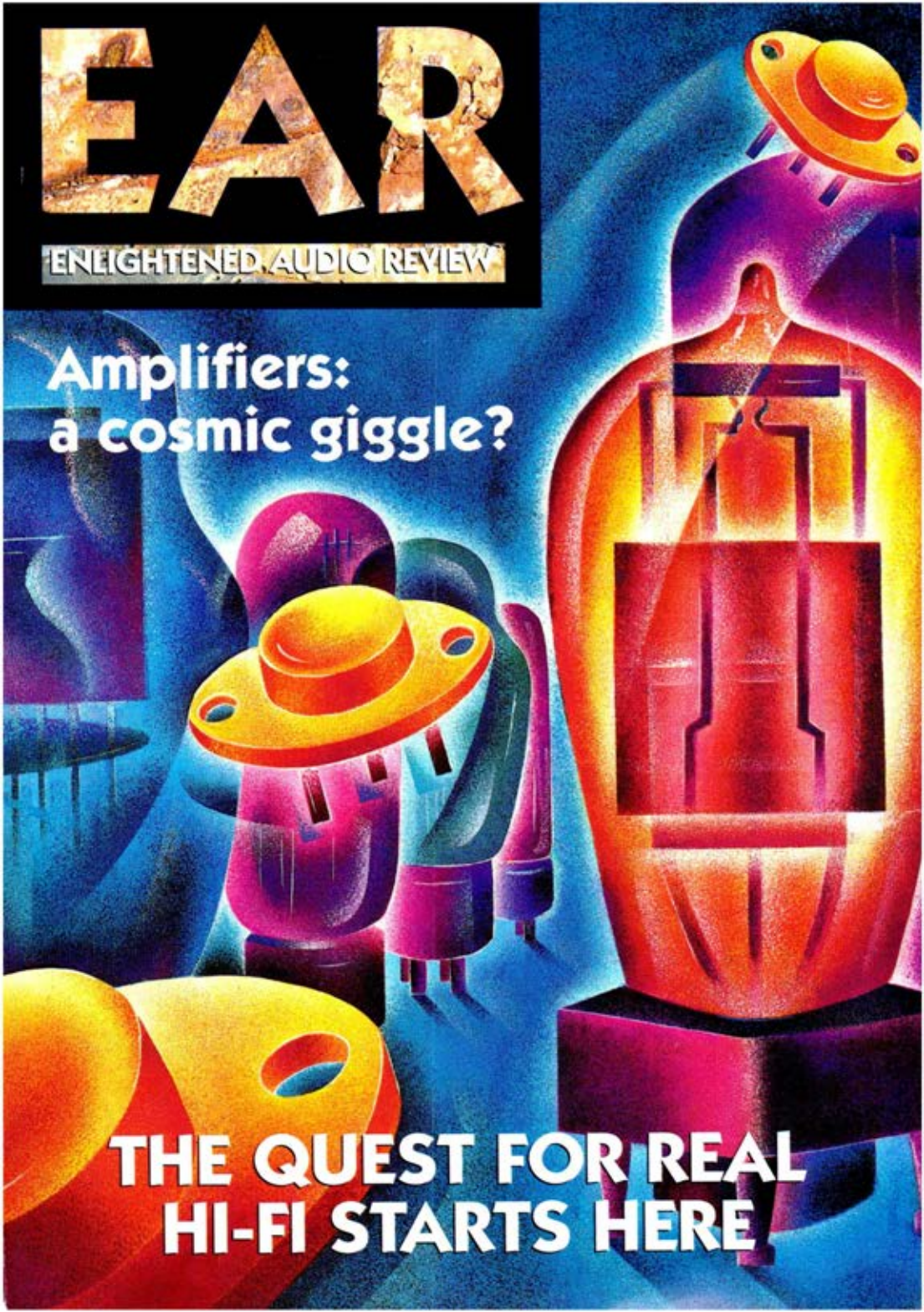


EAR

ENLIGHTENED AUDIO REVIEW

**Amplifiers:
a cosmic giggle?**

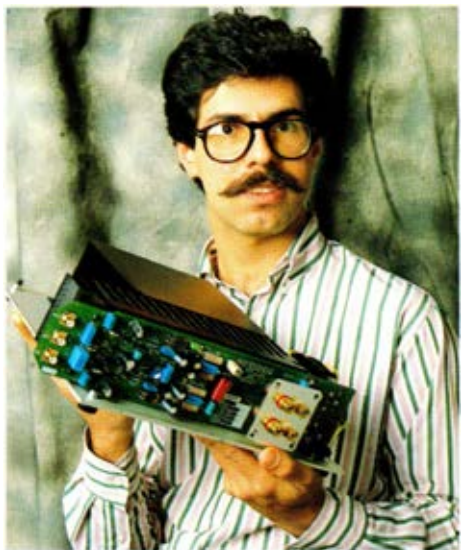
**THE QUEST FOR REAL
HI-FI STARTS HERE**



cont



Triode gratification kit style courtesy of Audio Note.



One man, one amplifier; Roksan's Touraj Moghaddam.

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Alan Sircom looks back to the days when hi-fi was huge, heavy and home-made. But what's that got to do with cows?



Eat that question

WHAT'S THIS EAR THEN? OUR MAN AT THE CONTROLS, JASON KENNEDY, ATTEMPTS TO INTRODUCE THE CONCEPT OF THE HI-FI MAGAZINE AS PHILOSOPHICAL FORUM.

Welcome to the first edition of the EAR a publication for anyone concerned, interested or obsessed by the sound of their records, discs or tapes. My name is Jason Kennedy; I've been on the staff of Hi-Fi Choice since it was relaunched in A4 format over six years ago, as Deputy Editor for the last couple of years.

At heart I'm an audio enthusiast. As Choice has become more broad based the amount of space available to ramble on about valve regulated power supplies has become somewhat constricted. So I decided to put together a journal for those readers who have got past the A400 or 8000A stage and share a serious interest in matters hi-fi. Our aim is to create a cross between Choice when John Bamford was the Editor, the old style A5 Choice books, and less mainstream publications like the

excellent Sound Practices. We want a forum of opinions, ideas and reviews that will inspire contemplation in our readers or at least amuse and interest them. The EAR is fundamentally for people who really like music and are prepared to make a few sacrifices in order to reproduce it effectively. I'm talking living room space and electricity bills, not goats, pyramids or spiral pieces of plastic, unless of course that's what it takes.

The EAR will initially be bi-annual, so there will be another one in the Autumn, probably on the cover of the October or November Hi-Fi Choice. Thereafter I'd like to build up to a quarterly rate. Whether we do so depends on you. If you like it and tell us that you like it — or at least buy the Choice issues which have an EAR on the front more enthusiastically than the other ones — the EAR will go from strength to world domination — well,



maybe independence then. So if you have any opinions, ideas, unusual systems or bribes, write and share your thoughts to the address at the bottom of page five. Next issue we'll make some space for your letters.

For the first few issues at least we intend to look at a specific component type in considerable depth. We will cover its historical evolution, the alternative design approaches, the different manufacturer philosophies and a variety of contemporary examples.

The historical and philosophical background to audio equipment is something that most magazines either don't have the space for or have little knowledge about. There aren't that many audio journalists who've been around long enough to remember what went before, or who even have a broad knowledge of what is available today. So we end up with a situation in which 'new' is assumed to be 'best' all the time. Quite often the opposite is the case.

Occasionally truly excellent products do come along, but identifying them is no simple matter. Considerable time and experimentation is required before it becomes clear that a component is truly worthy of praise. Too many products are hyped on the basis of too little investigation. This tends to distort the market, because a lot of people, hi-fi dealers amongst them, go for products with great reviews without stopping to listen to alternatives or deciding for themselves what is going to make the music sing. The ultimate consequence is that music lovers become disenchanted with audio, presume that what they've got is as

good as it gets, and don't bother investigating further.

Those of us who get paid to continue experimenting and listening have grown to appreciate that all hi-fi is a balance of compromises based on personal taste. I for instance, am pretty badly afflicted with tubes, horns and proper black records. Recent transistorised experience has suggested that many valve amplifiers are unhealthily compromised in several respects, yet also that their midrange

magic cannot be achieved in any other way. Paul Messenger who's been helping me with the EAR is similarly aware of the alternatives, but has opted for the solid state approach because he needs welly.

To get a mix of views I've asked a variety of people to contribute columns in which they have the freedom to talk about whatever they like. The fact that Alan Sircom managed to get a cow into his might suggest a slightly tighter brief next time. There's Jimmy Hughes writing about his system. This is a sort of Perspirations in response to Choice's Aspirations, on his own very interesting system in a regular

living room albeit rather over endowed on the software front.

I'd like to find similarly dedicated and unusual systems out in reader land. If you'd like yours featured, tell us about it, or write something along the lines of Jimmy's piece, telling us how you got to where you're at. But bear in mind that we can't afford to send photographers to John o' Groats.

Quite a few contributor's names may be unfamiliar. Chris Thomas, who carried the

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EDITOR'S ANECDOTAL RAMBLINGS

lion's share of the amplifier reviewing work, has been out of the loop since the mid-eighties. Before then he was on the staff of Popular Hi-Fi, and Hi-Fi Sound, and has since been working in the pro audio world. Guy Sergeant and Touraj Moghaddam are amplifier designers invited to give their personal philosophies on the subject — you'll find two radically different approaches there.

Dan Houston (ex Choice news editor and

genuine journalist) is talking about the music he's been listening to over the last year. Next issue we'll get someone else to do this and attempt to expand your musical horizons with some more rock solid recommendations.

Hi-fi enthusiasts too often fall into the trap of playing material that sounds good. What we want to do is expose you to a wide variety of music to help you make the most of your system; we don't intend to forget that music



The stuff that audio dreams are made of: just some of Japanese amp builder Ken Shindo's totally bitchin' kit.

is what it's all about. For instance as a result of personnel changes in the Hi-Fi Choice office I've been listening to and enjoying a whole lot of new stuff recently. I actually sat down at home and listened to a cassette the other night. Regular folk wouldn't think twice about doing that, but as a semi-victim of audiophilia it's pretty darn unusual for me, and I still think that cassette sounds pretty poor— but there was no alternative, and Raging Slab sounds like the baddest, ass kickin'est boogie rock you ever heard whatever the format.

Another name that will be familiar to only the very dedicated is Malcolm Hawksford. A lecturer at Essex University he was involved with the development of the LFD phono preamp. He's volunteered to say interesting things about matters digital. With CD now the prevalent software, it makes sense for someone try to expand our horizons in that direction.

To broaden the EAR's base we will be enlisting the talents of international correspondents. This time around we've pulled in Joe Roberts who edits Sound Practices in Austin, Texas. His enviable publication is every tube amp and horn speaker lover's favourite underground read.

Variety. That's what I want the EAR to have. It may say Enlightened Audio Review on the front, and hopefully that's what it will be inside, but you'll also find alternative translations for the EAR acronym atop each page (boy they're hard to think of!). There is no single path for all audiophiles to seek; there are as many paths as there are reasons for listening to music, and finding the right stuff to get you on that path is a matter of experimentation and exchange. Maybe we should have called it the APE, for Audio Philosophy Exchange, a great acronym if nothing else.

That's about all for the moment; now I've got to get this thing together before a rather imminent deadline. Read what takes your fancy and drop me a line; I want to know what you think. May the force be with you.



Editor

Jason Kennedy

Consultant Editor

Paul Messenger

Contributors

Richard Black
Malcolm Hawksford
Dan Houston
Jimmy Hughes
Richard Kelly
Paul Miller
Touraj Moghaddam
Joe Roberts
Guy Sergeant
Alan Sircom
Malcolm Steward
Chris Thomas

Designers

Norma Martin

Illustrators

Alan Nanson (Cover)
Clive Goodyer

The workers

Sam Syed
Lisa Nickson
Simon Davies
Rob Tribe

Photography

Chris Richardson



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A step in the Right Direction

In the world of electronics, size provides an accurate index of the relative age of a technological artefact. Big or heavy generally implies old and usually translates as 'obsolete'. Well, I'm here to say that single-ended triode

amps are definitely **BIG** in the States these days. In light of this triode fever epidemic, it appears that the widely believed rumours that this 1930s technology was obsolescent fifty years ago may have been premature.

I don't mean to suggest that the American audio industry was slow on the pickup or anything, but single-ended triode amps didn't appear out of nowhere. They've been a cause celebre in the inner circles of world audio mania for decades. However, here in the land of Krell and Audio Research, the traditional 'high-end' discussion on the topic of triode amps consisted of a few watery comments about old Japanese guys with horn loudspeaker systems, before quickly shifting to something more sensible. If there is any truth in the notion of progress, a seventy five pound, fifteen watt single-ended triode amp with jazz age era output bottles surely belongs in the dust heap of audio history — not as the subject of wildly positive reviews in the latest high-end journals.

When triode amps began appearing on the US audio scene, several native hi-fi scribes quickly took under their wings the biggest, baddest specimens of this new/old technology — huge triode monoblocks with 211 and 845 transmitting tubes. Heck, I probably would have done the same thing myself.

**THIS MAN IS INTO VALVES,
BUT NOT JUST ANY VALVES,
JOE ROBERTS IS TRIODE
MAN. HERE HE TRACKS THE
RISE AND RISE OF THE LOW
POWERED VACUUM TUBE.**

Maybe it has something to do with American culture, or maybe it's some kind of universal male thing, but there's something undeniably convincing about an eighty pound amplifier outfitted with blazing hot, foot-long industrial strength firebottles.

Whether such amplifiers are 'fetishised' because they look like something out of Tesla's lab, or merely tolerated in spite of it, is best determined on a case-by-case basis. In any event it sure is hard to look disinterested when confronted with a hundredweight plus of solid triode amp cooking away on the launch pad.

No way around it, high powered triode amps are very substantial devices. It is through sheer majesty of dimensions and heft that these amplifiers make their initial mark on our awareness. The dazzling white incandescence of thoriated tungsten filaments adds a touch of dramatic presence to any event. These instruments don't just take up space — they fully occupy it. A serious triode amp remoulds its environment with light, heat, and other ethereal energies. There is some heavy physics going on there — you can feel it with all of your senses.

Let the doubters rail on. When you spin some vinyl and turn up the wick, your ears will tell you that your eyes were right: this is something special. These directly heated time machines transport you into a zone where local notions of obsolescence and technological progress don't relate. Good triode amps do funny things to the space-time continuum. The sense of presence and 'being



there' can be surreal.

Maybe the uncanny event recreation abilities of SE triodes results from some sort of sonic gimmick, a harmonics and mirrors illusion. If so, it's the best kind of trick — one which gains rather than loses magic with time. After hearing a dozen or so such amps I am beginning to recognise some consistencies in the 'triode sound', but I'll be doggone if I can adequately put it into words. After running SE directly heated triode amps for a few years, many push-pull beam tube amps sound strained to my ear, as if they are trying too hard and all the effort is holding them back. The magic of single-ended triodes has something to do with the combination of a relaxed presentation and incredible speed and responsiveness. The over-used term 'natural' comes to mind.

Attributing this highly subjective sonic trait to a particular circuit configuration would require some vigorous groping in the dark. One obvious and noteworthy characteristic of SE designs is that they do not employ phase splitters such as are necessary to drive push-pull output stages. Consequently, SE can be considerably less tricky and complex than typical two-tube power amps; in simplistic terms, SE circuits do not dissect and then reassemble the musical signal as it passes through the amplifier. This philosophically correct electrical attitude may be the key to the truthful sonic performance of such devices.

No doubt about it. This SE triode stuff encourages profound reflection. Your first listen to a well tuned up triode powered system may lead you to you re-evaluate everything you ever heard up to that point. The initial wonderment I experienced with triodes never died away, and gradually transformed into a respectful ongoing fascination.

How can such a 'low power/high distortion' circuit put forth such dynamic, pristine, and vivid music? Beats me. More than one sober enthusiast went yogic after living with single-ended triodes and pondering the mysteries of the art, The SE sound is such a direct one

and so fundamentally 'right' that it's somewhat difficult to dissect in conventional analytical terms. The whole presentation of the musical experience is redefined in a fashion that disarms the most jaded. I guess you just have to be there yourself to understand.

Until the emerging North American triode renaissance began to take hold, getting to the place these amps take you was an uncommon treat. Triode amps were the exclusive territory of intrepid DIYers, since you simply couldn't just go out and buy an SE amp in the US, regardless of the size of your bankroll. It's unusual in today's world that you have to go out and build something because you can't buy it. It was a healthy challenge which brought many of us to a new level of involvement with the hobby. There is nothing in audio as exciting as the first audition of an amplifier you've built yourself — especially when it plays like a good SE triode should! Naturally, not everybody was ready for homebrew triode madness. Some commercial interest was required to lift the technology out of the deep fringe nether world and into the mainstream of audiophile consciousness.

Today, SE amps have fully arrived as 'real products' in the US market, mostly thanks to the efforts of designers who were true believers in the technology back when the audio professionals were laughing up their sleeves at the 'single-ended' crowd. As mentioned above, the high profile products these days are single ended 211 and 845 amps even though there are number of sweet low powered amps on offer from an ever growing number of manufacturers.

The first 'Born in the USA' big triode amplifier to break into the local press was the 805 from Cary Audio, a company which has been a major player in the US tube scene for a number of years. At the Winter CES, the big Cary amps were looking and sounding good in quite a few installations. This all-business amp features a 211 output tube driven by a 300B in the latest version. A visit to any of the rooms in Vegas where the 805 was



Last year's Cary 805 sans 300B driver, but still capable of showing what genuine SE triodes can do.

cooking would quickly dismiss any doubt that amps with one output tube can totally energise a room with sound. These bad mister fifty-watters can really rock and roll, even on jazz and classical material (even! Ed.)

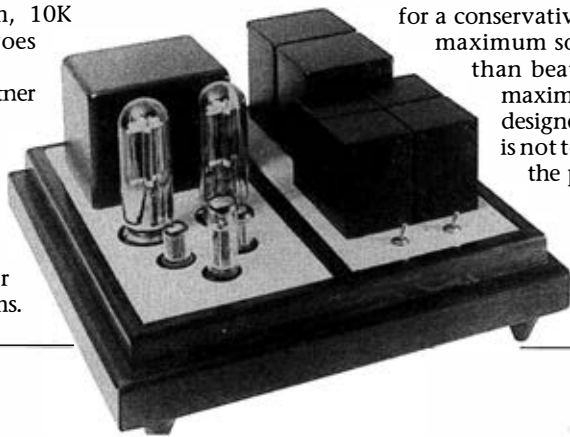
Another offering which oozes personality is the Kyrie single 211 amplifier from Chimera Labs. As the name suggests, the sound is claimed to inspire shouts of 'Lord, have mercy'. This 100lb/15W per channel monster amp uses an EL34 to shunt regulate the 6SN7 input stage and a second 211 to shunt regulate the B+ for the output tube. Chimera design whiz John Camille is an ex-fighter pilot and military-spec engineer who modifies and upgrades Tektronix test equipment in his spare time, so expect these babies to hold up on the test bench. Also expect a long mean time between failures — where John comes from, 10K hour reliability goes without saying.

Chimera Labs partner Dennis Boyle is a long time collector of theatre sound equipment and is known to have a special fever for LARGE horn systems.

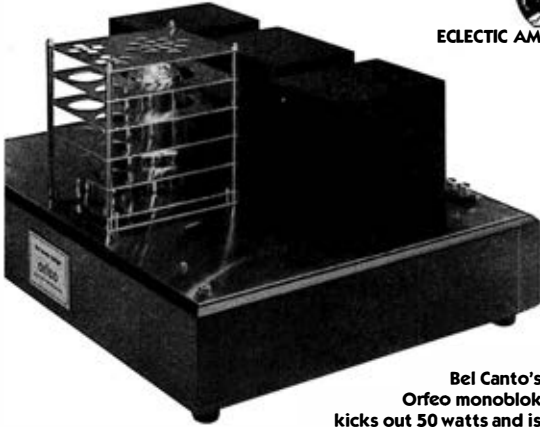
Not coincidentally, the Chimera Labs reference system is housed in a converted movie theatre in Dallas. These guys are currently installing a no holds barred, four way, full range horn loudspeaker system custom designed by Dr Bruce Edgar. The Texas-sized bass horns are each the size of two refrigerators, so there shouldn't be a shortage of bass in the place: those Chimera boys really know how to have a good time.

Another newcomer guaranteed to excite the fantasies of every thermionically oriented audio maniac is the Orfeo from Bel Canto Design. This single 845 dream machine sports a distinctive heatsink/ornament that is just too cool for words. The Orfeo allows the use of either balanced or unbalanced operation through a transformer coupled input. All electronics are mounted on a floating subchassis to eliminate mechanical vibration effects. The power bandwidth of this zero negative feedback amplifier is impressive — 3dB down at 4Hz and 40kHz at 30 watts. What a sexy piece! I mean, how can you go home to a black box integrated after you feast your senses on this fantastic 50 watter. Go ahead, sell your car and buy a pair.

In some ways, Wavelength Audio typifies what the scene is all about. Chief Engineer Gordon Rankin, a prolific experimenter back in the hacker days of triodes, handbuilds good honest amplifiers with the finest available parts. Not being much of a hypester, Gordon doesn't bother to get involved with the horsepower race: Wavelength's Sole 845 SE amp uses a 300B to drive an 845 output tube for a conservative fifteen watts of maximum sonic glory, rather than beating the tube for maximum power. As the designer puts it "the idea is not to get a lot of watts, the point is to get the



The Chimera Labs 211 stereo power amp not only sounds great but is bullet proof too.



Bel Canto's Orfeo monoblok kicks out 50 watts and is totally bodacious to boot.

most out of every watt." The Sole recently sent a few very famous reference grade PP pentode amplifiers looking for homes in the secondhand marketplace.

Now there is nothing wrong with a nice 845 amplifier, but I personally look forward to the day when the American market is ready for Wavelength's not yet in production one and a half watt single 45 amplifier. Heard that mighty midjet blow the doors off the house on pair of Klipsch La Scalas one time. When you've had experiences like that, you wonder how the commonly held notion that SE amps are only suited for light duty ever got started. Although single ended amps excel on mellow fare, the secret ingredient of the triode sound is an earthiness, a groundedness, that is equally right for Junior Wells, Anthrax, Paganini and solo lute recitals. On vocal music, from Grand Opera to field hollers, SE triode amplifiers catch tiny paralinguistic inflections and subtle vocal shivers that convince you that you're involved in significant form of human communication with the recording artist. The musical authority of triode amps has little to do with power specifications.

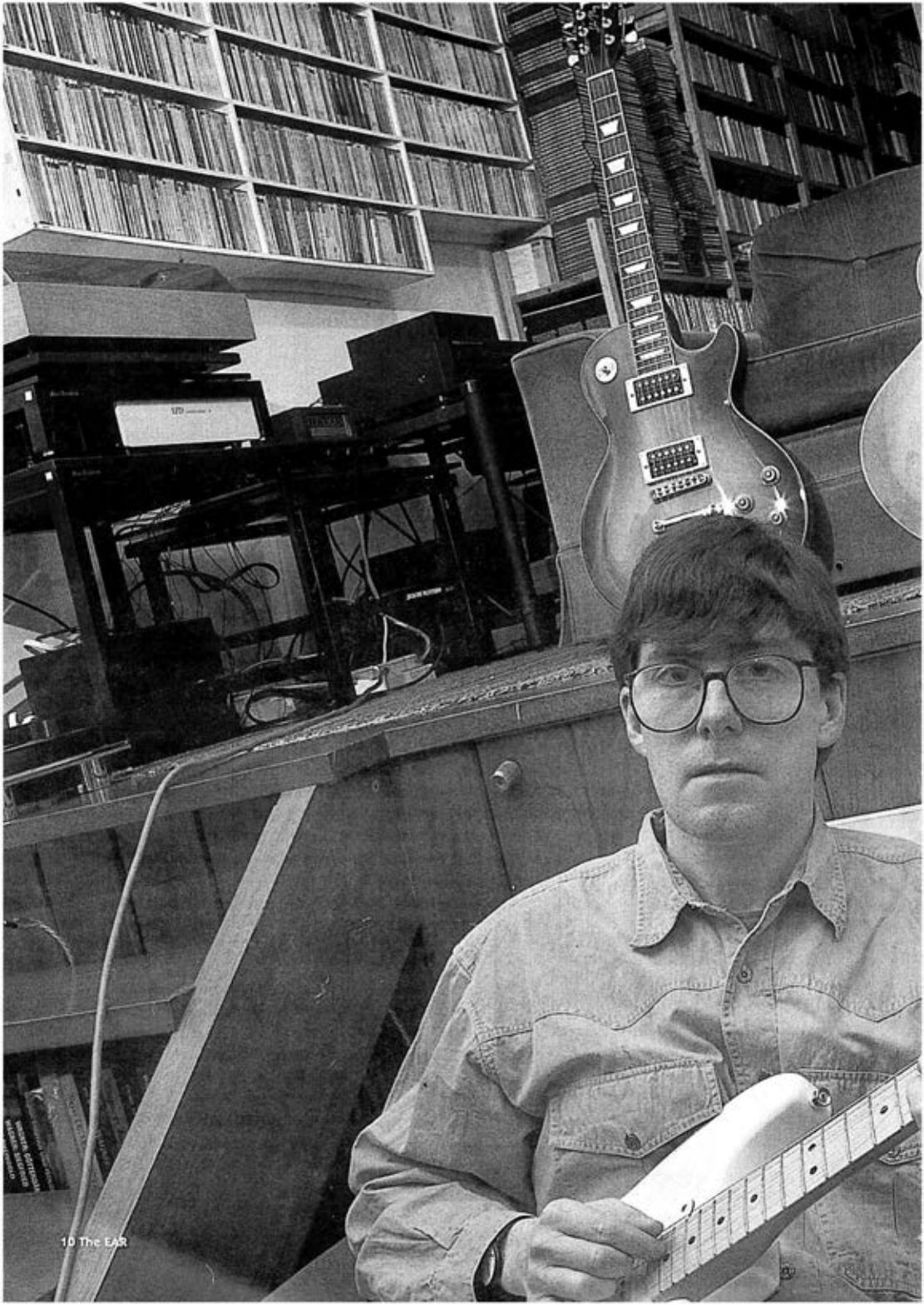
In my experience, tiny SE amps do all of this neat stuff every bit as well as, if not better than, the big mama triode

Wavelength's Sole 845 SE amp uses a 300B to drive an 845 output tube for fifteen watts of sonic glory.

amps. I'll take three watts and a horn any day. Looking at the big picture, however, the rage over big triodes is perfectly understandable. First, they are definitely the hippest thing to come along in years. Secondly, aside from being the ultimate in audio machismo and peer image management, transmitting tubes provide enough power (well up into the two digits range) to drive many of the not particularly efficient speakers presently in use. A twenty-five or fifty watt amp is a practical solution for a transitional age. When forward-looking manufacturers take up the call and produce some appropriately efficient speakers, then we'll be ready to roll out the killer five watt giant slayers!

In the meantime, many US audiophiles still consider under ten watt triode amps to be toys, completely unworthy of serious consideration. What can I say? This is a completely sensible reaction, maybe the only sensible reaction based on received wisdom. It is hard to believe until you hear it with your own ears. Perhaps those big amps will lure new converts to the fold on the basis of their special appeal. Whatever it takes to bring them to party — they'll stay for the music.







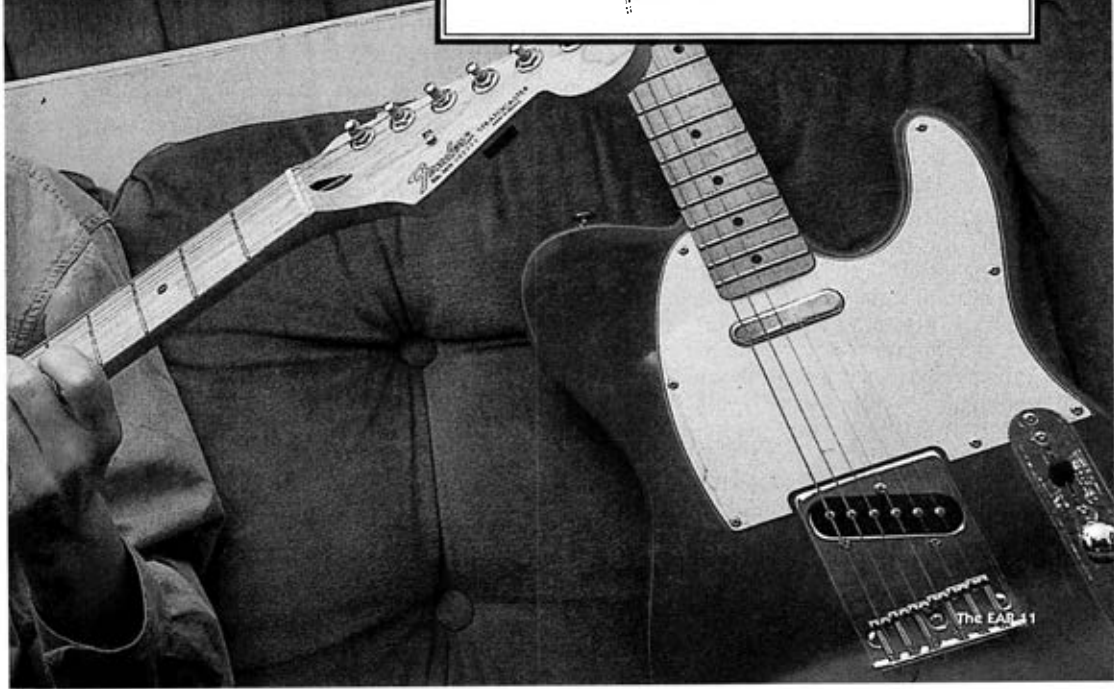
EXTREME AUDIO REVELATIONS

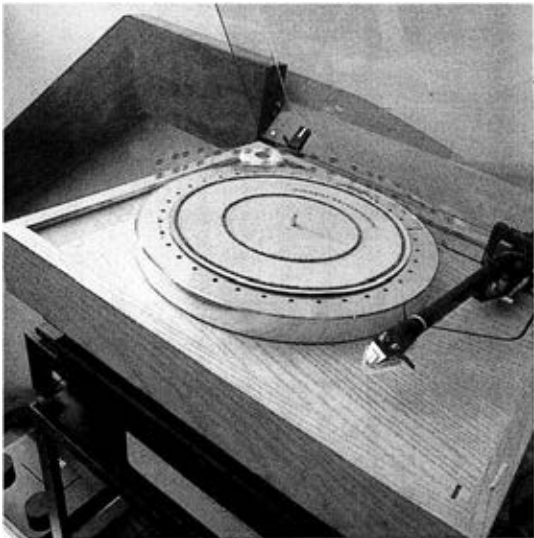
Jimmy Hughes Unplugged

MEET A REVIEWER WITH MORE RECORDS, MORE GUITARS AND MORE **PWB** THAN ANY OTHER.

Why do it? Why spend large sums on hi-fi? For some people owning expensive hi-fi is perhaps a status symbol, yet I suspect such individuals are in a minority. Most of us buy costly hi-fi to hear music reproduced with greater clarity and realism, so that we're drawn into the spirit of the performance as if at a live concert.

Yet our quest for greater clarity and increased fine detail can be a double-edged sword; many elaborate systems are so critical of recording quality that only a handful of discs (black or





The dramatic effect of letting Peter Belt near your hi-fi system: Jimmy has gone the whole hog with his Roksan Xerxes (above) which also has a Ringmat. Check out the Luxman transformer on his Argo HR: total heaviosity.



A rare sighting (above) of the NVA Integrated Statement with its SMA sockets and a small portion of Jimmy's fabled 'spaghetti'. Right: the trusty Sondek with a Mission Mechanic and the scars of years in the Belt fields.

silver) seem good enough. Poor recording quality acts as a barrier to the enjoyment of many fine musical performances.

This unfortunate state of affairs is surely inevitable: as clarity and definition increase, the system must become more critical of faults. However, in the real world and with some application of care and patience you can have a detailed analytical system without pulling every recording to pieces.

Certainly that's what I demand from my own hi-fi system. I want it to be clear, detailed, and dynamic so the music has lots of life and vitality. The sound must be clean and natural, with a realistic, lifelike tonal balance, giving full access to the music.

At the same time, it must allow music and performance to be appreciated without sonic limitations spoiling one's enjoyment. Although we're accustomed to thinking of good and bad recordings, it's surprising how many of the latter turn into the former when played on a well-balanced system that doesn't fall apart at the first sign of trouble.

The roots of my current system go back to Spring 1988 when I took delivery of a set of Impulse H-1 horn-loaded speakers. Before getting the Impulses I was actually rather sick of expensive hi-fi and had been enjoying music through a pair of Arcam 2 reflex loaded speakers.

