB
 Dynamic headroom (JHF) 0.29dB
Bandwidth (-3dB below half power)
 Disc in - power out 2Hz - 110kHz
 Disc in - tape out 2Hz - >200kHz
 Aux in - power out DC Hz - 84kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.7	46k	189
Disc MC.....	Phono	0.25	100	
Tuner/Aux.....	Phono	210	34k	
Tape 1.....	Phono	210	34k	
Tape 2.....	Phono	210	34k	

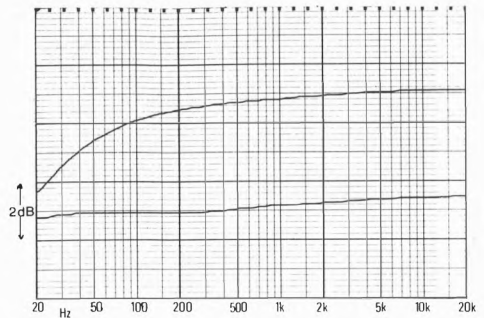
Disc overload MM 37dB
 Disc overload MC 36dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	380	215
Tape 2.....	Phono	380	215
Headphones (8 ohms).....		100	
(2 kohms).....		2.6V	

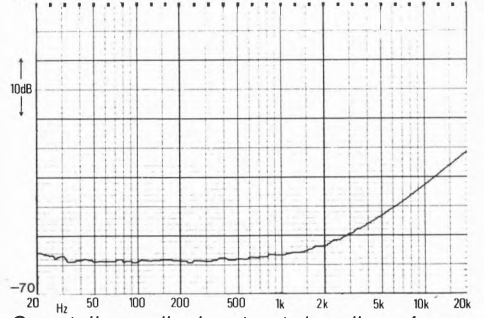
Noise (ref 1 Watt, 8 ohms)
 Zero volume -94dB
 Aux ref volume -85dB
 MM disc ref volume -81dB
 MC disc ref volume -72dB

Other

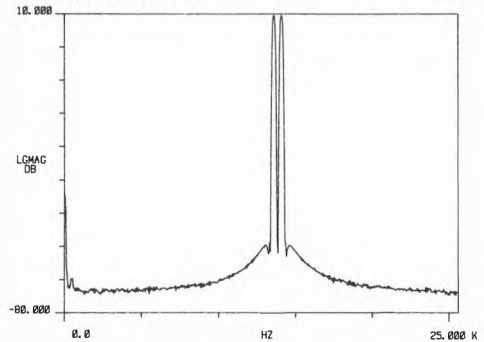
Damping factor 125
 THD performance excellent
 Hum performance above average
 Dimensions (W x D x H) ... 17(43) x 13(33) x 6(15) ins(cms)
 Weight 22lbs
 Typical purchase price £180



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Sansui AU-D7

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



Presentation, facilities etc

This model is almost identical to the *AU-D5* externally, though our review sample was finished in the alternative black finish. This we normally prefer, but on this occasion the permanently illuminated blue 'power' meter scale seemed even more lurid against a dark background, so it is a pity that it cannot be completely switched off. This is never going to be an amplifier which is easily ignored.

Features and facilities appear to be identical to those on the cheaper model, namely illuminated pushbutton operated inputs supplemented by rotaries for mode and record-sense. Four separate tone controls are centred on 10Hz, 100Hz, 1.5kHz and 15kHz respectively and accompanied by a defeat switch. A nice distinctive large rotary controls volume and is accompanied by a small balance control and an itsy-bitsy loudness button. All sockets are to phono standards, and provision is made for two speaker systems independently switchable from the front panel.

Lab performance

As expected the *D7* resembles the *D5* quite closely in many ways while offering rather more power. Power output is pretty generous by any standards and is quite well maintained into 4ohms, though 2ohm measurements were again impossible because of the action of the protection relays. However we think it is most unlikely that these will be triggered under normal program signals except perhaps under overdrive with the wrong combination of two sets of loudspeakers. A little care should perhaps be taken to avoid the lowest impedance types. The difference between single and dual channel drive was significant though not excessive.

The bandwidths were very wide as in the *D5*, and this in our view is unnecessary and something of a pity. The disc input frequency responses are rather strange, with the m-c bass rolloff even more pronounced than on the cheaper model, and the remaining parts of the curves less even. Overload margins and noise figures were also significantly poorer than those measured on the *D5*, which is inexplicable, or at any rate rather strange. Crosstalk was again very good, as was IMD, though the hum performance was below average and noticeable on the m-c input.

Listening impressions

The *AU-D7* received very similar comments to the *D5*, rating somewhat below average overall. Once again the sound quality via the moving-coil input came in for a fair degree of criticism both in terms of balance and hum, and it was felt that this input was not really worth taking too seriously. Again the sound was generally quite liked when the amplifier was playing quietly, but was felt to deteriorate significantly when driven above a few watts, with descriptions of stereo anomalies and positional insecurities. The bass quality was also consistently criticised, and was felt to lack definition, control and be somewhat 'detached'. When driven to louder levels, the presence/treble began to sound rather 'bright'. Overall the amplifier was criticised quite consistently in much the same way as the *D5*, and if anything gave results which were a little worse overall.

Conclusions

Something of a disappointment, this amplifier is more costly than the *D5* or *A9*, yet seems less well balanced than either. The poorer measured performance parameters than the *D5* are a

particular surprise, and the moving-coil input design would appear to need some attention. Auditioning results were fairly negative, and again a trifle worse than those for the D5, so despite the generous power available, this amplifier failed to win our confidence.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 117/124/119 Watts
 c/p level ref 2.83V=0dB 20.6/20.9/20.7dB
 Single channel 8/4/2 ohms

1 kHz, 0.1% dist 141/210/Relay Watts
 c/p level ref 2.83V=0dB 21.5/20.2/Relay dB
 Single cycle power 1 kHz, 8/4/2 ohms 156/270/Relay Watts
 c/p level ref 2.83V=0dB 21.9/21.3/Relay dB
 Dynamic headroom (IHF) 0.44dB

Bandwidth (-3dB below half power)

Disc in - power out DC Hz - 110kHz
 Disc in - tape out 2 Hz - >200kHz
 Aux in - power out DC Hz - 52kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	3.4	47k	180
Disc MC	Phono	0.41	100	
Tuner/Aux	Phono	270	100k	
Tape 1	Phono	270	100k	
Tape 2	Phono	270	100k	

Disc overload MM 28dB
 Disc overload MC 29dB

Outputs (5.0mV disc input)

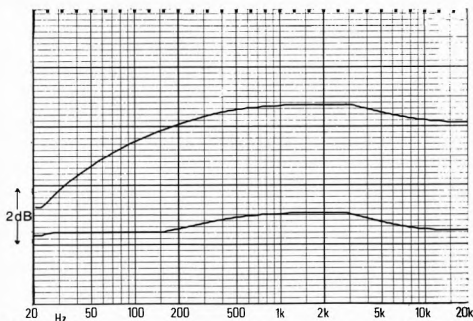
	Type	Level (mV)	Imp (ohms)
Tape 1	Phono	350	550
Tape 2	Phono	350	550
Headphones (8 ohms)		62	
(2 kohms)		1.6V	

Noise (ref 1 Watt, 8 ohms)

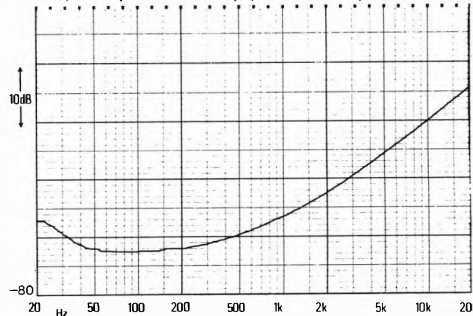
Zero volume -85dB
 Aux ref volume -73dB
 MM disc ref volume -72dB
 MC disc ref volume -70dB

Other

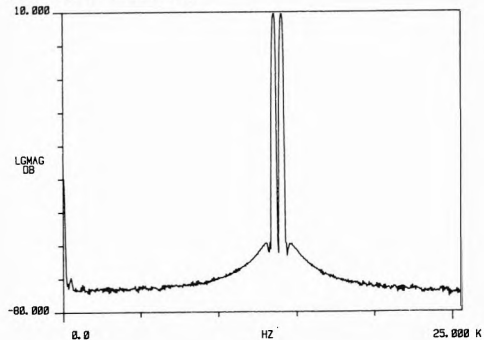
Damping factor 149
 THD performance excellent
 Hum performance below average
 Dimensions (W x D x H) 17(43) x 13(33) x 5½(14) ins(cms)
 Weight 21 lbs
 Typical purchase price £215



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Sansui AU-D9

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



Presentation, facilities etc

Despite following the number sequencing established by the *AU-D5* and *AU-D7*, the *AU-D9* appears to come from a completely different design source. It is much closer to the traditional Sansui look, which we prefer frankly to the 'super compo' influence, and has a smart rosewood finished case and rather less cluttered overall layout. Not only is the pre-amplifier section laid out quite differently, but the power amplifier section uses the unusual technique of feed-forward, reputedly similar to that pioneered not long ago by Quad.

The matt black fascia is neatly laid out, and is dominated by a large smooth volume control. However the identification of on and off positions on some of the pushbuttons is a little ambiguous without consulting the manual. Input selection bristles with indicator lights, and combines a rotary switch with pushbuttons for tape and for moving coil options (two sensitivities), while a separate rotary handles the selection of the signal sent to a recorder independently of the main amplification. Central pushbars select -20dB muting, infra- and ultra-sonic filters plus tone defeat, while the tone controls themselves have two turnover frequencies each, namely 150/300Hz and 3/6kHz. Either/or/both/off speaker switching is fitted, but after checking at least three times we must happily conclude that at least one major Japanese manufacturer has had the guts to leave the loudness control off - the muting offered instead is far more useful. Phono socketry is used exclusively.

Lab performance

This large and quite expensive amplifier has

plenty of power available, though not in fact much more than the far cheaper *AU-D7*. However the manner of its delivery appears to be rather better controlled, and shows only a slight difference between single and dual channel drive. Delivery is quite well maintained into 4ohms, though we could not measure the steady state power into 2ohms because of the protection relays. However we did get figures for single cycle peak power, which are probably more representative of a music signal in any case, and these show that the *D9* is capable of driving almost any load without significant voltage drop.

Bandwidths with all controls flat are rather wide, with no attempt whatever at low frequency curtailment, though the high frequencies are more sensibly limited. The disc input frequency responses, in contrast to those on Sansui's cheaper *AU* amplifiers, were exceptionally flat, though the m-m disc input capacitance is perhaps a trifle high for optimum matching to certain cartridge/turntable combinations. Crosstalk, distortion, hum and noise measurements were all very good, while no specific IM products are visible though the noise floor rises either side of the test signal. Overall this is a clean and well-balanced performer which gives us rather greater confidence than the cheaper Sansui models which we tested on this occasion.

Listening impressions

We had some hopes for this amplifier in view of the sterling auditioning results from its predecessor the *919*. Unfortunately, while attracting less criticism than the cheaper *AU* models, the *D9* only rated marginally above average overall, although the results were rather less consistent.

Essentially the comments were broadly similar to those for the D5 and D7, though the level of criticism was much lower, and no particular brickbats were levelled at the moving-coil input. Aggressive tendencies were thought to be well under control, though the amplifier did tend to sound a little 'thin' particularly when driven hard. Dynamics did seem a little 'softened' and some criticism was made of mid-congestion. Overall then this amplifier gave slightly disappointing results, though quite good by the general standards of 'mainstream' integrated amplifiers.

Conclusions

This is an extremely difficult amplifier to fault technically, and it offers plenty of power at a not unrealistic price, plus a reassuring feeling of 'build quality', a high standard of finish and a comparatively discreet domestic appearance (ignoring its sheer bulk). However our listening tests were not particularly encouraging, in the way that its predecessor's were, so we would advise potential purchasers to try to audition the amplifier for themselves before making a final decision.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 128/128/119 Watts
 o/p level ref 2.83V=0dB. 21/21/20.7dB
 Single channel 8/4/2 ohms

1kHz, 0.1% dist. 135/197/Relay Watts
 o/p level ref 2.83V=0dB. 21.2/19.9/Relay dB
 Single cycle power 1kHz, 8/4/2 ohms ... 176/300/400 Watts
 o/p level ref 2.83V=0dB. 22.4/21.7/20dB

Dynamic headroom (LHF) 1.0dB

Bandwidth (-3dB below half power)

Disc in - power out DC Hz - 68kHz
 Disc in - tape out DC Hz - 116kHz
 Aux in - power out DC Hz - 59kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.5	44k	221
Disc MC.....	Phono	.06/14	100	
Tuner/Aux.....	Phono	247	32k	
Tape 1.....	Phono	247	32k	
Tape 2.....	Phono	247	32k	

Disc overload MM 37dB

Disc overload MC 37dB

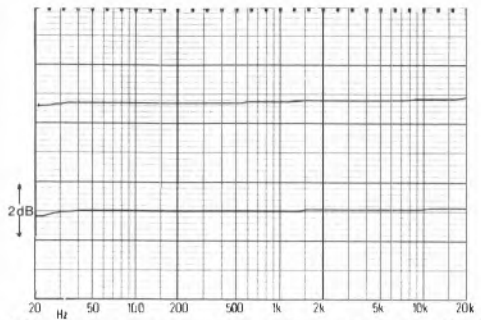
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	450	550
Tape 2.....	Phono	450	550
Headphones (8 ohms).....		100	
(2 kohms).....		2.6V	

Noise (ref 1 Watt, 8 ohms)

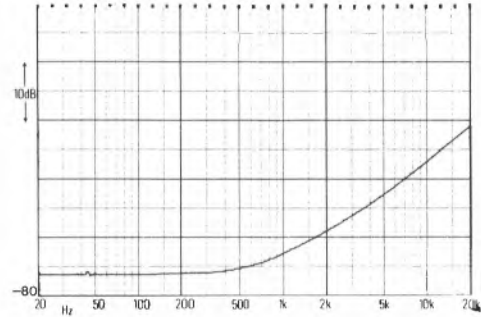
Zero volume..... -93dB
 Aux ref volume -87dB
 MM disc ref volume -84dB
 MC disc ref volume -77dB

