

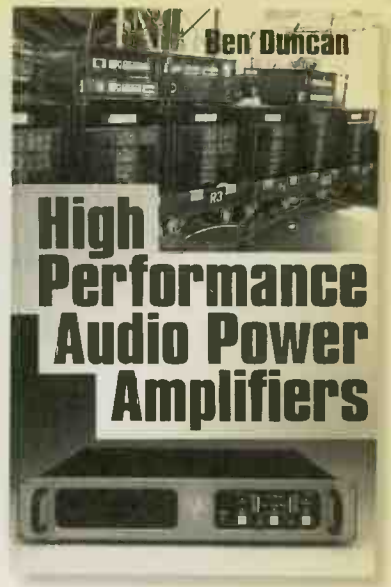
Hi-Fi

WORLD

NO.29 JUNE 1997

SUPPLEMENT

BOOKS



SUPERB

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All of the projects in this supplement have gone through rigorous listening and test procedures. The performance and specification of these projects can only be guaranteed on kits bought directly from World Audio Design Ltd.

KIT NEWS

If it's DIY and hot off the production line, you'll find it here.

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ASSEMBLAGE DAC-2 KIT

If you thought building a DAC kit was only for certified kit-o-holics, you'd be wrong. The HDCD Assemblage DAC-2 from The Parts Connection is so easy to construct even a first timer could build it and it sounds fantastic.

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AUDIOPHILE CABLES DIY-STYLE

Always on the lookout for an audiophile bargain, we try out four interconnect cables from Maplins to see if there are any hidden treasures waiting to be discovered.

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KLS9 - THE TUNING CONTINUES

In the best tradition of Hi-Fi World, we follow up a successful design with an improvement sequel. This month, find out how KLS9 can be fine tuned for impressive results.

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HIGH PERFORMANCE AUDIO POWER AMPLIFIERS

Ben Duncan takes a look at the theory, operation and also sound quality of power amplifiers, using knowledge and experience gained in the engineering and professional fields.

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PRACTICAL ELECTRONIC FAULT FINDING AND TROUBLE SHOOTING

If you've ever spent a week building the amp of your dreams only to have it sit there in silence when you switch on, Robin Pain's book is for you.

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From the theoretical to the practical, these are the pages to find DIY answers and inspiration.

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KIT NEWS

TRANSFORMERS NETTED

If you're a valve lover who's hooked up to surf the Internet, Lundahl at <http://www.lundahl.se/> might well be a site worth calling into. Lundahl specialise in high quality transformers - interstage, output (both single-ended and push-pull) and line level. For example, the LL 1621 PP interstage has a claimed bandwidth of 600kHz with a 4k Ω source.

RS GO LCR

RS Components have just announced the release of a new hand-held LCR meter imaginatively named the B131 (RS stock number 230-6546). This £208 version can be used to measure the value of inductance, capacitance and resistance at both 120Hz and 1kHz. Special features are a dual display which shows simultaneous values of

LCR and D/Q (dissipation/quality factors), auto-ranging and a parallel/serial mode. A cheaper alternative is the simpler 180-7149 LCR meter which sports only the basic functions and costs £86. For further details call RS/Electromail, tel: 01536 204555.

AUDIOCOM'S GROWING CAPACITY

Audiocom, the specialist component suppliers have now added DNM's slit-foil capacitors to their growing stock list. These capacitors are intended for use in power supply applications and their patented design is claimed to eliminate circulating currents in the aluminium foils. Attention has also been paid to constructional details such as foil type, connection quality and mechanical integrity.

Adding to the line-up are smaller value caps in the polystyrene Sufflex HS range. These are aimed mainly at filtering, equalisation and compensation networks in pre and power amplifiers.