Having previously owned a number of



expensive and elaborate speakers, driven by three big power amps, either as a full active system or tri-amped, it was lovely to use the little Arcams which could be happily driven by a decent integrated amp.

True, the sound lacked the scale and detail I'd been used to, but for me it was a case of losing the battle to win the war. With the Arcams I could forget all about hi-fi and simply enjoy music from LP or CD. But then the Impulse H-1 loudspeakers came along.

Of course I was impressed; there was no way the little Arcams could match their sheer authority. Yet I wasn't sure I actually wanted to upgrade; I liked the Arcams for their cohesion and integrity, and felt very comfortable with them. I used them with the internal damping removed, finding them very listenable — and surprisingly detailed and dynamic given their superficially smooth balance.

However, I did eventually go for the H-1s, and they became the mainstay of my system — I grew to like them very much, which is just as well given their size and the difficulties of moving them out of the room. Since 1988 I've used them successfully with a wide range of transistor and valve amplifiers.

Most reviewers use pretty expensive kit, and this can make it difficult to assess less exotic stuff sent for appraisal. So the high efficiency of the H-1s was a big plus point;

“True, the sound lacked the scale and detail I'd been used to, but for me it was a case of losing the battle to win the war.”

they're capable of revealing the qualities of a good expensive amp, but perfectly usable with something more basic.

Ever since I sold my DNM pre/power combination in 1989, I haven't actually had a regular amplifier of my own. However, John Michell's Argo line-level preamp has been in more or less constant use for over 18 months, and recently I've started using the Argo HR with its beefier power

supply and superior resolution.

Power amps have included Michell Alectos and the Audio Innovations Second Audios, and I've enjoyed excellent results with the NVA Integrated Statement. Yet for much of the time I've been happy enough using mid-market integrated amps as power amp stages driven by the Argo. These have included the JVC AX-662BK, Technics SU-A600 and SU-A900, Arcam's Alpha 5 and Alpha 6, Triangle TE-60, Marantz PM-54SE, and the Audio



Jimmy's system circa 1974: Transcriptor Hydraulic Reference turntables, SME 3009i and Fluid arms, Lecson AC1/AP1 amps, Gale GS401A speakers and no wire!



Innovations Alto.

I connect the output of the Argo to a suitable line-level input (tape monitor usually sounds best), turn the integrated amp's volume to maximum, then use the Argo to control volume and input selection. The result is surprisingly crisp and punchy.

Because most integrated amps are pretty sensitive (typically about 200mV), the gain in the system is very high, resulting in a lively, detailed, dynamic sound; the music has lots of power and presence without needing to be played loudly.

I find high gain in the system helps ensure more overtones and greater immediacy. Rather than sounding 'lazy' and slow, the music is vibrant and lively, with lots of attack and bite. As a result, you can play at lower volume levels without things sounding recessed and flat.

To me, clarity and definition at middle and low registers is critical. Many speakers are clear in the treble, but sound muddy and inarticulate at mid and bass frequencies. Such speakers may sound impressive on lively transparently-scored music with lots of percussion, but play something dense like a Brahms symphony and the sound seems thick and clogged.

Like all Impulse speakers the H-1 is undamped. This enhances mid/bass clarity, making the sound clearer and more articulate. To improve control and lower coloration levels without sacrificing liveliness, I've fitted my H-1s with Deflex acoustic panels which gave a fantastic improvement. I also prefer to run my speakers in reverse absolute phase.

I've quite a lot of PWB treatment in the room, and am very careful about leaving

unused electrical equipment in the listening environment, preferring to keep only what's being used at any given time. I therefore store my tuner and open reel/cassette recorders out of the main room because they're so infrequently played.

But perhaps the most radical thing about my system is the way I use the speakers. Rather than face them directly towards me, I have them back-to-front so the sound bounces off the rear wall, the idea being to create a fuller more integrated sound from deep bass to high treble.

One reason hi-fi systems emphasise faults may be because of the way most speakers present sound to the ear. Many problems occur because we sit close to very directional speakers where the treble energy emanates

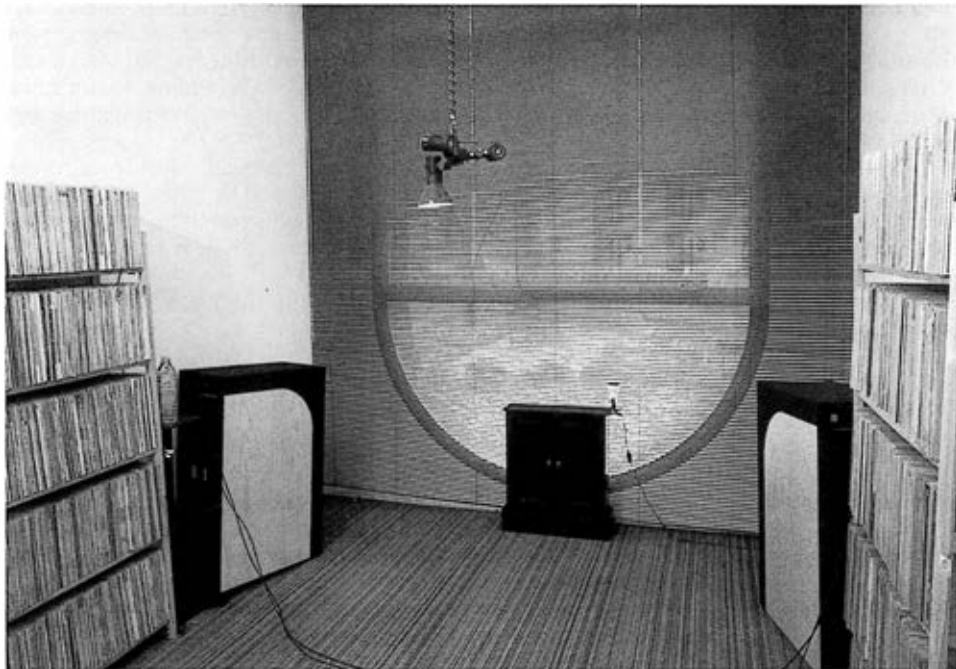
from a small concentrated area. Is it any wonder every blemish stands out in sharp relief?

In real life this isn't how natural acoustic sounds are made (But it is how most microphones work; Con. Ed.). Most musical instruments are not particularly directional, and those that are (a trumpet, say) are usually heard at a distance. Small dome tweeters produce highly directional prominent treble that shows up tape hiss, surface noise, and distortion all too clearly.

The idea of using H-1s back-to-front was

inspired by Shahinian Arc omni-directional speakers which can easily work both ways. The Arc gives a very bright forward sound that should make it excessively analytical. Yet, used with the drive units pointing towards a rear wall, they're amazingly seamless and integrated — spacious too, which is

“perhaps the most radical thing about my system is the way I use the speakers. Rather than face them directly towards me, I have them back-to-front so the sound bounces off the rear wall”



The most radical aspect of Jimmy's system, or so he claims, is the pair of Impulse H-1 horn speakers that sit three foot down from the listener, tilt downwards and bounce the sound off of his green venetian blind.

remarkable given their brightness.

I had grave doubts about whether H-1s could work reversed, and initial results were mixed. But I persevered, and eventually achieved success. It doesn't sound the way you might think; you're hardly aware the speakers are reversed so far as clarity and tonal balance go. What is apparent is the consistency and seamless integrity of the whole sound. Front-to-back depth is superb, readily defining close and distant perspectives. Ambience is more tellingly recreated, and when things get loud there's less of a tendency for instruments and voices to 'crowd-up' and move closer in terms of placement.

Put another way, it's as if the sound isn't coming from the speakers; you can't hear the drive units. Rather, it's like the music's being projected onto the rear wall (which of course

it is; Con. Ed), so it's around and behind the speakers resulting in a smooth balanced sound that's superbly integrated. The soundstage is enhanced by a sense of space that's very lifelike and realistic. Bright immediate recordings are vivid without that unpleasant claustrophobic closeness.

LP and CD are my main sources, and I rarely use my cassette deck, open-reel tape deck, and tuner. LPs are played on a Roksan Xerxes with Roksan Artemiz arm and an Audio Technica AT-OC30 moving coil cartridge. The latter sounds rather bright in traditional AT fashion, but tracks superbly. Phono stage is the LFD, or Michell Iso HR, both are excellent.

The Roksan sits on an Audiophile Base isolating platform on a Mana Reference two-tier support stand. The current CD player is a humble Denon DCD-1290, with Trichord



Research clock modification, partnered by an NVA DAC-ON. This sits on a Frameworks stand. I also have a Linn LP12 with Pink Triangle Linnk Linnk power supply and top plate, but tend to listen to the Roksan most of the time.

Cables are mainly solid core types; Vecteur for speakers, partly because the H-1s are wired with it, and various screened and unscreened interconnects, mostly DNM, but some special PWB treated cables which sound very good.

I'm a great fan of line-matching transformers, using various models from Audio Innovations, Marantz, and Lux with considerable success. Used between CD player and preamp they give an apparent increase of about 3dB in volume level. I've tried using transformers between pre and power-amp with good results too, though sometimes the gain is too high even for me!

The result is a stronger cleaner more dynamic sound, with greater firmness and 'body'. Pitch definition appears to be improved, and overall coherence is better. Rhythms are more keenly portrayed, with a finer sense of ebb and flow. While the use of transformers is anachronistic, I do find the effect quite addictive.

Overall my system gives a big clean well-defined sound that has power and scale, yet is subjectively friendly and easy to listen to. Noise — whether LP surface clicks or analogue tape hiss — is remarkably low, yet the impression is of a bright open tonal balance with no lack of treble. Dynamic range is wide, but the system doesn't need to be played loudly to fill the room with music.

Although my main taste is for classical orchestral, chamber and solo instrumental material, a wide range of music can be played with good results and the system is not

unkind to mediocre recordings. Faults aren't hidden, yet somehow the good aspects of the sound seem to outshine the bad. As a result, the limitations of a recording do not interfere with one's enjoyment of the music and performance.

I have an unusual split-level room measuring 12ft wide by 30ft long. The walls and floor are solid concrete, yet the room produces a warm mellow balance. If my system ever 'goes off', it's always in the direction of sounding thick and muddy rather than bright and edgy.

Criticisms? Well, I wish I could move the speakers a few feet further apart. They're about 11ft apart, but listening some 16ft back

dilutes stereo width somewhat. The speakers are placed in the lower section of the room, firing up its length. I listen from the upper floor which gives a nice feeling of space and distance. It is possible to listen from the lower part of the room, some 10ft from the speakers, but the sound isn't quite as spacious.

There's some emphasis in the 100Hz to 150Hz region which clouds bass

slightly on some recordings. At the same time my listening seat (roughly halfway down the room) is positioned at a null point leading to a loss of deep bass. Move just a few feet back and the bass line deepens noticeably, but unfortunately it's impractical to put seats there.

A strange system? Yep, I can't imagine anyone actually going out and buying something like it from scratch. I judge its success by the number of recordings I can enjoy today compared with (say) 10 years ago. Because my best discs sound better than ever, yet recordings that once gave trouble or originally sounded disappointing now sound fine, I think I've made progress.

“Overall my system gives a big clean well-defined sound that has power and scale, yet is subjectively friendly and easy to listen to.”



EMPIRICAL ARTISTIC REVIEWS
EAR reviewers air their
opinions on a bunch of
groovy components.



Wadia 6

I've never been a big fan of CD; neither the players nor the discs have half the attraction of the analogue alternatives; certain cassette decks have had more appeal than most CD players.

I'm sure I would have gotten over the tactile/aesthetic side of the equation if they made musically more compelling noises, but, up until now this has been far from the case. I'll grant that players have been getting better of late, and rarely have the grossly fatiguing nature of their forebears; and I'll admit that my familiarity with more expensive machines is a bit limited, but until exposed to the Wadia 6 my scepticism about the format was pretty firm.

The £4,000 6 is the only complete CD player that this Wisconsin based manufacturer produces. The rest of the range is made up of transports and DACs; none are particularly cheap but most have established enviable reputations. Having spent some time with the 6, I can see why. Not only does it look and feel very serious, but it also made my discs sound better than I imagined they could; yep really. Okay it isn't as relaxed as a Voyd turntable, but it did most things so convincingly that I'm no longer so averse to buying stuff on compact disc, because one day this sort of thing might become affordable.

The Wadia 6 is physically very solid, and not the sort of thing you manoeuvre without thinking about it. And it's got spiked adjustable feet (with nice little matching pucks to sit in to avoid maiming any softish surface; the tops of speakers, tables, sofas etc).

NOT ALL CD PLAYERS ARE EQUAL, A POINT RATHER EFFECTIVELY PROVED BY THE WADIA 6; JASON KENNEDY WANTS ONE.

But it is a very, very nice box, apparently hewn from solid aluminium and making the TEAC imitations look, well, affordable. It shares with them a fundamental component in the form of a modified VRDS die-cast disc drive.

But that's as far as the similarities go, although the rather vaguely laid out remote control might also be of TEAC origin; either way I could never find the button I wanted.

The 6 has a minimal selection of front panel controls covering open/close and play but quite a variety of sockets round the back. These include digital outputs in balanced, BNC electrical and AT&T optical forms, and volume adjustable analogue outputs from both balanced and phono sockets. The remote volume is nice to have but sonically not all that desirable. I listened to the 6 straight into Michell Alecto power amps, bypassing the preamp, and found the sound stage shrank behind the speakers and the sound lost a lot of immediacy and presence. There are probably power amps which might work better, but in my experience no preamp rarely sounds better than a good one such as the Argo HR. However, if you do use the digital volume control, a column of LEDs shows output level alongside one for phase invert and the blue track/time display.

The Wadia 6's *raison d'être* is of course to play CDs, a task which it carries out with such aplomb that I chose to play CDs for ninety per cent of the three short weeks that I had it. The key to its appeal lies in its splendidly high resolving powers and a presentational



balance that has energy and power without the usual fatigue factor or aggression. For me CD players tend to be either too bland and gutless or too painful to listen to for long periods. The Wadia 6 managed to extract the dynamics, vibrancy and life from a disc and present them without the usual uncomfortable side effects. But that's not all, it also had an excellent sense of timing and plenty of welly when called for, delivering the powerful if rather two dimensional sound of Deep Purple's Burn and the relatively expansive and slick Singles OST with equal ass kicking energy.

One of its most impressive skills is an ability to track the subtle differences between recordings. Listening to one of Frank Zappa's You Can't Do That On Stage Anymore compilations is always a rewarding experience, but rarely have I appreciated the variety in sound quality that tracks of different vintage, recording type and location can have. I must have listened to all six YCDTOSAs over the three weeks, although one of them is on vinyl so I probably listened to that one twice. Going back to the Voyd/SME IV/Grasshopper was always a more relaxing experience and I suspect it always will be, but the 6 kept me away for a lot longer than anything else.

Unfortunately I couldn't get hold of anything comparably excessive in the way of transports or complete players during the time I had the 6, but Choice devotees may remember my review of the top Accuphase transport/DAC combo. While I was trying with limited success to get enthusiastic about

the Accuphase, Kevin from Living Voice brought down the first pair of Hørning Agathon loudspeakers (a model I'm still enjoying to the full, by the way), plus his own Wadia 6 primarily to show what the speakers could do. What that 6 did was little short of duffing up the Accuphase, a rather embarrassing experience for that substantial and expensive machine. There's not much that most players can do when presented with this degree of resolution, coherence, power and dynamics. In many respects it is on a par with a very good, if not excellent, record player, something I never thought I'd find myself writing. A little more in the way of

leading edge definition might have been nice, although this might well have been a limitation of the discs involved. And it would also have been nice to have combined analogue style relaxation with digital style silence. But to be frank I find it

difficult to criticise the 6. I asked importer Steve Tayler at Acoustic Energy, what the advantages of the big two box

jobs were, and he said that bass performance was better, but presumably that's not all.

The most disappointing thing about the Wadia 6 is that it will no longer be made after this spring, and AE doesn't expect stocks to last past the summer. There will of course be a replacement, but it's still an unknown quantity, based on Pioneer's SPM transport and expected to cost more. However, what the 6 did was prove to a digiphobe that CD has real potential by giving him three weeks of CD based musical pleasure. Those of you that can afford it should snap up a 6 while you can.



The bluff face of a bad ass CD player: the Wadia 6 might not look too exciting but it can turn your discs into high fidelity music carriers.



Audio Note Kit One

If you speak to those who have their finger on the pulse of the real audio underground, there is only one valve for power amplifiers, the 300B. Yes of course, those really big power triodes like the 211 and 845 have a lot of potential too. But the substantial lump sums required to purchase a 211 amplifier makes it a prospect only for audio psychos with bulging wallets.

Even the 300B amplifier was not a cheap option until the £700 Audio Note Kit One power amplifier came along. The chunky grey stereo chassis even comes with a gain control, so it can be used with a preamplifier, or directly with line-level signals.

The circuit design is extremely simple, and brings the audio ideas of 60 years ago up to date. On the signal processing side the Kit One feeds the input directly into each half of a 6SN7GT double triode. This is then followed by the volume pot, and then to a SRPP (Shunt Regulated Push-Pull) driver circuit, using another double triode, this time a 5687.

The power supply is more modern in its approach, using high capacity voltage regulators. However, this is combined with a directly heated 5U4G valve to rectify the high tension. Once again, component quality is stressed, using a paper-in-oil capacitor in parallel with the electrolytics to improve performance at high frequencies.

High quality Beyschlag resistors are part of the package, although component quality can be further improved by using Holco or

COMMERCIAL 300B TRIODE AMPS MIGHT BE GOD'S GIFT TO AUDIO BUT THEY COST A PACKET. HAS ALAN SIRCOM FOUND AN ALTERNATIVE?

Shintosh resistors and Black Gate electrolytic capacitors instead.

One useful optional extra is the £90 cover, designed to prevent small children and animals from harming the valves, or themselves.

Unlike many kits on the market today, the Kit One comes with all the valves required. Some suppliers overlook this little extra, but as tubes like the 300B run at about £100 for a pair, this is quite an oversight. All the amp needs to get it up and running are a few tools, a fair degree of patience and about a week's worth of evenings. Or so we're told.

If you are the sort that has a basement full of unfinished projects and thinks that reading the manual is for wimps, then leave the Kit One alone. On the other hand, even if you have never turned your hand to anything greater than wiring a plug before, take the plunge and buy a soldering iron. The instruction manual is clear and comprehensive, giving the novice advice on soldering and construction tips. It even displays a sense of humour in places, which makes a pleasant change. Before doing anything to the Kit One it is essential to read the manual thoroughly.

Aside from the final interwiring and wiring components onto the valve bases, which is a little fiddly, the Kit One is a comparatively easy build and should not pose too many problems. Most of the resistive and capacitive components fit onto printed circuit boards, which makes construction and repair far easier than hard-wired designs. Audio Note has spent many years producing ready-built



products, and it shows in the step-by-step logic employed in building the amplifier. The mechanics are assembled first, followed by board stuffing and fitting, and final wiring.

But if it all becomes too much and you are overcome by solder fumes, Audio Note has a helpline, and offers a problem solving repair service which normally costs £90 unless you've done something really crazy to the amplifier. The Kit One can also be supplied ready built for an additional £330, which still ensures it is more than competitive, and also means that you can boast about your constructional prowess down the pub without ever having to wield a screwdriver.

All that glass does make the amplifier a trifle microphonic; however, the addition of a Base baseboard soon overcomes all traces of this, as well as making the amplifier considerably cleaner and clearer especially at the frequency extremes. This is no mean feat, as the Kit One is pretty good in these areas to begin with.

Eight watts of single-ended, Class A power doesn't seem like much, but partnered with a pair of sensitive speakers that aren't a taxing load, the Kit One breathes real life into any music it is presented with. In addition to the less than amplifier threatening Audio Note AN-E speakers, I tried it with a pair of the more difficult Jordan-Watts Aspect 1.1, a speaker intended more for use with 100W solid-state amplifiers. Although the combination wasn't a match made in heaven, the Kit One still performed more than adequately.

I confess to having the perfect room for the Kit One; it's small, with a pair of large and efficient speakers dominating one end. As such, I do not have to crank the system up far to get high sound pressure levels. I can

imagine that in a bigger room it could sound a little lost, especially if you like to play loud.

The amp has a tonal quality which is hard to pin down. It's very dark sounding, but not in a menacing way. The Kit One pulls a great deal from the recording, portraying the differences between individual records or CDs with ease. Playing around with an amplifier like this leaves all those usual hi-fi clichés behind, especially at the price. You quickly become embroiled in the music, whether it be a CD of The James Taylor Quartet, a tape of Handel's Messiah or an LP of Rage Against The Machine.

Even at its 'built' price, the Kit One is more than competitive. Other amplifiers at the

price may be able to separate out instruments better, others have greater 'detail' resolution, and plenty can present a more powerful, upbeat performance. Yet, after listening to the Kit One for several months, it lays almost everything else to waste, making most sound artificial, contrived



and 'hi-fi'. And although the amplifier does not pump out masses of deep, throbbing bass, it has one of the tightest and most rhythmic bottom octaves I've heard at this price. All in all, the Kit One disappears into an efficient system so effectively that, were it not for the warmth of the room and the glowing valves in the corner, you'd not even know that the beast was lurking there.

It's always rewarding to create something that works well, be it scrambled eggs on toast or the ceiling of the Sistine Chapel. The warm, glow of building your own amplifier will shine brighter than most, no matter how it sounds. As the Kit One is simple to build and sounds superb, I'm convinced that it will be warming up households for years to come.



Wilson Benesch turntable & arm

The vinyl LP may be in decline, but among those still playing records there's still plenty of interest in turntables, arms and cartridges. Even so, I wouldn't have predicted the launch of a new state-of-the-art turntable so late in the day.

Wilson Benesch, a new Yorkshire based company, still believes passionately in vinyl records. And while LPs may be widely perceived as low-tech and old-fashioned, the new £1,550 Wilson Benesch turntable and matching £950 ACT One tonearm are anything but.

The Wilson Benesch is very much a regular turntable and keeps faith with many accepted design principles like sprung subchassis, belt drive, synchronous motor, and so on. What is unusual is the use of an advanced composite honeycomb, resin-injected carbon-fibre laminate for the suspended subchassis. This special laminate is extremely stiff yet very light (just 286g), with self damping properties claimed to be some 100 times greater than most metals.

Wilson Benesch takes great care over the orientation of the carbon fibres to ensure maximum stiffness in the direction required. The result is a light but stiff platform to support the arm and bearing.

A low cogging Papst AC motor is used to drive the platter, powered from an external split-phase supply giving switchable 33/45 speed options. To help reduce the effects of belt stretch during start-up, an 'electronic clutch' powers the motor up gradually at switch on.

Despite this, start up is swift and positive,

**WHAT HAVE NINETIES
AEROSPACE TECHNOLOGY
AND NEEDLES IN GROOVES
GOT IN COMMON? JIMMY
HUGHES FINDS OUT.**

and the drive to the platter feels very solid too, the motor obviously having plenty of torque — just try slowing the platter with the side of your hand. The motor sits on a special sprung structure that helps eliminate vibration over

the length of the pulley shaft, and for extra precision each turntable is matched with its supply to a speed accuracy tolerance of 0.1 per cent.

The main bearing consists of a phosphor bronze housing, resin-bonded to the carbon fibre subchassis. The finely honed single point bearing itself is 100mm long, 12mm in diameter and made of D3 tool steel, turned in a computer controlled lathe. The inner and outer platter are made from aluminium with a polymer layer at the interface to improve mating and damping. A medium thickness felt mat is provided, and the lid is fabricated from glass.

Carbon fibre plays an important part in the ACT One tonearm too. The tapered one-piece arm tube and headshell is constructed from resin-injected triple-layer carbon fibre produced using a special pre-preg process. This uses fibres to which controlled quantities of solid epoxy resin have been added, before heat and pressure curing, giving much superior consistency to the old wet lay-up method, albeit at greater cost.

Interestingly, the fibres are orientated at 45 degrees to the length of the arm, the idea being to strike a compromise between beam strength and torsional stiffness. This arrangement was arrived at after listening, rather than on the basis of mathematical or computer analysis. The arm tube is fitted with



several light but stiff disc bulkheads, made from a foam material used to make missile fin cores, to reduce airborne feedback effects.

Wilson Benesch describes the ACT One tonearm bearing as 'kinematic locating'. It's a kind of uni-pivot arrangement: three captive balls sit in the bearing well, and a fourth ball on a stem that extends from the bearing housing, locates centrally on them. The main counterweight has two outrigger weights to assist accurate set-up alignment in all planes.

The bearing is arranged to be well above the very low centre of gravity, giving a very stable assembly that's free from the rocking movement that can afflict uni-pivot designs, rendering fluid damping unnecessary.

Sonically the Wilson Benesch turntable with the ACT One gives a very smooth open sound. It's detailed and articulate yet remarkably free from tonal glare or hardness. There's no lack of immediacy or bite, despite a high degree of refinement and control. I originally put this down to the arm and its non-metallic design, and subsequent measurements have confirmed the arm is remarkably free of break-up resonances. As a result, the sound lacks the added 'zing' and false brightness that many arms introduce. Using a variety of MC cartridges (Ortofon MC-10 and 20 Supreme, Clearaudio Gamma S, Lyra Parnassus), I got consistently good results.

I felt the sound was improved substantially by substituting a QR Developments Ringmat for the supplied felt mat; with this in place the clarity and stability of the turntable and arm could clearly be heard.

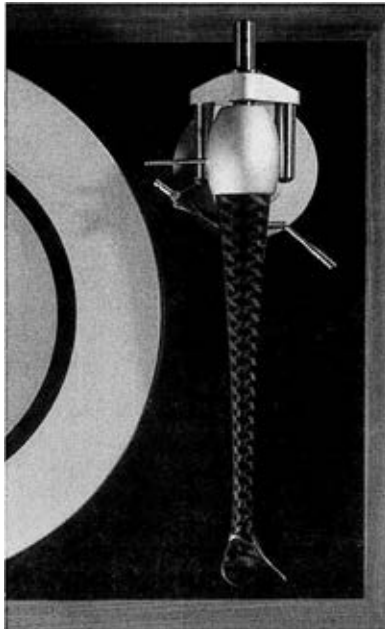
Speed stability is excellent, the overall sound having a CD like security and firmness, albeit with less tonal hardness and greater naturalness. Stereo imaging is wide and firm, the overall impression being one of solid, confidence-inspiring cohesion. Isolation from external vibration is good, and stability is enhanced by foam damping in the springs.

The bass sounds deep and tight, albeit less separated and dynamic than I'm used to from my Roksan Xerxes/Artemiz, where bass lines sounded more fluid and independent, almost as if balanced further forward in the mix. This could well be due to the decoupled counterweight on the Artemiz arm, rather than any difference between the turntables.

Initially I also wondered whether surface noise was lower on the Roksan, but now feel that the Wilson Benesch achieved a comparably high standard. Clicks and pops are low, though vinyl roar seems quieter on the Xerxes. The less forward sound of the WB helps minimise the nuisance value of noise by making it sound smoother and less tonally 'hard'.

Criticisms? As a user I bemoan the lack of a parking device for the arm; it's important to have something holding the arm safely in place while not being used. And I'd rather a lid that fully encloses the turntable — to keep dust and prying fingers away.

That aside, this is a fabulous unit that produces outstandingly clean natural sound. The heyday of the vinyl record may be over, but with turntables like this around the LP will never die!



The ACT One: top of the range materials and a revolutionary bearing. Whadda these guys want, a prize?



Marantz AX1000 Audio Computer

What can the audiophile who has everything do with £10,000? Apart from buying several hundred records, or

embarking on a comprehensive restructuring of the listening room, one could buy a Marantz AX1000. Why? Because the AX1000 is the first of a new breed of domestic hi-fi component known as an adaptive equaliser. That is, it has the capacity to measure a frequency response and automatically correct for it. So, in principle (ahem), you can now get a beautifully flat frequency response from your loudspeakers in your listening room, all thanks to digital signal processing (DSP).

Basically what engineering managers love to call a 'technology demonstrator', the AX1000 is a multi-function DSP computer which can perform an impressive array of functions with an audio signal. Apart from the room acoustic equalisation feature, it can tweak frequency response to taste as a parametric equaliser, add reverb (simulating a famous concert hall if you wish), provide movie surround sound, compensate for 'in-head' imaging of headphones, compress or expand dynamic range, suppress clicks, and carry out basic signal measurement functions.

It does all this by processing digitised audio, either fed from the digital output of a CD or DAT player or with an analogue input converted by an onboard ADC. Two independent DSP chips allow two functions to be carried out simultaneously, so you can, for instance, combine room acoustics correction with reverb generation. Since just describing all the functions available would fill this

TECHNOLOGY MEETS AUDIO
IN A £10,000 CLASH OF THE
DIGITS. RICHARD BLACK
SUPPRESSES HIS SCRATCHES.

review, what follows is necessarily a few selected observations on what seem to be the most interesting.

Flattening your room

Probably the most powerful feature is the room acoustics equalisation function. To do this it is necessary to measure the loudspeaker, room and system's frequency response. Conveniently, Marantz provides a decent quality AKG microphone to do this with. Plug it in, set the computer to 'Measure' (all functions are selected using the remote control, with the help of menus and instructions on the AX1000's colour graphics screens), and the system uses a pink noise signal to measure the response of each channel, then calculates coefficients for 14 digital filter sections to provide correction.

After ten minutes of number crunching, you end up with a response flat to within a dB or so across most of the audio band. The ATC SCM20 speakers in my room required up to 9dB of correction at low frequencies and 4-5dB higher up. The result? I have been in no doubt about the usefulness of a flat frequency response (all else being equal, as ever) since I heard Meridian's digitally equalised loudspeakers, and the AX1000 does make a noticeable difference in the lifelike reproduction of music. It may not be perfect (in fact measurements show its action to be quite crude), but it does improve things, especially in the bass where practically all small speakers could do with some help. Beware, however, of overzealous correction of extreme bass, which is likely to be a good way to blow up woofers and overheat amplifiers.



And expanding it

From the sublime (almost) to the ridiculous; who really wants the acoustic of the Royal Albert Hall in their listening room? And which seat in the RAH, anyway? Clever, perhaps, but pointless. But there is a more serious drawback with all the ambience control functions, which is that all add audible side effects.

Most obvious is a strange, grainy noise which fades up and then down again on the decay of a long held chord, as the DSP does its stuff. While this may not always be directly audible, there is no denying that all these functions thicken and confuse the sound a good bit before they add any very plausible simulation of ambience.

The headphone compensation is especially weird. It knows about six different makes of headphone including the Sennheisers I used, but it corrects their frequency responses to something I have trouble believing, and sends images (pretty much in the same way as 1970 vintage fake stereo did to some infamous LP reissues) all over the place.

Of the remaining functions, the parametric EQ seems to work well, but because the implementation is limited to local peak and dip functions its use is awkward and limited. It may be handy for correcting some oddball recordings, but it takes so terribly long to adjust it that most people simply wouldn't bother. The dynamic compression may come

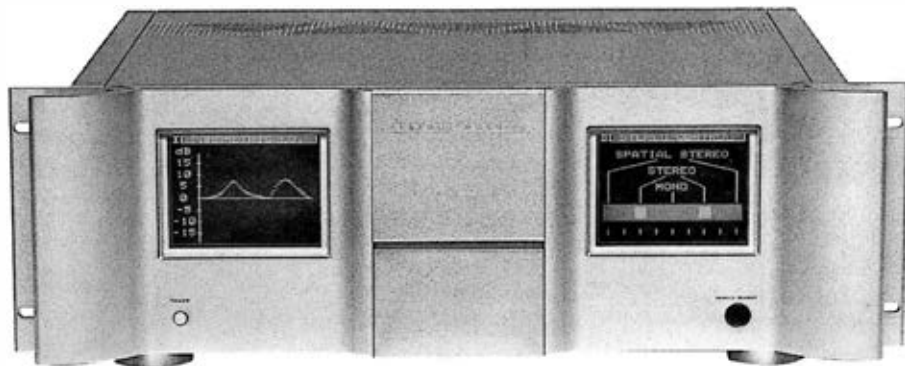
in handy for making tapes for the car, but the expansion function doesn't do anything worthwhile for Classic FM.

Scratch suppression proved another oddity; suppression depth can be varied from 0 to 100 per cent and I can't see why even at 0 per cent it should prove totally effective in eliminating a carefully made scratch across a test LP, as it did. However, on real-life LPs with a slightly scratchy surface due to careless handling and dirt, very little is suppressed at any setting, while music is accompanied by a sound somewhere between that of gently boiling water in a saucepan and someone tearing rags, depending on suppression level.

Conclusion

If, as I suggested earlier, one regards the AX1000 as a demonstration of what can be done, it's not really relevant that some of the features are not that useful.