Other

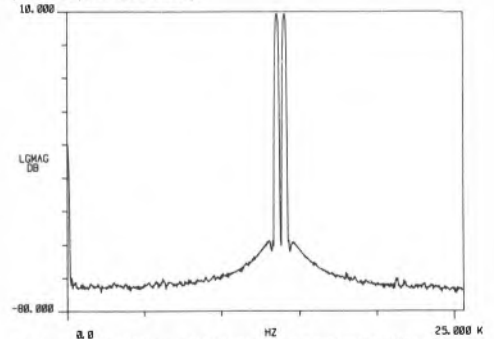
Damping factor 111
 THD performance excellent
 Hum performance average
 Dimensions (W x D x H) 17 1/2(44) x 16(41) x 6(15) ins(cms)
 Weight 32lbs
 Typical purchase price £350



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



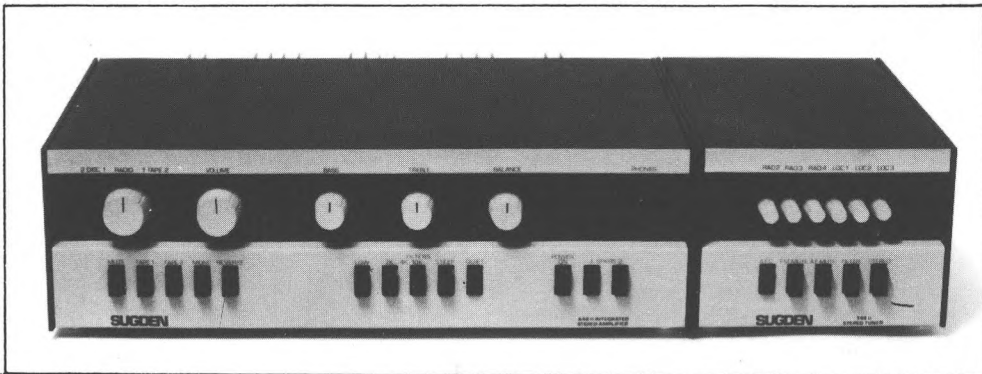
Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Sugden A48II/T48II (revised and reprinted)

J. E. Sugden and Co. Ltd., Carr Street, Cleckheaton, West Yorkshire BD19 5LA
Tel: (0274) 872501



This review has been adapted from that which appeared as a tuner/amplifier combination, shown in the photograph. Some care should be taken in comparing value judgements with those for the latest tests.

Presentation, facilities, etc.

One might be forgiven for an Oldenberg-inspired shock when first seeing this unusually styled amplifier from the well established Yorkshire firm: "It looks furry" being one reaction. In fact, the exterior is in the very durable Nextel finish, which has a suede-like appearance; the lack of reflections and tastefully chosen two-tone brown makes this an appropriately well-domesticated product. Construction is reassuringly 'solid'.

The amplifier feeds two sets of switchable speakers and a headphone jack, with inputs on DIN socketry including three sensitivity positions for disc. Traditional tone controls are supplemented by switches for stereo/mono, mode, tape monitoring and cross-dubbing, loudness (labelled 'quiet'), low and high filters, the latter being particularly comprehensive, with six alternatives. In summary, this is an interesting and refreshingly domestic design, soundly constructed, and with plentiful facilities.

Lab performance

The modest power output for the price is perhaps explained by the 'solidity' of delivery, with no difference between single and dual channel outputs, and with reasonable delivery into low impedances (the HF constriction being distortion limited, and not serious). The disc input bandwidth is well constrained, frequency response reasonable, though

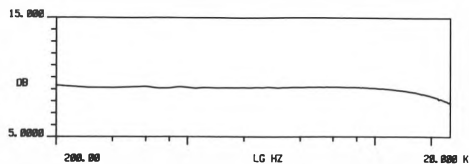
impedance and capacitance resisted our measure (findings in *Amplifiers* suggesting no problems). The DIN socketry is best used as such. Performance parameters were average, with hum excellent.

Subjective impressions

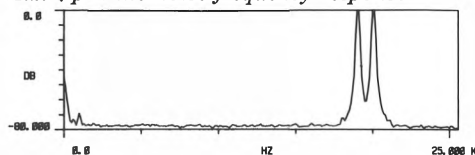
Steadily above average listening test results were recorded, with common descriptions of a smooth, powerful sound, with good 'integration', but a little 'gentle', and perhaps slightly fatiguing when loud.

Conclusions

With decor that is attractive to live with and generally good ergonomics and facilities, the respectable sound quality and technical performance give reassurance that implies that this model merits consideration. However it would have been nice to have had a built-in head-amp for moving-coil cartridges at the fairly high price of the unit.



Aux i/p white noise frequency response.



IM distortion.

GENERAL

Power
 Bandwidth (-3dB ref max power, disc)..... 21 Hz-30kHz
 Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist) .. 41/41/34 Watts
 Single channel 8/4/2 ohms (1kHz, 0.1% dist) .. 41/52/60 Watts
 Burst power 1kHz, 8/4/2 ohms 52/78/90 Watts

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM	DIN	Var	?	?
Disc MC	—	—	—	—
Tuner/aux.	DIN	170	150k	—
Tape	DIN	170	150k	—

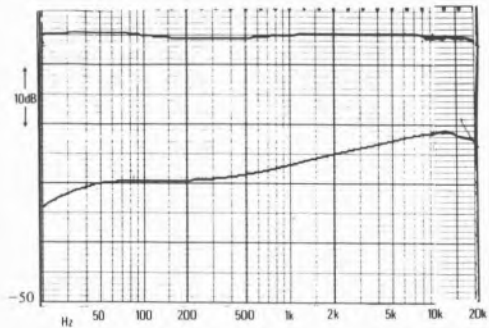
Disc overload 1kHz..... 31 dB

Outputs (5mV disc)

	Type	Level (mV)	Imp (ohms)
Tape	DIN	100	46k
Headphones (8 ohms)	Jack	50	—

Noise (ref 1 Watt, 8 ohms)
 Zero volume..... -75dB
 Aux ref volume..... -71dB
 Disc ref volume..... -74dB

Other
 Damping factor 52
 THD performance average
 IMD performance..... average
 Hum performance excellent
 Typical retail price..... £280



Disc i/p frequency response/crosstalk.

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Sugden C51/P51/(revised and reprinted)

J. E. Sugden and Co. Ltd., Carr Street, Cleckheaton, West Yorkshire BD19 5LA
Tel: (0274) 872501



This review has been adapted from that which appeared as a tuner/amplifier combination, shown in the photograph. Some care should be taken in comparing value judgements with those for the latest tests.

Presentation, facilities, etc.

This traditional, indeed quite old fashioned looking separates combination has been available in more or less the same overall format, though with continuous technical updating, for a decade or so, and yet it remains a neat and attractive solution to installations where the power amp can be tucked out of sight in a well-ventilated cabinet. The pre-amp and tuner are supplied with brackets for panel mounting, and with alternative self-adhesive feet. Any item may of course be used with other components if desired, and in combination are switched on from the pre-amp.

The pre-amp has rather complex input switching, which permits very flexible operation with both phono and DIN sockets, but takes a little learning; the instruction booklet details how disc sensitivities and equalisation may be modified. The traditional tone controls are supplemented by loudness, low and high filters (the latter having six alternative positions), plus mode switching. In summary, this is a highly flexible, compact, if slightly quaint design, though the visual and function layout makes operating a little complex.

Lab performance

With a slight power increase over the *A48* and similarly good delivery patterns, the *'51* remains on the expensive side, but shows good inter-channel

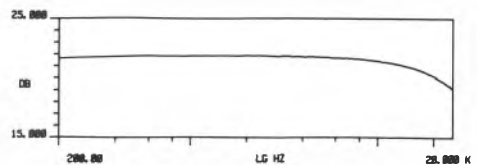
'stiffness' and competent delivery into low impedances. Disc input bandwidth was well constrained, but with a frequency response that will probably cause some coloration; we could not establish the capacitance loading, and the overload margin was lower than most. Inputs and outputs permit phono or DIN interconnection. Performance parameters were average, but with below average hum contrasting with the excellent result obtained on the *'48*, and a lowish damping factor.

Subjective impressions

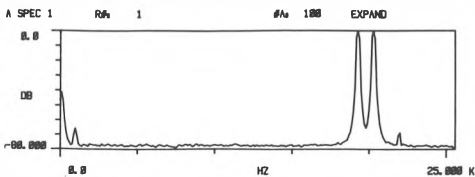
Fractionally better overall results than for the *A48* placed this combination comfortably above average, and in comparison with its stablemate it was considered rather more coloured and untidy, but also more detailed and 'livelier', with well-liked treble characteristics. The power amp heat sinks became rather hot.

Conclusions

On balance this combination was considered roughly on a par with the rather cheaper *A48*, and the idiosyncratic styling would appear to suit rather specialised applications, so we feel that the design remains worth considering.



Aux i/p white noise frequency response.



IM distortion.

AMPLIFIER

Power

Bandwidth (-3dB ref max power, disc)..... 17Hz-27kHz
 Both channels 20Hz/1 kHz/20kHz (8 ohms, 0.1% dist)... 46/50/44 Watts
 Single channel 8/4/2 ohms (1kHz, 0.1% dist) 51/69/71 Watts
 Burst power 1kHz, 8/4/2 ohms 56/85/100 Watts

Inputs	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM	Both	2.9	47k	?
Disc MC	—	—	—	—
Tuner/aux.	Phono	200	150k	
Tape	Both	210	150k	

Disc overload 1kHz..... 25dB

Outputs (5mV disc)	Type	Level (mV)	Imp (ohms)
Tape	DIN	345	200
Tape	DIN	16	31k

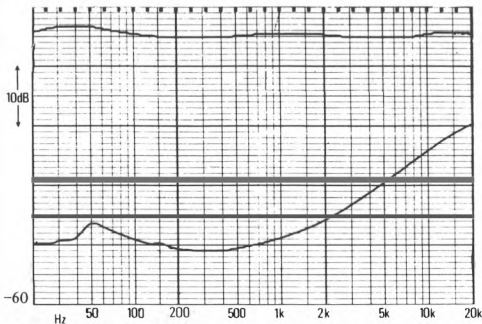
Noise (ref 1 Watt, 8 ohms)

Zero volume..... -73dB
 Aux ref volume..... -70dB
 Disc ref volume..... -73dB

Other

Damping factor 23
 THD performance average
 IMD performance below average
 Hum performance below average

Typical retail price..... £320



Disc i/p frequency response/crosstalk.

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Presentation, facilities etc

This combination of pre- and power amplifier is most attractive, with a standard of finish the equal of anything around, and a design that has distinct touches of Scandinavian flair, while sensibly not flying in the face of current fashion. Of the two units, the power amplifier is perhaps the most interesting in appearance, with the sculptured louvres through the case looking quite dramatic.

The large rotary control on the pre-amp (naturally) adjusts volume, and alongside are two smaller rotaries for balance and input selection. Two more rotaries further along adjust bass and treble, while at the other end another controls the output to the headphone socket, driven independently of the power amplifier. One pair of push buttons switch mono and loudness, the next pair subsonic filter and tone defeat, a group of four give tape monitoring and cross-dubbing, while the one on its own switches power. Apart from the attractive metalwork, the power amplifier is almost featureless (as it should be?), with its matching power switch and two LEDs indicating peak clipping. The rear panels use phono through-out, which is a bit of a break from European tradition, but not unwelcome. Inputs are provided for both moving-coil and moving magnet cartridges, with switching for variable impedance (100/47/33 kohm) and variable capacitance (20/120/350pF) beside the sockets. Incidentally, a matching tuner is also available, as well as a most interesting (and expensive) piece of modern furniture designed specially to house the units along with other equipment.

Lab performance

Belying its compact dimensions (if not its price),

these units were capable of a whacking 180 or so watts both channels driven, though the increase of 12% under single channel drive is a little high, so the power supply is not perhaps quite as 'stiff' as we would have liked. The power delivery is very well maintained into low impedances, showing a voltage drop of only 3.2dB into as low as 2ohms. Obviously this amplifier will drive any loudspeakers without problems, although there was slight current limiting into the lowest impedances.

Bandwidths show reasonable curtailment at the frequency extremes (or at any rate an avoidance of excess), the RIAA equalisation is very flat and nicely tailored, and the moving magnet impedance/capacitance variations are accurate and usefully flexible. The moving-coil input impedance is higher than usual, though we would be surprised if this made any significant difference. Distortion is quite low (if not quite as low as the latest Japanese amplifiers), and the noise and hum performances were not quite as good as we expected. One curiosity is that the gain matching through the pre-amp is not quite right, so that it is not difficult to clip the output section with modest level inputs when the volume control is set high. This may not matter in practice as there is plenty of volume at the control mid position with a typical input, and here the overload margin is high. But it does represent a chink in the armour of this otherwise impressive system. The IM spectrum showed the slightest sideband, and was noticeably free of the 'noise modulation effect'.

Listening impressions

Tandberg have no recent track record for ampli-

fiers, so it was pleasant to find that this expensive model did seem to deliver the goods subjectively, and was placed consistently high in the listening tests. The sound was considered 'open', 'clean' and commendably clear of confusion, if a trifle lacking control at high frequencies and not entirely well-defined at low frequencies. Generally quite 'busy' sounding with plenty going on, it nevertheless lacked the full dynamics and 'focus' of the best audiophile amplifiers.