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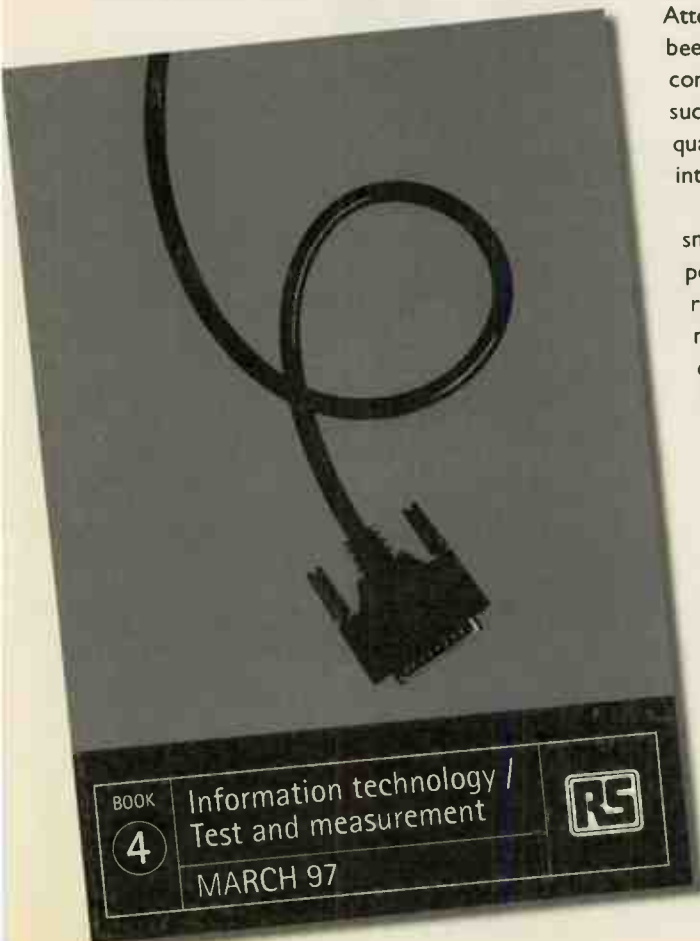


of a new power triode, the 3CX300A1. This triode is made at their Russian factory and has been designed specifically for audio use. Suitable for Class A, AB or B operation, it is claimed to be exceptionally linear and to work well in push-pull amplifiers - one pair can apparently produce 800W in Class B.

The 3CX300A1 can also be used as a substitute (once appropriate modifications have been carried out) for the 212E, 805 and 211 valves.

Resistance to microphonic effects as well as mechanical and thermal shocks has been improved thanks to the valve's ceramic-metal construction and the rigid mounting of cathode and grid on coaxial cones.

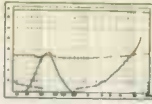
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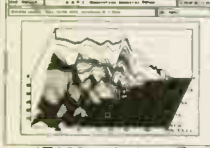
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TO BOLDLY GO THROUGH NEW FRONTIERS



(or How To Build Your First DAC Kit)

“Have you built a DAC kit before?”, Jon asked. I had to answer, “No”. “Good, try to build this DAC then”. With that I was handed a small box which had the words ‘Assemblage DAC-2. Digital Processor with HDCD’ stamped on it. This comes courtesy of The Parts Connection, the DIY division of Canadian company Sonic Frontiers, makers of high-end amps and CD players.

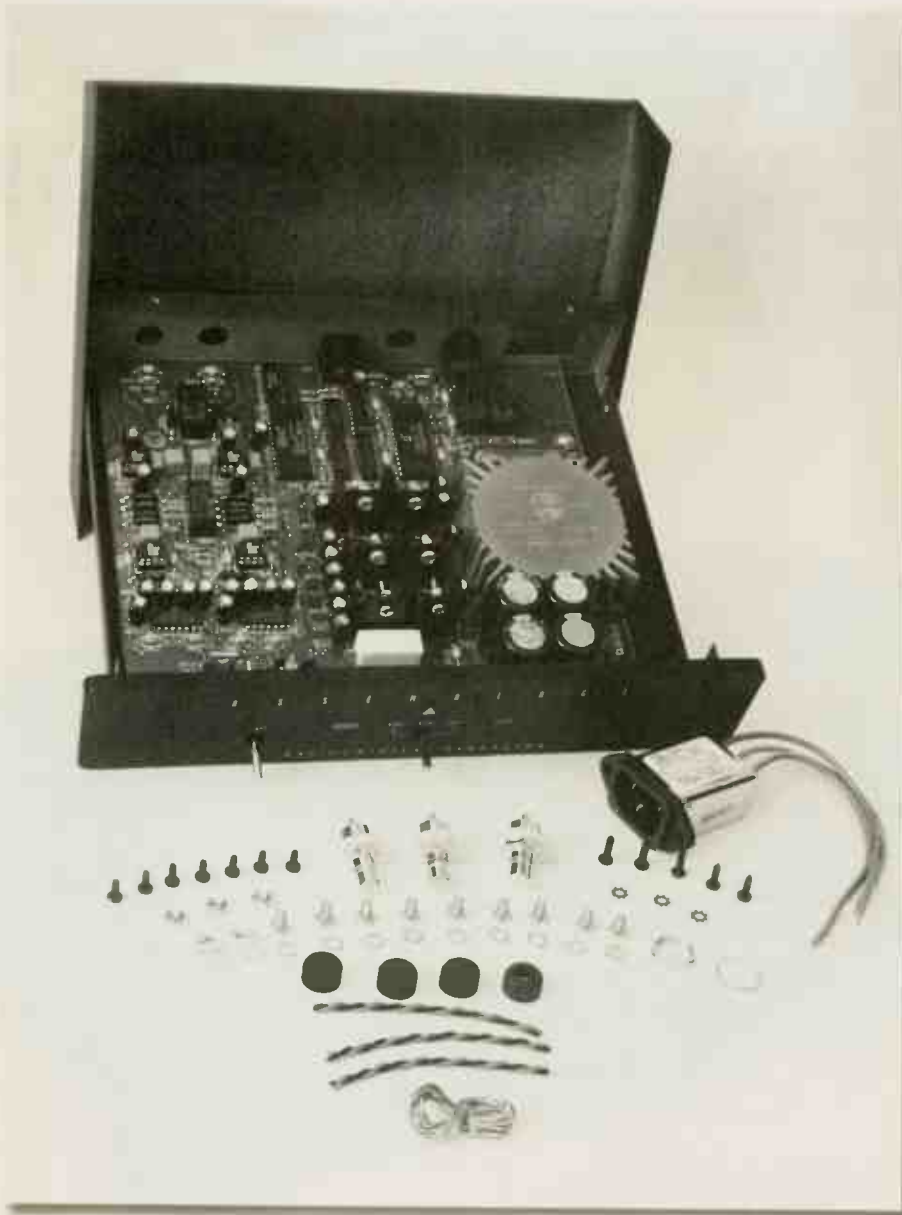
The kit was chosen for two main reasons. The first is that it has a built-in HDCD decoder. HDCD was developed