What is disappointing is that the implementation, especially of the ambience functions, is not very successful. Granted the EQ functions seem competent, but even there the room acoustic correction only appears to correct amplitude response, without attention to phase, so the solution is far from total. As for the rest, and the (very good) DAC included, it all hardly seems to add up to the price asked. But it's a great toy and could prove both worthwhile and affordable in a couple of generations time.





ELECTROSTATICS ARE RADICAL

The original Electrostatic

PAUL MESSENGER LISTENS TO QUAD ESLs WHEN LYING IN BED, AND RECKONS THE WORLD'S MOST FAMOUS ELECTROSTATIC IS THE BEST VALUE SPEAKER AROUND.

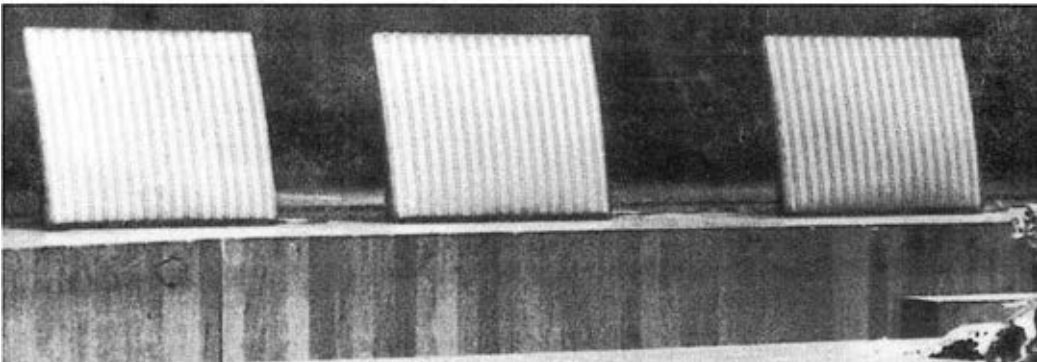
What's the best value in real audiophile loudspeakers? The same thing that's been the best value for the past thirty something years. A secondhand pair of old-style Quad Electrostatic loudspeakers. The second best value may well be two pairs of old Quad Electrostatics, which is something I'll return to much later.

Driving up Preston Street in Brighton the other Sunday, I spotted a pair in the window of a very small Sevenoaks Hi-Fi branch. They looked just the same as the pair I use daily either side of a bedroom TV, and which are also pictured on the front cover of my 1958 Hi-Fi Year Book.

Two weeks later they'd gone, sold for a very modest £350, to a man perfectly prepared to spend an extra £100 on the changing the

slightly damaged grilles, despite the fact that the performance had recently been refurbished back at the Huntingdon factory.

The original Electrostatic does need to touch base back at Huntingdon once every decade or two, just to cope with the ravages of time and dust, but Quad's rebuild charges are very fair and the company offers a same day turnaround, so you take the day off and catch up with the shopping in Huntingdon. International freight charges make it a somewhat less attractive proposition for those living outside the UK, but for anyone in this country, whose powers of discrimination lie way beyond their means, a pair of old Quads makes a logical partnership with the old Jaguar which rots much more rapidly parked outside on the drive. There must be nearly as many around too, because Quad sold



Imrat Khan and tabla player Sankha Chatterjee kickin' it Gayaki style with the aid of the world's most sophisticated PA system.



ELECTROSTATICS ARE RADICAL

54,000 examples over the 28 years of production between 1957 and 1985.

I last wrote about the Electrostatic about ten years ago, at a guess, probably on an IBM golf ball typewriter. Certainly I can't just pull out a disc to remind me what I said then, but some things don't change and this speaker still sets standards which most others can only hint at.

The much newer ESL63, its 1981 replacement and still in current production, now costs a much more considerable £2,860 new, with secondhand pairs trading at around £1,200-1,500. The '63 undoubtedly represents an improvement in certain worthwhile respects, but some audiophiles actually prefer the simplicity of the original, which remains an equally valid design.

It's not the universal panacea. No one loudspeaker is, and the peculiarities of Electrostatic are more extreme than most. There are very real limitations in this forty year design which some will find quite unacceptable, but which others may barely notice. There's also its aesthetics which were pretty bizarre back in the fifties, and haven't exactly matured with the passage of time. I've grown to quite like the appearance myself, partly because there's elegance in the way form follows function, but I'll concede that bizarre remains the most appropriate adjective after intrusive.

I'm not going to rabbit on at length about the sort of technicalities which would strike terror into the heart of even the successful VCR programmer. I do have to go a little below the surface, however, because how it

works translates into what it does well, what it does less well, and why it's so different.

Unlike nearly every other loudspeaker, there are no magnets, and nothing like the traditional cone or dome drive units. There's no enclosure for that matter either. Possibly the world's first AV-ready speaker uses an electrostatic rather than magnetic field, set up between two parallel perforated plates set very close together. This field acts a little like the permanent magnets used in conventional speakers, most obviously the area-drive panel designs of Magneplanar and others. In between the field plates is a light and very thin conductive film, not unlike cling-film, which is the diaphragm and moves to excite the air molecules which create the sound.

There are all sorts of interesting interlocking constraints which define the practical performance envelope. The plates have to be close together, so the available to-and-fro distance the diaphragms can move (the excursion) is very small, while the electrostatic field strength is limited by the (not very) effectiveness of the air as an insulator. The film-type diaphragms are lighter than the proverbial feather, which gives good mechanical coupling to the air, and also ensures that the air provides good mechanical damping of the diaphragm.

The Electrostatic actually uses three diaphragms: two bass ones, roughly 32x65cm placed either side of a central high frequency panel, roughly 15x65cm, which adds up to a total panel area of approximately 5000cm². This is mounted in a substantial wooden





ELECTROSTATICS ARE RADICAL

frame which is open at front and back, albeit with felt damping material built in behind.

The whole thing is then wrapped in a quite rigid expanded metal grille, to protect the dust jackets and plates from prying fingers, and protect prying fingers from the kilovolt electrostatic charges lurking inside. (Don't worry; even if you were to dismantle it and give yourself a shock, you'd survive the experience; we're talking only about charge, not current which is negligible here.)

What we therefore have is a large ultraviolet diaphragm area, left open back and front, which is very different from mounting two point-source type conventional drive units in a wooden box. The conventional loudspeaker enclosure has two functions, the main one being to stop the vibrations from the back of the main driver from cancelling with the opposite phase vibrations from the front. Sealed box enclosures are often referred to as infinite baffles, because the mounting board or baffle is wrapped around to form a box which completely cuts off front from back (and adds all sorts of horrible distortions of its own of course).

The electrostatic, however, is a finite baffle — a flat (okay, gently curving) source of soundwaves. Because it's not infinite, the front and back do cancel, but since the baffle is quite wide this only happens at quite low frequencies. Practically speaking, the Electrostatic will give an in-room response down to 50Hz, but that's your lot. As a matter of physics, you can't get really deep bass from an Electrostatic (although you can always play around with adding subwoofers).

It is also known as a doublet or dipole, and creates virtually the same sound behind as in front, and very little at all if you're edge-on. The speaker is almost sonically transparent: place one in front of another speaker or sound source and it provides very little attenuation or distortion. The down side of this arrangement is that the rearward radiation bounces straight off the back wall of a room and comes back, delayed and out-of-phase to try and cancel the wanted sounds

from the front of the diaphragm. The only answer is to keep the Electrostatic at least three feet — or preferably as much space as you can spare — away from the wall. (However, because dipole operation nulls side-on soundwaves, you can place them quite close to side walls.)

Another vital consequence of the panel diaphragms concerns the treble. Physics dictates that the distribution of sound from a source depends upon the dimensions of the source and the wavelengths being reproduced. Radiation is omni-directional (like a lightbulb) when the source is smaller than the wavelength, uni-directional (like a headlamp) when the source is larger than a wavelength. (There is of course a transition between the two, but let's not go into that.)

The Electrostatic treble panel's width corresponds to around 2kHz and its height to around 500Hz, so most of the treble comes out in headlight mode, beaming the whole range directly towards the axial 'sweet spot', while short-changing listeners off to the side but especially above and below the main forward axis. The concentric ring panel system of the ESL63 does much to overcome this problem, leaving the earlier Electrostatic a rather more selfish option — but have audiophiles ever been otherwise?

The other side of the directivity coin, however, is that ratio of direct to reflected sound is greater than usual. This is the opposite side of the Bose direct/reflect concept or the Jimmy Hughes approach (see *Perspirations*), and means that the influence of the room is minimised, which may or may not be a good thing, but which is certainly a valid and distinct characteristic. It may also be one reason why the Electrostatic experience has something in common with headphone listening.

The story so far gives us a large, ungainly and bizarre looking loudspeaker without any really deep bass that has to be stuck halfway out into the room. Hi-fi nuts have to suffer for their art. There are other demerits too. Sensitivity is low (though not in practice quite



as low as a 1m axial measurement implies), and power handling is pretty limited — you can have about 30V peak-to-peak before it sparks and punches a tiny hole through the diaphragm, which is OK once in a while but not something to keep on doing. (One bemused listener thought he'd been shot when I managed to arc all four of a stacked pair arrangement, in perfect synchronisation with a recorded gunshot.)

It don't go loud, and it ain't got welly, so what's all the fuss about? For that, you'll have to find a pair (the relatively difficult part), and listen to them. It should then only take about five seconds for the penny to drop. Nothing handles human voices better, and the overwhelming majority of loudspeakers don't even get to first base by comparison. Which matters a lot since the voice is our most powerful medium for expressing emotion.

Living with a pair of Electrostatics — or even two pairs in stacked mode, which I did for a while, many years ago — is an extreme experience. Extreme delight, at the extraordinary coherence, delicacy, focus and transparency of probably the best midband in the business. Extreme frustration because the extreme bass and treble doesn't match up to the midband, and because it won't go loud enough. Adding the extra pair will give 3dB more level, but at some expense in stereo precision (not to mention aesthetics).

Why do voices sound so good? I don't know exactly, but I suspect several factors contribute, notably the excellent phase linearity across the broad midband thanks to

the co-planar diaphragms, and also the absence of any internal box colorations. And although you don't get the sort of dynamic drama that a horn system can provide, the midband dynamic range — the ability to render detail well down in the mix fully intelligible — is quite superb. Whatever the reasons, the end result is always fascinating and highly involving, with a seductive combination of sweetness and intimacy.

The bass is a little flabby, trading a bit of midbass excess for true extension, but even this section is more informative than most, the panel resonances somehow being less intrusive than the enclosure/port resonance of a box loudspeaker. The extreme top end is also a little untidy too, but how intrusive this is seems to vary between individuals. My middle aged ears find it quite tolerable, but I know those who find it a little uncomfortable.

However you stack up the pros and cons, the original Electrostatic is undoubtedly a very addictive brew. Serious enthusiasts have been known to carry out modifications like leaving the grille off and/or removing the damping material, which is maybe acceptable if you've created an animal/children/char-free zone, but should be treated with due caution in my opinion. Those who become obsessed are welcome to experiment, but the complete finished and unmodified manufacturer's package remains a remarkably well balanced compromise overall. Now I've got to figure out how to balance the best AV dialogue speaker yet invented on top of the television.



The original Quad ESL and its creator Peter Walker with the 1978 State of the Art award from Stereo Sound.



EVERYTHING AMPLIFICATORY REVEALED

The amplifier evolves

PAUL MESSENGER BRAVELY ATTEMPTS A COMPREHENSIVE APPRAISAL OF THE AMPLIFIER.

The historical perspective gives clues to the how and the why things are the way they are today, which is helpful when change has been as rapid and as sweeping as the fifty or so years of post war hi-fi. Were he or she to step back in time, the current hi-fi enthusiast would be bewildered by the limited resources at his disposal in the forties, as the microgroove (LP) record, compact disc, FM radio, nor tape recorder had yet been introduced. The 78rpm shellac disc and AM radio were strictly mono.

Hi-fi in those days was very much a technical hobby, frequently appealing to the same sort of person who was into amateur radio. And with no specialist hi-fi shops as such, apparatus was almost entirely home built, often using valves and other components from the government surplus stores that gathered around London's Tottenham Court Road and Edgeware Road.

As often as not, the most famous designs of this period existed primarily as printed details of circuit configurations, originating from the valve manufacturers or legendary engineers such as DNT Williamson. Indeed, since much of the 'art' in valve amplifier design was vested in the construction of the output transformers, transformer manufacturers like Partridge were as well known as those who assembled complete amplifiers.

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, 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.

Outlandish dimensions gradually shrank with advances in transformer, valve and circuit design, but the advent of stereo in the fifties was a major setback to the domestication of the amplifier, because most of it needed to be doubled up. By this time most designs consisted of two units: the power amplifier/power supply, and the preamp, the latter drawing its power supplies from the former. 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 preamp, or to use a stereo power amplifier with both channels sharing a common power supply for economy.

Keeping pre and power amplifiers separate remained de rigueur for the serious enthusiast, as it still is today. But the popular end of the market was moving towards total integration, made feasible by smaller transformers and improved circuit efficiency, though not



without some compromise.

The transistor appears

Thirty odd years ago the typical 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, helped by falling real prices and rocketing sales of the stereo LP in the Beatles era, plus the introduction of stereo FM radio, while manufactured product overtook the home-constructed type in popularity.

At least until the last couple of decades, and to some extent still, the hi-fi business has insufficient commercial clout to warrant the high cost of developing its own dedicated electronic components. Most of the devices used are the crumbs from the table of radio, military, computer or telecommunications applications. These are adapted to hi-fi use by the ingenuity of the designers, but long-term developments remain 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 audio use, being fundamentally no more than a convenient electronic switch. However, switches are very important in electronics as a whole, and its potential for reliability, longevity, simplicity of mass production, and low voltage operation, were sufficient to divert nearly all research away from thermionics (valves). Indeed at the end of the forties prototypes existed of low voltage 'cold' valves which might have heralded a whole new generation of thermionics, had not the transistor appeared and usurped the development money.

It was the mid-sixties before the transistor really became a hi-fi force to be reckoned with — and thirty years on it is still scorned by many serious enthusiasts. The earliest transistor amps (like the Leak Stereo 30) certainly didn't match the sound quality of contemporary valve equivalents, but were so much

more domestically acceptable that they became a great commercial success.

First and foremost transistor amps run comparatively cool, avoiding the extremes of temperature that valves share with light bulbs, which reduces their working lives compared to transistors or fluorescent tubes. Running cool also allows greater siting flexibility and reduces the need for ventilation.

Second, the transistor amp is more compact and cheaper to make than the equivalent valve amp. Particularly when comparing power for power, mainly because output matching transformers need no longer be used. Leak's Stereo 30 transistorised integrated amplifier was very little larger than the company's valve stereo preamp which was being manufactured at the same time, and which needed to be used with even bulkier power amplifiers. Similarly the 45watt per channel stereo transistorised Quad 303 power amplifier was a similar size to the 15watt mono power amps it replaced.

Third, the transistor amplifier arrived about the same time that the low output magnetic cartridge had established a firm foothold, and the mid-sixties transistor amplifier caused less hum and noise problems than the valve equivalent. Finally, the transistor is much less subject to the gradual ageing process that has always plagued valves, and by and large its performance will not change much over 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 numerous implications of the sweeping changes they were making. 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 an attack on transistor amps per se. Rather it is a cautionary tale to illustrate the unfortunate way that fashion and commercial pressures tend to dominate the hi-fi marketplace, not always in the interests of the consumer. The lesson from history is that a ‘breakthrough’ in technology usually acts against the best interests of the user first time around, because many of the attendant problems are overlooked. The second and third generations usually turn out to be far safer bets, particularly as lower fashion status also results in a lower price! Witness the introduction and subsequent evolution of CD players.

Undoubtedly one reason 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 potentially rather nastier overload problems.

A similar state of affairs was repeated twenty years later in the introduction of the digital compact disc format. This was developed according to technical specifications that seemed more than adequate, and ought to have performed significantly better than the existing analogue formats. In practice, and despite ten years of CD development, top quality vinyl replay remains comfortably superior in important respects. History does indeed repeat itself.

Even though some die-hard enthusiasts might disagree, the transistor amp was a godsend from the point of view of turning hi-fi into a mass market consumer product.

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.

The amp receives a rival

At around the time that the integrated transistor amplifier was gaining a foothold, another form of integration known as a receiver was also starting to appear, combining a complete amplifier and tuner in the same case. This combination was particularly successful in the USA, but also did well in Britain at the time because of its compactness and a price saving of about 20 per cent over equivalent separate tuners and amplifiers (thanks to costs saved on power supply, transport and casework etc).

Despite a fair amount of success through the late sixties and the seventies, the receiver almost faded from the scene in the eighties. As the distinction between ‘real’ hi-fi separates and packaged systems widened, it suffered from a lack of credibility as an ‘in between’ product, perceived as a compromise by those buying hi-fi separates, yet without the complete package of integration of a music centre (complete with record and cassette decks) or the styling coherence of a stack system.

The receiver never quite disappeared from the UK scene, and has recently started to make a bit of come back via the AV surround sound scene. These AV receivers are rather different animals from their predecessors, due to the extra power amplification and AV processing functions, so comparisons are barely relevant. And the tuner stage in today’s receivers tends to be regarded very much as an afterthought, worth less than £50 of the total price and performing no better than those fitted to packaged mini systems.

Ultimately, the receiver lacks flexibility. If one decides to improve either amp or tuner, you really have to change both at once. There’s no control over the relative proportions in which the money has been spent



EVERYTHING AMPLIFICATORY REVEALED

either. As the various products have evolved over the years, so the receiver has fallen quite a long way behind the performance of separate tuners and amplifiers.

Revolutionary times

The mid-sixties arrival of the transistor and the receiver were two harbingers of a major revolution which took the hitherto cozy hi-fi hobby by the scruff of the neck, turning it into a mass market consumer electronics phenomenon in a few short years.

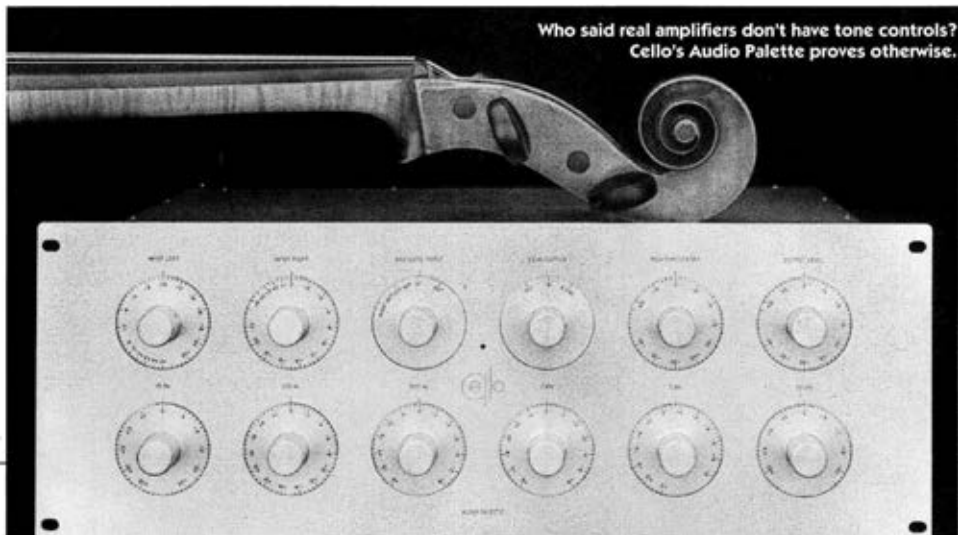
The early seventies found hi-fi sales booming like never before (or since!), almost total transistorisation, a handful of separate pre and power amp combinations and rather more integrated designs, plus a burgeoning of receivers. The quality of the actual electronic devices continued to improve and/or get cheaper, but most of the changes had more to do with fashion and marketing than any particular desire to improve the breed.

With a strong UK market, our domestic manufacturers introduced a number of imaginative and refined designs which continued to try and make the amp as small as possible. However, the market as a whole seemed to equate size with potency, and compaction beyond a certain point gave diminishing commercial returns.

The really crucial change was that Japanese brands, which only started appearing in the mid-sixties, simply took over the UK market. At the beginning of the decade brands like Goodmans, Leak, Armstrong and Rogers were at least on a par with Sansui, Trio, Pioneer, Sony et al. By the mid-seventies Quad was practically the only British amplifier brand left. (Companies like Arcam, Naim Rega and Linn had barely got started.)

It's a classic case history of British commercial bungling, as much to do with government as industry incompetence. 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 Yen was standing at more than 500 to the pound, and the cost of labour was low then too. Its electronics industry, already large from international transistor radio successes, discovered that the Japanese consumer was an avid purchaser of hi-fi equipment. This provided a home market





similar in size to the US market or the whole of Western Europe, giving enormous economies of scale and enabling the industry to respond quickly to specific local changes in demand anywhere in the world. The products themselves succeeded less perhaps on the basis of technical or sonic superiority than due to a reputation for excellent reliability, alongside a marketing professionalism which appealed to the less technical hi-fi dealer that was appearing.

It may not be immediately apparent why they achieved such a dominant position so quickly at the expense of so 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 allow a month's 'period of grace' before this came into effect was a piece of fiscal lunacy from which the market has never fully recovered. During this month approximately twelve months of normal business was done by seriously harassed retailers. There was no way British manufacturers could react to meet this twelve fold increase in demand, and some merely acquired a reputation for poor reliability 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 three containers of equipment a day).

This extraordinary route to a tax increase pre-empted the best part of a year's business, and it's 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 in the aftermath, the slump barely registered back at the giant Japanese manufacturing plants, because

for them it was a distant and isolated event.

In the immediate wake of this boom/slump the Japanese 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 became a significant market trend.

The eighties saw the market split into two different camps. Some consumers followed the Japanese-led trend towards greater complexity that was established at the start of the seventies, and which was to achieve its zenith in the quadrophonic debacle of the mid-seventies (about which the least said the better). Others, perhaps in reaction against this overt consumerism, but also because it became increasingly understood that simplicity in the signal path improved the sound quality, opted to go the other way entirely, even to the exclusion of tone controls.

This trend towards simplicity was by no means just a British phenomenon. Mark Levinson in the US as well as Naim in the UK attracted widespread derision by ditching tone controls, yet can now be seen to have set a lead which many others would subsequently follow.

From a 1994 perspective it's difficult to believe that none of the leading British amplifier brands (bar Quad) existed before 1970. Naim and Linn got going at the beginning of the seventies, Arcam, Mission, NAD and Meridian towards the end, while Audiolab, Musical Fidelity, Roksan and Audio Innovations all started up in the eighties.

By the late eighties these small, young British amp manufacturers with their stripped-down, sound quality oriented designs were threatening to take over from the bells-and-whistles Japanese stereotypes. So much so that Japanese brands, led by Rotel and Pioneer, have recently responded with their own 'stripped down' audiophile oriented models at close to mass market prices — and with considerable success.



The late seventies also saw the emergence of a third philosophy, based on rejection of the transistor in favour of a return to valve technology. The initial surge of interest seemed to peter out in the early eighties, but has come back with quite a bang over the past five years in particular.

The status quo today finds a market of considerable and fascinating diversity, well illustrated by those assembled for review elsewhere in *The Ear*. Sales are still dominated by the integrated, transistorised 430mm wide black box stereotype, but probably one with less features and a lot better sound than its predecessors, and as likely as not with a British rather than a Japanese brand name.

But above and beyond budget and mid-price basics lies a wealth of choice in presentation and performance which covers a much wider range of options than at any time in the past. The evolution of the marketplace itself is proof positive that important sonic differences do exist between rival brands and philosophies of hi-fi amplification, and that customers are prepared to pay a premium for superior sound quality.

The role of the amplifier

There's no doubt that the amplifier forms the heart of the hi fi system. Lose one of the other components and you probably still have a spare source, a single loudspeaker or headphones with which to listen. Lose the amplifier and the system is silent.

Its job, quite simply, is to accept signals from a variety of different sources, process them as required, and then amplify them sufficiently to drive loudspeakers. 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, and why a particular model includes or excludes these facilities.

Every amplifier consists of three basic 'building blocks', namely the preamp, power

amplifier and power supplies. These are normally combined together in the same box and called an integrated amplifier, but some designs, for either technical or fashion reasons, separate them into a variety of separate box configurations.

The preamp section contains the various signal inputs and their switching circuitry, extra signal processing stages (eg vinyl disc inputs and tone controls), plus output signals to feed tape recorders and separate power amplifiers. Having converted the different input signals to a common level, these are volume and balance controlled before being fed to the power amplifier stage.

The power amplifier section'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.

However they're packaged, the power supply or supplies are really an integral part of the other components and should not therefore be considered separately at all. Their job is to supply the right amounts of electricity in the right paces — and to do so at the right time.

The preamplifier

The modern amplifier has to accept signals from a wide variety of different sources, nearly all of which put out approximately the same sort of output, known as a 'line level' signal. The one exception is the vinyl disc record player's pickup cartridge, which requires very different and much more elaborate preamplification, including considerable extra gain and complex equalisation (see page 36).

Now that CD has supplanted vinyl as the prime source for many hi-fi users, a number of amps and preamplifiers which leave the vinyl disc stage out altogether, or offer it as an optional extra at a higher price, are appearing. However, a line-only amplifier doesn't preclude the vinyl option, due to the growing availability of separately packaged (and power supplied) dedicated vinyl disc stage only amplifiers, whose sole task is to



convert the output of a pickup cartridge to the necessary level and characteristic for any preamp line input.

What this means is that the preamp's main function is now simply to select between a number of inputs and provide volume and balance control. Some enthusiasts have adopted the extreme purist approach of making the entire operation passive (ie unpowered), using two top quality volume controls (one for each channel) and high class switches, in order to keep the input signals as clean and undisturbed as possible en route to the power amps. This minimalist approach is a godsend to those who like to roll their own hi-fi, and has a strong philosophical appeal to the purist, but flexibility is limited and results can vary somewhat unpredictably according to the other components used in the system.

The opposite side of this coin is the increasing availability of remote control operation among the current crop of amplifiers on the market. This is spurned by purists, and difficult for the smallest companies to implement. But we've all become so used to remotely controlling video recorders, television sets and CD players that to have to get up to change volume or select an alternative input seems to become increasingly and unacceptably tedious.

Although hi-fi enthusiasts seem to prefer the minimalist approach to preamplification, and are happy to sacrifice flexibility and convenience for the sound quality benefits of simplification, there are plenty of models around which offer various extra functions and features to tempt those who prefer to buy with their eyes rather than their ears.

Although multi-band equalisers have never achieved much popularity here in Britain, remaining a largely American phenomenon, basic bass and treble tone controls are still fitted to the majority of amplifiers. However, the high quality of modern source signals often renders them redundant for much of the time, while their inclusion costs money

and tends to compromise quality at the same time.

Vinyl disc replay

The vinyl disc pickup input should be designed around the signals it receives from a cartridge. Until the mid seventies this was almost invariably a moving magnet (MM, also known as a high output) type, with a typical output level of 1mV/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 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.

The fly in the disc input ointment, however, is the moving coil cartridge (MC or low output in the jargon). This normally produces a much lower voltage output than the moving magnet type, and consequently needs special treatment. To confuse the issue there are a number of high output MC cartridges about which are intended to work normally into any standard MM type phono input; but the majority, however, need about 20dB of extra gain.

This is often available within the preamp section of the amplifier, either as an addition or alternative to the standard MM phono input. Valve preamps rarely attempt direct amplification of low output moving coil signals, because of noise problems, preferring instead to use a booster/impedance matching transformer to bring MC up to MM levels.

Since the mid-eighties dawn of the digital CD age there's been a small but growing trend



towards preamplifiers with only line-level inputs — and a complementary supply of standalone phono stages to fill the vinyl replay gap, often with considerable effectiveness. It's slightly ironic that the last dozen or so years has seen top notch moving coil phono stages incorporated into and then gradually moved out of high end preamps; a full analogue circle.

The very nature of the phono cartridge is a mechanical miracle that has no right to work at all, and succeeds in doing so by mechanical 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. The major difference between the pickup and the other types of signal an amplifier has to deal with is that neither the bandwidth, nor the behaviour outside the required bandwidth are accurately known or predictable. The preamp 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 roll off, 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. Placing such a resonant circuit at the top end of the audio band isn't a very good idea from a sonic point of view, but it does at least

ensure that the amplifier's disc input doesn't receive any potentially embarrassing ultrasonic signals.

For a number of reasons, mostly to do with improving sound quality and performance predictability, many of today's cartridges — including, by definition, all moving coil types — are low inductance types. A good amplifier may well sound better when fed such a wide bandwidth signal, but the vinyl disc stages of budget models tend to be more unpredictable and compromised.

The phono 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 (such as impedance and capacitance) are not standardised, and yet can affect the performance of the system; and the absolute content of the signal in terms of bandwidth and amplitude is not precisely known, which could cause overload or slew limiting problems.

Tape in/output

Cassette tape recorder should be connected to the amplifier so that it can replay tapes via the system, and also record any of the signals being fed into the amplifier's other inputs, such as tuner, CD or vinyl disc — an added complication which can become quite confusing, especially if two tape decks are in use, and dubbing between them is required. The tape deck therefore needs four leads





instead of two: one pair carries the record output signal from the amplifier; the other the replay signal back to the amplifier.

There are a number of different ways of doing this, but by far the most common links the record output signal to the amplifier's input selection switch. If CD is selected, then the signals from the CD player are sent to the recorder as well as being amplified. The record out signal is taken off prior to the volume and tone controls of course, so you can still listen to the system at whatever volume you like while sending a consistent level signal to the recorder.

Some of the more upmarket cassette (and reel-to-reel) decks have a very useful feature called off-tape monitoring, which allows the quality of a recording to be checked while it is actually being made — a very handy way of avoiding later disappointment. To accommodate this feature, most amps use a 'tape monitor' switch, separate from the main input selector and often a simple pushbutton. Selecting tape monitor mode overrides the input selector so that the amplifier reproduces whatever is coming into the tape input sockets instead, though of course the input selector setting is still responsible for determining which source is being sent to the tape recorder.

CD input

Increasingly the most important input on a preamp these days is the one marked CD. In basic terms this is merely a line input like any other, and can indeed be just that. But because CD is the prime source for many hi-fi users, various extra precautions are often used to extract as much as possible from this particular input.

The search for the ultimate CD sound quality has led many audiophiles to experiment with ditching the normal powered preamplifier altogether, in favour of a passive (unpowered) preamp which merely consists of volume controls, selector switch, inputs and outputs. The advantages and disadvan-

tages of passive or active preamplifiers are the subject of fierce debate in esoteric hi-fi circles. There are even those who claim that using active preamps with integrated amps can improve matters. The answer probably depends upon the characteristics of the rest of the components in the system, and the personal taste of the user.

What is certain, however, is that there's rather more to a line input than appears on the surface, a fact proved by the variance in sound quality and price of line preamplifiers. Various factors affect the sound of line inputs but the primary ones are circuit design and topology, component quality, switching facilities and the amount of gain applied. Component quality is obviously a major factor influencing the price, but the other elements are down to the designer, and these are what create the sound differences between similarly priced products.

Volume control

The most important control on the preamplifier adjusts the volume level. So it's ergonomically desirable that it's easily accessible and readily identifiable. It's also important that volume can be adjusted over a very wide range, without significant shifts in channel balance.

A curious and totally unfounded 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 specific signal when the volume control is only halfway, increasing it above this point will only drive the system into distortion. The second half of its travel is therefore entirely wasted while the usable part of the range is



unnecessarily cramped, and a small amount of movement results in an undesirably large 'jump' in volume.

The ideal volume control should cover a range of at least 60dB, and do so evenly in order that similarly sized rotational steps result in similarly 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 very low levels. It is fashionable in some parts to use volume controls which mimic the action of professionally used 'attenuators', so that their operation consists of a series of steps. Cheap detent-action potentiometers which merely add a mechanical cogging action to a conventional continuous potentiometer can be a real pain, often making problems that can be heard at low volume levels significantly worse. Proper hard-wired pro-style switched attenuators are probably the best technique of all, but they're very expensive and rarely found on commercial products.

One useful technique that has been 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. This type of mute switch can therefore be 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, and arguably an undesirable addition on purist sound quality grounds.

The balance control

The final almost-essential is the balance

control. This is required to adjust the relative loudness of the two stereo channels, which can be useful in a number of circumstances. It's not likely to be needed very often, and some purist designs leave it out altogether, but it can be handy in various roles: compensating (more or less) for an off-centre stereo listening seat; 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; and compensating for volume control 'mistracking' (ie channel balance shifts), especially at very low 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. A great many balance controls are also fitted with a centre-indent, which 'clicks' at the centre position.