Conclusions

This is an expensive combination, but one which did consistently well throughout the tests. As an amplifier for the music lover who would rather avoid the occasional eccentricities of the audiophile market, and who rates style and engineering quality above simplistic value for money, the Tandbergs stand up extremely well, and are a welcome surprise from this tape recorder specialist.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 175/181/178 Watts
 o/p level ref 2.83V=0dB 22.4/22.5/22.5dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 205/315/386 Watts
 o/p level ref 2.83V=0dB 23.1/21.9/19.9dB
 Single cycle power 1kHz, 8/4/2 ohms 225/378/400 Watts
 o/p level ref 2.83V=0dB 23.3/22.8/20dB
 Dynamic headroom (IHF) 0.4dB

Bandwidth (-3dB below half power)

Disc in - power out 7 Hz - 89kHz
 Disc in - pre out 7 Hz - 110kHz
 Disc in - tape out 7 Hz - 77 kHz
 Aux in - power out 5 Hz - 114kHz
 Power amp only 3 Hz - 122kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.2	33/48/98k	34/131/334
Disc MC.....	Phono	0.16	1k	
Tuner/Aux.....	Phono	150	48k	
Tape 1.....	Phono	150	48k	
Tape 2.....	Phono	150	48k	
Power amp.....	Phono	1.1V	10k	
Disc overload MM.....				42dB
Disc overload MC.....				41dB

Outputs (5.0mV disc input)

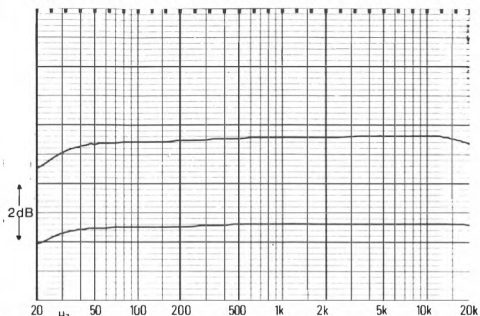
	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	300	1k
Tape 2.....	Phono	300	1k
Headphones (8 ohms).....		300 max	(separate control)
(2 kohms).....		17V max	

Noise (ref 1 Watt, 8 ohms)

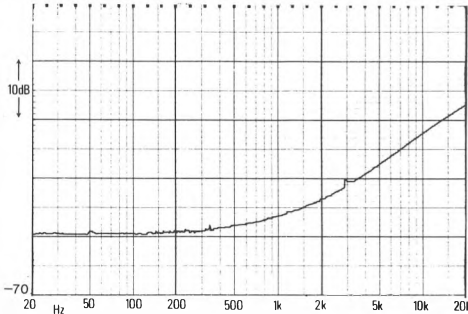
Zero volume 88dB
 Aux ref volume 82dB
 MM disc ref volume 78dB
 MC disc ref volume 73dB

Other

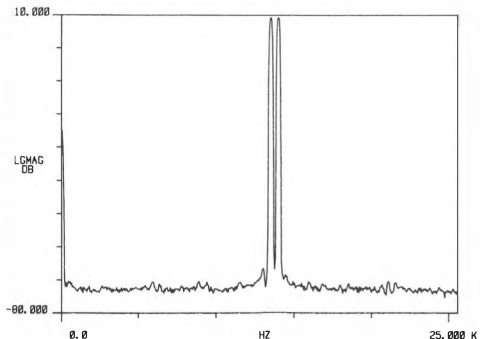
Damping factor 159
 THD performance excellent
 Hum performance very good
 Dimensions(W x D x H) ... 17(43.5) x 15(38) x 6.5(16) ins(cms)
 Weight 35lbs
 Typical purchase price £850



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

BEST BUY

Technics SU-V3

Panasonic UK Ltd., 107/109 Whitby Road, Slough, Berks. SL1 3DR. Tel (0753) 27516



Presentation, facilities etc

This is a reasonably compact and slim amplifier, with a very well finished satin-silver fascia. The control layout is neat and unobtrusive, apart from the light-type 'power' meters which are a little garish. The volume control is sensibly large and distinguishable, and function switching is delegated to three rotary controls, controlling speaker selection, tape recorder selection, and main amplifier input/output respectively; this arrangement permits tape recording to be made from any input whatever source has been selected for listening at the time.

Subsidiary controls are relegated to the bottom third of the fascia, and include bass, treble, and balance controls, and switches for low and high filters, 'loudness', and meter range. Sadly there is no mono switch, an unfortunate omission for owners of old and treasured recordings, as in such cases this helps to reduce surface noise and rumble. Phono inputs are used throughout, though there is DIN duplication on one tape position. Certain claims for operating principles such as 'new Class A synchro-bias' and 'DC' circuitry are made with unnecessary vigour on the front panel: such features are of nebulous benefit in themselves (the whole being greater than the sum of the parts), their main purpose being to give the copywriter or salesman something to talk about.

Lab performance

We are accustomed to excellent laboratory results on Technics models, and the *SU-V3* is no exception despite its comparatively modest price. Indeed it is somewhat encouraging to note that Technics do not seem prepared to sacrifice performance

and quality in an attempt to meet a particular commercial price target. Power delivery is generous for the price, and well maintained into low impedances, so selection of partnering loudspeakers is uncritical. However the difference between single and dual channel capabilities approaches 20%, indicating some limitations in the power supply 'stiffness', though this is by no means unreasonable for a modestly priced amplifier.

Most of the points one can raise concerning the technical performance are in the nature of quibbles rather than criticisms. The hum performance only rated average, and the disc input bandwidth might have been curtailed an octave below the measured 70kHz with advantage. Inputs and outputs have been sensibly chosen, so no matching problems are likely. Crosstalk measured quite well, rising to a reasonable -42dB from a very good low frequency -68dB. The intermodulation spectrum shows no specifically identifiable sidebands, though the noise floor did rise somewhat with the application of the tests signals on either side of these. The normally measured noise figures were however very good.

Listening impressions

Listening test results were consistently in the average and above average class, which is very encouraging for a model in this price class. Most descriptions included the adjectives 'bright', but in a 'forward' or 'open' sense rather than indicating aggressiveness. A somewhat 'powerful' sounding bass was felt by some to be slightly less well controlled than the best amplifiers. Detail and information presentation was generally praised

for an amplifier in this class, and it managed the far from easy feat of sounding quite lively and generally well-controlled at the same time. Amongst non-moving-coil models, it was clearly one of the top performers.

Conclusions

This is clearly a very competent design, which is modestly priced but has made few compromises to this end. Certainly there are some indications that the power supply has to work fairly hard, but then this is part of what cost-effective engineering is about. The auditioning gave consistently encouraging results, which suggest that this is amongst the leading budget designs in terms of sound quality (something which we would have been reluctant to say about earlier Technics models). And if this alone is not enough, the power delivery is also generous for the price. Our only regret is that the choice of features is very much consumer- rather than audiophile-oriented, and it would have been nice to have had a moving-coil cartridge input instead of flashy power meters, mono and tone-bypass switches instead of speaker switching.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 50.5/54.6/54.6 Watts
 o/p level ref 2.83V=0dB 17.0/17.4/17.4dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 65/95/112 Watts
 o/p level ref 2.83V=0dB 18/16.8/14.5dB
 Single cycle power 1kHz, 8/4/2 ohms... 78.7/136/195 Watts
 o/p level ref 2.83V=0dB 19/18/17dB
 Dynamic headroom (IHF) 0.07dB

Bandwidth (-3dB below half power)

Disc in - power out 10Hz - 70kHz
 Disc in - tape out 11Hz - 57kHz
 Aux in - power out 5Hz - 104kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.5	47k	160
Tuner/Aux	Phono	140	86k	
Tape 1 & 2	Phono	170	78k	
Tape 2	DIN	170	78k	

Disc overload MM 36dB

Outputs (5.0mV disc input)

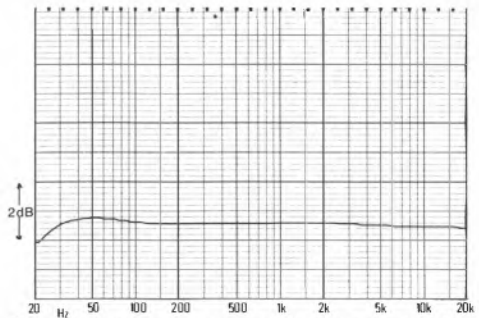
	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	260	550
Tape	DIN	28	78k
Headphones (8 ohms)	Jack	68	
(2 kohms)		2.5V	

Noise (ref 1 Watt, 8 ohms)

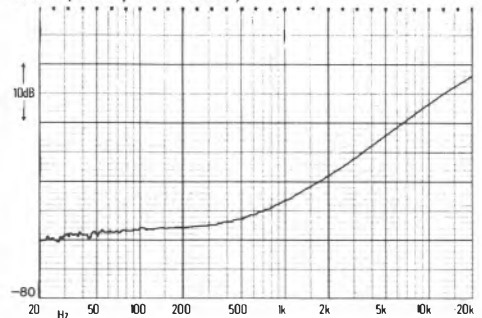
Zero volume -90dB
 Aux ref volume -84dB
 MM disc ref volume -80dB

Other

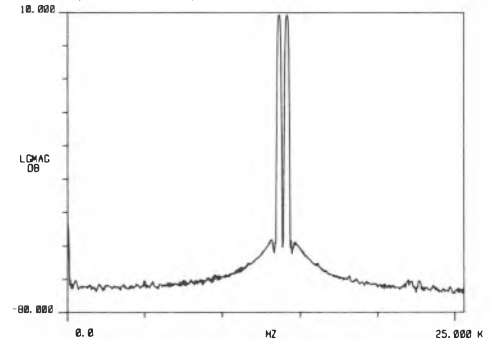
Damping factor 34
 THD performance excellent
 Hum performance average
 Dimensions (W x D x H) 17(43) x 13½(34) x 4(10) ins(cms)
 Weight 16lbs
 Typical purchase price £120



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

BEST BUY

Technics SU-V7

Panasonic UK Ltd., 107/109 Whitby Road, Slough, Berks. SL1 3DR. Tel (0753) 27516



Presentation, facilities etc

The *SU-V7* delivered to us was pleasingly finished in a dark, neutral matt-brown, with the panel lettering in a complementary lighter colour; an alternative version is available with a silver fascia. The front is divided horizontally into two sections, the top part featuring the most used volume and selector controls. Showing the way fashions change, the volume control has a nice continuous smooth action without discrete steps, and the 'power' meters fitted to the cheaper *V3* have been dispensed with.

By and large the facilities provided appear to have been carefully chosen. Moving magnet or moving-coil type cartridges may be accommodated, recordings may be made from any source irrespective of the source being listened to, and a full tone control bypass switch is fitted. Switching also controls speaker selection, mono/stereo, high and subsonic filters and loudness. There is a smattering of indicator lights as well as Technics' traditionally tasteless illuminated 'new class A synchro bias' panel. These niggles aside it is a pleasantly unassertive design which is easy to use. Phono sockets are used throughout on the back panel, with DIN duplication of one tape set.

Lab performance

The power output is very generous for an amplifier at this price level, and delivery is well maintained into 4ohm loads. However, the 2ohm load tests actuated the protection relays and also showed some limitations under our single cycle burst conditions, so some of the most awkward speaker loads might be best avoided, and a little care may be needed if driving two pairs of speakers hard,

at a party for instance. One curiosity which we found was that after the protection had operated, if the amplifier was switched off and then on again immediately, the maximum power available was reduced by 2dB until the amplifier had been left off for a considerable time: this may be a useful extra measure of protection or a sample irregularity, but regular party givers might take note. There was virtually no difference between the power outputs with one or both channels driven, which is a good point.

The disc frequency responses were commendably flat, and the measured bandwidths showed some attempt at control, with no excessively high frequencies present. Inputs and outputs showed sensible values throughout with no potential matching problems; the headphone output had slightly greater attenuation than usual, though this may well be no bad thing. The intermodulation test showed better than average results, but the background noise spectrum did not appear quite as 'clean' as other amplifiers under these conditions. Measured noise figures, harmonic distortion performance and hum performance were all fine. Overall this is clearly a very competently and cost-effectively designed amplifier.

Listening impressions

The results of the various listening tests were both consistent and favourable, the sound being described as generally 'lively' and 'open', perhaps a little presence/treble 'bright', but with good overall coherence and reasonable dynamics. Some misgivings were made of a lack of real 'power' at the bass end and a rather 'grainy' effect on the sound as it was driven harder, but stereo and separation were both well liked. The con-

sistency of these comments was unusually good, so we feel reasonably confident in presenting them, and confirming a solid above-average rating for this model.

Conclusions

This is a pleasantly styled amplifier which consistently gave above average results on both the technical and the listening tests. The price is quite modest, the power quite generous, and there is very little ground for criticism, so we can do little but endorse its obvious merit.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 96/96/96 Watts
 o/p level ref 2.83V=0dB. 19.8/19.8/19.8dB
 Single channel 8/4/2 ohms

1kHz, 0.1% dist. 102/170/Relay Watts
 o/p level ref 2.83V=0dB. 20/19.3/Relay dB
 Single cycle power 1 kHz, 8/4/2 ohms ... 107/200/224 Watts
 o/p level ref 2.83V=0dB. 20.3/20/17.5dB

Dynamic headroom (IHF) 0.12dB

Bandwidth (-3dB below half power)

Disc in - power out. 3Hz - 59kHz

Disc in - tape out 4Hz - 104kHz

Aux in - power out. DC Hz - 76kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.	Phono	2.8	47k	163
Disc MC.	Phono	0.190	215	
Tuner/Aux	Phono	170	61k	
Tape 1 & 2	Phono	170	64k	
Tape 2.	DIN	210	64k	

Disc overload MM. 35dB

Disc overload MC. 35dB

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	300	530
Tape 2.	DIN	32	77k
Headphones (8 ohms)		22	
(2 kohms)		800	

Noise (ref 1 Watt, 8 ohms)

Zero volume. -87dB

Aux ref volume. -80dB

MM disc ref volume. -80dB

MC disc ref volume. -77dB

Other

Damping factor 42

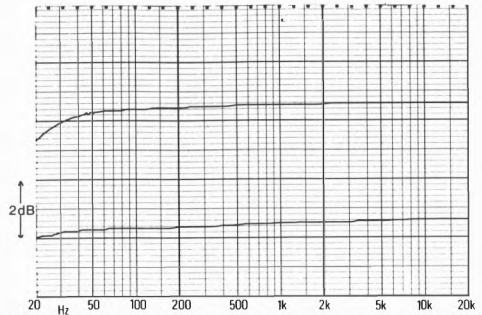
THD performance excellent

Hum performance good

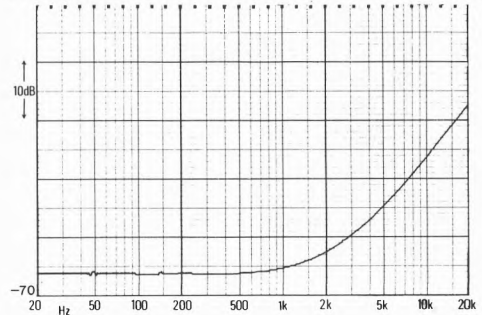
Dimensions (W x D x H) ... 17(43) x 14(36) x 5(12) ins(cms)

Weight 26lbs

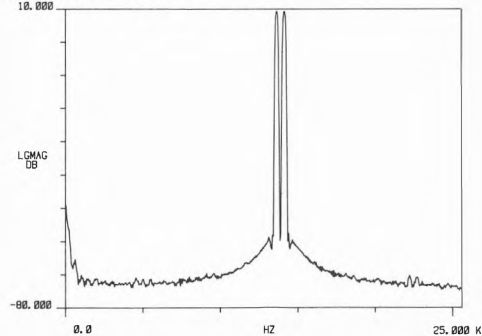
Typical purchase price £190



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Trio KA900

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



Presentation, facilities etc

This is the middle model in Trio's new *Sigma*-drive threesome, which are handsome and quite expensive models with a special facility intended to compensate for any distortions introduced by the speaker cable by including it within the amplifier's feedback loop. This involves running an extra pair of cables, but special double cables are supplied (3m). Some interesting styling features are also introduced, with a pre-select volume control and hinged smoked glass flap covering subsidiary functions. The case is a little flimsy due to the considerable ventilation provided.