by a company called Pacific Microsonics Inc. Apparently, before the analogue music signal is put onto the CD it is fed through an HDCD encoder. This converts the analogue signal into a high resolution digital one.

Now, this digital signal contains too much information to fit onto a conventional compact disc so it is processed using algorithms based on Pacific Microsonics’ research into psycho-acoustics and auditory perception. Once the perceptually important information has been identified, it is encoded on to the

standard compact disc in two ways.

Part of the information is added directly to the standard signal, optimising the use of the available bits. The other part is ‘hidden’, once again within this standard signal. So when an HDCD disc is played on a conventional player it should sound slightly better because of the directly added information. But the player will remain unaware of the hidden information. With an HDCD equipped player this ‘hidden’ information will be identified and decoded, so (theoretically) giving a better sound.



The second reason for choosing this kit is that The Parts Connection also offer an upgrade for the DAC-2 which includes all sorts of higher spec components to make the DAC sound even better, thus making this a truly upgradeable project.

Questions buzzed around my head. Does HDCD work? What will it sound like? More importantly, once I built the DAC would it work? Admittedly The Parts Connection offer an Assembly Guarantee in which they state that if you can't get the DAC-2 running they will do it for you. Even so it was with trepidation that I opened the box.

BUILDING THE DAC-2

I had a mental image of what I would find inside, hundreds of little resistors, capacitors and other such bits with a number of complex ICs, each component needing pinpoint precision to solder it on to a virgin motherboard. I was very wrong and rather surprised with what I found.

My first thought was that someone had already assembled the kit. The motherboard actually comes fully stuffed. As you can see from our pictures it really is packed with components, everything down to the transformer.

My second thought was that the casing was impressively solid. The main chassis on which the motherboard is directly mounted is a strong folded steel plate coated with a powder textured black paint. The front panel is what really gives the impression of quality though. It is made of 5mm brushed aluminium with switch labels neatly screened onto it.

Having laid out all the components on the workbench I did the only sensible thing and read through the instruction manual. Just a quick word on this manual before I carry on. It must be one of the best thought out, easiest to follow and concise construction manuals in the history of kit making. It really is geared for the complete beginner. As long as you can solder there should be no problem making this kit at all.

It starts off like all good manuals should with a checklist of the bits that should be in the kit. Then there's a section on the tools needed to complete the project and guidance is given on how to solder and how to strip wire correctly. When you actually come to the construction section you'll find step-by-step instructions, each one partnered by numerous photos to clarify the text. It really is very difficult to make a mistake.

As previously stated, the motherboard comes pretty much completed and is already temporarily mounted into the main chassis. The front panel is also mounted. The first step involves removing the two 10mm nuts that hold this panel in place. There are numerous circuit components in fairly close proximity to these nuts and care has to be taken to avoid damaging them.

Once the front panel is off, the two screws which hold the motherboard during transit are removed, and the board is removed. Make sure the board is put somewhere safe to one side at this point, as it is extremely exposed and vulnerable to damage in this state.