Other inputs/outputs

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.

The switching used to connect and cross-connect two tape recorders might be useful, since many people have probably now accumulated more than one recorder. However, in practice the full cross-connect flexibility is often unnecessary, since only the better of two decks is likely to be used to record from the other, while those who plan to do lots of tape copying are probably better off opting for a twin-transport cassette deck. Cross-



dubbing is normally accomplished using an extra five-position rotary switch, which does add to the complexity as well as versatility of an amp.

Another tape routing method allows the signal being sent to the recorder to be different from the one which is being replayed via the loudspeakers. 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, for example, enabling a radio broadcast to be saved for later while you're spending the evening playing records.

A 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.

DSP

Rarely yet found on serious hi-fi stereo amplifiers, digital signal processing (DSP) techniques are used extensively in multi-channel AV amplifiers and processors. Either as part of the decoding of movie soundtrack surround information, or to emulate the acoustic characteristics of certain environments and generate surround sound effects.

When used in the context of multi speaker surround sound set-ups the DSP effect can be quite striking, though whether it furthers the state of the art or even enhances the listening experience with purely music sources is open to debate. It's interesting to note however that several fairly serious hi-fi companies are experimenting with DSP, and obviously feel that there is some scope for increasing standards of fidelity. What's more, unlike CD, it's not restricted to a particular standard.

The power amplifier

The power amplifier has the supposedly simple task of driving the loudspeakers with the signal it receives from the preamp. 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. We're not about to launch into a jargon-ridden treatise on electronics, but a brief examination of the relationship between electricity and hi-fi will help establish a perspective on some of the controversies surrounding amplifier design.

Electricity is concerned with the movement of sub-atomic 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 all about the storage or reception and reproduction of 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. One of the most useful techniques in this task involves 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 entirely mechanical systems like the early 'pre-electric' gramophones, or even use fluidics; electronics is merely the easiest medium in which to work.

Household plumbing provides a good example which helps explain some basic electrical concepts (although the parallel should not be taken too far). When water flows through a tap, two considerations (or 'param-



EVERYTHING AMPLIFICATORY REVEALED

eters', 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

The analogy becomes rather more hazy when considering how one actually 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



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

completing a circuit so that a voltage difference is set up 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).

With the more complicated alternating signals used in audio, the simple concept of resistance becomes the more complex impedance, which includes two rather more awkward loads known as 'capacitance' and 'inductance'. These are similar to resistance, but their behaviour depends on the signal-



frequency, 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 these complex loads make the situation much more difficult to understand, it's actually just as well that they exist, because much of electronics is based on tinkering with their properties.

So far we have examined electricity rather than electronics, yet the distinction is an important one. Indeed confusion is created because certain aspects of hi-fi engineering involve electrical engineering, while others are rooted in electronics. In a nutshell, electrical engineering is concerned with using electricity as a form of energy; electronics is to do with using its properties in, for example, signal processing and control functions.

Electrical energy is concerned with quantities, so the electrical current is as important as the voltage, but with electronic signal processing current plays a minor and usually quite insignificant role; the signals are normally modelled by the voltage, and the circuitry is kept at high impedance to avoid the inconvenient heat and magnetic fields that large currents generate.

However, to get down to power amplifiers at last, their essential task is to deliver energy to the loudspeaker, in order to recreate the audio signal from the 'voltage model' that has been passed through from the preamp. Ensuring that the output voltage corresponds to a magnified version of the input voltage without significant distortion is the part of the problem that attracts most attention, because it is in the more familiar field of electronics, and because voltage is much easier to measure than current.

Having presented this voltage to the loudspeaker, it's the speaker which decides how much current must be supplied at any instant in time. And the current which is drawn will correspond to the instantaneous voltage and

impedance at that time. Here we encounter some controversy between designers, over exactly what the impedance of a speaker is, in order to decide what the amplifier has to do to drive it accurately.

Those who read the loudspeaker reviews in *Hi-Fi Choice* will be aware of curves which show 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' does to some extent represent the resistive load of the speaker, and hence the current that will be drawn in response to any particular voltage, it is also an oversimplification which doesn't take full account of out-of-phase capacitive and inductive components. Nor is any allowance made for the dynamic, transient interaction of speaker and amplifier under complex music signals, an area which is still only partly understood.

Power supplies

Many successful amplifier designers consider that power supplies comprise the most important single part of any design. Indeed one could describe an amplifier as a power supply connected to a loudspeaker, with the audio signal processing controlling this supply rather like a tap controlling a flow of water. A variety of different design approaches exist, 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 power 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 shortfall 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 (one for each channel) 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 other factors come into the picture. The most important is that two supplies will inevitably cost nearly twice as much as one. Furthermore, music consists of peaks rather than averages, and the smaller separate supply may be less capable of providing voltage or current peaks than a bigger shared supply.

The twin power supply may offer certain advantages in reducing interference between channels, but is also likely to reduce the peak power capability of the amplifier. 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 they could be with a similar unregulated supply, so a higher capacity will be needed to obtain equivalent peak performance. There's also the extra cost of the regulating circuitry to consider.

The power supplies' functions are to provide the required current and voltage at every stage of the amplification, in such a manner that all points of supply remain independent and 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 preamp current handling and loudspeaker transient current requirements. Those designers who emphasise both the subjective performance of 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.

Reviewing amps: the pitfalls

There is no component more difficult to evaluate than the amplifier. Two quite opposite schools of thought exist among designers, the problems coming down to choosing the criteria that are relevant for design or evaluation. Here the reader will have to make some effort to establish his or her own criteria, rather than merely taking the reviewer's, or his critic's, word 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. The 'objectivist' point of view 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 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 is its power capability in relation to price, one's loudness requirements and loudspeakers, and the features and facilities that are needed.

The alternative, and increasingly accepted 'subjectivist', stance proposes that amps are a long way from 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. The situation remains controversial because current methods of subjective assessment tend to be unreliable, while objective measurement techniques cannot be relied upon to give results which properly correlate with claims for sound quality either.

Choosing and using an amp

How does one set about choosing an amp from the plethora of models 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 end result.

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?' Provided one is reasonably careful, it is probably true to say that there is no such thing as too much power, but addressing three questions will give a more useful and meaningful answer.

How loud do you like to play music? How large is your listening room? How sensitive are your loudspeakers? The first will depend on personal taste; the second on circumstances, so we may as well consider an average room of say 80 cubic metres; the third can have the most marked effect of all.

Across the broad range of available loudspeakers in one of our surveys there can easily be a difference of as much as or 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 much as 40 watts to achieve a similar level.

This in turn means that lower sensitivity 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). Fifty watts or so is likely to leave sufficient in hand for the 'average' situation, but if sensitive speakers are used 20 watts may be more than ample.

If you start to find even more powerful (100 watts per channel or more) amplifiers beginning to strain with insufficient 'headroom', using more sensitive speakers 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 higher levels; simple specifications give no reliable indication of whether a combination will sound good at high levels.

When choosing an amp it obviously makes sense to check that the inputs provided are going to match your other equipment adequately, and the outputs for tape, headphones, and, most importantly, loudspeakers likewise. Genuine input incompatibilities are fortunately very rare, and usually it's sufficient to ensure that there are enough line level inputs to allow for some future flexibility if the need arises.

However vinyl disc users should take a little



more care to ensure that the amplifier input provides a good match for the chosen cartridge (or vice versa). In the first place cartridges fall into two main groups, high or low output (sometimes referred to as MM or MC respectively). Most vinyl ready amps cater for the high output variety, some offer the high/low option, while

others go for either/or, sometimes with the ability to make internal adjustments if requirements change.

Physical appearance is an important factor too. This may be prejudice, but I sometimes wonder whether the matt black monster that sits among its brethren on the shop shelf is very well suited to blend in with lounge decor, or merely slavishly following the stereotype. 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.

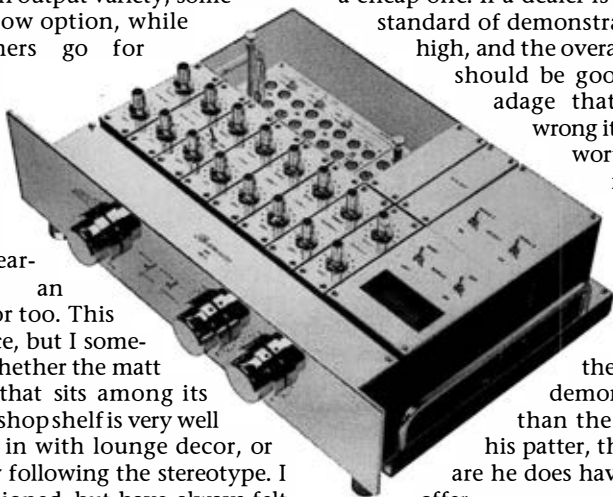
It therefore seems a pity that the average customer gets little alternative to 430mm width and bible black finish — though to be fair, few attempts to break the mould have been notable commercial successes. However, the more adventurous will find that British manufacturers, most of whom are small enough in scale not to be designing for a global mass market, offer a much wider variety of different styles and finishes than the larger Japanese brands.

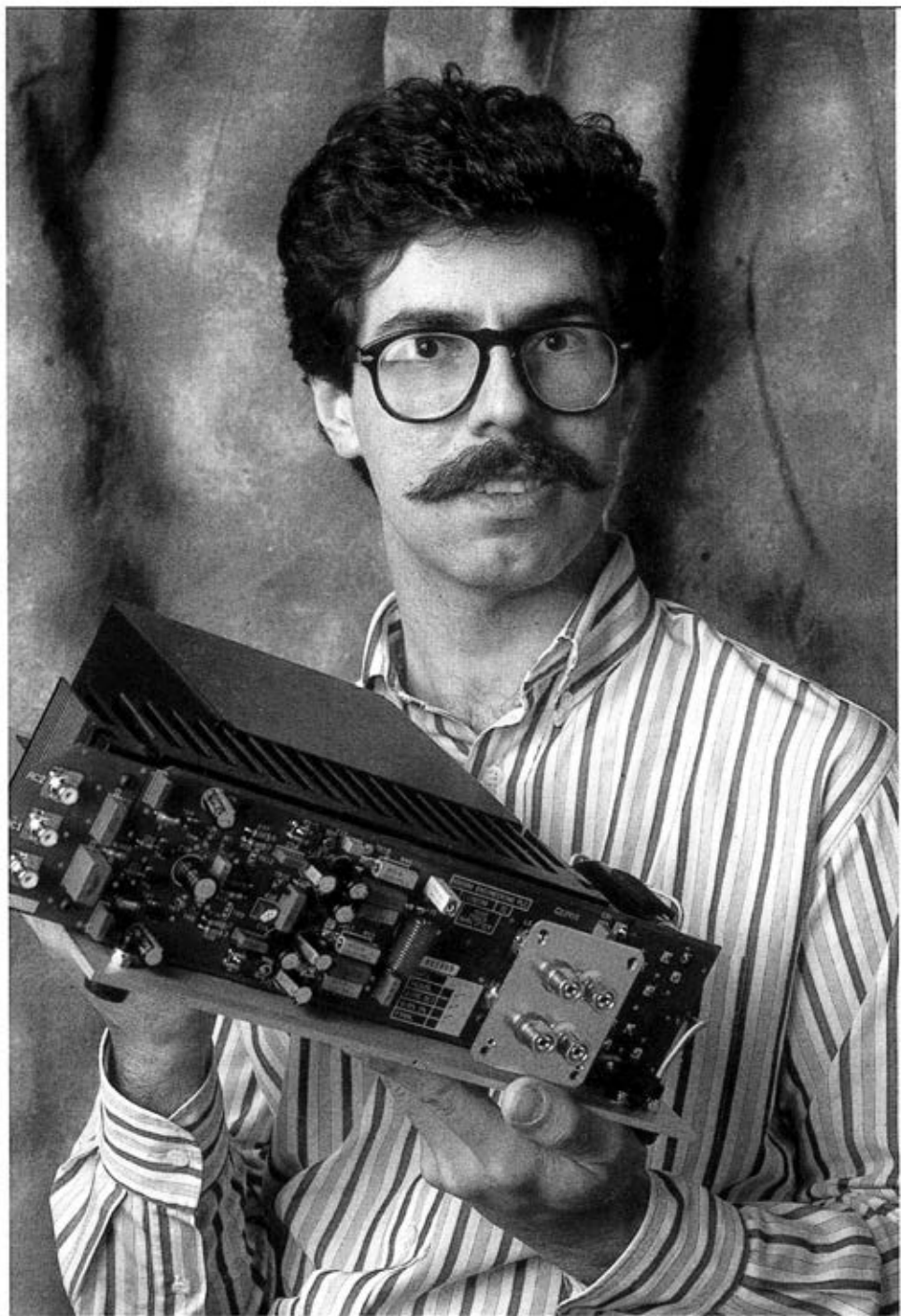
The final and in our view overriding criterion must be sound quality. We have done our best to give advice on this aspect of an amplifier's performance, but this is a tricky field. We do feel that no hi-fi product should be purchased without prior demonstration, and that the customer should ideally be

afforded the opportunity of a home demonstration with the chance to compare one or two alternatives.

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 that '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 cables; speaker and interconnect cables are an intrinsic part of the signal path, and it can be worth spending as much as ten per cent of the total equipment cost on them to achieve a system's full potential. In some instances (eg Naim) the amps are designed to work with a specific cable and it would be foolhardy not to use that cable. Don't unplug inputs or outputs while the amp is switched on — this is just 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.







The Roksan theory

JUST AS THERE'S MORE THAN ONE WAY TO SKIN A CAT, THERE'S MORE THAN ONE WAY TO DESIGN AN AMPLIFIER. TOURAJ MOGHADDAM LIKES THE VEHICULAR APPROACH.

Circuit design, topology, layout, components and power supplies are all merely parameters in amplifier design. The relationship between these parameters and the sonic performance of the final design has been the quest and the challenge for designers since the dawn of audio electronics. To put another perspective on amplifier design, let us consider the car and how we would like it to perform. Why a car? Because it's an analogy which highlights some of the challenges facing the designer.

- ◆ The car should be able to ride on any terrain.
- ◆ Should have the most comfortable ride yet be the most responsive when driven hard.
- ◆ Should be the quietest and yet the fastest.
- ◆ Should be the most powerful and yet the most economical to run.
- ◆ Should be luxurious and yet inexpensive.
- ◆ The overall shape should be sleek and the interior spacious.

Some of the objectives set above are contradictory in nature. It is only possible to design this car with its contradictory objectives optimised to certain criteria. An amplifier is not different in this respect, and it is equally impossible to design the perfect amplifier. Just as a Formula One car is different in its

concept to a family estate car, a budget integrated amplifier would have its design parameters optimised differently to a state of the art pre/power combination. The objective is to optimise the balance of all the relevant parameters.

Over the years many designers and critics have developed techniques to measure certain parameters which theoretically define the performance of an amplifier. These conventional measurements do indeed separate the competent designs from average run of the mill products. However, many amplifiers that have been through these tests and measured very similarly, couldn't sound more different. Is this inconsistency because we are not measuring the right parameters, or not measuring all the parameters that matter, or not measuring these parameters correctly?

For example, why do so many powerful and high current delivery amplifiers sound relatively 'sluggish' or 'slow' in tempo? On the other hand why do some 'medium' power amplifiers, in the same system, sound faster, more dynamic and rhythmic than others? An amplifier which is performing well in a particular system must be responding correctly to the rest of the system components. It is therefore important to consider the whole system in order to analyse an amplifier correctly. After all, we can't avoid using loudspeakers in order to listen to and judge the overall sonic performance of the amplifier.

Hi-fi systems rarely capture the involve-



ment of the live performance, and this is often because of limitations in amplifiers that are unable to preserve the dynamics, tunefulness, tempo, space and the interaction between the musicians that can exist in the source material. To address the design parameters responsible for these qualities, it is important to understand fully how the amplifier works.

One often misunderstood concept is that the input signal to an amplifier travels through it, is amplified, and then fed to the output. In fact the amplifier only 'looks' at the input signal and copies it at a greater amplitude. The power supply of the amplifier, on the other hand, should act as an endless reservoir which feeds the output, its ability to do this effectively dependent on its efficiency and responsiveness to the load placed on it. The 'flow' from the reservoir to the output is controlled by the circuitry that copies the input signal, and the accuracy of that copy is paramount in order to reproduce the source material faithfully.

Once the amplifier output is controlling the load presented by the loudspeaker, measurement of relevant parameters will accurately highlight their effects on the sonic performance. Only after these parameters have been measured correctly and their effects understood, can the designer(s) begin to address some of the problems discussed above. It would then become apparent that the design, layout of the PCB, choice of components and even the casework all contribute to the overall performance.

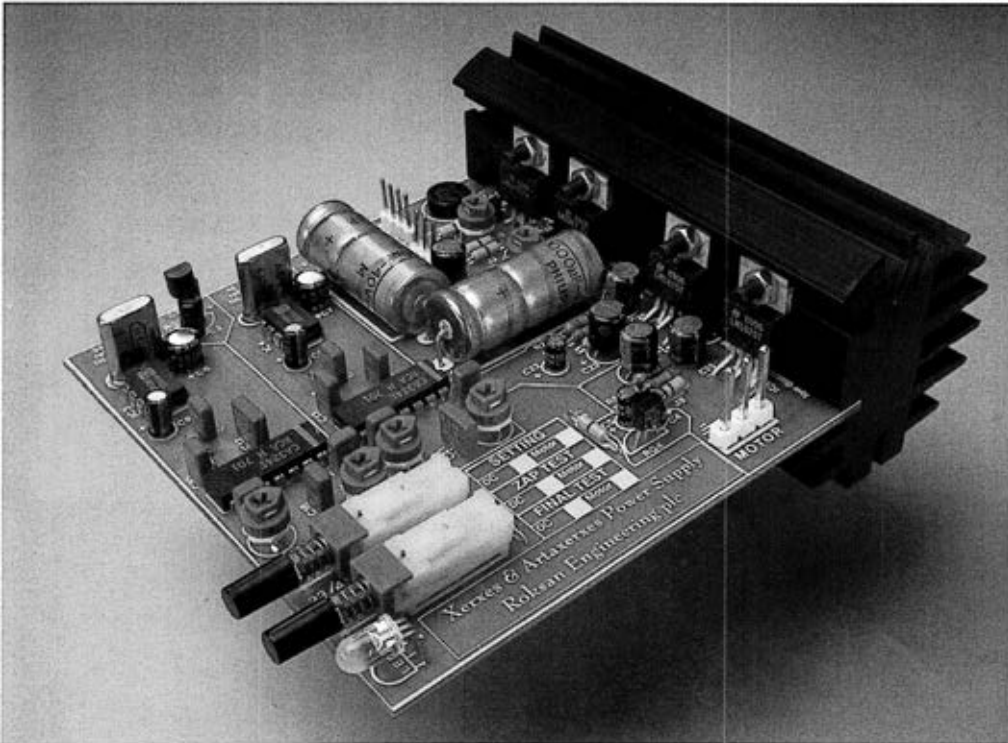
Over five years ago Roksan embarked on its first amplifier project with the following objectives. We wanted to design a coherent sounding amplifier with excellent dynamics and realism. It had to be musically involving and able to preserve the tempo across the audio band, from the lowest notes to the highest harmonics. It had to portray the structure of the music and the space between different musicians, and had to make it easy for the listener to choose the musical instrument or the musician he/she wanted to listen

to. The power amplifiers had to be capable of handling a wide range of loudspeakers.

We felt that most high quality amplifiers excelled in some areas and fell short in others, and wanted an amplifier with which we could listen to the music and not 'hear' the amplifier. As Bernard Shaw once said; "Progress is impossible without change", so we made a few changes. After extensive listening to and measuring of many parameters, the circuitry, its layout, the type of components and the topology of the amplifiers were finalised.

The design of our first amplification system is as revolutionary as our Xerxes record player was nearly a decade ago (he would say that though, wouldn't he? Ed.). The ROK-L1 preamplifier utilises two PCBs, one for 'earth' and the other for the signal. The two PCBs span the back panel of the preamplifier and connect directly to the input and output terminals, and every input is switched through an ultra low noise relay, further shielded to preserve the delicate input signal. The amplification circuitry is fully complementary and symmetrical to ensure faithful reproduction of the input signal. The ROK-L1 preamplifier requires an external power supply to feed its circuitry. Despite this, internally there is a power reservoir and local high speed, ultra low noise power supplies to further regulate the input power. Even the switching relays and the tape outputs have their own separate regulated supplies.

The ROK-DS1 dedicated power supply acts as the main DC reservoir for the preamplifier. It's based on the same principles by having the entire circuit on the PCB directly mounted to the output sockets. The 350VA power transformer is shielded internally and externally to minimise any noise interference. As a supply to the main reservoir, the transformer is capable of a continuous 7 amps AC per side. The rectification of the AC supply from the transformer is via discrete high speed diodes to optimise the response, and the wide band reservoir for the regulators ensures a stable, ultra low noise $\pm 26V$ DC to feed the preamplifier. Typically the ROK-DS1 has less



This neat little power supply was designed for the late lamented Xerox turntable and Artaxerox phono stage.

than 10 microvolts of noise from 1Hz to 3MHz.

The ROK-M1 monoblok power amplifiers have a 1000VA, 7.5 kg power transformer which can continuously deliver over 11 amps AC per side. The shield for this transformer and the main heatsink, which acts as a secondary shield, effectively eliminate any transformer induced interference. The entire amplification circuitry from input to output terminals is on one PCB directly mounted to the heatsink. The symmetrical and complementary circuit design, coupled with tight component tolerance, contribute towards accurate input signal reproduction. There are three inputs to choose from, DC (Direct coupled), AC1 and AC2, which differ only in bandwidth. The DC input, for example, has

its -3dB points at 0.5Hz — 120kHz, a very low output impedance (typically less than 0.05ohms) with a high current delivery of ± 13 amps to the output stages, enables the power amplifier to control almost any loudspeaker. This control is achieved without compromising the speed/response of the amplifier to the load. Techniques such as active or passive multi-amping can be used to control very difficult loudspeaker loads. With this method the amplifier design and drivability is optimised.

The most important part of amplifier design is understanding the whole circuit, and with this mind we will endeavour to continue our research to ensure that Roksan equipment continues to provide a high standard of sound quality.



EGREGIOUS AMPLIFIED RAPPERS

The Audio Innov

AUDIO INNOVATIONS' MAIN DESIGN DUDE GUY SERGEANT WHIPS OUT HIS TUBE AMPLIFIER

At present there is probably more interest in valves and valve amplification than at any time since they ceased to be the building blocks of electronic equipment in the 1960s. It is interesting to consider why this remarkable resurgence of enthusiasm has come about; why this apparently outmoded technology inspires a fervour that its modern equivalent seems incapable of matching; and why valve amplifiers almost became extinct at all.

Beginning with the last of these, valve amplifiers were simply too large, too hot and too expensive. By the measurement criteria used to evaluate performance they were soon matched and surpassed by smaller, cooler running and cheaper solid state alternatives. Reading through the literature of the time one does get the impression that the development of the new transistor circuits was viewed with a certain mild scepticism. It was almost as if even the engineers working with the new technology knew that what they could hear did not quite tally with the measurements they were taking. But those days were long before subjective evaluation reared its (problematic) head, and the technical 'progress' was greeted with much the same unquestioning acceptance that for the most part accompanied the more recent launch of digital audio.

Today's highly regarded transistor amplifiers are often large, expensive, and take days or weeks to reach optimum operating temperatures. This is partly due to the misguided

belief that there are some qualitative advantages to be gained by using grossly inefficient loudspeakers. There aren't. Other than making the living room look like a set from Star Wars and impressing the hell out of neighbours who know no better (an important consideration for some purchasers of expensive hi-fi) such a combination serves little useful purpose.

By the mid 1980s the popularity of this ridiculous approach had reached its peak world wide. But there has been little or no new development along these lines for over 10 years, and once consumers realised that there was no progress being made, some began to reconsider the technology that had been left behind.

The small quantities of valve power amplifiers that were available in the early 1980s generally mimicked the

specifications of their transistorised competitors, while valve preamplifiers also enjoyed some commercial success, as their beguiling characteristics became apparent.

Anachrophilia

Serious Japanese enthusiasts have been investigating low powered valve amplification and high efficiency loudspeakers since the 1970s. The approach had all but been abandoned in the west but was effectively reintroduced on a small scale by Jean Hiraga in the French magazine L'Audiophile. There has since been a proliferation of valve amplifier manufacturers worldwide. Some old valve types have been resurrected, and there are rumours of



Have you seen this man? The Two and a half Watt Kid, aka Guy Sergeant, is part of the power supply crazed, single ended triode liberation front.



EGREGIOUS AMPLIFIED RAPPERS

ations approach

DESIGNER'S AXE AND GIVES IT A GOOD GRINDING ON THE GREAT POWER SUPPLY STONE.

new audio valves under development.

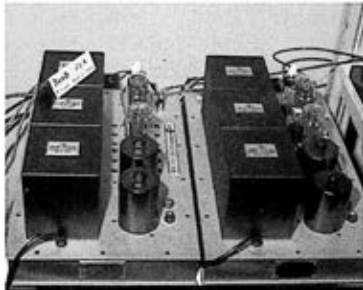
So what is the appeal of this anachronistic technology? It has to be more than just being able to say 'I'm different and discerning', more than the warm friendly glow of a few filaments, or even the potential for 'hands on' involvement when replacing valves or resetting bias.

With almost any valve amplifier there is an organic quality to the reproduced sound that is beyond the scope of almost all solid state designs. There may well be excessive distortion, limited bandwidth and some lack of clarity, but it is this natural quality that first catches the attention. Once a taste for it has been acquired, life becomes a quest to find a valve amplifier that gets the other aspects right as well.

I find the flaws in the performance of a bad valve amplifier as objectionable and distracting as anyone. I can think of many instances where a simple and conventional transistor amplifier would be preferable because it just wouldn't be so obvious. If I could find a transistor amplifier that gave better results than the best valve amplifier (and if I could afford it), I would have no hesitation in buying one, especially if it would fit inside a matchbox. I don't have any nostalgic yearning to fill my living room with glowing tubes (why not? Ed.).

Every man and his dog are now building valve amplifiers, and the choice has become bewildering. Since the early 1980s, when all

that was available were high powered and priced behemoths from the USA, the audio industry's obsession with fads and buzzwords has left a tangled trail of assorted and occasionally abandoned design philosophies for the unfortunate customer to unravel. Those giant amplifiers were both complex and exceptionally powerful. Speaker sensitivity had been sacrificed at the altar of low coloration, and anything less than 100 watts a channel, particularly in the larger American living rooms, was unthinkable.



This is the sort of thing that gets Guy hot; a home made single ended triode design with Western Electric 300B output tubes from L'Audiophile in Paris.

Nostalgia

Audio Innovations began manufacturing and marketing simple low powered and relatively affordable valve amplifiers in 1984. These used class A circuits and had more in common with the old Leak

and Lowther amplifiers than anything else, so were only suitable for use with higher sensitivity loudspeakers. In 1987 we launched the first volume manufactured all triode amplifier for over 40 years. At around the same time Croft was also manufacturing a sensibly priced range which included an output transformerless design reminiscent of the American Futterman amplifiers of the late 1970s.

Since then there have been triode coupled pentode and tetrode amplifiers, all triode amplifiers, single ended designs and all manner of strange valve/transistor hybrid circuits; then there are variations on each of these themes where the valve type is more



important than the configuration in which it is used.

To offer a full assessment of the respective merits of each approach requires both technical appraisal and subjective evaluation beyond the scope of this piece. Unfortunately the measurement criteria still used to judge audio amplifiers are the same ones that led to the original rejection of valve circuitry in favour of solid state designs in the 1960s. Remarkably, even in 1994 it remains impossible to explain why there is so little correlation between measured and subjective performance — other than to suggest that the measurements are irrelevant or that the likeable qualities are imaginary.

Apart from information concerning noise, power levels and input sensitivity I believe that the other measurements taken are about as relevant as the amplifier's overall dimensions or its weight. Note that this only applies to amplifiers. Digital equipment or loudspeakers can, to some extent, be described by their measured performance.

To offer a rational explanation for the character and behaviour of the Audio Innovations L2, P2 and Second Audio amplifiers tested in this journal, I have to include observations on the alternative design approaches that could have been adopted. These views are totally prejudiced by a preference for loudspeakers that convert a relatively large percentage of the electrical energy supplied to them into sound rather than heat. I have never encountered an inefficient loudspeaker that was able to reproduce an adequate degree of dynamic contrast, although I've heard plenty that can play loud. Whether this lack of resolution is a function of the speaker design or of the necessarily large and complex amplifier required to drive it is open to question. I would always make the judgement using sensible loudspeakers and a handful of watts at most. Anyone who claims that their amplifier sounds better when it is working hard needs their head looking at.

Unfortunately the valve amplifier revival has not yet fostered a new generation of

affordable, efficient loudspeakers, even though there are signs that the market may be starting to move in that direction.

The Power Paradox

The high powered valve amplifiers that are currently available tend to be generally rather vague in character, with bass performance that can at best be described as lacking punctuality. If you really feel the urge to buy a very powerful amplifier, stick with transistors, as it will be cheaper in the long term.

True class A operation (all other things being equal) is still preferable whatever the type of amplifier. There are now many different class A pentode and tetrode designs available, most of which have a sparkle and life that they share with the better designs of the 50s and early 60s. Component quality has improved considerably since that time, and contrary to popular belief, the output transformers that can be purchased today are technically far better than their predecessors, due to improvements in materials.

Triode amplifiers are back in a big way. Chinese factories are now reproducing the most famous triode tubes such as the 2A3, 300B, 211 and 845. These allow the development of the most simple circuits which may be operated without negative feedback and which, if properly implemented, can give tremendous speed, clarity and dynamic range. Some of the newer designs are chasing after the higher power outputs achievable with pentodes, and compromising quality by operating triodes out of class A. This strikes me as the audio equivalent of putting orange juice in a glass of Dom Perignon.

The output transformerless amplifier still has many devotees. There are several companies now manufacturing them in the US and elsewhere. While they may share the grace and clarity of other triode amplifiers, in my view they lack any sense of grip or control even with horn speakers. It isn't necessary to regard the output transformer as such a problem. There are other design considerations that have a far greater influence.



Taking the simplicity and nostalgia a stage further has led to the reintroduction of the single ended power amplifier. This particular bandwagon has left tracks all the way from Japan where any number of companies are making 'reproductions' of the Western Electric WE91A amplifier. In Europe and the US there seem to be so many 'new' designs that the small market that exists for this type of product is already saturated. The circuit topologies and the valve types have become precious talismans: 'if it isn't done this way or it hasn't got those then it can't be any good'. I would be the first to admit that I shared some of these dogmatic beliefs for a while, but experiences over the past few years have dissolved them.

Supplies matter most

Incorporating any one or two of these design features is no guarantee of a satisfactory performance. The key area in the design of any single ended amplifier is not the valve used, not the quality of the output transformer or the components, but the design of the power supply. A single-ended triode amplifier is far more dependent on the quality of its power supply than any other kind — and yet no one, anywhere, at any price, appears to be paying any attention to it. It is as if the obsession with the circuit topology is blinding the designers to what they are actually asking the valve to do.

These same designs often include a low impedance cathode-follower driver circuit, and the power supply is again ignored, whereas if that type of driver is to work at all (and I have my doubts on that score) its power supply cannot just be an afterthought.

If the power supplies are properly attended to, the single ended circuit is arguably the best (as well as the most expensive) solution, but current examples, including some most extravagant Japanese exotica, can all be comfortably outperformed by a humble push-pull pentode amplifier with a good supply.

Push-pull triode amplifiers, such as the Second Audio, are less dependent on supply

quality than single ended designs, and can therefore sound more purposeful and dynamic, although the added complexity of the configuration can result in a loss of clarity and finesse.

The valve types used have also become part of similar dogma. Any of them can be better than any other if they are used correctly. This applies as readily to the comparison of valves such as the EL34 and KT88 as to comparisons between various triodes. The current favourite and subject of many a new amplifier design is the Chinese version of the WE 300B, but for anyone to proclaim its magical properties over any other audio triode is ridiculous. Its advantages are better described in terms of ease of use, cost/watt and availability.

Having experienced the benefits of careful power supply design and weighed them in importance against circuit configuration and component choice, I anticipate that future developments within our product range **will** focus more on this area of design. The P2 phono stage features valve rectification, a two section LC filter and a valve shunt regulator circuit referenced to valve voltage stabilisers. The power amplifiers may in future have to undergo some of the same treatment.

It occurred to me some time ago that there was probably some perverse (and inverse) relationship between quality and efficiency in amplification. Nothing good is ever easy. The more watts that it is necessary to put into an amplifier to get one out, the better it's likely to sound. An efficiency of under three per cent would be fairly serious.