The presentation and finish are rather nice, the volume control being an extended slider for pre-setting level with an illuminated touch-sensitive fade panel which alternately mutes or brings up the volume to level. Clumsily sited right next to the slider, and not very clearly marked, are the main input selector pushbars, and the remaining 'unconcealed' power switch is on its own at the end. The smoked glass cover is quite a nice way of keeping the amplifier simple to operate, while making sure that everyone knows there are lots of buttons for manipulation! Set back with small black legends on a reflective fascia this is not the easiest of control panels to use (particularly the labels attached to the input identification lights). Two large pushbuttons select disc options (1/2, mm/m-c), and three more give mode, loudness and subsonic filter. Balance and 'record out' rotaries are followed by switches for defeat and turnover frequency selection for the two tone controls. Finally, a rotary switches speakers and *Sigma*. The rear panel allows mm impedance adjustment (33/47/100kohm), and uses phono sockets DIN duplicated on tape B.

Lab performance

Power output was very respectable, approaching 100 watts, though there was a significant difference between single and dual channel drive indicating some room for improvement in the power supply. Nor was the power very well maintained into low impedances: 4ohms was okay, but 2ohms showed significant curtailment so low impedance speakers are best avoided, particularly if two pairs are to be used simultaneously.

Bandwidths are rather wide, showing no LF curtailment but some disc HF roll-off. The equalisation is very good on mm input, but less so on m-c, which only just meets ± 1 dB and is likely to give a 'heavy' bass performance: as the m-c cartridges we use tend to have much firmer bass than mm models, the combination could prove unfortunate. Noise performance, crosstalk, THD and disc overload were exemplary, but the hum performance was below average and the IM spectrum showed a slight difference component and some 'noise modulation effect'. Inputs and outputs showed sensible and typical values suggesting no compatibility problems, while the mm input capacitance is low enough to pose no practical problems to cartridge optimisation; nevertheless we would have preferred variable capacitance to the variable impedance fitted. The two figures for damping factor relate to *Sigma* and non-*Sigma* conditions. Quite a lot of heat was produced, and DC offsets were a little higher than we would have liked.

Listening impressions

First of all, the sound with *Sigma* was significantly preferred to the sound without using the supplied

cable, showing improved stereo, 'focusing', HF, mid clarity, and bass tautness. However a very similar sound was obtained without *Sigma* but using normal heavyweight cable of high quality, and in fact this was felt to sound slightly 'sweeter' and more subtle than the rather 'forced' Sigma sound. However, although the sound did appear to have potential in terms of clarity, it was not liked particularly well on the listening tests (blind tests done with RS cable after hands on comparison with *Sigma*). Criticisms were directed at a certain 'brightness', which worsened when driven loudly, plus a rather ill-defined bass. Overall the promise of this design was marred by a feeling that the sound was insufficiently integrated, and overall results tended to be a little below average.

Conclusions

This is an interesting design in many ways, but it is quite expensive, presumably because it is rather elaborate. Our listening tests did not really confirm that the extra *Sigma* facility was really necessary, so this does not seem to be a particularly competitive model even though some results were promising.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 91/95/95 Watts
 o/p level ref 2.83V=0dB. 19.6/19.8/19.8dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 106/110/53 Watts
 o/p level ref 2.83V=0dB. 20/17.4/11.2dB
 Single cycle power 1kHz, 8/4/2 ohms. 144/120/76 Watts
 o/p level ref 2.83V=0dB. 21.6/17.8/13dB
 Dynamic headroom (IHF) 0.85dB

Bandwidth (-3dB below half power)

Disc in - power out DC Hz - 78kHz
 Disc in - tape out DC Hz - >200kHz
 Aux in - power out DC Hz - 70kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.	Phono	3.0	33/49/100k	192
Disc MC.	Phono	0.28	130	
Tuner/Aux.	Phono	170	40k	
Tape A & B.	Phono	170	42k	
Tape B.	DIN	170	2.0M	

Disc overload MM. 40dB
 Disc overload MC. 40dB

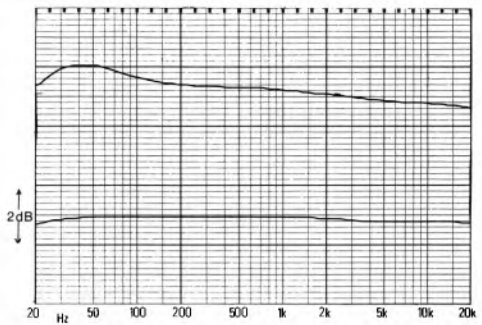
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape A & B.	Phono	300	325
Tape B.	DIN	150	100k
Headphones (8 ohms).		40	
(2 kohms)		2.3V	

Noise (ref 1 Watt, 8 ohms)

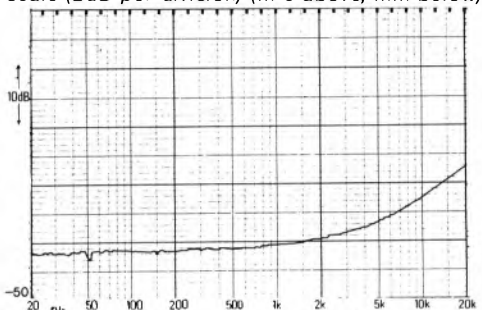
Zero volume. -90dB
 Aux ref volume -81dB
 MM disc ref volume -79dB
 MC disc ref volume -78dB

Other

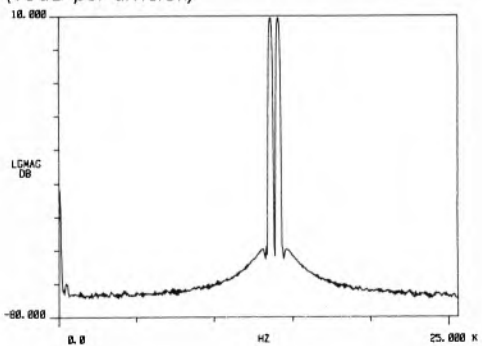
Damping factor (see text) 76/614
 THD performance excellent
 Hum performance below average
 Dimensions (W x D x H) 17½(44) x 15(38) x 5(13) ins(cms)
 Weight. 23lbs
 Typical purchase price £310



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Trio KA1000

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



Presentation, facilities etc

This top model of Trio's *Sigma* threesome comes in two boxes to preserve the 'non-magnetic amplifier' concept which they introduced a couple of years ago. To this end the power supply is separately housed, the object being to keep the audio amplification as free from ferrous metals and magnetic fields as possible. The main feature is the *Sigma* drive concept, which enables the loudspeaker wires to be included in the amplifier's feedback loop, thereby extending this distortion cancelling technique as far as the speaker terminals.

Presentation is very attractive, with the major functions on the top part of the front panel, and the less important ones partly hidden under a smoked glass panel. Unusually the volume control is operated by an illuminated touch fader panel, whereupon it rises or falls to and from a level pre-determined by a slider. This runs alongside some indifferently labelled pushbars which control the major inputs, with power on/off the final outside control. Under the flap there are plenty of knobs and tiny pushbuttons, and a great deal of fine black-on-silver writing which is difficult to read in its recessed location. Facilities are more or less the same as those on the 900, with the addition of a balance control defeat switch (!), so two pushbars switch disc 1/2 and mm/m-c, and tiny buttons mode, subsonic filter, loudness and balance defeat. Two rotaries control balance and record out selection, then three pushbuttons and two rotaries adjust tone, with defeat and turnover switching. Finally a rotary switches loudspeakers and *Sigma*. The back panel offers three mm disc impedance options (33/47/100 kohm) and is

phono throughout but with DIN duplication on tape B.

Lab performance

This is quite a powerful amplifier at 128 watts per channel, offering a slight improvement over the 900 and showing a rather similar delivery pattern. Once again there was close similarity between single and dual drive channel, but again drive was fairly restricted into low impedances, with a 'soft-clipping' effect into 2ohms. So while overload is not unpleasant with this design, higher output impedance speakers are to be preferred.

Bandwidths show no permanent restrictions at low frequencies (rather the reverse, as a matter of philosophy), but the disc input is quite sensibly curtailed at 60kHz. The RIAA curve shows the same falling trend on the m-c input (± 1 dB) as did the 900, although the mm input is very flat; subjectively this may be unfortunate because m-c cartridges tend to sound 'firmer' in the bass than mm types in any case. DC offsets measured +69/+99mV, which is higher than we would have liked. Though no specific IM products are visible on the spectrum, the 'noise modulation effect' is quite marked. Noise figures are generally fine, leaving a little room for improvement on m-c input, while harmonic distortion and hum were very good. The low disc input capacitance facilities optimisation of moving magnet cartridges, though we would have preferred to have seen variable capacitance rather than the variable impedance offered. Input and output parameters are fine.

Listening impressions

Plenty of opportunity for comparison is offered by the *Sigma* function, and with the supplied (4m) cable *Sigma* certainly offered an improvement, particularly in terms of stereo accuracy and general 'tautness'. However when we compared good heavy duty cable (10m RS 56 strand) used without *Sigma*, with the provided cable used with *Sigma* we preferred the former slightly overall – there seemed to be a little less 'brightness' and a generally marginally sweeter overall balance. Ignoring *Sigma* then the amplifier came out a little above average overall, with some complaints of 'bass heaviness' (frequency response?). Generally balance was quite good apart from this, and the sound considered clear, 'clean', with good stereo, if lacking a little in dynamics.

Conclusions

This is a very competent design, but one which is perhaps a little over-elaborate. The *Sigma* drive system does work, but would appear to offer little if any advantage over high quality heavy cable. The extra elaboration of the non-magnetic system is also perhaps questionable, because although this amplifier was quite well received, it did not appear to sound *that* exceptional. A sound enough performer, but no particular bargain.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz

8 ohms, 0.1% dist. 126/128/128 Watts

o/p level ref 2.83V=0dB. 21/21.1/21.1 dB

Single channel 8/4/2 ohms

1kHz, 0.1% dist. 128/121/77 Watts

o/p level ref 2.83V=0dB. 21.1/17.8/12.8dB

Single cycle power 1kHz, 8/4/2 ohms. 169/112/77 Watts

o/p level ref 2.83V=0dB. 22.3/17.5/12.8dB

Bandwidth (-3dB below half power)

Disc in - power out. DC Hz - 60kHz

Disc in - tape out. 2 Hz - 230kHz

Aux in - power out. DC Hz - 114kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.	Phono	2.6	34/50/100k	182
Disc MC.	Phono	0.24	133	
Tuner/Aux.	Phono	160	52k	
Tape 1 & 2.	Phono	160	54k	
Tape 2.	DIN	160	52k	

Disc MM. Phono 2.6 34/50/100k 182

Disc MC. Phono 0.24 133

Tuner/Aux. Phono 160 52k

Tape 1 & 2. Phono 160 54k

Tape 2. DIN 160 52k

Disc overload MM. 40dB

Disc overload MC. 40dB

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape.	Phono	300	326
Tape.	DIN	58	99k

Tape. Phono 300 326

Tape. DIN 58 99k

Headphones (8 ohms) not taken

(2 kohms) taken

Noise (ref 1 Watt, 8 ohms)

Zero volume. -90dB

Aux ref volume. -80dB

MM disc ref volume. -78dB

MC disc ref volume. -73dB

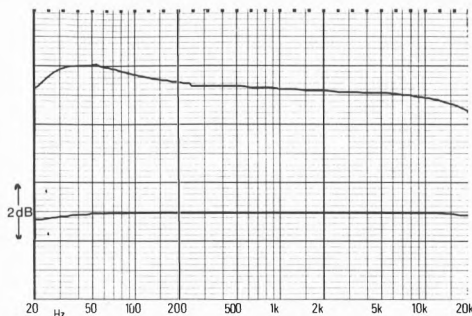
Other

Damping factor. 87/860

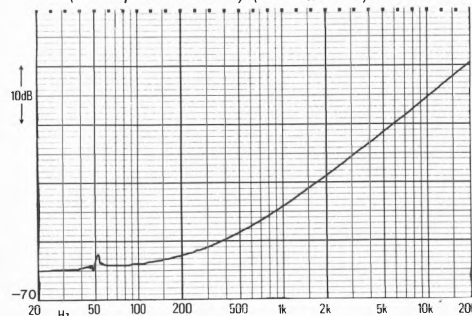
THD performance. very good

Hum performance. excellent

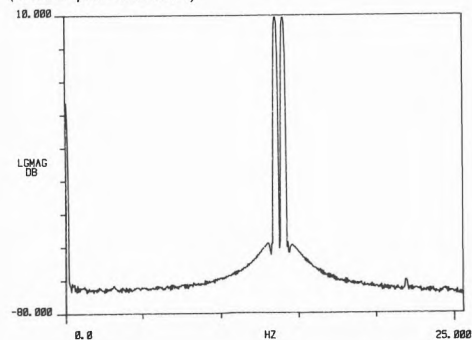
Typical purchase price. £540



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Yamaha A560

Natural Sound Systems Ltd, 10 Byron Road, Wealdstone, Harrow, Middx. HA3 7TL. Tel 01-863 8622



Presentation, facilities etc

This budget model from Yamaha doesn't give much away to its bigger brothers in standard of finish, and the economies have been well disguised. The silver fascia with satin-finished knobs are more or less standard at the cheaper end of the market, likewise the fairly wide range of facilities that this model sports.