Our approach to product design has always been, and will continue to be based on the subjective performance of the product regardless of its price. The means used to achieve the end may include valves, transistors, magnets or even steam, provided that the results are satisfactory. This approach may not be as easy to sell as whatever the flavour of the month might be, lacking as it does the political correctness of the latest fads and fixations. But we have never been too concerned about following fashion. Fashions change.



ENTRY, APERITIF, RECEPTION

The secret world of the hi-fi reviewer

A couple of months ago we decided to take an in depth look at six of the more high profile pre/power amplifiers on the UK market. After much haggling and more than a couple of problems we ended up with the selection you will see on the following pages.

In order to get a different perspective to the usual Choice fare we went for a more extravagant price bracket and brought in the talents of Chris Thomas. Chris is not a new member of the reviewing fraternity, just a lapsed one, and his perspective has a distinctively fresh yet worldly feel to it as a result.

We also let Paul Miller loose with his probes and test equipment. For the technically inclined among you he explains his tests fully and completely over the page.

To round off the reviews Paul Messenger and I spent some time with the amps at Paul's place. The results are chronicled in the 'Second opinion' column. We used rather similar sources to Chris but somewhat more manly speakers. The fact that the results tally so well is a touch alarming, but at least we managed to contradict Mr Miller's expectations on occasion.

The Subjective response

Amplifiers come in all shapes and sizes from a single box to a multi component active set-up. You can pay many, many thousands for hardware that essentially does the same thing as a £150 integrated. Back in the days of yore, cost went hand in hand with power and more

CHRIS THOMAS AND PAUL MILLER HAVE BEEN HAVING FAR TOO MUCH FUN PLAYING WITH HALF A DOZEN TASTY AMPLIFIERS, BUT WHAT EXACTLY HAVE THEY BEEN DOING?

consideration was given to an amps ability to deal with sine waves on a test bench than musical information. But after the British hi-fi renaissance of the early and mid seventies it was realised that amplifiers did indeed have a major say in the way that systems handled music. It took a big improvement in source components to

bring this about, however, and these days the choices on offer have never been greater.

None of the six amplification systems under consideration here tells the whole truth. Each one of them adds its own particular brand of coloration and distortion to the incoming signal. Each of them behaves in a different way when confronted with a real life loudspeaker load. The difficulty presented to any reviewer or prospective owner when auditioning them is which version of the truth to believe. Somewhere in our heads we manage to conjure up a reference against which we are comparing what we hear, and making judgements. We could simply compare the sound of instruments pouring from our speakers with our experience of them in a live situation, though it gets tougher when you realise the enormous impact a recording studio can have, right down to altering completely the whole shape or envelope of each note, which goes to the heart of the character of all musical instruments. Given an input of sufficient quality a very good amplifier plays music in all its weird and wonderful forms, by allowing you into the architecture of the piece. The tempo, chordal structure and progression, rhythm,



instrumentation etc — and of course the most important thing to all good musicians, the 'feel'. Musicians react emotionally to both their instruments and the piece they are playing whether it be the most plaintive folk tune from a solo flautist or the sort of heavy electronic street-rap designed to make you reach for your Uzi. A hi-fi system should allow you to make emotional contact with the music. It should be able to lift you beyond constant analysis of the sound to a place where the equipment is irrelevant and the musicians speak to you. When it does this it can be called a great hi-fi system.

To try and understand what each of these amplifiers is capable of I lived with them for as long as copy dates would allow and tried them with a number of inputs. These include my Naim CDS CD player, a Sony DAT machine, using studio masters that I know quite well, while the phono listening was done on my LP12/ARO/Lyra Clavis set-up perched atop a Mana Reference table. Speaker connections were made using Naim NAC A5 cable, and the interconnects, where not provided, were from the Chord Company Cobra range. Loudspeakers were chosen to provide differing problems and flavours for the amplifiers. The efficient Audio Note AN-Js, the inefficient and diminutive ATC SCM 10s and my own Naim SBLs were all pressed into service.

The measurement programme

The test program includes both standard IHF-A202 measurements together with more advanced techniques made available by the IEEE controlled digital test equipment currently employed in my lab.

Power output, dynamic headroom and peak current

Quoted in good old fashioned Watts this refers to the maximum output voltage of the amplifier into 8 and 4ohm loads, one channel driven to 1 per cent THD. The IHF-A202 dynamic headroom test employs a gated 1kHz

signal, 20 cycles on/480 cycles off, and refers to a maximum of 1 per cent THD into 8ohms relative to the continuous power available into that same load.

By contrast the maximum current available from an amplifier is measured over a shorter 5msec period into 1ohm, though still adhering to a limit of 1 per cent THD.

Separation, THD, IMD, noise and sensitivity

All input sensitivities are measured with respect to an output of 0dBW (=1W/8ohm) and full power at 1kHz for each pre/power combination. Noise is measured with respect to the IHF input levels of 5mV (MM) and 0.5V (CD/line), input shorted, A-wtd and assessed as the true rms figure of twenty, 3rd-octave averages.

Separation is measured some +20dB above the nominal sensitivity while THD is referred to an input of 2V (CD/line), 50mV (MM) and 5mV (MC). For CCIR IMD the respective peak composite (19kHz + 20kHz) levels are 10mV (MC), 100mV (MM) and 2V (CD/line).

Broad-band radio frequency inter-modulation test

In general terms this test reveals just how sensitive an amplifier is to spurious radio frequency noise, whether introduced directly or indirectly.

Conventional measurements examine the performance of the amplifier under closed-loop conditions where many of the inherent circuit non-linearities are compensated for by one or more feedback networks. By contrast this RF test probes the linearity of the amplifier under open-loop conditions where it is both non-linear and uncompensated.

A precision RF signal generator is employed to produce an RF carrier signal at 20mVp-p, modulated to a depth of 100 per cent using an external pseudo-random noise source. The resulting non-correlated AM/RF signal is then ramped between 1MHz-1GHz by controlling the generator through an IEEE interface BUS



and using a dedicated program.

Once connected to the amplifier (via a line input) any subsequent demodulation/intermodulation between the sweeping carrier and its pseudo-random sidebands results in a non-correlated noise appearing at audio frequencies at the output of the amplifier. This represents a change in the noise floor of the amplifier over a discrete portion of its frequency range.

By comparing the steady-state noise-floor of the amplifier with its noise floor under the influence of RF IMD, a measure of the difference and therefore the actual effect of RF IMD can be deduced. It is this difference in the noise floor that is shown on the RF IMD plots.

The depth or Z-axis is calibrated in steps of 100MHz and denotes the changing frequency of the RF carrier. By contrast the X-axis is restricted solely to the audio band (in this case 50Hz-20kHz) and is calibrated across a log, rather than linear scale. The vertical or Y-axis gives an indication of relative amplitude and is scaled in steps of 2dB over a maximum range of +16dB.

Clearly, any demodulated RF noise that causes a change in the noise floor greater than 16dB will give rise to a plateau effect on the plot. This situation is clear enough on the example plot which demonstrates an amplifier's undue sensitivity to RF noise centred on bands at 140, 200, 575, 730 and 850MHz.

If an amplifier were singularly insensitive to RF noise then this plot of relative change would appear as a series of straight, unperurbed lines.

Ultrasonic distortion test

This is a particularly revealing test that highlights the interaction of signals at different levels and changing frequencies. Harmonic and intermodulation distortions are produced (called 'routes' in the text) by such mechanisms as slew-limiting or the progressive reduction of feedback, the latter revealing an increase in open-loop non-linearities.

Three driving signals are employed, a 0-

20kHz sweep ($1 = F_{0-20k}$) and continuous 20kHz tone ($2 = F_{20k}$) which raise the amplifier to just 1W output (re 4ohm) while a 0-50kHz-0Hz bi-directional sweep ($3 = F_{0-50k-0}$) continues some -24dB below. A 2V CD/line input is adopted, but for MM disc inputs a pre-equalised signal is used (re 10mV @ 1kHz). An amplifier should be treated as a voltage source so each plot is individually calibrated in dBV (0dBV = 1V at 4ohms).

These sweeps were chosen to represent the kind of HF and ultrasonic signals likely to be handled by an amplifier in normal use. The ultrasonic spurious generated by CD players is a well-documented example, but it is less widely appreciated that the 20-50kHz band noise from an record player or FM tuner can persist at levels only 10-20dB lower than peak signals in the audio band.

Moreover the relatively low 1W/4ohm output chosen for these plots is typical of the power level encountered during our listening tests using high sensitivity loudspeakers. This also means each amplifier is evaluated at the same low output where unpleasant crossover distortions are more obvious.

Certain of these ultrasonic distortions will introduce IM products within the audio band of the amplifier - a point of particular interest with disc stages where IM routes typically increase in level with decreasing frequency as a function of the RIAA characteristic.

The most obvious harmonic products are determined by multiples of the F_{0-20k} sweep (1) (given by 4,5) and the F_{20k} tone (2) (given by 6,7). The remaining distortions shown on the 3D are produced by intermodulation between either or all of (1), (2) and (3) and (1) together with the harmonics of (2), ie (6) and (7).

Directly audible IM distortions include the difference products $F_{20k} - yF_{0-20k}$ [$y = 1,2$] given by (8) and (9) and $2F_{20k} - 2F_{0-20k}$ given by (10). Higher-order difference IM distortions associated with multiples of (2) and (1) will also wend their way directly into the audio band.



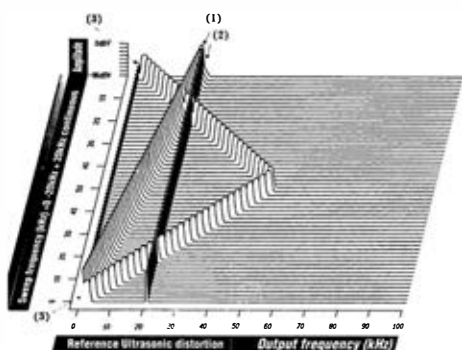
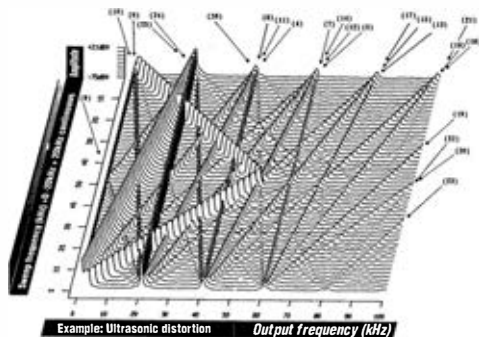
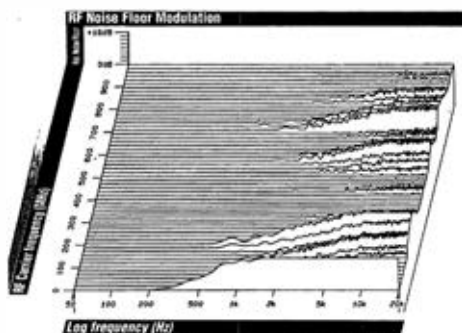
This example plot shows a variety of basic IM routes such as $F_{20k} + yF_{0-20k}$ [$y = 1, 2, 3$] given by (11,12 and 13) together with higher-order secondary IM distortions such as $2F_{20k} + yF_{0-20k}$ [$y = 1, 2, 3$] and $3F_{20k} + yF_{0-20k}$ [$y = 1, 2, 3, 4$]. These are marked as (14)-(16) and (17)-(20) respectively. Extremely high-order routes such as $4F_{20k} + yF_{0-20k}$ [$y = 1, 2, 3$], (21)-(23) are also visible.

Of course there are the interactions between (3) and (1) and (2) to consider. Three summation IM routes are clearly visible: $F_{0-50k-0} + F_{0-20k}$ (24), $F_{0-50k-0} + F_{20k}$ (25) and $F_{0-50k-0} + F_{0-20k} + F_{20k}$ (26)!

In general the presence of 2nd-order in-band IMD products seems to encourage a warmer, softer and richer sound quality, particularly if these distortions arise in the disc stage. The equivalent 3rd and higher-order IMD mechanisms introduce a harder and less beguiling character.

A word of warning. Do not use these plots as some sort of guide to the absolute quality of the amplifiers because this is simply not the case. Any distortion mechanism represented on the plot will have some subjective consequence. Conversely, just because a peculiar coloration or distortion is heard this does not mean it will necessarily be manifest on the 3D plot. This test remains but one piece in a very complex jigsaw and the results must be viewed in the light of those obtained via the RF IMD test.

The combination of ultrasonic distortion and RF IMD plots can provide a valuable indication both of the amplifier's subjective performance and its likely compatibility with other audio equipment, particularly CD players. An amplifier that gives rise to a 'clean' ultrasonic plot but suffers RF demodulation may well sound coarse or muddled as a result. Conversely, a relatively constant carpet of innocuous closed-loop distortions can effectively mask the fatiguing effects of RF IMD. Taken together, these two plots give considerable insight into the potential sound quality of an amplifier.





Arcam Alpha 5

This £240 amplifier was included at the last minute as a kind of stalking horse. We were obviously not expecting it to be as good a product as its far more expensive counterparts, but were interested to see in which ways it differed from them. And if and how the huge price differentials were reflected in their relative musical performances.

After all, amplifiers are all supposed to do exactly the same thing, but with different levels of competence.

The Alpha 5 has just about everything you need. Four line level inputs, plus one for tape, an MM phono stage and switching for a second set of loudspeakers. It also

YOU MIGHT THINK THAT ALL BUDGET AMPS SOUND ALIKE, BUT THE ALPHA 5 IS ONE THAT REALLY STANDS OUT.

has tone controls. These are sensibly shallow in operation and could be of some use in a budget system, allowing the tonal balance to be altered subtly. But the more purist approach is catered for too, as a front panel-mounted switch bypasses both the tone and balance controls, giving the amplifier a cleaner, leaner and slightly more dynamic and focused sound. Output power is quoted as being 40watts per channel into 8ohms. The Alpha 5 is

unmistakably Arcam in appearance even at 50 yards, sharing the familiar corporate look of the rest of the company's range.

The CD input is very clean and controlled even when faced with the superb Naim CDS as a totally unreasonable input. It never seems too intimidated by the sheer volume of information pouring into it, and although it does not have the low end grunt to drive a pair of large speakers totally convincingly, it never really loses its overall shape and composure either. At least not until the volume control is well advanced. In fact it doesn't take too long before you forget that it's such a relatively inexpensive amplifier



and just listen to the music.

Trilok Gurtu's Living Magic CD has sort of crept up on me over the last few months. Its peculiar rolling rhythms can become very infectious. They get into your head, you see, and before you know it you are walking, and even eating to their beat.

I liked the way in which the Alpha kept hold of the mood of Transition, one of my favourite tracks at the moment. After a tight tabla intro, the whole track dissolves into a rubbery rhythm that hovers around a big, loose-skinned drum. And all this is taking place in a cave (well, a digital reverb unit actually). Transition might sound loose but is, in fact, tight enough to set your clock by. The Alpha 5 sailed straight through it, keeping the rhythm nicely in check and not getting over-fussed by the full-bodied extension of the bass.

One of the best things about the Alpha 5 is the benevolence of its line inputs. My Sony DAT player is certainly no paragon of even tonality. With the wrong material — studio masters mixed by madmen with attenuated frequency responses due to years of high volume abuse, for example

“The Arcam gets the essentials just about right — or as right as you can expect from a sub-£250 integrated.”

— it can hurt! On material that was mixed with a more sensitive touch, though, it can really drive an input. The Arcam seemed to enjoy its no nonsense approach. Give this amplifier a signal to get hold of and it won't let you down. Give it a Prince CD to play and it will

have you tapping your feet.

The Arcam Alpha 5 gets the essentials just about right — or certainly as right as you could realistically expect for a sub-£250 integrated. It has a fine sense of timing and doesn't allow instruments to get too uncoordinated. Bass is reasonably extended and tuneful. This applies to the MM phono input too, which is admirably smooth, progressive and free from the thin peakiness that afflicts so many budget designs. This is a purpose built input of the kind that Arcam has had so much experience with over the years, not something that was thrown in as an afterthought.

Straight comparisons with the other amplification systems here are meaningless considering the price differentials involved but





interesting nevertheless. The Arcam paints its pictures on a smaller canvas. It also has far fewer colours at its disposal and uses smaller brushes.

It can sound thin and lightweight but its aim is true. It is very open, does not get easily confused and does not over impose itself on the music.

Lab Report

Direct comparisons with the slightly more expensive Arcam Alpha 6 prove to be most illuminating, since both of these amplifiers share the same quasi-complementary power amp stage. However different voltage rails are used in the two designs.

The Alpha 6 provides an insignificant +0.6dB/+0.8dB boost in output into 8ohm and 4ohm loads yet both the 5 and 6 are perfectly capable of sustaining momentary bursts of 430W or more into very low and tricky loud-speaker loads.

The ability to provide such massive chunks of power is extremely unusual for a mere 50-60W integrated amplifier, and suggests that both the Alpha 5 and 6 will hold their own against far costlier competition.

Incidentally, the Alpha 5 is the 'quieter' of the pair with a 10dBV advantage in residual noise that stretches its overall A-wtd signal-to-noise ratio from the 80dB

Integrated amplifier: Arcam Alpha 5

Maximum Continuous Power Output	20Hz	1kHz	20kHz
8ohms	58.6W	59.6W	56.4W
4ohms	85.6W*	94.1W*	90.3W*
Dynamic Headroom (IHF)			+1.4dB (83.0W)
Maximum Current (5msec, 1% THD)			20.7A
Output Impedance			0.061ohm
Damping Factor			130.4
Stereo Separation	(1kHz)	CD/Aux	MM
	(20kHz)	73.3dB	74.5dB
		47.9dB	46.7dB
Channel Balance	(1kHz, -20dBV)	0.62dB	0.67dB
	(-60dBV)	1.23dB	1.28dB
Total Harmonic Dist.	(0dBW)	-81.2dB	-76.8dB
	(2/3 power)	-89.5dB	-79.8dB
CCIR Intermod. Dist.	(0dBW)	-89.5dB	-77.4dB
	(2/3 power)	-95.5dB	-78.5dB
Noise	(A wtd, 0dBW)	-85.9dB	-80.0dB
	(2/3 power)	-98.1dB	-82.3dB
Residual noise	(unwtd)	-73.9dBV	-74.4dBV
Input Sensitivity	(for 0dBW)	22.5mV	254µV
	(for full output)	175mV	2.0mV
Disc Overload	(1kHz)		107mV
	(20kHz)		1000mV
	(50kHz)		2150mV
Tape Output/Impedance		9.5V (disc) / 1.87kohm	
Input loading		19kohm/100pF	47kohm/120pF
DC offset, left/right		+0.5mV/-0.5mV	
Retail Price		£230	
		*2.5A line fuse blows >BBW	

figure that's specified for the Alpha 6 to 86dB (ref 1W/8ohm). This is most likely to be due to the reduced hum fields surrounding its more modest power supply.

On the other hand the Alpha 5 is no less sensitive to spurious RF noise, which suggests that some CD player combinations will prove just as unpredictable (see RF IMD plot). Sadly a wider S/N ratio can actually make the effects of RF IMD more obvious as the lower noise floor reveals more low-level distortions.

Moreover there's a marked increase in what are, presumably, crossover distortions at low signal levels. This is most graphically illustrated on the

main 3D plot (centre, opposite), which shows the very high-order intermodulation distortions (the V-shaped tracks) that appear well ahead of any conventional harmonics. This plot is indicative of distortions that occur at just 1W output into 4ohm where crossover-like artefacts increase with frequency.

Technically at least, the Alpha 5's phono stage is on a par with that of the Alpha 6, though it's actually based around a cheaper — if no less accomplished — Signetics NE5532N op-amp. Once again the MM response is sensibly tailored with a -3dB roll-off at some 22Hz, chosen

to avoid the subsonic rubbish kicked-up by record warps and arm/cartridge resonances.

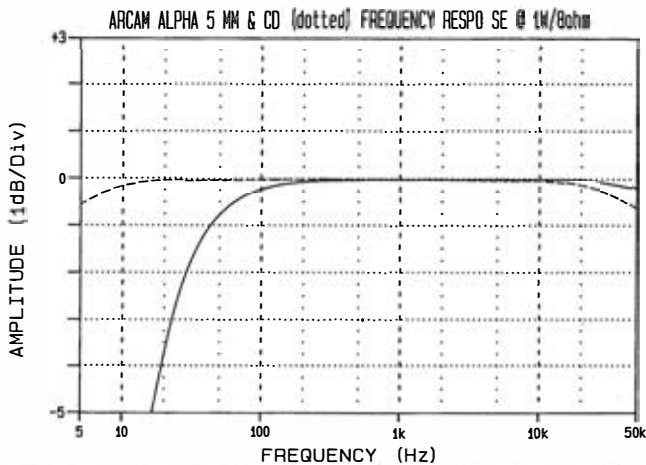
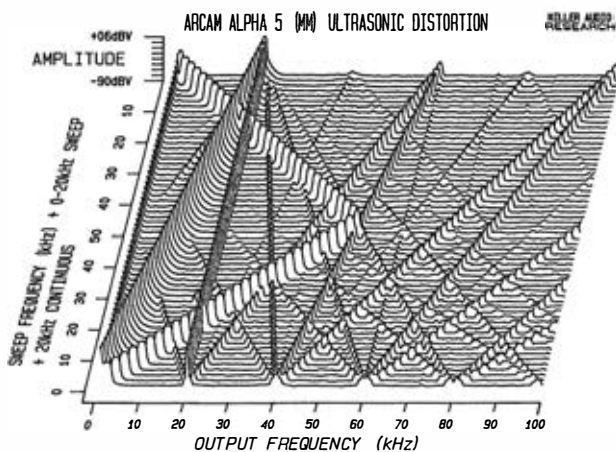
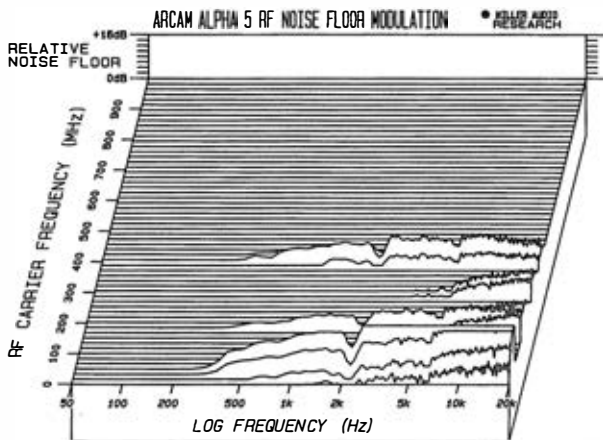
Second Opinion

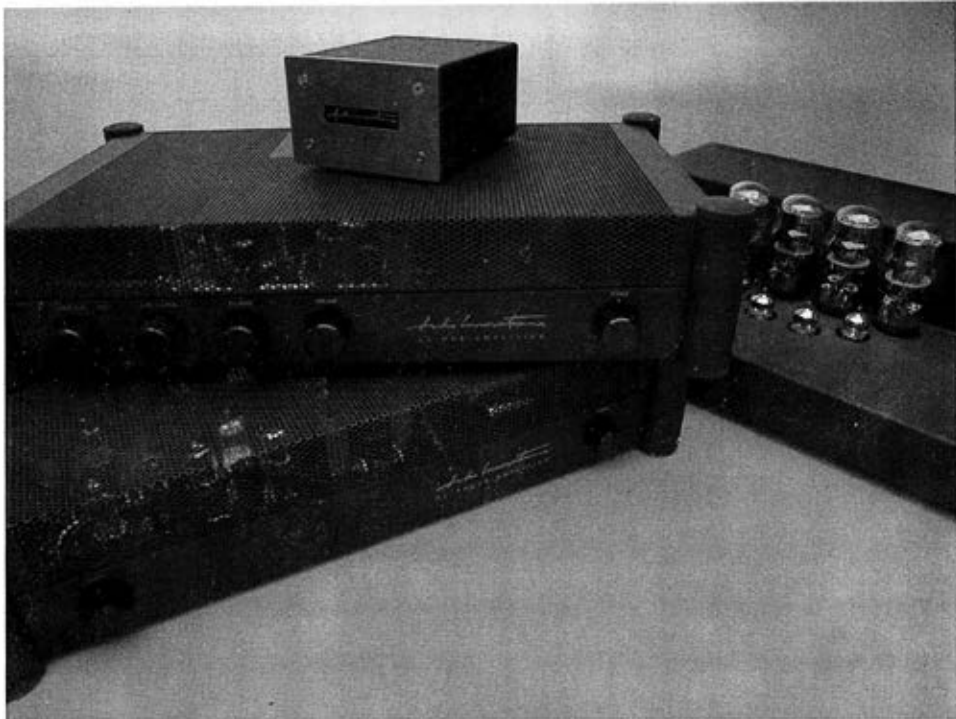
Although it was nice not to hear the thoracic vertebrae squeak in protest, it came as no surprise that this little budget integrated was rather out of its depth among the remaining two-, three-, four- and five-box monsters. What did come as a surprise was the deft way Arcam's Alpha 5 came up smiling, with not even a trace of omelette among its buttons.

By absolute standards it may not be a great amp; but by budget standards it's an absolute stonker, just as another sample ably demonstrated in a budget group test last Autumn (Hi-Fi Choice, issue 123).

The cosmetics of the sonic presentation are more than slightly foxed, with a rather shut-in top end that offers little in the way of transparency or delicacy, and an almost furry thickening to the bass.

But the whole is greater than the sum of any parts, and this particular whole is a whole lot of fun. It hasmessen a cheerful bouncy coherence that tempted incautious experiment with the upper reaches of the volume control, and always managed to convey much of the spirit of the music being played at the time.





Audio Innovations

L2 & transformer, P2, Second Audio monobloks

Though the resurgence of interest in valves has largely passed me by, I was fascinated to get a chance to live with these amplifiers. As supplied, the Audio Innovations is a five-box amplification system that comprises the P2 phono amp and T2 moving coil transformer, the L2 preamp, and two monoblok Second Audio power amps.

The L2 accepts four line inputs plus a tape recorder for which it offers full monitoring, though this drops to three line inputs if a phono cartridge is used.

For this review the P2

SO VALVE AMPS ARE
YOUR BAG, HUH? AUDIO
INNOVATIONS CAN
MEET JUST ABOUT ALL
OF YOUR NEEDS.

phono amplifier supplied the L2 with a line level signal but since it has a built-in gain control it could just as easily be used as a dedicated phono preamp, bypassing the L2 and driving the Second Audio monobloks directly.

To increase versatility with MC cartridges even further, switchable input impedances of 20 or 80ohms are offered, while the preamp provides

switchable input sensitivity which could be a real boon if used with other power amplifiers. The power amplifiers have speaker outputs for 2, 4 and 8ohm loads which are well worth experimenting with regardless of the nominal impedance of your speakers.

Internal construction of the amplifiers seems to be to a high standard, but I can't really say the same for the casework which, to my eyes, looks terribly naff and isn't really acceptable for an amplifier that costs well over £4000. Clearly these amps would have to be musically



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very special indeed if they were going to impress.

Guy Sergeant of Audio Innovations had suggested that half an hour warming up should see them reaching peak performance and he was right. From the moment I pushed the Play button on the Naim CDS this Audio Innovations combination made music. Over the time that I spent listening it was superbly confident and with just one or two exceptions it never failed to offer new and often dramatic insights into all types of music. Regardless of the speakers used or even the type of input. It has to be said that there is something benevolent about the sound of this set-up: there's never a hint of strain or pain.

Shawn Colvin's *Fat City*, (used with all of the amps tested here), was portrayed in such a different light that you might easily have thought it a different mix and occasionally a different album altogether. Acoustic guitars that seemed so brash and forward on everything else but the Naim had an uncanny resemblance to a real guitar. You could hear the clash of the strings as the plectrum strikes them, the way they settle down and then the warmth of the body top as it takes over. The sound went right down to the gentle but linear decay that a top quality instrument gives you. It was all there. No snatching of notes, arti-

cially exaggerated leading edges or feelings of breathlessness. *Fat City* seemed slightly slower than on the other amplifiers, but this is an amp at ease with itself and, more importantly, in time with itself. Any tensions that creep in are concerned with the music and the musicians, and that is exactly how it should be.

As various instruments come and go the Audio Innovations takes them all in its stride. Before long you are completely relaxed into the piece. This amplifier just exudes confidence and it rubs off on the listener. The sheer presence of the vocals and the tangible feeling of width to the presentation is matched by articulation that is extremely rare even in the best audio systems.

Any criticisms I thought I might have about a valve amp's softness in the bass were dispelled very quickly. The low end just seems very natural and very tuneful. Perhaps it doesn't quite have the sharp and clearly delineated sense of precision that the Naim achieves, but it never draws undue attention to itself. It's just there, and if you want to follow it you can. In fact you can pick up and follow any thread of the music you like and nothing will get in the way: the separation and stereo image are marvellous. The AI easily created a three dimensional soundstage and maintained

the illusion of rock solid clarity with all the speakers I tried (inefficient ATCs included) and didn't run out of steam even at quite high levels. And all this from just 15watts!

The phono stage is almost as impressive. In common with all the other amplifiers here, it has a hard job coming near the superb MC stage of the NAC 82, and if you were really nit-picking you could say that the ultimate resolution of the Audio Innovations P2 was not quite as sharp or finely etched. But unless you had them next to each other I doubt that you'd find anything missing or even care very much if you did. Naturally there are advantages to be had by using the P2 directly into the power amps. It is certainly cleaner and a tad drier.

The Sibelius violin concerto was as enjoyable as anything I heard during my time with these amps. The sheer beauty of Oistrakh's relationship with his violin and the sweetness of tone that he extracts from it were wonderful. The natural way in which the instrument grows in volume, the quality of his vibrato, his bowing technique and his sensitivity to the piece all conspired to make it a special experience, full of emotion and about as far from regular 'hi-fi' as you could imagine.

The only area where these amps really failed was on



heavy electric music recorded live. The Audio Innovations lends such recordings a polish that they shouldn't really have and don't want.

Bass, though admirably extended and quite tight, fails somehow to really drive the piece along with the pace, verve and grip that it should. When confronted with ass kicking rock and roll they are a little too polite and rounded, as if they had burnished the nasty edges from all those screaming instruments and left them sweeter for your ears.

Lab Report

I first tested the Second Audio monoblocks about six years ago (see Hi-Fi Choice issue 63) since when this parallel push-pull design has been extensively revised, reducing the gain of its ECC88 input stage and uprating the transformer complementing its bulbous 2A3 output triodes. The upshot is an input sensitivity that has been reduced from the impractical 32mV of old to a more realistic 220mV.

In tandem with the buffered ECC82-based L2 preamp, this confers an overall input sensitivity of 151mV. The 'low output' setting on the L2 is ideally suited to high-level line sources like CD, providing a 10dB cut in the L2's output and maximising the usable range of its volume control with the partnering Second Audio power amps.

Pre/Power amplifier: Audio Innovations P2 Phono preamp/L2 line preamp/
Second Audio Power amplifiers

Maximum Continuous Power Output	20Hz 8ohms 4ohms	1kHz 3.4W 4.4W	20kHz 10.3W 10.8W	20kHz 9.0W 9.1W
Dynamic Headroom (IHF)				+0.6dB (11.8W)
Maximum Current (5msec, 1% THD)				2.0A
Output Impedance				4.13ohm
Damping Factor				1.94
Stereo Separation	(1kHz)		L2/Second Audio 57.5dB	P2 phono preamp 56.9dB
	(20kHz)		33.3dB	32.3dB
Channel Balance	(1kHz, -20dBV)		0.12dB	0.31dB
	(-60dBV)		0.04dB	1.62dB
Total Harmonic Dist. (for 1V out)	(2/3 power)		-56.3dB	-43.3dB
CCR Intermod. Dist. (for 1V out)	(2/3 power)		-46.1dB	-54.7dB
Noise (re 1V out)	(A wtd, 0dBW)		-47.1dB	-20.5dB
Residual noise	(2/3 power)		-73.3dB	-66.9dB
Input Sensitivity (for 1V out)	(unwtd)		-46.1dBV	-92.7dBV
Disc Overload	(for 0dBW)		151mV	43mV
	(1kHz)			5.07mV
	(20kHz)			84mV
	(50kHz)			142mV
Preamp output/Impedance			21V/4.8kohm	1.95V/6.2kohm
Input loading			40k/220kohm	47kohm/80pF
DC offset, left/right				0mV/0mV
Retail Price L2/P2/T2/Second Audios				£699/£699/£299/£2999

The Second Audio's new transformer has markedly improved its power bandwidth and output, which is now +4.2dB up from 3.9W to 10.3W. Furthermore, with a relaxed 3 per cent THD ceiling it's possible to squeeze out 20-21W (8ohm) and 4.8A maximum current, though this is outside true class A operation. This represents a substantial improvement over the original but sensitive, easy and essentially non-reactive loads are still essential if its high 4.1ohm output impedance is not to modify the loudspeaker's treble response or result in splody bass.

Fortunately the new P2 phono amplifier (MM or MC sensitivity can be selected internally) adopts a more conventional response than previous designs and its high THD is composed purely of inoffensive second-order mechanisms. This warm and smooth character is superimposed over the charismatic and highly novel multiple-order distortions emanating from the Second Audio, whose 'fingerprint' is as obvious from this 3D plot as it was back in 1988.

This pattern appears to bring a distinct colour and spaciousness to the sound of the Second Audio while

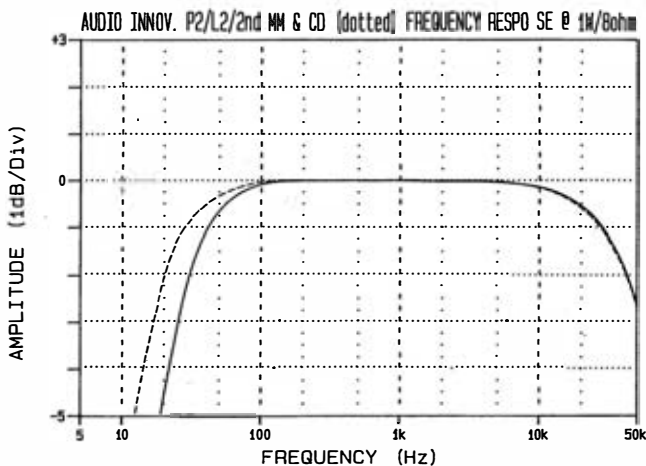
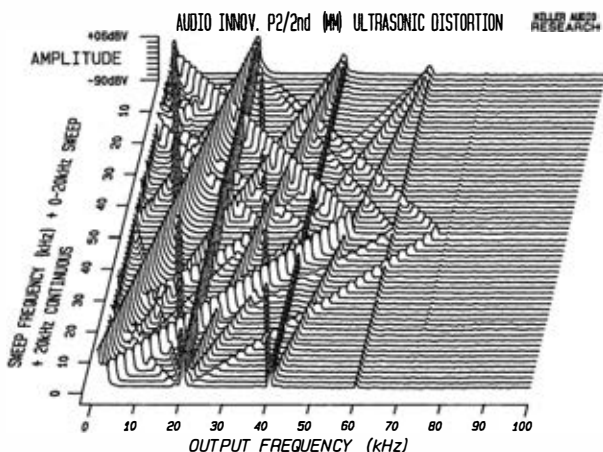
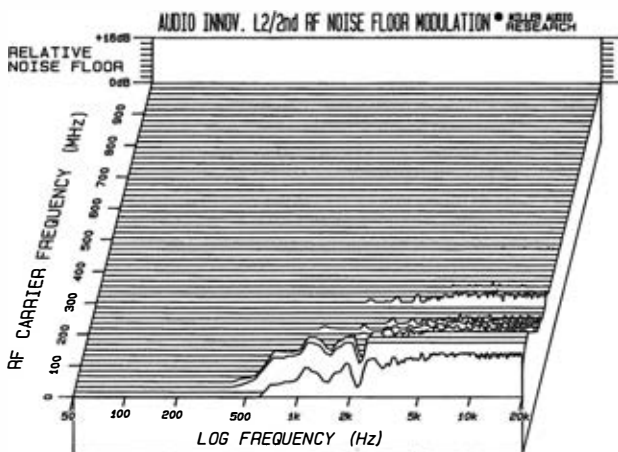
camouflaging any disruptive graininess that might stem from RF IMD (see plot). Straightforward hum and noise, however, could still do with being reduced from the current -46dBV.

Second Opinion

This four-box combo may be bulky and pricey, but it's proof positive of the reasons why the valve roller has been building up such a head of steam recently. It may not have the bottom end extension or slam of the typical transistorised leviathan, but its midband delicacy and dynamic life leaves solid state in stolid stasis. There's a lightness of touch that's all meringue compared to even the deffest suet pudding.

The focus is firmly on the midband and presence regions, giving voices and strings (picked, strummed or bowed) a rare and delightful transparency and realism. Nominal power may be as limited as actual grunt, but that was no disincentive to winding up the volume as high as we dared.

Like the bass, the extreme top end is a little retiring, but sweet and informative nonetheless, while the coherence between upper bass and midband is exceptional. This amp will bring excitement even to moribund systems, although the slippers-by-the-fire set might find the whole experience a little too edge-of-seat for easy relaxation.





Bryston

BP1 & transformer, BP 20, 4B/NRB

This £4,000+ Bryston combo hails from Canada and fits the bill of the big, tough North American amplifier perfectly. The BP20 preamp comes with five line level inputs via RCA sockets and requires the use of the BP1 phono amp and matching transformer if turntable listening with a moving coil cartridge is required.

The Brystons offer balanced or unbalanced connection between phono stage and preamp, and between pre and power amp. The preamp apparently has no wiring; all components are plugged directly into glass epoxy circuit boards.

**YOU WANT TO THRASH
THOSE SPEAKERS INTO
SUBMISSION? THESE
MIGHT BE JUST THE
AMPS TO DO IT.**

External construction is first class, with the controls having a real quality feel. The amazing 20-year warranty certainly seems to confirm Bryston's confidence in the long term durability of these products.

The 4B power amplifier alone weighs over 40 pounds and can function as either a stereo amplifier (giving a mere 250watts into 8ohms) or bridged, as half of a monoblok pair. In this latter

configuration it can deliver enough power for small welding jobs. Bryston should have fitted deeper 4mm speaker sockets, however, as those fitted only give about half a good contact.

It takes the merest tweak of the volume control for the colossal power of the Bryston to make itself felt, but it does need at least 24 hours to warm up properly before being used in anger.

With the AN-Js both the CD and DAT inputs were bright enough to verge on the uncomfortable. Shawn Colvin's Fat City had loads of overt detail, impressively big, deep bass, and strong backing vocals but there was



also an unpleasant edge to everything, especially the unnecessary electronic effect on the lead vocal.

But this amplifier sounds fast. It seizes onto the plectrum attack of the acoustic guitar and shocks you with the power and presence it can instantly summon from a black background, projecting the instrument into your living room. It stops just as quickly, and though it feels in adequate control of the speaker cones it was never really totally enjoyable with the Audio Notes as it constantly snatched at notes.

The Bryston's way of doing things never lets you really relax into the music: everything is a little too frantic. Its rather sudden presentation with CD is always leading your ear away from any real insight into the subtleties of the piece.

Things got better with the less efficient ATCs though. The sound was less in-your-face, but with ample power to get the SCM10s really moving, the Bryston was now better fun with CD.

All of the musicians on the Fat City album had now taken a couple of steps back from the microphone and left the amphetamines at home. Suddenly the lead vocal was less processed and more like a breathing human voice, and the lyric too was more intelligible, despite the best efforts of the producer.

The Bryston phono stage was somewhat disappointing

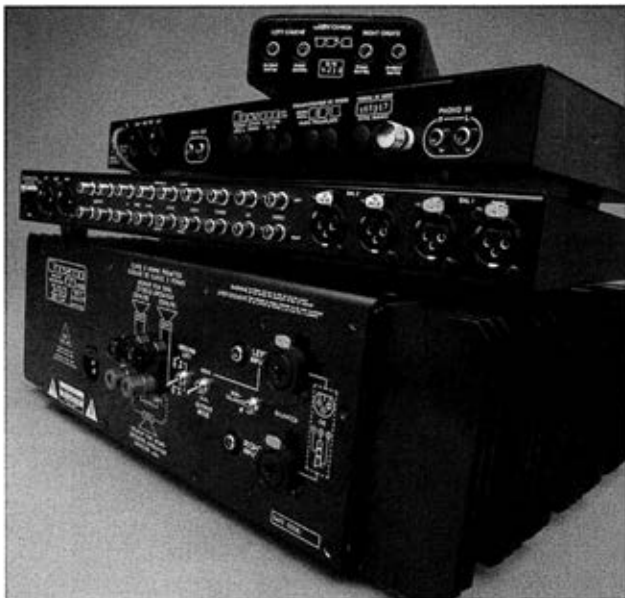
— there's certainly a lack of high end articulation and strength. Cymbals in particular seemed to lack any real natural explosive bite. They can also appear somewhat colourless and compressed, causing one to sound pretty much like another.

In common with other transformer-based MC step-ups that I have tried, there was a gentle rolling away of low frequencies, leaving the sound a little soft and muted. Its balance was certainly a lot calmer than most, though.

Although the Bryston was an easier amp to live with when driving the ATCs, it still lacked a convincing sense of musical precision. It

struggled manfully with Victor Bailey's bass playing on Weather Report's Sportin' Life, but left it over-plump and way too soft, though very full bodied. To some extent this trait diminished when I connected up the SBLs. Bailey's bass playing now seemed to have something to do with the songs.

Encouraged by this, I tried Birdland from Quincy Jones' Back On The Block. The Bryston found the SBLs a lot more accommodating and even on this fairly complex material it showed a real glimpse of previously hidden capabilities. Holding on to the walking bass theme with impressive tenacity, it still



If you need welly, then look no further than this Bryston combination. Finding the best speakers for it can be tricky though – try the Naim SBLs.



ESSENTIAL AMPLIFIER REVIEWS

snatched somewhat at the percussive links and fills that wander in and out of the song. But it kept its shape well at extraordinarily high listening levels, and this seems to be the Bryston's main strength. The way it can crank up the volume is quite amazing. It just goes on an on getting louder until something gives. Experience tells me that it's unlikely to be the Bryston.

With Ry Cooder's CD, *A Meeting By The River*, the Bryston's ability to deal with musical complexities was less taxed and the compositions were far more enjoyable now. There was more time and space for the melodies to unravel. If only it was as composed when the going gets tough.

Lab Report

I have never encountered an amplifier so intelligently and ruggedly constructed that the manufacturer feels happy to offer a full 20-year warranty. Until, that is, the Bryston BP1/BP20/4B-NRB combination landed on my test bench and proceeded to punch-out a massive 480W into 4ohm ably supported by a huge 31A of clean current. Bridged into an 8ohm load it will give more than 900W.

The only amp to exceed this figure significantly is NAD's 208 (Hi-Fi Choice, issue 124) but, rest assured, the 4B-NRB will drive the

Pre/Power amp: Bryston BP1 phono preamp/BP20 line preamp/4B-NRB power amp

Maximum Continuous Power Output,	20Hz	1kHz	20kHz
8ohms	310.2W	330.2W	295.6W
4ohms	434.4W	483.0W	434.4W
Dynamic Headroom (IHF)			+1.1dB (429W)
Maximum Current (5msec, 1% THD)			31.0A
Output Impedance			0.024ohm
Damping Factor			334.7
		BP20/4B-NRB	BP1 MM Phono Preamp
Stereo Separation	(1kHz)	91.4dB	75.5dB
	(20kHz)	71.4dB	49.4dB
Channel Balance	(1kHz, -20dBV)		0.07dB
	(-60dBV)	0.07dB	0.02dB
Total Harmonic Dist.	(0dBW)		-91.7dB
	(2/3 power)	-100.7dB	-95.5dB
CCIR Intermod. Dist.	(0dBW)		-93.5dB
	(2/3 power)	-100.5dB	-102.5dB
Noise	(A wtd, 0dBW)		-78.7dB
(re 5mV in)	(2/3 power)	-99.0dB	-81.8dB
Residual noise	(unwtd)	-67.2dBV	-82.0dBV
Input Sensitivity	(for 0dBW)		12.2mV
(for 1V out)	(for full output)	224mV	9.28mV
Disc Overload	(1kHz)		126.5mV
	(20kHz)		1150mV
	(50kHz)		1810mV
Preamp Output/Impedance (unbal)		16.5V/52ohm	13.6V/109ohm
Input loading		50k/25kohm	50kohm/260pF
DC offset, left/right			+1mV/-1mV
Retail Price BP20/BP1/TF1/4B-NRB			£1126/£673/£692/£1756

most recalcitrant of speakers without raising an eyebrow. All three of these Bryston separates adopts a dual-mono topology with little or no internal wiring and the option of balanced inputs and outputs.

There also seems to be plenty of compensation at work judging by the low 0.02ohm output impedance and very low 0.0009-0.003 per cent distortion of the BP20/4B-NRB combination. In fact THD at low levels is purely a measure of residual noise, not harmonics — just glance at the 'clean' 3D plot!

Even tested as supplied (with inset gain/balance trim-

pots left undisturbed), the BP1 MM disc preamp offers an incredible 0.02dB channel balance, 82dB S/N ratio and a response that's utterly flat from 20Hz-20kHz. On the other hand its 9.3mV input sensitivity is rather low and 49dB channel separation is poor by Bryston standards.

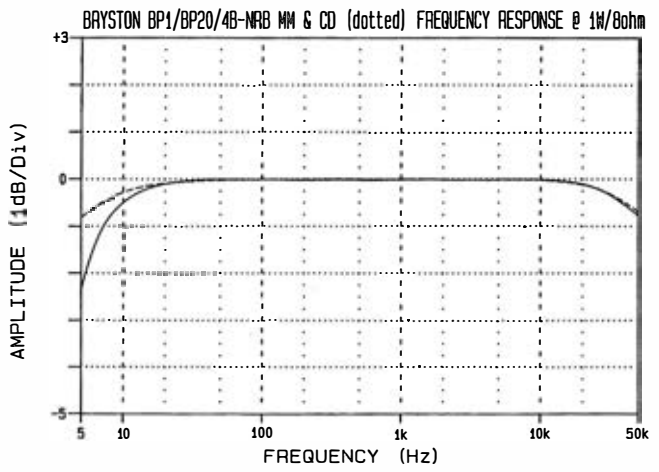
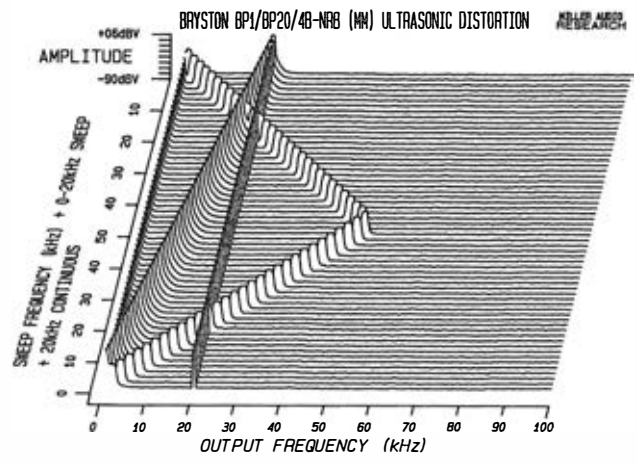
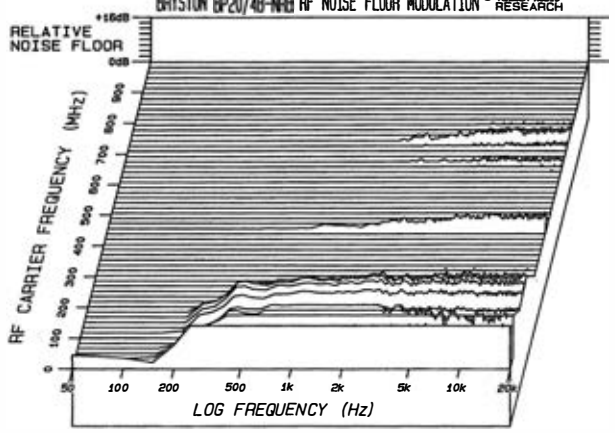
Channel balance is just as accurately matched through both the BP20 line preamp and 4B-NRB power amp, with the latter contributing to an overall residual noise of -67dB. If the 4B has an Achilles heel, it's the potential noise modulation caused by RF IMD. Once again the subjective effects of RF IMD

— long-term disinterest or listening fatigue — are often more readily exposed by an amp that appears so remarkably linear under closed-loop conditions. And few are as linear as the Brystons.

Second Opinion

It takes five different boxes, all different sizes, and all the figuring out of the order, the connections and the placement before this Bryston combo can be persuaded to amplify an MC signal. So I started off with the power amp alone, fed from my regular (Naim) preamp and sources. In this mode the sound was a little dull, rich and somehow slightly old fashioned. But beyond the slightly disappointing overall balance, the sound itself is rather entertaining.

The same confidence came through when the whole Bryston caboodle was up and running (unbalanced), but now it sounded slightly but distinctly bright as well as hefty, giving a boom'n'tizz effect when driven hard. Balanced connection gave a worthwhile further improvement in coherence, balance, and transparency. Timing is better than some, although slight overall time-smear takes some life and enthusiasm out of the equation. But there's some agility nonetheless, plus good dynamics and dynamic range, while the whole thing stays impressively under control even when working hard.





Musical Fidelity F22/F15

You could never accuse Musical Fidelity of making an anonymous product. The £1,000 F22 pre and £1,899 F15 power combination, along with the Audio Innovations, certainly drew by far the most interested stares from those who saw it glowing menacingly across the room.

I think it is fair to say that Musical Fidelity has always gone for a different approach to amplification, with all manner and class of device, and this set-up is no different, being a hybrid design incorporating both valves and transistors. The F22 preamp operates in class

**VALVES, TRANSISTORS,
REMOTE CONTROL:
THE MUSICAL
FIDELITY F22/F15
HAS 'EM ALL.**

A. It provides six line inputs, though Input 1 can be configured as an MC or MM phono input by Musical Fidelity at a very reasonable cost. This, it seems to me, is a really good idea and is certainly a lot more convenient and economical than having to purchase a separate phono stage like the Rotel Michi.

There is an excellent remote control too that operates all switching functions

and gives smooth access to the volume control. A tri-colour LED in the volume control shows the preamps status upon switch-on, first turning red for a few seconds, then yellow and finally green as the output relay opens and connects to the power amplifier. It also makes it easy to see exactly how far the volume control is advanced. Which is no bad thing when dealing with an amplifier of this power and volume potential.

Connections between the units can be made either by regular RCA leads or by balanced XLR connectors. I used the balanced option throughout my listening in



accordance with the instruction manual's suggestion.

The power amp is a monster (though less so than the even more monstrous F18). It can deliver 100watts per channel according to the book, but makes no mention of which load this applies to (see table). In common with the F22 it has a distinctive front panel. The handles are more for looks than convenience and you certainly wouldn't want to spend too long hauling it around — those heatsinks could do you a very nasty injury.

I was expecting a lengthy warm up period and wasn't disappointed. This is another amp that can sound quite tense for a while after switch-on, and I couldn't help but think that auditioning it in a dealer's dem room without allowing it several hours to stabilise would give a false impression of its potential.

After 24 hours I was ready to take the Musical Fidelity out for its first spin. It didn't take long to realise that the tonal balance and efficiency of the Audio Note speakers did not suit the amplifier at all. This combination can produce a lot of quite peaky midband energy which makes it difficult to listen to, and after a little experimentation I moved on to the ATCs. The sound lost a lot of its brashness and though its presentation was still forward, it began to exhibit a lightness of musical touch that was lacking before.

The MC input showed some interesting musician-ship on Zakir Hussain's LP, Making Music. This sparingly recorded album offers an intriguing amalgam of traditional Indian music with Jan Garbarek's distinctly North European tenor and soprano saxophone textures. The way that this contrasts with the tablas in the mix gives a distinct feeling of wild desolate spaces being pierced by an alpine horn.

The Musical Fidelity amps seemed locked into the piece. As Garbarek blows harder and increases pressure on the instrument you feel its warm tonality fading away as a shriller, harder sound ebbs in and his vibrato becomes wider and more intense. This is the nature of the instrument and the will of the player, the MF made comparatively light work of it. The explosive

percussive elements are a stumbling ground for amplifiers which often latch onto the finger striking the taut skin, but then forget that there is a whole harmonic element that rings from the tabla body. There is also a rhythmic framework and time signature to the percussion and it was here that the MF failed to be totally convincing.

The amp is fast, but there is a tendency for it to get a bit excited. The more subtle elements of the percussion are what really give Making Music its swing, and this acts as a pendulum against which the other players interact.

John McLaughlin's playing on this album is out of this world, but you need a high quality system to have any chance of understanding what on earth he's up to with his acoustic guitar. What can seem like an unnecessary bit



The F22 preamp offers six line inputs, but one of these can be configured for use as either a moving magnet or moving coil phono input.



of flash technique on one system shines like an essential beacon of harmonic clarity on another. I liked the way that the MF coped. It could display the nature of the instrument, the soft plectrum on low tension strings, and still be understandable, stopping and starting well and not getting too wheezy as the pace accelerated.

Criticisms of the phono MC input when the amplifier was used with the ATC's were few. Perhaps it lacks a little high frequency clarity (it certainly isn't as vivid as the Naim, nor as quiet). It can also sound a little muted on piano but its power and presence are impressive.

Unfortunately I was never as happy with the MF when using either CD or DAT as an input. A friend who brought a DAT master of some tracks he had been producing said that he thought it was way too bright tonally but very detailed. I had to agree.

Shawn Colvin's Fat City album was a disappointment, being too bright and harsh and having a bass which seemed compressed and squashed into an overcrowded midband. Perhaps the Naim CDS's very forthright impression of events was at odds with the way the Musical Fidelity views the world, but I found it an unhappy combination. In case you're wondering, I also tried the F15/F22 with the Naim SBLs and that didn't work very well either.

Pre/Power amplifier: Musical Fidelity F22/F15

Maximum Continuous Power Output,	8ohms 4ohms	20Hz 104.1W 148.6W	1kHz 107.0W 154.7W	20kHz 100.6W 148.6W
Dynamic Headroom (IHF)				+0.76dB (127.5W)
Maximum Current (5msec, 1% THD)				10.2A
Output Impedance				0.246ohm
Damping Factor				32.5
Stereo Separation	(1kHz) (20kHz)		CD/Aux 93.3dB 64.0dB	
Channel Balance	(1kHz, -20dBV) (-60dBV)		0.16dB 0.31dB	
Total Harmonic Dist.	(0dBW) (2/3 power)		-65.6dB -69.9dB	
CCIR Intermod. Dist.	(0dBW) (2/3 power)		-63.1dB -71.9dB	
Noise	(A wtd, 0dBW) (2/3 power)		-77.1dB -93.6dB	
Residual noise	(unwtd)		-62.6dBV	
Input Sensitivity	(for full output)		13.2mV 138mV	
Line Overload	(1kHz) (20kHz) (50kHz)		>15V >15V >15V	
Preamp Output/Impedance			10.0V / 51.9ohm (unbalanced)	
Pre/Power input loading			38kohm/80pF	47kohm/40pF
DC offset, left/right				+0.5mV/+1.9mV
Retail Price F22/F15				£1000/£1899

Lab Report

Both the F22 preamp and F15 power amp are hybrid designs that draw upon MF's experience of 'manipulating' sound quality. Both rely on ECC88 triodes as part of their linear-cascade input circuitry and it's this, rather than their balanced operation, that minimises their joint susceptibility to RF interference. Achieving a clean RF IMD plot without recourse to violent input filtering, for example, should bode well for sound quality.

Similarly, the valve inputs are coupled to solid-state driver and output stages that, in the F22's case, reduce its output impedance to a useful 52ohm (unbalanced). Likewise four pairs of TO-3 style

bipolar power transistors maintain a hefty 100-150W output from the F15, a good few tens of watts being within its class A envelope. As a result its 10A maximum current is not up to the speaker-busting standards of previous MF amps, but the F22/F15 relies on stealth rather than brute force.

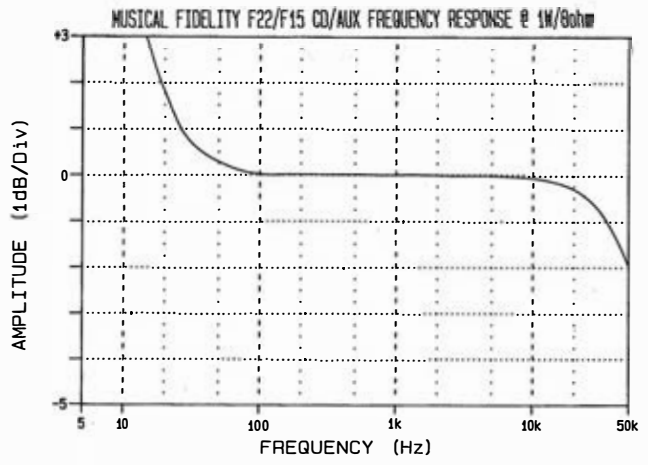
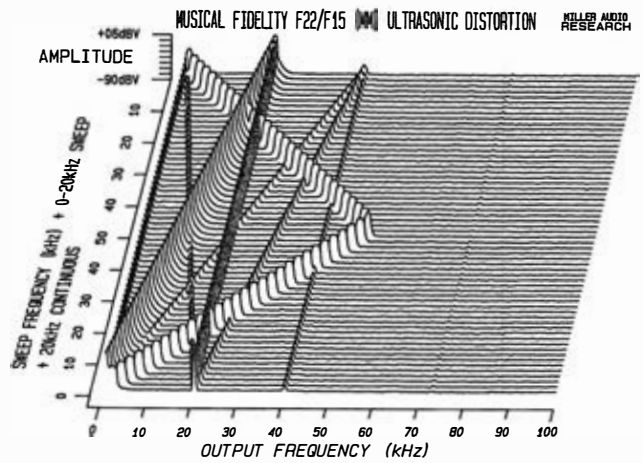
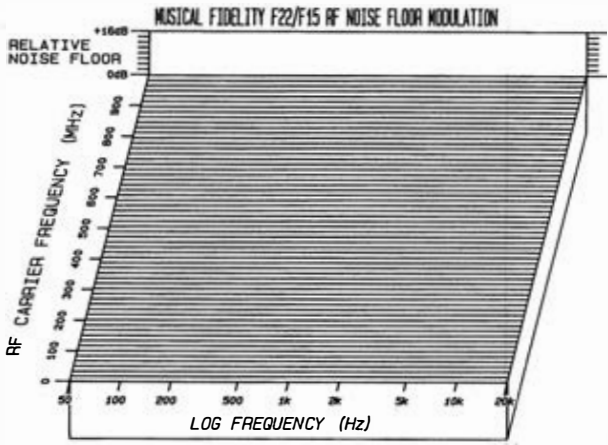
The 3D plot clearly shows the second-order nature of its distortion, which reaches 0.05 per cent without introducing a trace of unpleasant higher-order mechanisms. In my experience very few amps govern both the level and character of distortion with such success, a ruse that will surely exert some influence over the warmth and smoothness of its sound.

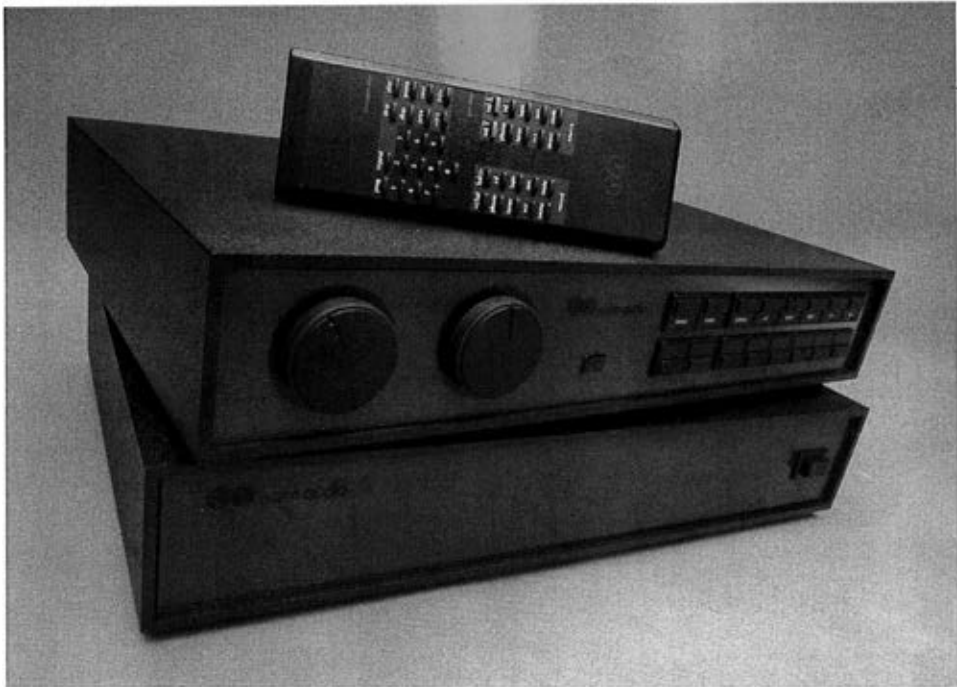
Another feature, typical of MF separates, is a contrived subsonic bass boost which reaches +5.5dB at 7Hz, returns to 0dB at 3.6Hz (off the chart) and then falls to a -3dB point at 3.1Hz. Quite what the average reflex speaker will make of this is anyone's guess, especially as the F15 has a fairly high 0.25ohm output impedance.

Second Opinion

The F15 power amp started out promisingly enough, with fine overall neutrality. At modest levels the sound was very easy and relaxing with good control and transparency, if a shade thick and heavy with lazy dynamics. Winding up the volume a tad started to raise further question marks: there was plenty of detail but no real sense of purpose and flow, and a degree of time-smear that left this listener more than a little frustrated.

Adding the F22 (via unbalanced connections) only compounded the problem, giving a warm, cuddly sound that remained loose and flabby. The first response to lamentable dynamics was to turn it up in the hopes of generating a bit of life, but the pudding effect remained until balanced pre-to-power interconnects were used. These rescued the sound from ignominy, bringing quite dramatic improvements in coherence and sweetness, although it's still not the most exciting sound.





Naim 82/180

Naim Audio has been designing and building amplifiers in Salisbury for more than 20 years now. The company has never gone in for wildly esoteric design or rapid model changes. Its reputation is founded instead on solid electronic engineering, continuous development and rigidly controlled manufacture. Just about everything at Naim is done in-house, and the company has a reputation for being both conservative and dogmatic — often at the same time.

Both these products are among the latest in the slowly evolving Naim range. The £1,880 NAC 82 is a six

FOR THOSE WHO DREAM OF A NAC52/NAP135 COMBO BUT JUST CAN'T AFFORD IT, HERE'S A WORTHY ALTERNATIVE.

input preamplifier, derived from the top of the range 52, with separate monitor and record sides. It is fully remote and requires two separate power supplies. The first, housed in a small box, comes with the 82 and supplies power only to the switching and control side of the preamplifier to keep any digital noise out of the audio circuitry. Powering the audio side of the amplifier can be achieved in several ways. All Naim power ampli-

fiers with the exclusion of the NAP 250 and mono 135's can be slaved to provide the voltage required for the preamplifier and this was the combination supplied. Upgrade potential is high as the NAC 82 can also be separately powered by adding up to two Hi-Cap power supplies, which I am assured brings huge improvements.

The £898 NAP 180 power amplifier is indistinguishable from its bigger brothers from the outside as it comes fitted in the same well-established full-width non-magnetic aluminium case. Naim was the only company to provide an interconnect lead, the custom-made SNAIC, which



does the job of carrying the signal from the preamp to the power amplifier and the power the other way. All line inputs are via lockable DIN connectors except for input one which, just as unusually, uses BNCs.

When I asked Naim why it seems intent on flying in the face of convention a spokesman for the company told me that they use them simply because they sound better with their amplifiers. They know, they say, because they have done the research. Seems fair enough to me.

As with Musical Fidelity's F22, Input One on the Naim can be easily configured for MC or MM with plug-in boards, and that was how the 82 was supplied. Naim's advice on warming up was that the preamplifier may improve for anything up to three weeks so the combination should be left switched on permanently.

Listening with the Audio Note speakers through the CD input showed almost immediately that although the 82/180 did not have the most obvious power in the group, it was right up there with the best for control. Shawn Colvin's *Fat City* lacked the broad technicolour canvas that the Audio Innovations portrayed. Instead there was a leanness and unfussed sense of clarity and focus to the performance. The steel strung acoustic guitars around which most of the arrange-

ments are based assumed a perspective in the mix that seemed entirely natural. Now they were not just individually dynamic sounds, but instruments, being played by people in a studio. Vocal performance was superb. The excessive equalisation on her voice is there of course, but it is not over accentuated. It doesn't have the permanent tonal sweetness of the Audio Innovations but the NAP 180 starts and stops with enough natural precision to make it easy to understand the lyric.

In comparison with the more powerful amplifiers here the Naim had less sheer bass level but there was very little to criticise in the way it dealt with the low end. It is tight, very tight, and exercises extraordinary control over both the shape of the note and its dynamics.