The large knob is a smooth action volume control, next to which rotary switches select inputs served by a large illuminated display, and 'record out' switching and cross-dubbing so that a tape recorder may be operated from the amplifier independently of the signal source actually being listened to. Four smaller rotary knobs give balance, variable loudness, bass, and treble, while pushbuttons select speakers, power, m-c/mm disc, and high filter, the latter button looking like something of an afterthought, though the power switch is nicely distinguished. Phono sockets are used exclusively on the back panel.

Lab performance

This model packs quite a punch, with around 80 watts a channel both channels driven, though the increase measured with single channel drive is rather large, indicative of a rather 'loose' power supply. The delivery is quite well maintained into both 4 and 2ohms, particularly under 'single cycle' transient conditions, so this amplifier is most unlikely to have any problems driving any loudspeakers, though as usual a little care should be taken if intending to use two pairs simultaneously and loudly.

Bandwidths show some slight curtailment at low frequencies, but little apparent attempt to control things at high frequencies. Inputs and

outputs appear to have been sensibly chosen for general compatibility, though the m-c disc input impedance is rather lower than the more usual 66-100ohms. The RIAA curves were quite good, with just a slight bass rise before rolloff at low frequencies on moving-coil. Distortion was excellent, usually below noise, while the noise figures themselves were pretty good except on the m-c input, which was rather average. Hum performance was excellent, and crosstalk likewise, while the IM distortion spectrum shows a slight difference component only, though the 'noise modulation effect' is rather more pronounced than many. Cartridge input overload margins were adequate, though not up to the best performers. All-in-all, there is very little to cause concern.

Listening impressions

Sadly the promising technical performance was not reflected in the attitudes of the panelists, who were fairly consistent in disliking the sound with this amplifier. Main point of criticism was the bass, which was considered 'loose' and lacking in detail and definition, despite sounding quite powerful. The high frequencies were less negatively received, though still regarded as 'artificial' by some, while the general sound was said to lack 'bite', separation and 'focus'. However there was some dissent, so it is probably worth trying to check the sound out for oneself if this amplifier's (many) other strengths appeal.

Conclusions

This is a difficult amplifier to sum up, because the technical performance and power available are very good for the price, while the features have

the added benefit of a moving-coil input. Indeed it is only really the (fallible) subjective testing that let it down, so we advise taking notice of this competitive model, and trying to assess the sound quality for oneself, preferably in the intended system.

GENERAL DATA

Power stage

Both channels 20 Hz/1 kHz/20kHz
 8 ohms, 0.1% dist 78/83/78 Watts
 o/p level ref 2.83V=0dB 18.9/19.2/18.9dB

Single channel 8/4/2 ohms
 1kHz, 0.1% dist 98/144/172 Watts
 o/p level ref 2.83V=0dB 19.9/18.6/16.4dB

Single cycle power 1kHz, 8/4/2 ohms 126/215/324 Watts
 o/p level ref 2.83V=0dB 21/20.3/19dB

Dynamic headroom (IHF) 0.9dB

Bandwidth (-3dB below half power)

Disc in - power out 8 Hz - 129kHz

Disc in - tape out 12 Hz - >200kHz

Aux in - power out 7 Hz - 79kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	3.0	46k	180
Disc MC.....	Phono	0.2	10	
Tuner/Aux.....	Phono	145	64k	
Tape 1.....	Phono	145	64k	
Tape 2.....	Phono	145	64k	

Disc MM..... Phono 3.0 46k 180

Disc MC..... Phono 0.2 10

Tuner/Aux..... Phono 145 64k

Tape 1..... Phono 145 64k

Tape 2..... Phono 145 64k

Disc overload MM..... 33dB

Disc overload MC..... 33dB

Outputs (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	300	500
Tape 2.....	Phono	300	500

Tape 1..... Phono 300 500

Tape 2..... Phono 300 500

Headphones (8 ohms)..... 120

(2 kohms)..... 2.6V

Noise (ref 1 Watt, 8 ohms)

Zero volume..... -83dB

Aux ref volume..... -83dB

MM disc ref volume..... -80dB

MC disc ref volume..... -74dB

Other

Damping factor 59

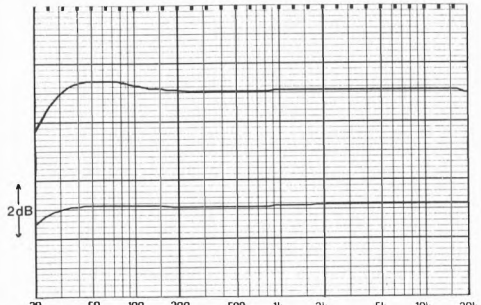
THD performance excellent

Hum performance excellent

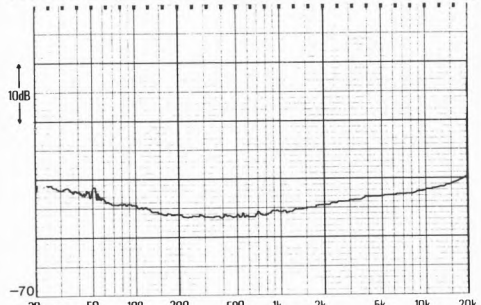
Dimensions (W x D x H) 17(43) x 12(30) x 4½(11) ins (cms)

Weight 15lbs

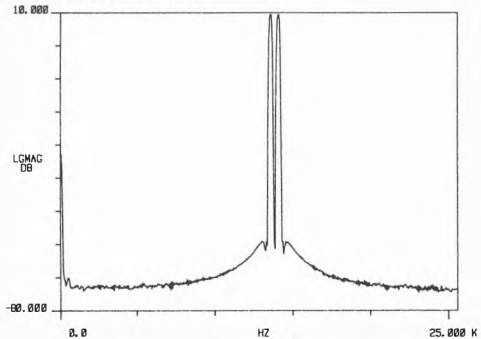
Typical purchase price..... £99



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Yamaha A960

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow, Middx. HA3 7TL. Tel 01-863 8622



Presentation, facilities etc

Clearly from the same family as the 560, this slightly larger model has a similarly high standard of finish, but quite a number of extra facilities, which give the front panel a rather cluttered appearance. In fact the variety of different knobs, buttons and sliders is so great and arranged in such a fashion that this cannot be considered an elegant design in the Yamaha tradition; it is far too 'bitty' looking, even though the organisation is logical enough.

The single rotary naturally enough controls volume, while two horizontal sliders adjust balance and give variable degrees of 'loudness compensation'. A further horizontal slider is a variation on the power meter theme, though more accurately it would be described as a user-adjustable peak level indicator. The idea is that one sets this to the (peak) power handling of one's loudspeakers, and if it starts to blink repeatedly then you are taking a chance and should turn things down a little. Tone is adjusted by means of two vertical sliders, augmented by small pushbuttons to select turnover frequency. Other tiny push-buttons select loudspeakers, subsonic and high filters, and mono/stereo. Three rotary switches select inputs, phono matching circuitry (m-c/mm options LED indicated), and the signals sent to tape recorders. Finally three chunky illuminated perspex switches operate power, total bypass, and disc over-ride: pushing in these three allows the amplifier to be used simply as a volume control for a disc source, avoiding all the intermediate complexities. Rear panel socketry is phono throughout.

Lab performance

Although this is quite an expensive amplifier, it is

also exceedingly powerful, giving over 130 watts per channel. Very little difference between single and dual channel drive shows good electrical supply control. One point of criticism which might have been a sample fault was that the transformer produced quite a lot of mechanical hum with modest power demands, so it was either loose inside or perhaps under-rated. Delivery appears restricted into low impedances, due to current limiting, but the 'single cycle' transient conditions suggest that short-term demands will pose no problems. A little caution is perhaps necessary if choosing two sets of speakers for simultaneous use at high levels.

Bandwidths are rather on the wide side, though the RIAA equalisation is quite flat. Input capacitance is really too high for optimisation with a number of cartridge types: the variable impedance can assist fine tuning, but variable capacitance is much better suited to flattening the very high frequency perturbations in modern moving magnet cartridges. Distortion products were generally below the noise thresholds, and these were about average with a little room for improvement on the m-c input. Some quite obvious low level sidebands can be seen on the IM spectrum, but one should also notice that the 'noise modulation effect' is almost absent. In all other respects the technical performance is good, with sensibly chosen inputs and outputs.

Listening impressions

A rather mixed bag of results on the listening tests give the 960 an overall rating about average, though not terribly consistently. The overall impression was that this was another amplifier which changed its character somewhat with level, sounding quite pleasant when used fairly

quietly, but becoming progressively less pleasant at higher levels. A slight 'coarseness' and 'thickening' was described in the midrange, with 'tizzy' treble and 'loose' bass effects coming into the picture at higher levels. However there was some dissent over this model, so we advise people to confirm or deny our findings for themselves.

Conclusions

This amplifier gave rather mixed results overall. Fine power output and a quite versatile pre-amp is in its favour (marred by disc input capacitance but assisted by bypass circuitry), but mixed listening results, mechanical hum, and rather muddled styling mute our enthusiasm somewhat.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist. 131/135/131 Watts
 o/p level ref 2.83V=0dB. 21.1/21.3/21.1dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist. 131/114/66 Watts
 o/p level ref 2.83V=0dB. 21.1/17.5/12.2dB
 Single cycle power 1kHz, 8/4/2 ohms ... 141/242/342 Watts
 o/p level ref 2.83V=0dB. 21.4/20.8/19.3dB
 Dynamic headroom (IHF) 0.23dB

Bandwidth (-3dB below half power)

Disc in - power out 6Hz - 90kHz
 Disc in - tape out 3Hz - 170kHz
 Aux in - power out DC Hz - 63kHz

Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.5	34/47/96k	280
Disc MC.....	Phono	0.16	100	
Tuner/Aux.....	Phono	154	60k	
Tape 1.....	Phono	154	60k	
Tape 2.....	Phono	154	60k	

Disc overload MM..... 39dB
 Disc overload MC..... 39dB

Outputs (5.0mV disc input)

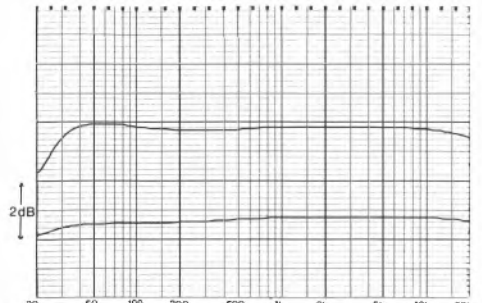
	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	300	550
Tape 2.....	Phono	300	550
Headphones (8 ohms).....		80	
(2 kohms).....		2.5V	

Noise (ref 1 Watt, 8 ohms)

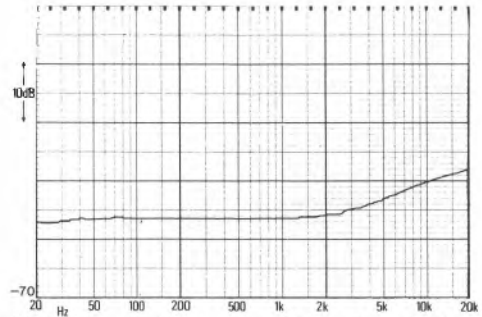
Zero volume -80dB
 Aux ref volume -80dB
 MM disc ref volume -78dB
 MC disc ref volume -73dB

Other

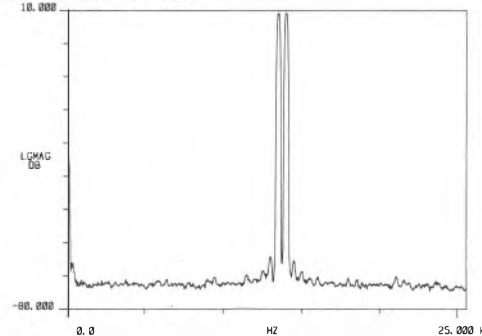
Damping factor 52
 THD performance excellent
 Hum performance average
 Dimensions (W x D x H) ... 17(43) x 14(36) x 5(13) ins(cms)
 Weight 23lbs
 Typical purchase price £260



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear, vert. range 90dB)

Yamaha C6/M4

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow, Middx. HA3 7TL Tel 01-863 8622



Presentation, facilities etc

This *macho* combination from Yamaha is not cheap, but it gives a lot of amplifier for the money, and is one of the heaviest in the book. The power amplifier is the most striking, with its metal grillework top section reminiscent of the days of valves, and its weight reinforcing this impression (no glow, however). What is a little irritating is that the units cannot be sited easily with the power amplifier sitting on top (to help ventilation) and with the fascias flush, because the power amplifier is much the deeper unit, with its feet missing the rear of the pre-amplifier. Furthermore the fascia of the pre-amplifier slightly overhangs the case, which suggests console mounting.

Both units are smartly finished in matt black with large square illuminated pushbuttons for power, speaker switching (on power amplifier), and -20dB muting (which will usefully extend the rather cramped range of the smooth-action volume control at its low end). Complicated parametric tone control circuitry makes the pre-amp fascia quite busy, but apparently has good flexibility, allowing a single 'notch' or 'bump' of adjustable size and 'sharpness' (Q) to be placed in each band (31.5–800Hz, 500–12.5kHz). When we examined the responses on a scope, we were disappointed to find that a sharp ' Q ' could not really be obtained. This circuitry may be routed to tape recorders, power amplifier, or defeated via a rotary switch, the parametric requiring four small rotaries and two sliders. The final small rotary knob controls balance, while two rotary switches select main inputs, and 'record send'. Finally, a rather fiddly row of small black-on-black pushbuttons select high and low filters, pre-out on/off, disc 1/2, and mm/m-c.

Mindful of the elaborate controls on the integrated amplifiers, the absence of even a loudness button is a surprise.