The result of this is to bring the bass playing into sharp focus and allow the listener full access to the bass lines. More important, however, is the way that the Naim amalgamates this and the other constituent parts of a song into a performance, and I think that this is its single most impressive feature. Because of its control over the incoming signal and its refusal to be fussed, even when confronted with the most complex of music, the 82/180 lays bare all the rhythmic elements and you begin to see into the piece. It is forever casting its almost

microscopic gaze across the music, showing you the bits but never to the detriment of the whole

The MC phono input is also of the very highest standard and shows the same rigorous commitment to the music, warts and all. I think it is completely capable of being used with even the most sophisticated of moving coil cartridges (Naim offer two types of MC board). I was especially impressed at how quiet this input was and pleased that, although it obviously has terrific high frequency extension and shows tenacious bite, it never accentuates surface noise or scratches.

This was evident with the Audio Note and SBL speakers, but not so much with the ATCs. Somehow the Naim never seemed quite at home with the tonal balance of these speakers and their inefficiency probably didn't help. Not that the 180 has problems driving them: it's just that they grow a little excited and uncomfortable as the volume is increased and somehow never seem to move enough air.

Naim's SBL was a much happier match, but so it should be. It's quite obvious that this speaker is tailored for Naim amplifiers and the 82 preamplifier really opens them up. Given a very, very good source they confirm what an excellent amplifier this is for the music lover as distinct from the hi-fi enthu-



ESSENTIAL AMPLIFIER REVIEWS

siast. The speaker and amp seemed locked together, and although the system is unspectacular by many standards, it plays all kinds of music and that's no mean achievement.

Lab Report

More so than most, Naim's various pre and power amplifiers are clearly designed to be used together: witness the combined power supply feed and audio signal interconnect that runs between the NAC82 and NAP180. This unusual, if not unique, arrangement ensures that the NAP180 power amp, for example, will rarely be partnered with a 'conventional' RCA phono socket equipped preamplifier.

Not that there's anything particularly unconventional about Naim's design philosophy. The NAP180 still uses a single pair of power transistors in its quasi-complementary output stage, for instance, a tried-and-tested circuit that goes back some 20 years. Naim puts greater emphasis on the well-regulated, dual-mono power supply that sustains its +2.1dB lift from 63W to 102W into 4ohm.

Equally characteristic is its high 0.225ohm output impedance that's largely due to a 0.2ohm series resistor. Otherwise the NAP180 relies on a moderate inductance/low capacitance loudspeaker cable to complete its output zobel network. The spaced-

Pre/power amplifier: Naim NAC82/NAP180

Maximum Continuous Power Output,	20Hz	1kHz	20kHz
8ohms	58.6W	62.9W	62.9W
4ohms	92.2W	102.0W	101.0W
Dynamic Headroom (IHF)			+0.73dB (74.4W)
Maximum Current (5msec, 1% THD)	9.9A		
Output Impedance			0.225ohm
Damping Factor			35.5
		CD/Aux	MC
Stereo Separation	(1kHz)	76.9dB	75.2dB
	(20kHz)	52.8dB	50.9dB
Channel Balance	(1kHz, -20dBV)	0.41dB*	0.45dB*
	(-60dBV)	1.54dB	1.59dB
Total Harmonic Dist.	(0dBW)	-83.8dB	-56.4dB
	(2/3 power)	-83.5dB	-56.3dB
CCR Intermod. Dist.	(0dBW)	-88.5dB	-49.0dB
	(2/3 power)	-74.0dB	-48.6dB
Noise	(A wtd, 0dBW)	-74.1dB	-71.6dB
	(2/3 power)	-88.2dB	-75.2dB
Residual noise	(unwtd)	-62.9dBV	-61.9dBV
Input Sensitivity	(for 0dBW)	9.5mV	13.0µV
	(for full output)	75.7mV	103.6µV
Disc Overload	(1kHz)		9.46mV
	(20kHz)		113.1mV
	(50kHz)		167.5mV
Tape Output/Impedance		5.9V (disc) / 585ohm	
Input loading		50kohm/160pF	420ohm
DC offset, left/right		+18.6mV/+21.1mV	
Retail Price NAC 82 S/NAP 180		£900/£1800	

conductor geometry of NAC-A5 makes it an obvious candidate for the job, but cables with a far higher parallel capacitance (like Isolda or early Audioquest designs) are best avoided.

The guts of the NAC82 preamp are equally traditional though using an external PSU to feed the input selection logic, display and Clare switching relays is clearly a sensible move. This leaves us with an uncomplicated set of results, distortion hovering around 0.006 per cent via line and 0.16 per cent via disc, courtesy of Naim's discrete high-gain MC RIAA stage. Even here the 3D plot reveals distortion to be almost solely second-

order within the audio band, restricting harsher higher-orders to the periphery of its moderate feedback loop.

An uncommonly high input sensitivity is perhaps its most inappropriate feature. Bearing in mind that just 76mV (0.076V) is required for full output, the massive 2V available from CD sources will necessarily restrict the range available from its analogue volume control. Otherwise this is all reliable stuff.

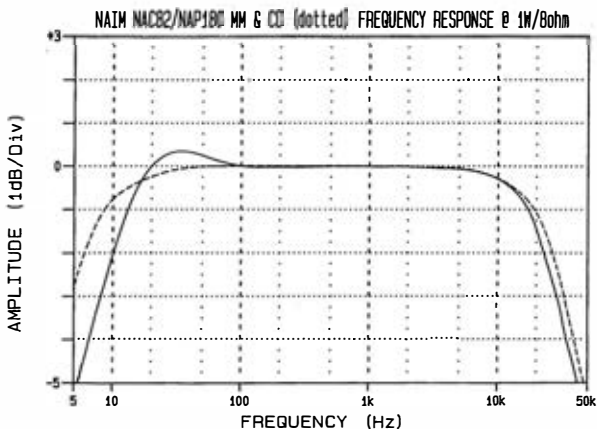
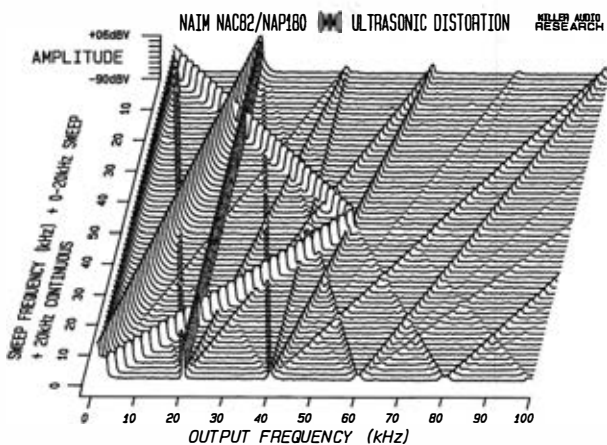
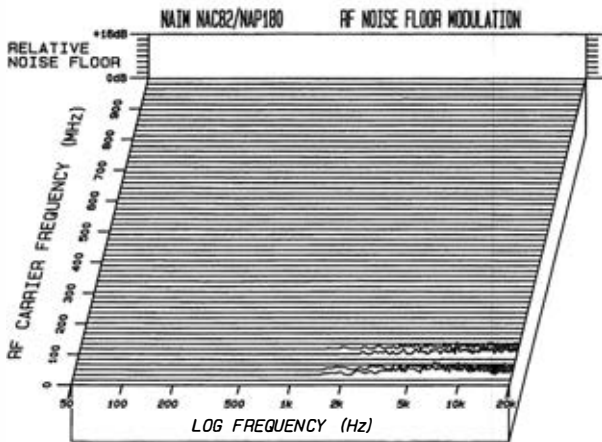
Second Opinion

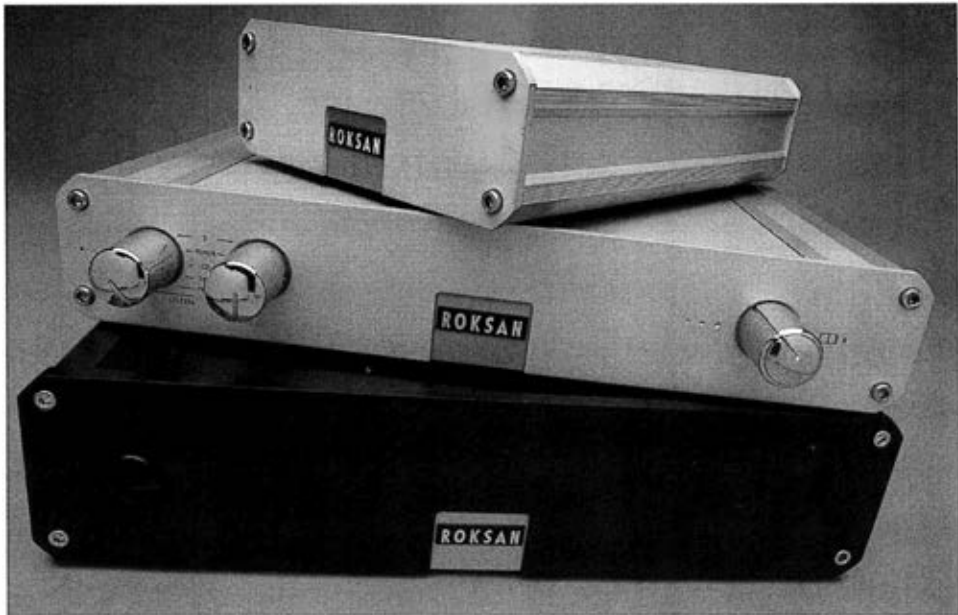
Since the system used for these second assessments normally uses Naim amps for controlling and driving duties, substituting this

NAC72/NAP180 halfway through immediately gave comfortably familiar and undoubtedly impressive results. This two-box mid-price Naim combo doesn't match the drama or analysis of the four-box NAC52/NAP135 in regular use, but it does have a close family resemblance and it offers maybe half the performance but for less than a third of the cost.

The Naim sound is quite distinctive, with a musical fluency and coherence that's only matched by the Audio Innovations valve amps. Its presentation, though, is less transparent and neutral than some. The attractively dynamic broad midband tends to dominate the sound — the presence region sounds a bit shut in and the bass lacks the thunder and definition found elsewhere. Nonetheless the Naim has timing as good or better than any of the group.

After you've had a few minutes to acclimatise to the sonic character, the decent leading edge resolution makes the whole experience pleasantly relaxing, natural, unforced and informative, especially on simpler material. More complex passages have a slight tendency to clog up towards the bass end, while definition and resolution are a little soft-focused. There's fair transient punch, and an overall coherence that positively encourages winding up the volume.





Roksan

ROK-L2 & DS1, ROK-S1

Roksan is not a company that you immediately associate with amplification. Its name was made in the eighties with the excellent Xerxes turntable but the company has gone from strength to strength, reaching the point today where it can offer a complete Roksan system. As if that's not enough, the system boasts two of the best source components around.

The new CD player seemed exceptional during a brief listen a few weeks back, and I have been looking forward to hearing the TMS turntable for some

ROKSAN IS BEST KNOWN FOR ITS TURNTABLES AND CD PLAYERS, BUT COULD THAT ALL BE ABOUT TO CHANGE?

time — it promises to be an information extractor of the highest order.

There's an engineered feel that runs through all Roksan products and the £2,490 L2, S1 combination is no exception. (The L2 comes with the DS1 preamp power supply.) Cases are all of a machined alloy and devoid of excessive controls, giving a solid purposeful and slightly conservative look, alleviated

only by the long volume and selector knobs. I really like this layout. Volume and balance are incorporated into one dual concentric pot while the other two deal with monitor or record selection. In this way, and in common with the Naim, it is possible to listen to one input while recording another. All inputs and outputs are via RCA phono sockets.

Touraj Moghaddam, the founder of Roksan, had told me that the amplifier, particularly the power amp, needs a long time to warm up. He was right. Although it sounded quite good from cold, there was a chill edge



to the tonal balance and an over-dry, somewhat flat perspective to the presentation. To be honest I'm not really sure that I ever got it totally warmed up, and would not be surprised to find that it grew steadily better for a couple of weeks or so, like the Naim.

From the earliest listening tests a few traits emerged that were ever present.

I was never totally happy with the amplifier at low levels. And the Audio Note speakers only seemed to accentuate this. At low levels the Roksan seems rather shy and is quite unprepared to come out of its shell — the music remained resolutely in the boxes. As the volume is advanced though the Roksan comes out to play, and the additional weight and strength of the amplifier starts to awaken the speaker cones from their slumber.

The clean appearance is in many ways mirrored in the Roksan's sound quality. It never reaches out of the speakers and slaps you in the face like the Musical Fidelity; it's far too much of a gentleman for that. Instead it seems to be reserved, cool and slightly aloof — just the job for tackling John McLaughlin's introspective playing of the music of Bill Evans. This CD, although containing some of the most beautiful tunes and playing you are likely to hear, has not been endowed with the most accessible sound quality.

Five acoustic guitars, all nylon strung, and an acoustic bass must be a nightmare to record, especially if you want to retain the natural sound of the instruments — all that soft attack from low tension strings and multiple instruments operating in the same frequency range. The scoring and playing have to be outstanding if the songs are not to drown in a sea of body resonance.

Play this CD on most systems and you will probably nod off before the end. It needs a superb CD player and an amplifier that isn't too excitable. The Roksan fits the bill and it did a very good job at keeping the perspectives of the instruments understandable, particularly on unison parts where there is a real charm in the soft warmth of the backing guitars. The Roksan managed to keep the identity of the instruments separate and stopped them sounding thin and woody. They were harmonically rich yet not overstated; most importantly it allowed you into the structure of the pieces, never leaving you in any doubt that the music was moving along harmonically as well as tempo-wise.

The Roksan is controlled and even polite in what it has to say. It is very pitch coherent too. Pianos do not wander around during note decay unduly, though one often wished for a bit more

projection. Play something upbeat and forward, advance the volume control and give the amp something to bite on, and your respect for it grows.

Jan Hammer's *Snapshots* CD is made from sounds you are unlikely to encounter in the natural world, composed as they are within the oscillators of a number of synth modules. But Hammer is a master at adding tone, breadth and warmth to his voicings, and the Roksan is amp enough to demonstrate this. It copes with musical complexities superbly, and its refusal to budge from a confident stride allows sounds to blossom and die. Without undue intermodulation from the other multi-timbral layering that Hammer spreads thickly over his canvas.

On the negative side there is a slight thinness to the way the Roksan does things and an overall constriction to the stereo image that can leave you longing for the amp to let go a bit. Often, just as you think you have grasped what the amp is all about, it leaves you disappointed, partly due to its neatness. Music that you could have sworn would suit its particular way of doing things fails to gel — and then the most unlikely pieces reveal a special charm.

Using the Michi phono stage, David Oistrakh's magnificent interpretation of the Sibelius Violin Concerto was



full of passion and pathos through the AN speakers but disappointing with the ATCs and SBLs, each of which introduced a vagueness of purpose to the performance and gave little clue to the soloist's greatness.

Lab Report

Early versions of Roksan's high-speed MOSFET power amp and fully complementary, symmetrical preamp were not without teething troubles. A mild but parasitic RF oscillation accompanied the output of the ROK-S1, for example, though this has now been damped-out at the expense of an output impedance which has risen from 0.0029ohm to 0.0068ohm. Meanwhile the 95W output, despite falling to 83W at higher frequencies, remains comfortably within Roksan's 50W spec.

Other features of the power amp, including its low noise (just -90db ref 1W), minimal susceptibility to external RF interference and low distortion (typically 0.0025-0.0035 per cent) are to be applauded. Distortion via the ROK-L2 preamp has also been cut from, typically, 0.1 to a low 0.003 per cent. This is reflected in the appropriate 3D plot which reveals very high frequency, second-order distortions — harmless crossover artefacts which persist at low signal levels.

Sadly some of the ROK-L2's other foibles remain. Gain is limited to just +7.5dB

Pre/power amplifier: Roksan ROK-L2/ROK-S1

Maximum Continuous Power Output,	20Hz	1kHz	20kHz
	8ohms	91.0W	82.5W
	4ohms	111.2W	112.3W
Dynamic Headroom (IHF)			+0.8dB (114.1W)
Maximum Current (5msec, 1% THD)			10.9A
Output Impedance			0.0068ohm
Damping Factor			1176
		CD/Aux	
Stereo Separation	(1kHz)	85.0dB	
	(20kHz)	60.4dB	
Channel Balance	(1kHz, -20dBV)	1.34dB	
	(-60dBV)	6.11dB	
Total Harmonic Dist.	(0dBW)	-90.5dB	
	(2/3 power)	-89.2dB	
CCIR Intermod. Dist.	(0dBW)	-98.9dB	
	(2/3 power)	-102.5dB	
Noise	(A wtd, 0dBW)	-90.1dB	
	(2/3 power)	-104.2dB	
Residual noise	(unwtd)	-78.4dBV	
Input Sensitivity	(for 0dBW)	21.8mV	
	(for full output)	215mV	
Line Overload	(1kHz)	4.17V	
	(20kHz)	4.27V	
	(50kHz)	4.35V	
Preamp Output/Impedance		10.1V / 19.0ohm	
Pre/Power input loading		52kohm/100pF	32kohm
DC offset, left/right		+46.2mV/+49.7mV	
Retail Price		£995/£1495	

(1V out for 421mV in) which is more than sufficient for a 2V CD source but rather low for an old tape deck or tuner whose output amounts to just 200-300mV. Fortunately the input sensitivity of this combination is set at a moderate 215mV but its low 4V line headroom is sailing pretty close to the wind, providing a margin that's just +6dB above the 2V CD spec but well within the range of some maverick high-output players and DACs.

Furthermore the lower range of Roksan's volume pot is still plagued by poor tracking, the error between channels amounting to 6.1dB at -60dB. In practical terms the useable range of

this dual-concentric control is really no more than 55dB before channel balance errors become very significant

Second Opinion

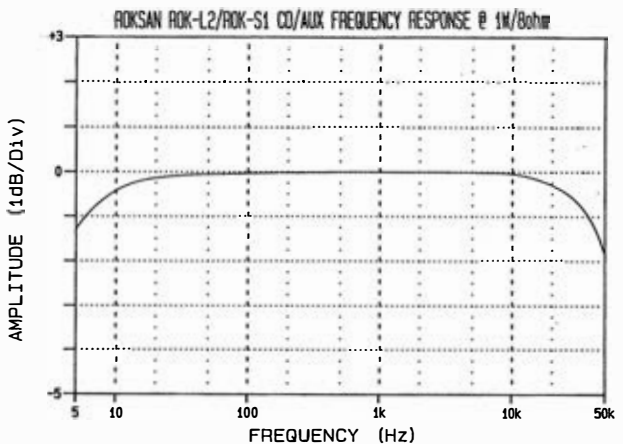
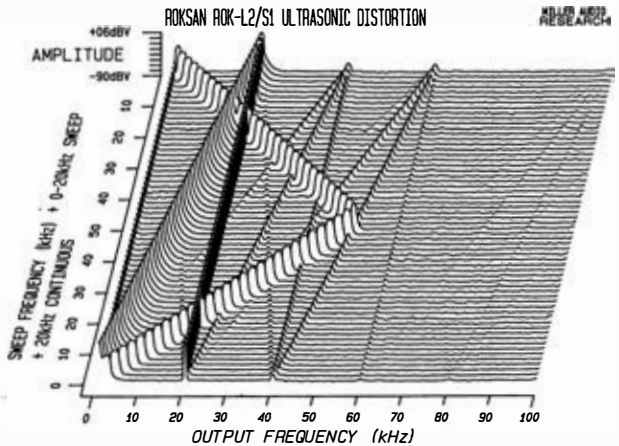
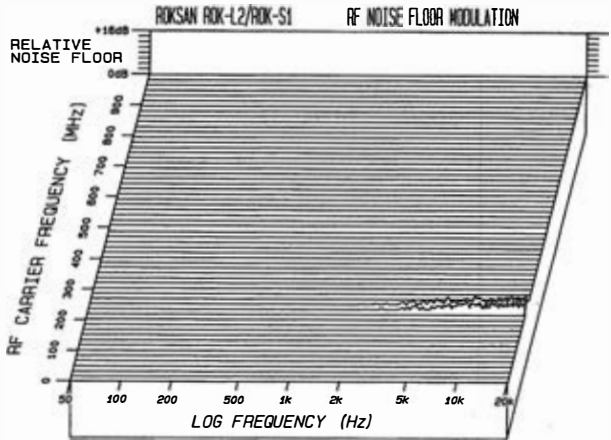
Roksan's current (temporary) lack of vinyl disc facilities might have introduced an element of unpredictability. But the character of this amp nevertheless seemed pretty consistent whatever combination of step-up and equalisation was used, and this character didn't seem to change significantly when using CD as the source, nor when just the power amp was used with alternative preamplification.

The sound is notably

punchy and clean, especially in the upper midband and presence region, which gives vocal lines excellent projection and clarity. Presentation tends towards the lean and aggressive, but whether it oversteps the mark in the latter respect is really a matter of taste, and the sort of system that's wrapped around it. Certainly it sounds happier driving reasonably restrained speakers.

Timing is pretty crisp and taught with fine punch and drive and a decent enough dynamic range. The bass end was less convincing though. Impressively dry and with fine subjective extension, there was an odd quality that was difficult to pin down, but it was noticed each time the amp was powered up — not quite detachment but more a slightly disjointed quality, perhaps relating to phase shifts.

For all that the experience is entertaining and involving — invigorating even — and brings fine detail to plucked and strummed strings, with a good differentiation of textures throughout the midband. The upper reaches of its power delivery were just a shade uncomfortable though, due in part to a lack of full bandwidth coherence and partly to slightly aggressive tendencies.





Six of the best?

CHRIS THOMAS PUTS THIS DYNAMIC SEXTET OF AMPLIFIERS INTO PERSPECTIVE. FOR THE FIRST TIME IN YEARS PAUL MESSENGER FINDS HIMSELF IN AGREEMENT.

The aim of this review was not to find the 'best' amp, though I can't deny that strong preferences did emerge for me personally. There are obviously many, many other combinations of both source components and loudspeakers that may well yield different results. But, having said that, we are talking about very expensive amplifiers, and not very complex speaker designs, so I would have expected none of them to have any real problems making a good sound.

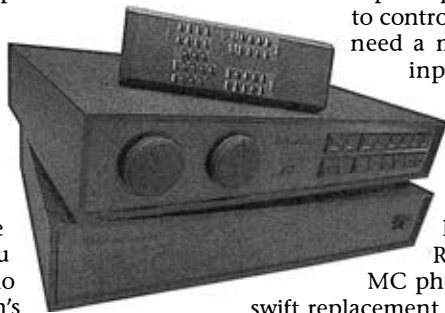
One thing that did bother me throughout though was the excessive brightness and harshness that the CD listening exposed. OK, I know that CD always has the potential to be that way. But when you listen to the Audio Innovations' or the Naim's terrific performance with silver disc it does leave you scratching your head somewhat.

The Arcam shows what can be done for a modest £230. It responds well to all kinds of inputs and should be happy driving most decent speakers. But don't expect too much.

The right balance of equipment needs consideration. The phono input demands something of Rega 3 quality, and given that the little Alpha should sing sweetly and keep you happy until the upgrading bug bites.

The Briston has many impressive qualities, but the package assembled here will set you back a cool £4250. For this you get a power amp with enough welly to drive practically any speaker you can think of to destruction. And a preamplifier that's not quite up to controlling it. But it really does need a much better MC phono input. Possibly the transformer is a limitation.

Both the Roksan and the Musical Fidelity have good things to offer. At £2,500 plus £695 for the DS-1 power supply, the ROK L2/S1 also needs an MC phono input onboard or a swift replacement for the Artaxerxes. With the right speakers I am sure this amplifier could be very good. There is something undeniably musical about the way it goes about its business. I could find lots of things to criticise, but always enjoyed listening to it and would be very interested to hear it as part of a full Roksan system. Based on my experi-





ences I'd say that it's very nearly right and with a little development could be excellent.

The Musical Fidelity left me with the impression that it's somewhat quirky. So much promise and yet I never felt as if I had really come to grips with it. It was as good with the ATC's as it was poor with both the Audio Notes and the SBL's. It has power to spare and a good, if not spectacular, MC input. The remote is great and on occasions so was the music. But it performed inconsistently with the equipment it partnered, so I am going to have to sit on the fence with this one. It costs £3,000, and needs a lengthy warming up period, which is worth remembering if you have an audition.

This was the first time I had heard the Naim NAC 82/NAP 180 combination, but in many ways there were no real surprises. This is a typically Naim product, well built, and capable of great things if used with the right equipment. It worked magnificently with the Naim CDS and SBL's as you might expect, but it also imposed itself totally on the Audio Notes and wrung a memorable performance from them. This Naim combination sounds and feels like a totally sorted amplifier and has the best MC input that I have tried with the exception of the NAC 52. I should imagine that adding two extra Hi-Cap power supplies would move it straight into super amp status. At £2,700 it almost seems a snip.

Finally then the Audio Innovations set-up. Let's get the criticisms out of the way first. The casework is just not good enough for an amplifier that costs the thick part of £4,700. The rest is all downhill. I thought that this was a beautiful amplifier. Perhaps it sugar coats the music. If you believe some of the other amplifiers here, then it certainly does. You probably won't like it if you listen to a lot of guts 'n' thunder rock. You will find it relaxed. But it brings a real sense of poise and vibrancy to the vast majority of music and on some albums it is nothing short of exquisite. It really does feel totally at ease with itself, displaying a richness of tonality, espe-



cially on acoustic instruments that is totally refreshing. Add to this a really solid and convincing stereo image that you can practically step into and you'll begin to understand why I liked it so much.

Paul's opinion

The 'second opinion' listening tests ended up with a rather truncated timescale, and without any knowledge of Chris Thomas' findings or methodology. It's maybe a regrettable coincidence that we both choose to use Naim CDS CD players and Linn Sondeks although the speakers I used — a combination of wall-mounted Westminster Royale drivers and the same company's giant 215DMT studio monitors — were certainly very different.

Intriguingly, and very encouragingly, the overall findings proved remarkably similar. I regularly found myself chuckling in agreement when reading Chris' copy a day or two later, admiring how much further he'd got into the various amps than my rather superficial efforts, and feeling that the latter were perhaps a little superfluous. Certainly there's not a lot I can add to his conclusions, except to take some delight from the observation that this is the first occasion in years of subjective amp reviewing that I've encountered such unusually close corroboration of independent listening findings. Maybe we subjectivists are starting to get there at last!



EASY ASSEMBLY REPRODUCERS

A Nice Bit of Kit

RICHARD KELLY INTRODUCES AN ECONOMICAL WAY OF GETTING INVOLVED WITH SERIOUS HI-FI — BUILDING IT YOURSELF.

In these days of enforced financial restraint one of hi-fi's few growth areas appears to be the build-it-yourself scene. In the past this area has suffered an image problem due to a lack of imaginative and innovative design, coupled with average quality components.

From the relatively barren era of the mid-eighties we have now progressed to a bewildering glut of products from the acceptable to the very good. And it is amongst loudspeakers that there is the most diversity of designs and prices. This most encouraging state of affairs enables even the most cerebrally challenged of us to upgrade our flagging systems without sacrificing various limbs, while boosting the self esteem through mastering the complexities of cabinet making and electrical engineering. Yes, all this is possible with a little help from your congenial kit manufacturer.

Where do you start? By reading of course. First decide what type of speaker enclosure is going to suit: reflex, horn, transmission line or even open baffle. One company that will definitely help is Falcon Acoustics, which handles a multitude of invaluable publications in your quest for knowledge. I personally find the historical aspects of kit design totally engrossing, and even though technically illiterate I rather enjoy the challenge of deciphering and understanding the obscure laws that govern the everyday

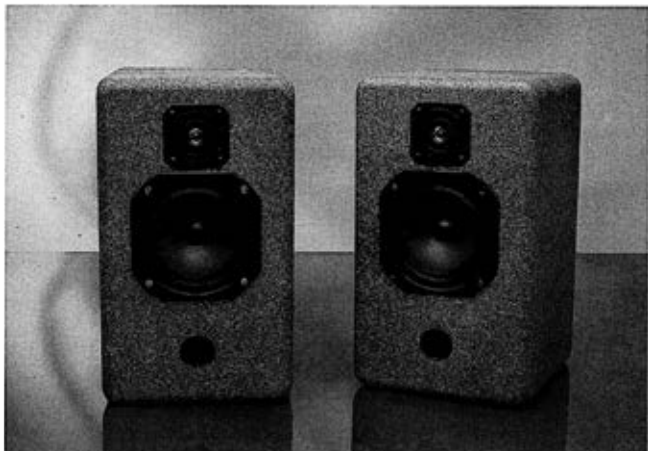
pleasure of recorded sound.

The best starting point is the evergreen classic that influenced and educated all and sundry in audio engineering; Loudspeakers: The Why & How Of Good Reproduction by G.A. Briggs. Although last revised in 1949, this book is very easy to read and introduces such diverse concepts as impedance, phons and decibels, frequency response, resonance and vibration, cabinets, horns, room acoustics, crossovers, phase effects and very much more. For £5.80 plus p&tp it has got to be the most cost efficient personal upgrade going.

For the ambitious there is a tome called Electrostatic Loudspeaker Design & Construction by Ronald Wagner (£15+p&tp). This really is the far side, not that it advocates the impossible, but rather it makes the impossible seem so feasibly sane. If you want to build a pair of six foot monsters driven by high voltage amplifiers for a cost approaching that of keeping a dog topped up with Winalot for a year, you've got to buy this one. It really opens the mind to learn that all you need to make the conductive membrane is a pack of clingfilm and a proprietary liquid soap! I kid you not, but don't blame me if you vaporise yourself.

Also available are two magazines of note: Speaker Builder and Audio Amateur. Back issues are available and I can especially recommend Speaker Builder issues covering the developments of Paul Voigt. If

"This most encouraging state of affairs enables even the most cerebrally challenged of us to upgrade our flagging systems without sacrificing various limbs."



Faraday FS1. This finished version was Recommended when Paul Messenger tested it; he reckoned it offered unmatched transparency at the price.

horns are your bag then there is plenty of relevant information to help/confuse you. I mention horns because they are one of my weaknesses, but plenty of other designs are also covered. It is well worth the time and effort to read as much as you can on the subject, to save much sweat and disappointment when you get down to the nitty gritty.

Falcon also sells all the necessary hardware. Drive units from KEF, Focal, SEAS, Audax, Coles, Dynaudio, Elac, Peerless, Scanspeak and Siare, together with relevant crossovers, wadding, and anything else that could possibly be needed. In fact the only thing omitted from the list is a decent first aid kit. High efficiency interests many valve amplifier users and Falcon has a range of 89dB sensitivity speakers based around Focal units, which start at £123 for the basic bookshelf DB13 through 12 different models up to floor-standers costing £557.

Buckets and spades

For those readers that like messing about with buckets, spades, piles of sand and lots of water, Faraday Sound, whose speciality is low density concrete enclosures is ready to help you. A three model ready-to-go range share

a common cabinet and differ in the choice of drive units. Faraday also offers the chance to purchase the cabinets less ancillaries for £60 a pair, leaving the customer to use units of his own choosing. The company is happy to provide suggestions and advice on driver choice, and will tell you where to purchase anything from crossovers to binding posts. Faraday will even supply plans for you to cast your own concrete cabinets, but £60 for the ready built ones seems a fair price considering the effort and cost of

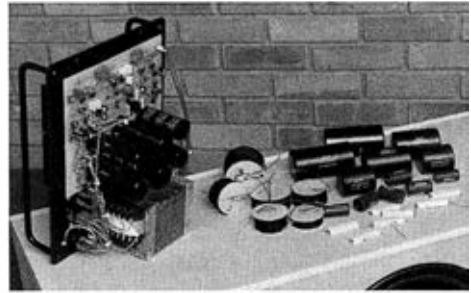
making casting moulds. For all details, Faraday has a £9.95 booklet, refundable against any purchase.



IPL's M3TL transmission line design, easily built cabinets but rather obtuse dissenting crossover networks.



EASY ASSEMBLY REPRODUCERS



Above left: Wilmslow Audio's SPL Satellite incorporates a 28mm cloth dome tweeter and woofer from Morel for £162. Top right; a Vifa tweeter and ATC midbass unit atop a 55 litre design and below right; the active and passive components for the kit versions of ATC's SCM 50 and 100 designs, prices run from £1,850 to £2,995.

IPL Acoustics is one company that I have dealt with when building the S3 SEAS based floorstanding transmission line design. Although not entirely happy with the instructions, I found the cabinets remarkably easy to build. The crossover proved to be a different kettle of fish. With my limited knowledge of standard circuitry I made a few basic errors, but with some expert help the problem was soon resolved. IPL apologised for my ignorance and assured me that the problem could be easily rectified. Dismissing my notion of euthanasia, the company opted to

make the instructions more lucid, while drive units from SEAS, Morel, Audax, Visaton and Elac leave nothing to be apprehensive about.