Lab performance

Ample power is delivered by this combination into 8ohms, and this is also very well maintained into low impedances (near exemplary results on the single cycle, where the amplifier behaves very much as the ideal voltage source). One could perhaps niggle slightly over the differences between single and dual channel drive and between continuous and single cycle conditions, which together suggest a slight lack of control. But the performance is really very fine, giving no loudspeaker matching worries.

Bandwidths show sensible curtailment of the disc input, if rather sporadic efforts elsewhere. The RIAA curves are nearly flat, but the disc input capacitance on the moving magnet input is on the high side at 266pF, which will make optimisation with a number of such cartridges impossible. Distortion is very low, but noise figures are quite exceptional, so some (generally third) harmonic products could be seen. Similarly the IM distortion spectrum shows some low level sidebands, but the 'noise modulation effect' is effectively absent. Hum and crosstalk likewise gave excellent results, so this is an amplifier with an outstanding overall technical performance.

Listening impressions

As if to confound the fine technical performance, the results of listening tests were rather ordinary, and not particularly consistent, rating overall about average. The sound was considered clean and powerful, but somewhat untidy and tending

to sound aggressive when loud, while a certain 'brittleness' in the sound was also mentioned. Criticism was made of some midrange muddling and less than 'firm' bass performance. However our results were not very consistent, so maybe the reader should try and check this for himself.

Conclusions

This is a difficult amplifier to summarise. It is beautifully finished and attractively presented, though not without the odd quirk. Technical performance was excellent throughout, with substantial power delivery into any load, compromised only by a moving magnet input capacitance that will exclude a few cartridge models. Listening tests gave inconsistent and rather too average results for confident recommendation at the fairly high price, but we would advise interested prospective purchasers to try to deny or confirm these for themselves.

GENERAL DATA

Power stage

Both channels 20Hz/1kHz/20kHz
 8 ohms, 0.1% dist 128/136/132 Watts
 o/p level ref 2.83V=0dB 21/21.3/21 dB
 Single channel 8/4/2 ohms
 1kHz, 0.1% dist 149/248/343 Watts
 o/p level ref 2.83V=0dB 21.5/20.9/19.5 dB
 Single cycle power 1 kHz, 8/4/2 ohms 178/312/600 Watts
 o/p level ref 2.83V=0dB 22.5/22/21.7 dB
 Dynamic headroom (IHF) 0.54dB

Bandwidth (-3dB below half power)

Disc in - power out 9Hz - 57kHz
 Disc in - pre out 7Hz - 64kHz
 Disc in - tape out 7Hz - 235kHz
 Aux in - power out 7Hz - 128kHz
 Power amp only 6/DC Hz - 170kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	1.45	46k	266
Disc MC.....	Phono	0.072	52	
Tuner/Aux.....	Phono	95	43k	
Tape 1.....	Phono	95	43k	
Tape 2.....	Phono	95	43k	
Power amp....	Phono	1.15V	25k	

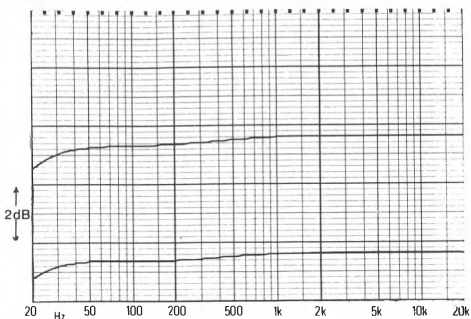
Disc overload MM..... 45 dB
 Disc overload MC..... 43 dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	350	215
Tape 2.....	Phono	350	215
Headphones (8 ohms).....		30	
(2 kohms).....		660	
Pre-amp out (max vol).....	Phono	13V	925

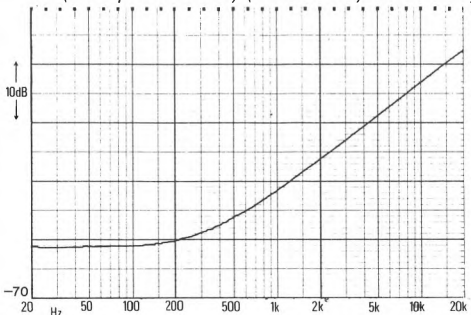
Noise (ref 1 Watt, 8 ohms)
 Zero volume -98dB
 Aux ref volume -94dB
 MM disc ref volume -85dB
 MC disc ref volume -85dB

Other

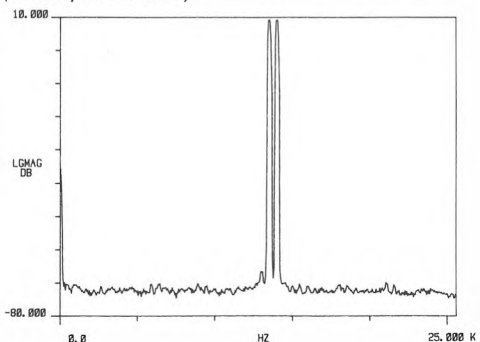
Damping factor 300
 THD performance excellent
 Hum performance excellent
 Dimensions (W x D x H) 17(44) x 15(38) x 10(25) ins/cms
 Weight 53lbs
 Typical purchase price £160 + £250



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

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This is now the third successive year that the authors have collaborated on a major *Choice* project based around amplification (last year amplifiers, tuners and receivers were combined). So not only do we have an unusually detailed and comprehensive overview of the current market place, but some degree of historical perspective as well. In many ways this is even more interesting than the comparison and examination of current product.

The most obvious change has been that power has become significantly cheaper, paradoxically particularly amongst the cheaper amplifiers. However the delivery of the power has changed somewhat, and it appears that designs today are more closely optimised to drive the (mythical) 8 ohm load than they used to be. This means that they are a little more fussy about speakers that they will drive happily, so some 'universality' appears to have been sacrificed presumably in order to be able to quote 8 ohm power specifications which are bigger than the opposition for the price.

It continues to be a philosophical debate whether the amplifier should be cost-effectively engineered to produce maximum level/power into 6-8 ohms, or whether it should try to behave like the ideal 'voltage source', where current availability is effectively unrestricted. In the first book, the contrast was drawn between 'voltage source' type designs like the Meridian 105 and Sansui 919, and much cheaper models capable of the same 8 ohm rating, like the Quad 405 and Sony designs, which acted much more like current sources. And it is still our experience that the 'voltage source' types tend to sound better, even though it would appear to be impossible to carry out a valid scientific comparison.

So we tend to regard the power trends as rather negative. For an amplifier designed to produce a modest 30 or 40 watts for a low selling price there is some justification in optimising around 6-8 ohms. But for a prestige model with heavyweight power supply it seems foolish to restrict current demands too early. Though loudspeakers may measure 6-8 ohms or so under 'steady state' sine wave drive when everything has settled down, there is considerable doubt that the constant stopping and starting of a music signal bears any resemblance to the steady state condition. Suggestions that the amplifier should be designed to try to drive 'the impossible load', or at any rate not get too upset by such a prospect, remain persuasive.

Another rather unfortunate trend has been a significant overall increase in the capacitance

presented to the cartridge by the pre-amplifier at the moving magnet input. The ideal value for matching any of the cartridges around is probably 100-150pF, because this allows for an extra 70-150pF contribution from the turntable/arm lead-out wires, and those who wish to use cartridges which are designed for high capacitance loading can easily add a further 150pF or whatever by means of an external adaptor. Many of today's new amplifiers have input capacitances of 200, 300 or even 400pF, which compromises their universal application.

It is perhaps reasonable to argue that by now cartridge manufacturers should be making cartridges which are not affected by their loading, and it can also be argued that a high capacitance on the disc input is a useful technique for protecting the amplifier from receiving ultrasonic garbage that does nothing but harm. But we are not living in an ideal world, so amplifiers should at least have the capability of matching most of today's cartridges, and a switch to do this is a minor cost compared to the various fatuous gimmicks that tend to be fitted to even the cheapest of today's amplifiers.

On this subject, it was a little exasperating to find that some designs which offered adjustable capacitance were inaccurately calibrated, the indication being that they had not taken account of the inherent capacitance of the input as well as the add-on switchable value. The Pioneers managed to considerably reduce the usefulness of this facility, while the Elite fell far behind the exemplary results for the Lentek in this respect.

Unfortunately commercial amplifier design is as much a matter of fashion than of sound engineering. There are indications that fashion trends are moving in the right general direction, but it is also obvious that this has more to do with demand than with design intention. In the first issue meaningless power meters were starting to appear on their latest models; last year in the *Receivers* issue it was difficult to find an amplifier without them, and now thankfully they are beginning to disappear again, though still hanging on grimly at the low end of the market.

We must admit that we find it somewhat depressing that there is (presumably?) still insufficient international demand to warrant a major consumer electronics manufacturer producing a truly audiophile-oriented integrated amplifier for, say, £100. The NAD 3020 gets quite close in a number of respects of course, but it is still overburdened with unnecessary complexities, and its big brother the 3140 was something if a disappointment, with facilities appearing to have

CONCLUSIONS

taken precedence over the pleasant overall balance of its cheaper stablemate. The Rotel 520 prototype which we examined has some potential in this direction, though our sample was really too early for any definite conclusions to be reached. At this stage it does at least seem to be pointed in the right direction.

One welcome trend is that there are now rather more amplifiers around where one can bypass the various fripperies, making them much simpler to use and probably nicer to listen to. However specmanship still has a habit of taking over, so defeating the filters etc. often means that bandwidths become too wide for the inherent capabilities of the design. It is still very much our experience that wide bandwidth is a dangerous thing even in the best designs, and that some inherent bandwidth control could enhance most of the designs where it has not been fitted.

Our experiences in the listening tests force us to conclude that internal close control within the amplifier is still one of the most important determinants of good sound quality. Therefore, if it is necessary to offer super-wide bandwidths for marketing reasons, then these should be the option, rather than *vice-versa*. The NAD 3020 is a good example of how this is done, with its special 'lab in' power amplifier socket permitting wide bandwidths for those who wish to experiment, whereas in its 'normal use' state the frequency extremes are quite carefully controlled, to avoid internal stress as much as possible.

Though it appears to be a small point, there is plenty of evidence to suggest that switching in the power signal path can only harm the overall sound quality. Yet it seems to be a commercial requirement to provide two sets of speakers plus headphones, all switch-controlled. The option used by A&R to have their cake and eat it too is particularly ingenious, with one set of terminals being connected without switching, but with an alternative set which is routed via the headphone socket's muting switch. There is surely no reason why this idea could not be extended further, yet speaker switching still appears on nearly all the cheaper models in the book, and on many more expensive ones besides.

The most serious aspect of the 'fashion angle' on amplifier design appears to be the haste with which a model is rushed from original design to development and thence production in a very short space of time, so that it remains as 'up to date' in appearance for as long as possible. This seems to have two repercussions. First, most of the products have the appearance of being designed 'by committee', in that they lack a

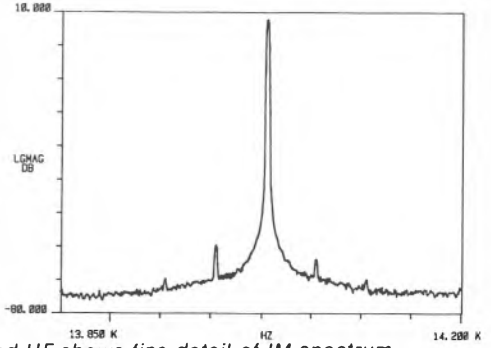
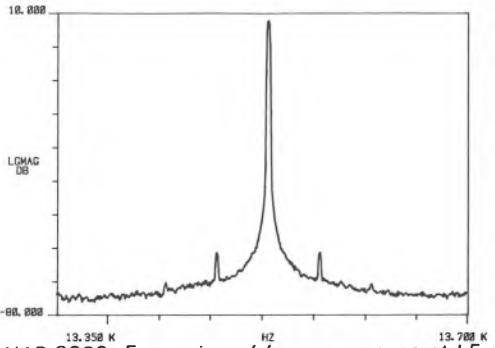
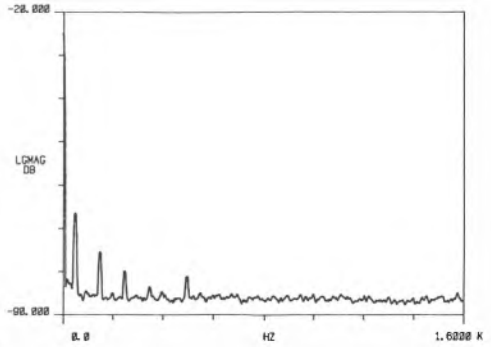
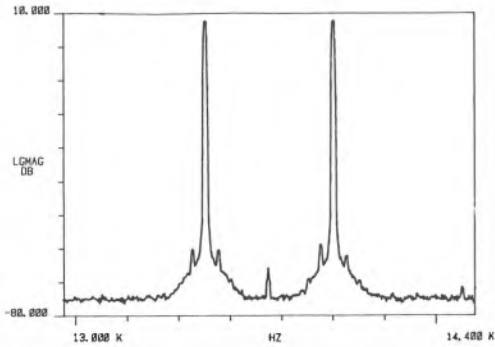
convincing totality and harmony, and tend to be somewhat unbalanced as a result. (One could contrast this not only with single designer audiophile-oriented products, but also with successful mass-market turntables like the B&O models and the Technics SL series: both have a unity which makes them stand out, and both have or will be around for a long time as a result.) Secondly, there is clearly little time for serious development work on many new products, yet a properly developed if superficially unfashionable product is far more likely to give better overall balance and hence sound quality. For example, we have been familiar with the A&R A60 since the original prototype five years ago. It is not a 'great' amplifier even now, but it has shown steady and audible improvements on a continuous basis over the years, and may certainly now be regarded as a 'classic' which sets a very high standard in its price class.

One could argue that a product should be 'right' from the drawing board, but no-one is infallible and even the best original concepts benefit from some development work from time to time. And the difficulty with the mainstream consumer electronics products is that the dictates of fashion say 'all change' each year; last year's models are substantially ditched, to be replaced by significantly different designs which have no chance to have their 'rough edges' knocked off them before they are slung into the marketplace.

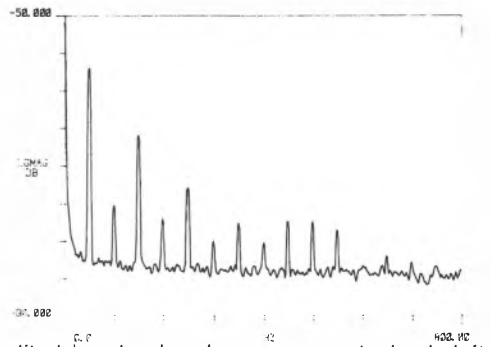
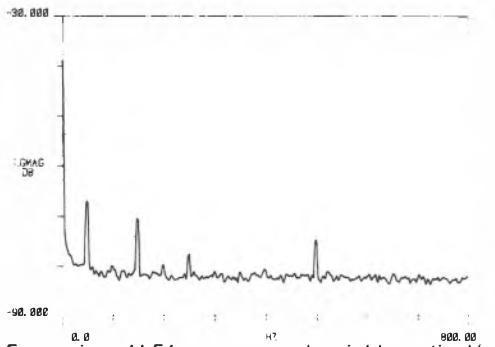
The test procedures have not changed very dramatically, and we are still looking for the elusive 'super test' which correlates measurement and listening test results accurately. This time we have presented the disc input frequency responses more accurately on an expanded vertical scale, which shows that quite a number of amplifiers have weak spots here, and also goes somewhat towards helping explain some of the subjective findings.

By and large the moving magnet inputs showed quite flat responses, though often with sufficient deviation to result in audible coloration. (While it is true to say that amplifier frequency responses are better than those measured on loudspeakers and cartridges, when there is an error it tends to result in a whole band being elevated or depressed, which will permanently affect tonal balance somewhat.) More disturbing perhaps were the anomalies found on some of the moving-coil inputs which are now being increasingly fitted (and welcomed on principle by us) on cheaper amplifiers. Often however the performance of the input is too poor to justify its inclusion, and it has clearly been cynically slung

CONCLUSIONS



NAD 3020. Expansion of frequency axes at LF and HF shows fine detail of IM spectrum.



Expansion of LF frequency and variable vertical (amplitude) scales show hum components clearly: left, B&K generator alone; right, Sansui A9.

CONCLUSIONS

in as an afterthought in the hope of boosting sales, rather than being treated seriously as an essential part of the amplifier.

Another new test which we have included this time is a modification of one first attempted in the *Receivers* book. Regrettably it has still left us with a certain amount of egg fouling the beard. The two-tone intermodulation test should be quite a powerful discriminator, though it is still largely a static rather than dynamic test situation. In an attempt to increase its usefulness we close up the two tones to a difference of 500Hz, while examining the complete spectrum in one go from 0–25kHz. The result has been that the discrimination of the digital spectrum analyser was not fine enough to give really useful results across such a wide bandwidth. The spectrograms still have meaning, but the analysis can only be on a rather crude level, and we were unfortunately unable to undertake finer discrimination tests on the entire test group.

The result is that instead of nice specific sidebands either side of (and between) the test tones, plus the difference frequency component of 500Hz (and hum products), in many cases we have a 'noise modulation effect', whereby the noise floor appears to rise either side of the test tones. In fact this is because the analyser works by sampling and averaging, so that closely spaced sidebands (on a compressed horizontal scale) will be averaged out into the 'rising noise' effect.

We cannot completely explain what is happening in such cases, but have included some more detailed spectrograms which suggest that where there is a noise modulation effect, it does hide some sidebands, even though these cannot be specifically identified. However there are a number of oddities that we cannot fully explain yet, and which presumably relate to the sampling system and the way it works. So at the present time we feel that the results of these tests should not be subjected to rigorous analysis or form the basis of firm value judgements. They are interesting, but we cannot yet be entirely sure of their full implications.

One distinct worry was the number of actual failures or faults which we encountered while doing the tests. No fewer than eleven out of fifty five – a disturbing twenty percent – showed some problem or another. Two of these were almost certainly down to us, but the others remain as a question mark of reliability standards in general. Are we seeing falling standards of quality control as market competitiveness continues to sharpen? Frankly I think we were just unlucky, and DW reports that 1–2% is much nearer his shop

experience. And it was interesting to note that the failures were spread quite evenly across the board, not concentrating on a particular sector of the market.

Ignoring the two for which we think we were responsible, the 'list of embarrassment' included the following items: Aurex *SB66*, pre-amplifier fault, not replaced/re-submitted in time for inclusion (so no *Clean Drive* to examine); Amcron *D150*, blow up during half power bandwidth testing – a stressful situation, but this design is supposed to be fully protected – not replaced owing to detail model/design changes; *HK750*, output device stopped working; Rotel *RC1010*, intermittent pre-amplifier switch operation; Yamaha *A560*, high crossover distortion, returned and re-submitted; PS Audio, mm disc input impedance switching incorrectly wired; Trio *KA1000*, power supply unit non-functioning on delivery; Electro, pre-amplifier intermittent dry joint (a tricky one for QC to have caught); Quantum, intermittent initial disfunction on pre-amplifier, seemed to rectify itself.

Going through the results carefully, it is surprising how few amplifiers approach a totally balanced result, and this above all seems to be the key to good subjective performance. So while one can criticise certain performance aspects in 'compromise' designs which sound good, their overall balance still seems to distinguish them from the run-of-the-mill. It is also noticeable that the more expensive designs, seemingly trying extra hard to prove their superiority over cheaper designs now that power outputs vary only a little, tend to go 'over the top' in some respect, and so upset the overall balance and subjective performance.

A subjectively good result seems to be attainable at any price level without resort to 'super technology', merely by following comparatively simple rules which are less concerned with the actual performance of the amplifier on specific parameters, but which have more to do with preventing the amplifier from being able to get itself upset no matter what is hung on the front or back.

Have amplifiers got better over the years we have done these tests? A little perhaps, but not a great deal. They have got cheaper in real terms, but the cheapest models which we included this time did tend to be a little marginal in hi-fi terms. It is fair to say that hi-fi amplifiers start at about £70, and that below this the compromises get rather severe, which is pretty much what we found 2–3 years ago (inflation notwithstanding).

At the more expensive end of the market prices do seem to have risen rather more amongst audiophile type equipment (though the heavy-

weight Japanese equipment was stayed remarkably competitive). However, in all honesty we cannot admit to having terribly impressive results from auditioning many of these, though as a group they did rate a little higher than the mainstream commercial designs. The difference was certainly slight enough to question the value for money of many of the more expensive designs, even when using ancillary equipment of the highest quality.

Overall it is fair to say that there has been comparatively little change in amplifier total performance over the last few years. There have been minor improvements in power outputs and distortion performance. But power delivery patterns have become a little more suspect, and disc input capacitances tend to have risen rather too high. Subjectively there has probably been a marginal overall improvement, but we feel that there is still plenty of room for this to continue. We hit a rather nasty crop of unreliability problems this time, which we fervently hope is not typical (and we don't believe is our fault, as we haven't changed the test procedures much and this hasn't happened before).

The important thing about an amplifier still seems to be its overall balance rather than exceptional performance in some particular area, and most of the models still show plenty of room for improvement here; this does not seem to be an aspect of design to which much importance is given.

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BEST BUYS & RECOMMENDATIONS

Deciding the Best Buys and Recommended models is always the hardest part of any *Choice* project, or to be more specific the really difficult part is actually drawing the dividing lines. To 'balance' an issue we might regard 10% of the models as falling into the Best Buy section, and perhaps the next 20% into the Recommended grouping. But on this occasion we have been much more restrictive. This is because the dividing lines fell quite clearly where they were. The Best Buys obviously distinguished themselves in sheer value for money terms, while the Recommended models also 'selected themselves' on a combination of competitiveness, auditioning and generally good overall balance. We have also included a listing of 'Worth Considering' models, where generally good results have been obtained, but where we lack sufficient confidence to 'flag' the corner, for one reason or another (often high price).

One of our toughest problems has been in coming to terms with the wide difference in price between 'mass market' and 'audiophile' products. As a group the latter are inclined to sound better than the former, but not perhaps by as much as one might expect, particularly as the ancillary equipment used for our listening tests is deliberately of the very highest quality in order not to compromise the performance of these models in any way. For this reason we have been very conservative in our recommendations on this class of product, preferring to place the better examples under 'Worth Considering' so as to invite the potential purchaser (with the help of his dealer) to convince himself of the value of the product in relation to the value that he places upon his pound notes.

BEST BUYS (in approximate ascending price order)

JVC AX1 (£72)

This is a smartly finished well-balanced design offering good compatibility on inputs and outputs, with very respectable listening test results for the price. Some criticism was directed at the bass sound quality, so auditioning prior to purchase is worthwhile.

NAD 3020 (£90)

Firmly established now as THE budget-priced amplifier, there are slight grounds for technical criticism (some RIAA error), but listening test results still give significantly above average ratings to this low-priced model.

Technics SU-V3 (£120)

Fine technical performance and an excellent standard of finish, if a trifle on the gimmicky side, this unit returned consistently above average listening test results, and showed evidence of careful cost-effective engineering. Power output is quite generous.

Technics SU-V7 (£190)

Good overall technical performance, nicely chosen facilities, and smart but discreet presentation make this model very competitive. Power is quite generous, and sound quality ratings were consistently above average, though with a slightly 'thin' character.

A&R A60 (£198) (*HA10* m-c booster £48)

Though some aspects of the measured performance appear to fall a little behind Japanese competition, the sound quality invariably beats them, indicating excellent design balance. Now well established, with a good reliability record, input compatibility is very flexible, though some care should be taken in choosing loudspeakers as power is a little restricted.

RECOMMENDATIONS (in approximate ascending price order)

Sansui A9 (£135)

In many ways a rather frustrating and irritating design, the A9 nevertheless is very powerful for the price, and did reasonably well subjectively. High disc input capacitance and RIAA errors suggest that this unit should be auditioned prior to purchase.

Crimson 510/520 (£228)

Well above average subjective performance, and reasonably sound technical results (good input/output flexibility, but below average crosstalk and hum) dictate recommendation at the modest price. The slightly 'quirky' design is not too convenient to use (battery powered pre-amplifier).

Pioneer A8 (£330)

This rather brash heavyweight may be aimed at the flashing lights market, but gave an above average subjective performance, plus generally good technical results marred by mis-calibrated disc input capacitance switching; lots of power available.

Marantz PM5 (£399)

Rather brash and aggressive styling, but consistently above average subjective results and plenty of power, plus respectable overall technical performance place this model in the recommended class. Misgivings concern the

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BEST BUYS & RECOMMENDATIONS

high disc input capacitance, high heat output, and generally rather over-sophisticated complexity.

Tandberg 3002/3003 (£850)

Though this is an expensive combination, it did a great deal to justify the price, with a well balanced technical performance, fine finish, great power, and consistently well above average listening test findings, though we did not like the volume control very much.

WORTH CONSIDERING (in approximate ascending price order)

Marantz PM310 (£69)

A good effort for the price.

Yamaha 560 (£100)

Powerful, good facilities but sound disliked (check).

Denon PM510 (£144)

Some promise, but inconsistent audition.

Denon PM540 (£190)

As above, quite powerful.

NAD 3140 (£189)

As above, unusual features.

Yamaha A960 (£260)

Powerful, promising but inconsistent audition.

Rotel RB/RC1010 (£290)

As above.

Pioneer A7 (£270)

Flashy, lively sound, a little 'untidy'.

Quantum 207 (£280)

Powerful with promising audition.

Sugden A48II (£280)

Civilised sound and appearance.

Rogers A100 (£320)

As above.

Bryston 3B (£400)

Gutsy power amplifier, sharp edged case.

Hitachi HM/CA 7500 II (£390)

Clean heavyweight, a little 'leadon'.

JVC AX9 (£485 inc MC2E cartridge)

Clean heavyweight, a little 'chromium plated'.

Trio KA1000 (£530)

Rather flash, nice sound, powerful.

Yamaha C6/M4 (£540)

Genuine heavyweight, technically excellent, mixed audition.

Exposure (£570)

Nice sound but noisy.

Electro (£575)

Fine power amplifier (low power).

Meridian 101/105 (£700)

Fine power amplifier (high power).

PS Audio (£670)

Promising sound, rather expensive.

Lentek (£750)

Clean and neutral sound, very flexible.

Elite Townshend (£860)

Promising sound, rather expensive, a bit noisy.

Amcron SA2/DL2 (£3000)

Technical masterpiece, domestically an ergonomic embarrassment, silly price.