One company that needs little introduction is Wilmslow Audio, which advertises widely in hi-fi magazines. I've built one of its QUAD ESL oriented sub-woofers: good woodwork and a good moron guide made it a doddle, and it worked pretty well too. And I managed to improve it somewhat by adapting an outboard active crossover. That's half the fun of kits. You're not likely to feel inhibited about modifying something you've

**"I've built one of its
QUAD ESL oriented
sub-woofers: good
woodwork and a
good moron guide
made it a doddle"**



EASY ASSEMBLY REPRODUCERS

built yourself. Wilmslow has a large range of kits to suit all pockets, using drive units from most of the aforementioned brands together with the excellent Volt bass drivers — definitely the thing for subwoofers.

I was also rather taken with the DBS6 kit. I have no experience of building it, but heard it at Eric Braithwaite's place. Going from QUAD ESL63s straight to DBS6s was no great pain: rather different I grant you, but I didn't have to leave the room screaming. For £187 you get everything but the cabinets, the end result depending very much on your wood-working skills. It is a small but very dense design and I wouldn't have thought you'd have much change out of £100 for a really superb pair of cabs, so for under £300 you get a speaker that Wilmslow claims is competitive with £600 ready made alternatives, the sort of equation which is not unusual in the kit speaker market.

One company that supplies drivers direct to the public is Bandor Loudspeakers. There's something that sounds just right about these aluminium coned devils, the only drawback being that they are a little more costly than average, but it's money well spent. The other complication is that you are going to have to design and build your own cabs to use them in.

Finally, The Speaker Company is relatively new on the scene, but proprietor Mike Aldington has been around for quite some time working for the opposition and has learnt a great deal from the experience. First he got totally analysed, that's to say installed full testing facilities to verify and prove all future designs. All supplied 25mm MDF woodwork is machined to the highest order, and the kits designed to hold together whilst you're assembling, so clamps and pinning are redundant — all simple but clever stuff.

T.S.C. is the distributor for the latest technology in cabinet damping, Deflex Acoustic Panels manufactured by Spectra Dynamics. This new form of damping is receiving critical acclaim from many quarters and is strongly recommended. Spectra hasn't

stopped at the cabs: realising that harmful reflections come off the back of the magnet it has developed a different density polymer pad called Magnapad, from three to ten inches in size and costing from £7.95 to £25.95 a pair.

The free catalogue is equally professional, well illustrated and highly informative. Page footnotes give relevant equations and data for finalising your own cabinet design should you so wish. Should you have a computer sitting around at home, Boxcalc for boxes, and Netcalc for crossovers are two programmes they supply. The extensive product line-up includes the H.P.D 10, a sensible size horn speaker which uses a compression driver for the treble is an attractive proposition at £740 all in.

Addresses

The Speaker Company,
Unit 9,
Waterside Mill,
Macclesfield,
Cheshire.

SK11 7HG
0625 500507

Wilmslow Audio,
Wellington Close,
Parkgate Trading
Estate,
Knutsford,
Cheshire.
WA16 8DX
0565 650605

Bandor Loudspeakers,
Design and
Development Studios
11 Penfold Cottages
Penfold Lane
Holmer Green
Bucks
HP15 6XR
0494 714058

Faraday Sound
248 Hall Rd
Morwich
NR1 2PW
0603 762967

Falcon DIY Speakers
Falcon Electronics
Tabor House
Mulbarton
Norfolk
NR14 8JT
0508 578272

IPL Acoustics
2 Laverton Rd
Westbury
Wilts

BA13 3RS
0373 823333

DBS Audio
PO Box 91
Bury St Edmunds
Suffolk
IP30 0NF
0284 828926



EXCELLENT ANALOGUE RECORDS

Dan's Retrospective Record Review

A COUPLE OF WEEKS ISN'T REALLY LONG ENOUGH TO ASSESS A RECORD, SO WE GAVE DAN HOUSTON A YEAR OR SO TO PICK SOME TITLES WHICH STAND THE TEST OF TIME.

It sounds like a strange request — to talk about records you listen to a lot, albums which, by their homogeneity of musical content continue to be played over and over again. I suppose like most music lovers I fall into the trap of buying an album, playing it thoroughly while getting to know it, then shelving it and calling the process record collecting. Often those in the hi-fi fraternity, plus the occasional sister, play just favourite tracks, and mostly use them to show off the system itself: “Just listen to this drum solo”, that sort of thing.

So many musical evenings become genteel disc jockeying events, with the host loitering by the system perusing the sleeve of the next offering. What said host plays when he gets home from work and would like to couch-out for a few hours is probably an entirely different matter.

A quick glance through the stack of records leaning against my loudspeaker stands confirms my guilt as being a member of the audio fraternity. I've been re-setting up my system, soldering up a new arm cable, replacing the cartridge and dismantling and re-building my Mana Acoustics turntable table. At each stage I've been playing those favourite tracks which convey the purity of vocal music, frequency extension, dynamics or soundstage. But most of the albums I'm using don't stand up to playing more than one or two tracks. I've even bought double albums like Van Morrison's *Hymns to the Silence* just for his memorial to teenage years On Hyndford Street. Don't get me wrong; I

think it's an acceptable expense, and the song takes you right into Van's nostalgic dream of past youth, complete with tattered Jack Kerouac paperback in hand and Radio Luxembourg playing at night in the days before semi-conductors; before rock and roll.

The album I've probably played most, though very seldom all the way through, is the five LP, or three CD, *Bob Dylan Bootleg Series 1-3*. Released three years ago, it contains previously unheard material spanning his 30 year career. Columbia's greatest poet sounds as abrasively nasal as ever and more so on some tracks which are obviously first takes, captured here with bum notes and all, and often with much less 'production' and other studio artefacts than usual. For the fan the lack of polish on these tracks is most important: takes like *Tangled up in Blue*, originally for *Blood on the Tracks*, are presented with sparse musical arrangements which distil the essence of the songs.

Many regard this collection like a musical Tardis, which is much bigger once you get inside it, and takes you back in time. As one commentator wrote: “it's like being back in the sixties again”, and although I wouldn't know, it is certainly like being back in the seventies and perhaps even in the next century. A blues track like *Blind Willie McTell* might herald Dylan's next phase, post country, post rebel generation, post rock star, post lay preacher, as a return to his early influences, listening to the Delta Blues men. The sense of timing has always been there, but can an island owning, globe-trotting multi-



millionaire really get the blues?

As BB King says: "If you want to make it bluesy, it can be fun and still be bluesy". He says it on *Live at San Quentin* which has as good an atmosphere as any recently recorded live album I've heard. It contains many favourite songs from a long recording career: *Into the Night*, *Never Make a Move Too Soon*, *The Thrill is Gone*, *Sweet Sixteen*, *Let the Good Times Roll*. The picture of the crowd of cons slowly getting into the King's charity jailhouse rock comes off the record with the clarity you'd normally only get from a video. He gets compered by a screw, splits the crowd for choruses, has to break for lunch — all that stuff which brings the event into focus. The acoustic is very out-of-doors and you can almost feel the sunshine.

Back in the studio I've found John Lee Hooker's *The Healer* remains a favourite more than earlier and subsequent offerings. But that could be because I find Bonnie Raitt's admission that she is in the mood for (his) love a little quirky in their duet. The salient point about Hooker is that his recordings are always clear. They make his presence felt, a tradition established during his early career with the Chess label.

On the soul front I've had to look no further than Al Green's *Greatest Hits*. I never listened to this album much before, but over the last year it's been on the turntable every other day. It's the blues-inspired sense of timing which gives this re-released seventies retrospective its appeal. Soul fans probably prefer the original discs but I hope they would agree that this isn't a song too long, nor does Green pitch a note

wrong. What's more, it scores high on the boogie factor scale.

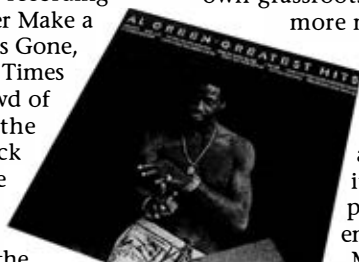
Dollar Brand's double album *African Sun* is probably no more special than any of his other albums; it's just the one that I've come across. The South African pianist melds his own grassroots musical influences with a more metropolitan style acquired over years living and playing in New York. You couldn't call the album modern jazz, it's far more accessible than that, though it does stretch the intellect in places while remaining eminently listenable.

More traditional jazz arrangements appear on the Cole Porter compilation *Red, Hot and Blue* by a host of artists from Roddy Frame (*Aztec Camera*) and U2 to Lisa Stansfield and KD Lang. The surprise is to find contemporary artists singing these songs so well; Porter was

writing for the likes of Ella Fitzgerald (and her extraordinary vocal range). This must be one of the most delightful double albums I've ever bought and confirmation that the great songwriter's work is as contemporary now as it was in the thirties, forties and fifties.

This is hardly a definitive list of gem albums released in recent years; I could have included the Eric Clapton and Neil Young *Unplugged* recordings, and a host of others I don't

listen to throughout. Nor does it include the wealth of jazz and classical material I've been finding in Brighton's second hand record stores. But I've found that this small selection has stood the test of time, and expect that they'll still be favourites in five years.





Zen and the art of digital technology

Digital audio is often criticised by audiophiles as being in some way inferior to pure analogue. Criticisms vary from accusations of sterility to comments that it sounds veiled and lacking in that quintessential ingredient of musicality. I believe that this viewpoint may have much to do with the renaissance of valve circuitry, where the listener perceives virtue in the archaic technology of glowing tubes, plated metalwork, precious metals and the sonic signature intrinsic to many a thermionic amplifier. We even see this technology being applied to some CD players which use valves in the final stage of signal processing, as information flows from a digital to an analogue representation, in a final attempt to embed an analogue character to the sound — or should that read lack of transistor character.

A system that can simultaneously please several senses, that is sonically enlightening, is visually elegant and has an aesthetic and engineering beauty that extends from the material to the tactile, will endow confidence and excitement in the brain's pleasure centres. The harmonising of several sensual responses creates a sum that transcends the individual parts. Are we then using such an approach as a surrogate for technological deficiency?

I admit that valve technology offers a certain fascination and can deliver exemplary performance, but I am not convinced that it is necessary in the quest for ultimate sound quality, especially as the intelligent use of

LEST YOU FEEL THAT THIS PUBLICATION IS ANTI-CD WE HAVE ENLISTED THE TALENTS OF DR MALCOLM OMAR HAWKSFORD THE CD GURU.

digital signal processing becomes more commonplace and is interfaced with correctly designed analogue circuitry.

The translation of an acoustical event through several energy conversions

and stages of signal processing requires a precision that extends beyond everyday experience, especially as much of the performance must be gained open loop with little opportunity for correction other than in a local sense. In my view, simplicity is the key, especially within analogue stages, and this simplicity is proportional to the final quality of reproduced sound.

But even after the nostalgia has subsided, we are still faced with the question, 'Is digital audio flawed and is there a performance barrier that will ultimately bound sonic performance?'. Maybe this question is too premature. We sit at the dawn of creating a new era of virtual sonic reality, although to date the technology is not yet in place. So the question must be restricted to two channel stereo and a comparison made between existing analogue and digital systems. There are a number of arguments I would like to develop. However, I would like to open with my own opinion on digital encoding to counteract some of the persisting misconceptions that abound in the audiophile world, and to make clear the direction from which I approach our subject.

Fundamentally, I believe the theory that describes the digitisation of an analogue signal and its translation back to analogue



using uniform sampling and uniform quantisation with dither is exact. It fully defines performance boundaries which are sufficient to meet the requirements of the most exacting audiophile. The performance of a correctly functioning 16-bit system sampled at 44.1 kHz (with one proviso relating to ultrasonic bandwidth) is adequate for and possibly greater than that required for near perfect audio signal communication within a two channel stereo context. In simple terms uniform sampling will restrict the bandwidth to around 20 kHz while, with optimum dither and uniform quantisation, the quantisation distortion will translate to a benign and barely audible noise. This will behave in an identical manner to a low-level additional noise which is no more intrusive than the analogue noise generated by an amplifier. I believe this to be fact, and I leave it to my critics to disprove this statement in a scientifically acceptable way.

So what is all the fuss about; why do some digital systems and many recordings sound poor, and why are some DACs so expensive? At a high level, the answer is straightforward. The performance of electronics that try to meet the theoretical performance targets is deficient. In practice it is extremely difficult to design electronics that are so transparent that the boundaries dictated by the 16-bit/44.1 kHz specification is the limiting factor. Unfortunately, the imperfections at the ADC and DAC gateways are rarely musical and can endow the sound with an electronic and veiled quality that makes relaxation difficult, and a preference for pursuing other activities after about 20 minutes. There is by the uncertainty principle a fundamental law which implies that a piece of hardware can never be exact in its performance, and therefore by implication will embed a sonic signature, however small.

At the time when compact disc first entered the marketplace, my attention was focused on the design of analogue amplifiers for moving coil cartridges. This task proved more demanding than text book electronics would

suggest, and several years passed until a definitive solution emerged that has already stood a 10 year test of time. This design is the kernel of the LFD MC disc preamplifier, but I must also acknowledge the significant contribution from Dr Richard Bews of LFD Audio. Richard has shown me the critical path of component selection which has proved crucial in maximising overall performance. I mention this design not only because it taught me to appreciate the inter-relationship between topological minimalisation, de-sensitisation of power supplies, grounding architectures and component choice, but also because the same problems are encountered in the design of current-to-voltage converters (ie trans-resistance amplifiers) in multi-bit DACs. In fact the problems are so similar that they hold a significant fraction of the key to achieving the ultimate performance of a DAC.

Consequently, as an adjunct to my claim for digital coding theory, I would like to emphasise that the design of a DAC (or indeed, ADC) depends as much upon the analogue as the digital design, assuming of course that the digital processing is correct in an algorithmic sense, and that the interfacing protocols are also correct. Indeed, I prescribe to the view that the system is essentially analogue; it is only the information and the interpretation of it that is digital.

There are many factors that relate to the performance of a DAC, and in a more general sense a CD player, and I shall be debating these further in the future. My aim is to show a pathway to how the best performance can be achieved in the context of a digital system, to impart a better understanding of the principles, and to reflect upon the developing digital technology that promises to redefine the way we perceive an audio system. Clearly we are now poised at a technological juncture, and audio will never be the same again.

To conclude, I would like to reflect on two recent experiences, both to illustrate the performance convergence of analogue and digital audio, and to demonstrate how digital



audio can move on to extend the performance of your hi-fi system.

Last year, I had the opportunity to compare a recently developed DAC by SME with a very high quality analogue system that used the SME Model 30 turntable with Series V arm, LFD MC1 battery disc preamplifier, Krell reference power amplifiers and mass loaded and structurally enhanced Quad ELS63 loudspeakers. The comparison was performed in the music room of SME's Alastair Robertson Aikman, with access to the same recordings on both vinyl and polycarbonate (ie CD). After approximate synchronisation, the two systems could be auditioned, and the performance convergence was remarkable. This underpinned my faith in digital coding theory and also showed that when the colorations inherent in all analogue replay systems are reduced, then there is a correctness to the sound that transcends the method of storage. In this comparison I include all aspects of reproduced sound, from stereo presentation to scale, transient attack and overall tonal balance.

The second example I would like to describe relates to work done at Essex University on the digital correction of loudspeakers. Once a signal is in the digital domain it is possible to introduce exact mathematical processing without suffering the deficiencies of complicated analogue circuits with their loss of transparency, and transfer function alignment problems where phase response correction is virtually impossible.

The processor is inserted between a CD transport and an outboard DAC. The processor implements a digital filter whose transfer function is the inverse of the loudspeaker. Consequently, the overall system exhibits a near flat amplitude response with almost zero overall phase distortion; crossover defects are also corrected, at least with respect to the on-axis performance. Thus the system can to a certain extent cheat on the loudspeaker designer, and compensate for errors which are often too difficult to control by traditional analogue design. Some loud-

speaker companies have hitherto been reluctant to embrace this technology, which they incorrectly see as a criticism of their products. In truth, the technique is a new tool that can be used to fine tune the performance of a loudspeaker in order to achieve greater overall accuracy. In fact our experience suggests that the better the quality of the loudspeaker the more rewarding are the benefits of fine tuning. Remember, analogue quality is not compromised as the additional processing is purely within the digital domain. This technology is here to stay and is I believe a pointer to the future.

We therefore have a powerful means of improving the performance of a sound system in a way that is difficult to achieve with pure analogue. Consequently, digital systems have the inherent ability to extend performance to a level of accuracy greater than that normally encountered. And if you return to the premise that digital audio need not be flawed, then the future is indeed bright, and we ought to be moving to embrace the new opportunities rather than looking back to a past era. Of course, the electronic design needs to be exemplary for these advantages to accrue, but doing this correctly need not be expensive. In fact it is the nature of things digital that costs can be reduced, given time. This should act as a warning for an industry that remains complacent with the ways of the past. However, the technology is now in place and can and will form a rewarding and exciting upgrade path.

In optimising the performance of a CD system there are several issues that need attention. These relate to the conversion method, jitter performance and special coding techniques that can extend the performance of the medium. In particular I want to address the question of audio bandwidth and the future role of surround sound, which in many ways is the final challenge in digital audio. In the meantime open your mind to the intelligent use of digital signal processing. The electronics are getting better and some designers really do care about sound quality.



The mountain comes to Malcolm

WE SHOULD HAVE KNOWN BETTER THAN ASK MALCOLM STEWARD TO WRITE ABOUT TWEAKING. HE DOESN'T TWEAK, HE GETS SOMEONE ELSE TO DO IT FOR HIM.

Write something about tweaking," said the Editor. "Can't," I replied, "I've given it up." Actually, I haven't, not completely; I just tweak vicariously nowadays. I've done my share of soldering, cone-ing, spiking and all that life-consuming shit. Nowadays I'm happier to let someone else toil and simply reap the benefits if the operation's a success.

I've not joined the only-nutters-tweak brigade. In fact, my system has undergone some ludicrous improvements recently thanks to the efforts of one who tweaks with a vengeance, Mana Acoustics' John Watson. Any of the digital's-perfect-so-let's-stop-this-nonsense-now persuasion would be deeply dismayed by the transformation wrought by relocating my Naim CDS CD player from a four-tier Mana Reference table to Watson's maddest, baddest seven-tier stand. Although the cost of this Ultimate Behemoth is way above typical tweak level it still qualifies because of its nature: only a determined, perfection-seeking audiophile would countenance supporting hi-fi components on six sheets of laminated medite, one of glass, fifty feet of sand-blasted, powder-coated iron and

fifty-six hand-turned adjustable spikes.

After hearing the platform's effects upon the CDS I straightaway ordered seven-tier number two for my Pink Triangle modified, battery powered, DC-motored, tweaks-a-go-go Sondek, which became petulant when I started ignoring it. The UB'd CDS was smokin' while the four-tier supported Linn sounded tired by comparison. Now that both sources are on an equal footing support-wise, the turntable sees as much use as the CD player.

Detailing the dramatic improvements these examples of the welder's, glass blower's, medite board laminator's and spike-threader's arts have wrought isn't easy. I reckon that discussing the gains in neatly compartmentalised, quantitative terms is missing the

point, although there have been definite leaps in dynamic scope, frequency extension and imagery, all of which are readily discernible if you want to get into A/B testing tables, which I don't. The improvement I value most — and it's one that's demonstrably attributable to parking the sources on the seven-tier towers — is that the system sounds less like a hi-fi system in respects that I find particularly





rewarding. For starters, when I crank it up to the levels that, I'm told, only Paul Messenger and I deem appropriate for fully appreciating the devil's music, there's less sense of strain or of any component threatening imminent self-destruction. That alone makes these lounge monsters worth entertaining.

The second gain, one that will doubtless appeal to a wider audience but which is certainly linked to the first, is that the seven-tiers reduce the mechanical quality that tinges the performance of every system I hear, no matter how esoteric, sophisticated or costly it might be. Face it, your hi-fi, regardless of the badges it wears, doesn't really sound much like real music, does it? No guitarist is going to walk into your room while you're playing Led Zep II and say, "Hey, neat trick; where've you got Jimmy Page hidden."

While the new Mana tables can't pull that kind of stunt, they come a damn sight closer than most 'accessories' — if you really want to denigrate such fundamental items by referring to them, as many consumerist audiophiles do, as though they were on a par with stylus cleaning brushes. They radically diminish that ever-present feeling that your system is playing a not very convincing con-trick on your senses. In hi-fi reviewing argot, the music flows more naturally. In musical terms, good playing grooves, makes more sense and communicates far more fluently; it touches nerves.

Other smaller Mana additions to the system that have helped it towards convincing my ears that J. Page Esq. really is lurking behind the drapes are speaker stands for my active Naim SBLs. Don't bother pointing out that my SBLs are floor-standers because I worked that out for myself over seven or so years ago. Let's call them speaker plinths to satisfy the pedants, stumpy one-tier widgets that raise the Sibyls a couple of inches off the floor. Don't ask me how they work but they do. John Watson's theory — which he also applies to the SoundStage platforms that are the basis of the seven-tier tables — is that they provide a 'suspended floor' for

whatever's resting on them. That's a plausible explanation, but how come they improve the sound of speakers that were already parked on a suspended floor?

I would have been better able to test the second-floor notion more thoroughly had not the floor beneath my CD, turntable and electronics recently been replaced. The original wooden floor was becoming unstable — probably from the weight of the four heavily laden Mana tables it supported — and the only solution was to have the house-tweakers in to rip up the offending woodwork and fill the hole with concrete. Not exactly a cheap operation but at least I can now walk past the equipment without trashing whatever expensive cartridge I happen to be baby-sitting.

The performance gains elicited from sorting the floor, installing the Ultimate Behemoths and the speaker plinths have all been far more than subtle. These and my experiences have made me redefine my notion of tweaking to exclude anything that provides those marginal improvements that so many audiophiles enjoy chasing. I had my share of the lots of pain for little gain tweaking, in the days when setting up turntables was more about persistence and prayer mats than pleasure and platter mats. I can think of many more profitable ways of spending an afternoon than dressing arm-cables and swapping suspension springs to squeeze another gnat's worth of whatever out of my system. Such activities generally result from an inability to see the wood because your vision is impaired by trees. We've all been there, gleefully demonstrating how the latest tweak adds another hundredth of an octave of bass to the system while its treble strips the enamel from listeners' teeth.

Tweaking that involves little reward is out. I now want dramatic improvements not minuscule differences. I only want advances of the magnitude that will have Jimmy Page knocking on my door saying, "Excuse me, pal, but this is weird: I'm standing in your doorway yet I can hear myself playing Kashmir in your living room!"



Here's one I made earlier. ♦ ♦

IF IT WEREN'T FOR ALAN SIRCOM'S UNCLE LES YOU MIGHT NOT BE WONDERING WHAT ON EARTH THAT HEIFER IS DOING AT THE BOTTOM OF THE PAGE. OR WOULD YOU?

Every now and then, I think back to my first ever hi-fi. Aged nine, I inherited a mighty Heathkit system from my Uncle Les. This huge kit from the early Sixties, roughly the size of a small cow, was simply too massive and passé for the Seventies man-about-town, so Uncle Les swapped it for a brushed chrome music centre — a decision he regretted for years.

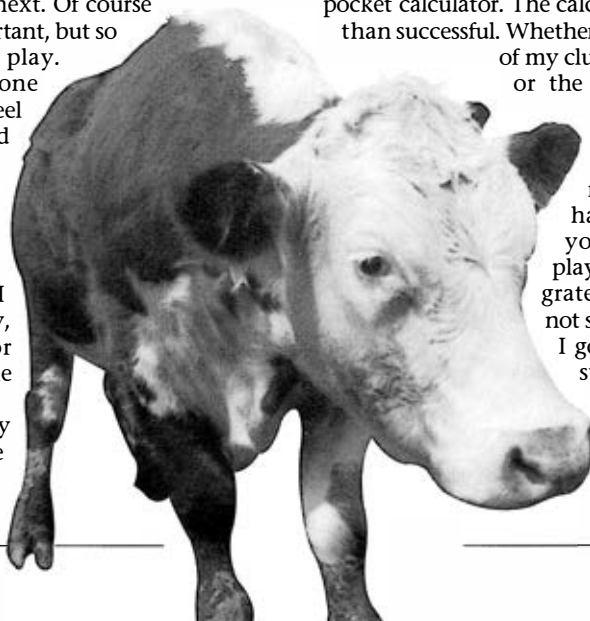
I, on the other hand, loved it, as did the cat who was often found inside the vast teak cabinet, snoozing on top of the valve tuner. With big, chunky controls and glowing lights, it transported my pre-testosterone-enhanced imagination to the controls of a B movie spaceship one minute and HG Wells' Time Machine the next. Of course the music was important, but so was the sense of play. Carefully threading one of my three open reel tapes (The Doors, Led Zeppelin or early Derek & Clive — which had a considerable effect on my convent school education), I became a master spy, like James Bond or Harry Palmer in The Ipcress File.

Even the assembly instructions read like something from This Island Earth. It

gave the constructor comprehensive instructions on putting each component together, with lists of component valves and complex circuit diagrams. When I discovered that Uncle Les had built this on his own, I was deeply in awe — he had made music, from bits of metal and glass. He quickly became a combination of Mozart and Thomas Edison in my eyes. This was nothing like my Airfix model kits, this was real grown-up stuff. I was determined to follow in his footsteps, so I started in earnest to build some electronic projects of my own.

Like most of electronics-mad Britain at the time, I saved up my £9.99 (plus p&p) in the hope of building a white Sinclair Cambridge pocket calculator. The calculator was less than successful. Whether it was because

of my clumsy soldering, or the poor instructions, or simply that no-one told me that you had to earth yourself before playing with integrated circuits I'm not sure, but the joy I got when I first switched it on and I got a row of red zeros, soon turned to crushing





dismay when I discovered that four times four gave a result of 'JJJJJJJ'.

Unbowed, I tried building all manner of electronic gadgets, with varying degrees of success. In retrospect, probably the most effective was the active preamplifier for my electric guitar, which I tried to pass off as my A level Physics project. It worked quite well, but boosted the gain of the guitar by so much that my quiet practice sessions turned into Hendrix-esque feedback frenzies.

My least successful endeavours were the audio experiments. I made vile solid-state phono preamplifiers on Veroboard that hummed like mad, or equally nasty 10W transistor power amplifiers that screamed. Then came Punk, and I abandoned everything for a glorified Dansette and bedroom anarchy.

It was only later that I realised that these hesitant steps into electronics, fuelled by a long-since-sold Heathkit radiogramme and years of watching Tomorrow's World before Top of The Pops, would set me up for years of seeking the ultimate hi-fi solution. My soldering iron has been covered with over a decade's worth of dust, but now, for the first time since the Sixties, making your own hi-fi system has become a real alternative to simply walking into a dealer and opening your wallet.

Part of this revolution has been due to the resurgence of 'hollow state' technology, that is, valves. This is not the place to become involved in the valves against transistors argument, but from a constructional viewpoint there are far fewer devices in a valve amplifier, making it far easier to build. Consequently more and more kits are appearing on the market.

I welcome these kits with open arms — almost. The proviso is that we have moved

so far away from the post-war hobbyist ethic that a number of people with limited electronics knowledge will try to build amplifiers which can do some serious damage to life and limb. Additionally, it is the responsibility of the kit manufacturers to produce seriously good instruction manuals. The Audio Note Kit One manual, for example, is excellent,

but I also know just how poor some manufacturers can be at producing decent documentation.

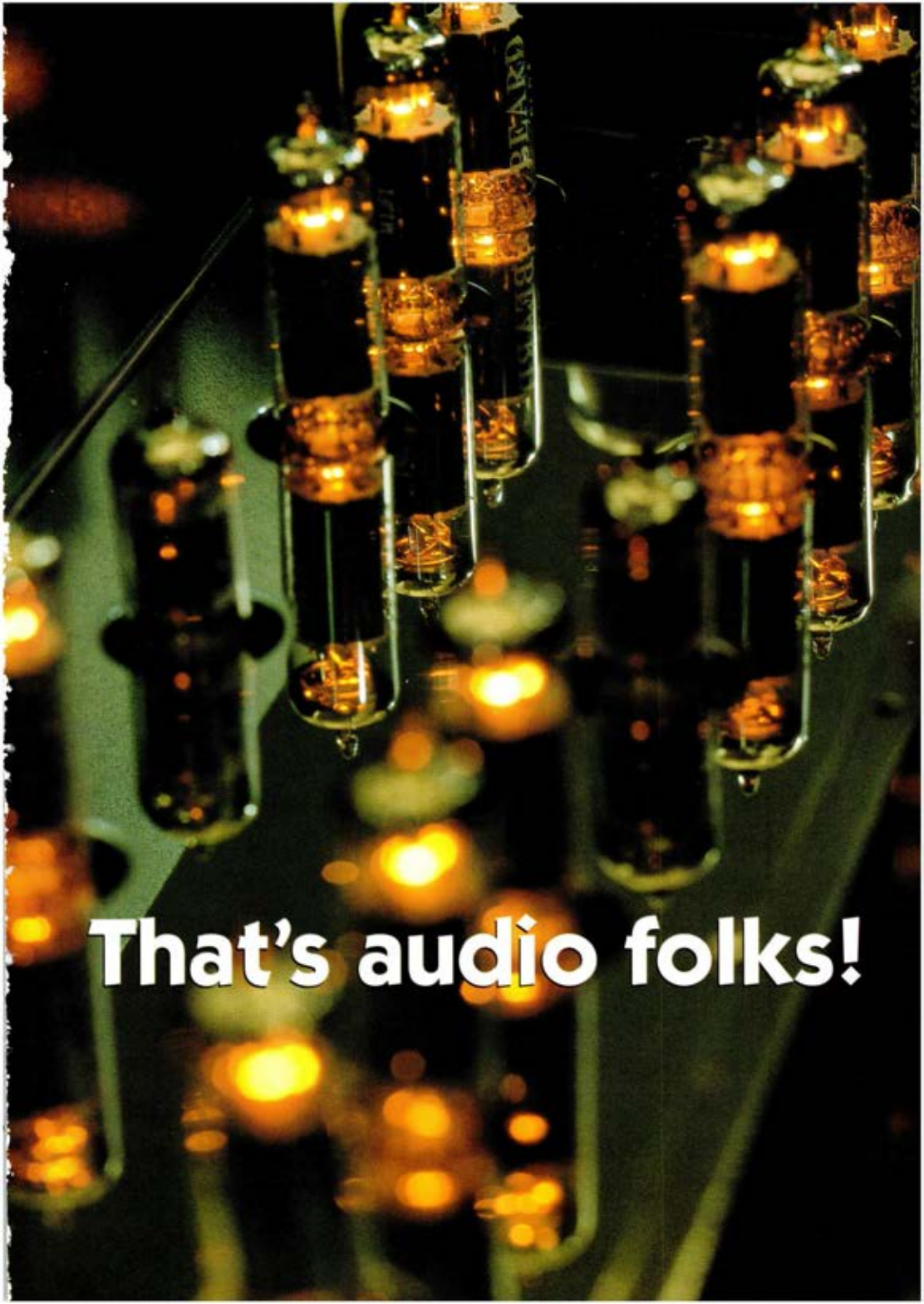
It's important not to look scornfully on people who build their own hi-fi. Far from being tight-fisted eccentrics, determined to save a few notes by DIY, many are true enthusiasts determined to build the best possible system. Jean Hiraga's Maison de L'Audiophile in Paris is a

tribute to this. There, people make huge Onken horns and single-ended triode amplifiers just for the love of building the stuff, not to save francs.

If we look back to our hi-fi heritage, it is littered with names like Briggs and Williamson, who produced designs for speakers and amplifiers to be built by real enthusiasts. Of course I don't want or expect the industry to return to the state where it was almost impossible to buy hi-fi unless it was in kit form, but a healthy sprinkling of specialist manufacturers, awakening that long-forgotten interest in making things, can't be bad for the future of hi-fi.

Sadly such a return to the potting-shed still locks hi-fi into a very male world — no woman would be daft enough to shut herself away with a soldering iron or jigsaw for weeks on end. However, to use yet another Sound Practice's phrase, the 'Wife Acceptance Factor' may be low on building big, glowing valve amplifiers, but at least it keeps us blokes out of the pub. Well some of the time anyway.

"the joy I got when I switched it on and saw a row of red zeros, soon turned to crushing dismay when I discovered that four times four gave a result of 'JJJJJJJ'."



That's audio folks!

THE HI-FI LAW OF DIMINISHING RETURNS

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