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OVERALL COMPARISON CHART

	POWER								DISC INPUT				
	Both ch. 8ohms				Single 8/4/2ohms				Single Cycle 8/4/2ohms				
	Moving Magnet								Cap	imp	sens	noise	Bandwidth
	Watts				dB ref 2.83V				pF	kohms	mV	-dB	Hz-kHz
Akai AMU 11	23	13.7	14.5	13.5	8.8	15.6	14.4	11.5	127	56	2.8	74	19-100
Akai AMU 33	49	16.9	17.6	16.3	13.5	18.6	17.9	15.4	130	48	3.8	78	10-60
Amcron SA2/DL2	289	24.6	24.7	23.9	22.7	25.4	25.2	23.2	30	48/97	var	86	2.5-113
A&R A60	44	16.4	17.1	13.8	6.6	18.1	16.8	8	120	48	2.0	78	20-50
Bryston 2B	68	18.4	18.4	17.0	14.6	19.3	18.2	17.3				(89)	3-90
Bryston 3B	139	21.4	21.4	20.8	16.9	22.1	21.7	21.2				(90)	3-82
Crimson 510/520	43	16.3	17.3	16.0	13.7	18.7	18.0	16.8	47	45	2.3	76	20-58
Denon PM510	64	18.0	18.1	17.1	14.5	18.1	17.3	15.5	280	50	2.6	82.5	6-35
Denon PM540	97	19.9	20.5	18.9	15.2	21.4	20.2	17.8	230	50	2.5	81	3-63
Denyo AU 3000M	39	15.9	16.9	14.8	11.3	17.6	16.4	13.1	220	45	2.4	74	9-50
Eagle AB500	58	17.6	18.4	16.4	10.5	19.3	17.0	14.0	127	55	2.9	82	22-110
Electro 25w	25	14.6	14.7	13.8	11.5	14.8	13.8	12.8	176	48	1.5	73	2-94
Electro 'bridged'	90	19.5	19.5	17.6	12.6	20.0	18.6	16.3	176	48	1.4	68	2-100
Elite Townshend	93	19.7	19.7	18.0	7.9	19.8	18.6	10.9	var	46	5.0	76	5-38
Exposure (III)/IV/VII	87	19.4	20.0	18.8	16.6	20.6	20.0	18.1	60	46	7.5	67	4-43
Harman Kardon HK750	64	18.0	18.5	17.0	14.9	19.3	18.9	17.5	150	42	2.8	78	0->200k
Hitachi HM/CA 7500II	104	20.1	20.2	17.1		21.0	17.2	11.0	156	var	2.8	82	2.5-137
JVC AX1	37	15.7	16.2	15.1	14.3	17.0	16.8	15.4	110	49	2.8	80	8-71
JVC AX4	78	18.9	19.6	15.0	8.8	20.4	14.8	8.8	337	46	2.8	80	5-152
JVC AX9	119	20.7	21.2	17.2	11.6	21.4	17.4	11.7	160	var	2.5	82	2->200
Lentek	72	18.6	18.7	18.3	11.9	19.4	18.9	protected	var	var	var	79	7-36
Marantz PM310	49	16.9	16.0	13.9	6.0	16.9	15.4	6.0	230	46	2.8	74	11-51
Marantz PM550DC	72	18.5	19.1	14.8	7.3	20.0	19.5	8.3	335	47	3.3	77	5-103
Marantz PM5	100	20	20.5	19.6	17.7	21.9	21.4	19.8	370	54	2.5	78	4-35
Meridian 103	48	16.9	17.6	16.0	13.9	18.5	18.0	14.6	various			84	3-45
Meridian 103D	57	17.6	17.6	16.4	13.9	18.5	18.0	14.6	various			84	3-45
Meridian 101/105	117	20.7	20.7	19.0	17.5	22.0	21.7	19.6	125			84	3-45
NAD 3020	35	15.4	16.4	15.6	14.0	17.2	16.8	15.8	121	47	3.0	80	16-41
NAD 3140	73	18.6	19.6	18.0	15.0	20.0	19.0	17.9	var	50		69	14-42
Onkyo A25	52	17.2	17.8	16.3	13.2	18.6	17.5	15.2	220	43	3.5	77	8-93
PS 2/III/LCC	40	15.9	17.0	16.1	15.0	17.2	16.7	15.7	var	var	2.2	74	3-63
Pioneer A7	86	19.3	19.9	18.7	15.1	20.6	20.0	15.3	213	51	2.5	82	5-86
Pioneer A8	108	20.3	21.0	19.9	15.7	21.6	20.6	15.9	var	50	2.3	81	3-78
Pioneer A9	147	21.7	22.2	19.2	13.0	22.4	18.9	13.3	var	51	2.5	82	3-87
Quantum 202	50	16.9	17.6	16.4	13.8	19.0	18.3	16.6	127	48	3.8	72	10-49
Quantum 205	145	21.6	21.6	20.2	17.8	23.2	22.8	21.0	127	48	3.8	72	10-49
Quantum 207	88	19.5	20.0	18.8	16.5	21.0	20.4	19.2	127	48	3.8	72	10-49
Reference Master	40	16.0	16.0	12.0	6.8	16.7	13.0	7.0	300	51	2.5	80	16-37
Revox B750	105	20.2	20.4	18.9	8.1	20.6	19.7	18.7	228	var	var	79	18-103
Rotel RB/RC 1010	144	21.5	22.2	21.3	15.9	22.8	22.4	18.7	400	47	2.3	83	4-129
Rotel RA520	36	15.6	16.2	15.1	13.4	16.6	16.0	15.4	22	50	1.7	76	22-24
Sansui A5	33	15.2	16.4	14.0	10.0	17.0	16.0	12.5	240	50	2.6	73	8-75
Sansui A7	58	17.6	18.5	17.0	13.9	19.7	19.0	16.0	320	47	2.6	77	7-46
Sansui A9	88	19.4	20.0	18.9	16.0	21.0	20.4	18.3	330	49	2.6	72	7-63
Sansui AU-D5	90	19.6	20.0	18.7		20.0	20.0		189	46	2.7	81	2-110
Sansui AU-D7	124	20.9	21.5	20.2		21.9	21.3		180	47	3.4	72	0-110
Sansui AU-D9	128	21.0	21.2	19.9		22.4	21.7		221	44	2.5	84	0-116
Tandberg 3002/3003	181	22.5	23.1	21.9	19.9	23.5	22.7	20.0	var	var	2.2	78	7-89
Technics SU-V3	55	17.4	18.1	16.8	14.5	18.9	18.3	16.9	160	47	2.5	80	10-70
Technics SU-V7	96	19.8	20.0	19.3		20.3	20.0	17.5	163	47	2.8	80	3-59
Trio KA900	95	19.8	20.0	17.4	11.2	21.6	17.8	13.0	192	var	3.0	79	0-78
Trio KA1000	128	21.1	21.1			22.3			182	var	2.6	78	0-60
Yamaha A560	83	19.2	19.9	18.6	16.4	21.0	20.3	19	180	46	3.0	80	8-129
Yamaha A960	135	21.3	21.3	17.5	14.2	21.4	20.8	19.3	280	var	2.5	78	6-90
Yamaha C6/M4	136	21.3	21.7	20.9	19.3	22.5	22.0	21.7	266	46	1.5	85	9-57

*See text

OVERALL COMPARISON CHART

DISC INPUT				TAPE (mV/ohm)			Typical Prices £	
Moving-coil			IN	OUT				
imp ohms	sens micro V	noise -dB	sens/imp	Phono	DIN			
			140/90k	260/24	28/77k	60	Akai AMU 11	
			180/100k	200/1.3k		110	Akai AMU 33	
100	var	86	235/85k	500/500		3000+	Amcron SA2/DL2	
var	var	75	100/49k	150/5k*	115/104k	190	A&R A60	
			700/48k			299	Bryston 2B	
			850/48k			399	Bryston 3B	
86	40	75	50/47k	100/1.7k		210	Crimson 510/520	
100	270	75	160/70k	300/390	45/470k	144	Denon PM510	
100	260	73	150/67k	300/450	45/500k	190	Denon PM540	
			170/39k	300/2k	20/87k	75	Denyo AU 3000M	
			172/80k	250/2k	46/20k	120	Eagle AB500	
99	60	71	78/9k	250/1k		575	Electro 25w	
99	65	66	78/9k	250/1k		880	Electro 'bridged'	
var	280	68	170/26k	170/1.2k		860	Elite Townshend	
474	300	65	400/9k	700/100		560	Exposure (III)/IV/VI	
			150/31k	260/1.5k		195	Harman Kardon HK750	
10	105	77	150/43k	265/580		390	Hitachi HM/CA 7500II	
			160/73k	290/510	30/66k	72	JVC AX1	
100	215	75	190/46k	290/800	38/70k	166	JVC AX4	
100	200	77	200/66k	380/319	48/76k	500*	JVC AX9	
var	var	79	100/64k	190/550		750	Lentek	
			180/60k	300/278		70	Marantz PM310	
108	340	66	180/76k	270/470		150	Marantz PM550DC	
74	250	74	180/39k	325/600		400	Marantz PM5	
46	130	79	150/19k		100/6k*	430	Meridian 103	
46	130	79	150/19k		100/6k*	550	Meridian 103D	
46	100	76	150/19k		100/6k*	700	Meridian 101/105	
			220/36k	280/1.6k	56/68k	90	NAD 3020	
			250/56k	780/2.8k	250/74k	160	NAD 3140	
330	310	65	190/64k	240/980		110	Onkyo A25	
10	170	66	360/8k	600/870		670	PS 2/III/LCC	
100	250	75	150/47k	250/3k		270	Pioneer A7	
var	250	77	150/47k	235/3k		330	Pioneer A8	
var	100	78	156/50k	250/2.6k		450	Pioneer A9	
32	120	70	170/37k		185/17k*	240	Quantum 202	
32	120	70	170/37k		185/17k*	450	Quantum 205	
32	120	70	170/37k		185/17k*	300	Quantum 207	
			130/180k	200/1k		295	Reference Master	
			180/108k	130/2k	110/270k	500	Revox B750	
100	140	71	145/40k	290/450		300	Rotel RB/RC 1010	
			inop	70/47	15/87k	90	Rotel RA520	
			150/70k	190/4.5k		78	Sansui A5	
			150/64k	180/5.0k		105	Sansui A7	
9	160	71	156/60k	200/5.0k		135	Sansui A9	
100	250	72	210/34k	380/215		180	Sansui AU-D5	
100	410	70	270/100k	350/550		215	Sansui AU-D7	
100	60/140	77	247/32k	450/550		350	Sansui AU-D9	
1k	160	73	150/48k	300/1k		850	Tandberg 3000	
			170/78k	260/550	28/78k	120	Technics SU-V3	
215	190	79	210/64k	300/530	32/77k	190	Technics SU-V7	
130	280	78	170/42k	300/325	150/100k	310	Trio KA900	
133	240	73	160/54k	300/326	58/99k	540	Trio KA1000	
10	200	74	145/64k	300/500		100	Yamaha A560	
100	160	73	154/60k	300/550		260	Yamaha A960	
52	72	85	95/43k	350/215		540	Yamaha C6/M4	

KJ Leisure Sound

The Sound Approach to Hi-Fi

Can we 'Sound Off' a little about the current trend for reducing the enthusiast market to one budget system?

We agree that the NAD/DUAL/MISSION system is excellent value for money and offers really good performance, but hi-fi doesn't stop there – there are many more products available to the discriminating listener that offer superior performance – albeit mostly at a higher price.

We refuse to subscribe to the trend that it's not worth spending more than the cost of the NAD system – which is the overall impression we get from reading certain sections of the hi-fi press. There are many fine products to be auditioned and which, if blended properly into a system, will give a

very satisfying performance – the value is in the personal pleasure you derive from listening to them.

(A Mini Metro will get you there – but a Rolls Royce does it much more pleasantly).

We stock most of the better buys identified in this magazine and many more products besides. In fact we stock most of the major brands and a lot of the lesser known. Neither have we forgotten the need to offer good value for money, whether that be on 'Special Offers' or in giving competitive prices on regular lines. In fact, we prefer to meet or beat any other genuinely offered prices.

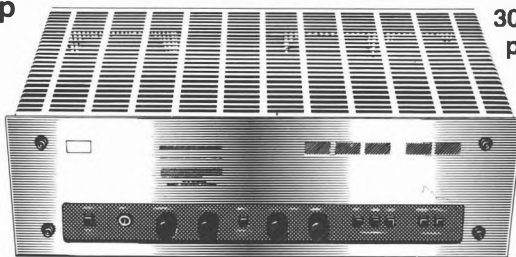
Sound us out sometime!

Luxman LX33 Valve Amp

At long last an integrated valve amplifier at a price you can afford. A performance that's silky smooth, warm yet open – if you can't get on with transistor amps and you like the smoothness of valves then audition this one. It's a modern 'state of the art' valve design with inexpensive valve replacement.

This amplifier is available *exclusively* from KJ, so visit your most convenient branch for a demonstration.

Vital Statistics – Size 17¾" w x 6¼" h x 12¾" d; Weight 42lbs approx. (heavy); Price: **£399**



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The Sound Approach to Hi-Fi



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Amplitude: Size or magnitude, and hence level or loudness of a signal, for example.

Bandwidth: A range of frequencies with presumed defined upper and lower limits.

Capacitance: An element of electrical impedance that is particularly important when matching pickup cartridge, arm leads and amplifier input characteristics to achieve a flat frequency response from discs.

Clipping: This is the state reached when a circuit is overloaded and overdriven, resulting in bad waveform distortion and audibly unpleasant effects.

Coloration: A general term used to describe the audible effects of distortions, particularly in loudspeakers and record players. These are usually caused by frequency response irregularities and/or resonances.

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.

Decibel: A logarithmic unit used in audio to indicate the relative intensity of a sound or the relative strength of a signal.

Distortion: The total percentage of unwanted signal present in a wanted signal.

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).

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.

Frequency: The rate of a cyclic (repeated) vibration.

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.

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*.

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.

Hum: Self explanatory and onomatopoeic; caused by interference of mains frequency or harmonics (50Hz etc in UK), perhaps as a result of poor earthing arrangements.

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.

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.

'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.

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.

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.

Noise: Random unwanted low level signals generated fundamentally through thermal excitation on the molecular level. Poor system design may make it intrusive.

Ohm (also eg kohm): measure of the load presented by a device to an electrical source.

Phono: The most commonly used plug/socket combination in audio components.

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.

Presentation: Area of frequency band in upper mid/lower treble which emphasises any forward quality in the human voice.

Sensitivity: The amount of signal input required to generate a specified signal level output, or *vice-versa*.

Signal-to-noise, signal/noise, S/N: The difference in total output when an applied signal is removed.

Transient: Signal of very short duration.

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*).

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Super FF



The System that beats the system.

Arguments over which system is best (or worst) for which type of distortion have been raging for years.

But now, Sansui have perfected a system that ends disputes once and for all.

Because their revolutionary new Super Feedforward System is designed to eliminate *all* kinds of distortion.

At *all* frequencies.

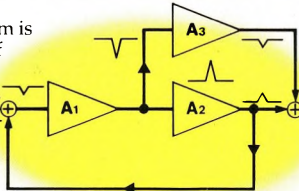
What Super FF does

Distortions such as harmonic, intermodulation, cross over, switching, TIM and envelope have been virtually eliminated.

And even the, as yet, unknown and unquantifiable types of distortion are guarded against. (TIM was once considered one of these.)

How Super FF works

The diagram shows how a distortion, generated in A2, is returned to the input in reverse phase, where it is added to A1. The reverse phase signal is then amplified by A1



and sent to A2. Thus distortion is reduced at the output of A2. This is the working principle of NFB.

In the Super Feedforward system, a reverse-phase signal at the output of A1 is also sent to error correction amp A3, where it is amplified and then sent on to the output (rather than the input) of A2.

In this way the feedforward circuit removes what little distortion NFB fails to eliminate.

The Super FF Unit

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The development of the Super Feedforward system confirms this.

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