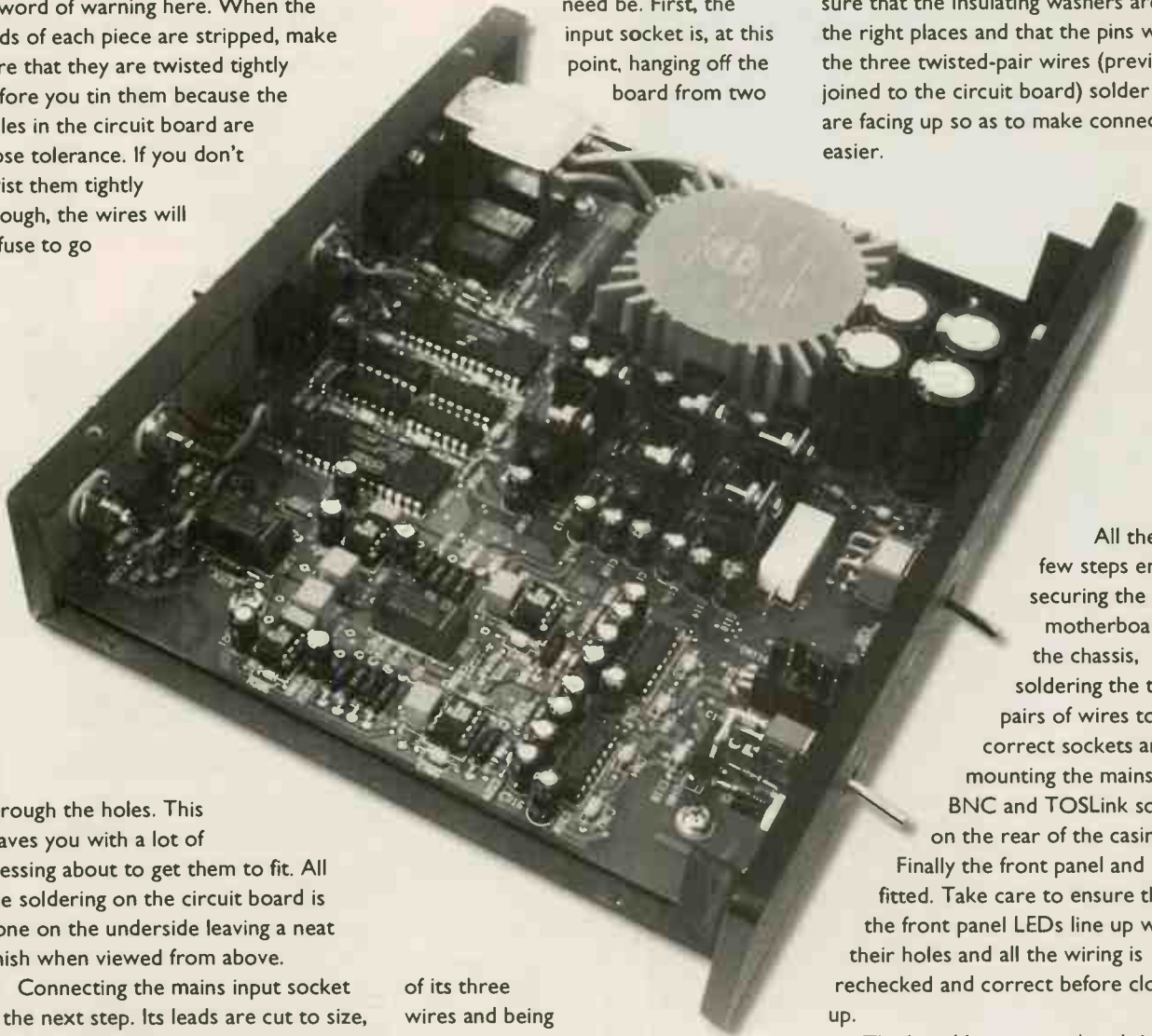
Next, the three lengths of twisted-pair Kimber Kable provided are stripped at each end and tinned - even the solder is provided with this kit. These three wires are soldered into the appropriate places on the motherboard. A word of warning here. When the ends of each piece are stripped, make sure that they are twisted tightly before you tin them because the holes in the circuit board are close tolerance. If you don't twist them tightly enough, the wires will refuse to go

board. One of these then needs to be resoldered in an adjacent position, thus stepping up the input supply capability.

Nothing wrong with that you might say. True, but two things make this step more awkward than it need be. First, the input socket is, at this point, hanging off the board from two

resistor first and then solder the input socket on. End of complaint.

The next step is to mount the three supplied gold-plated phono sockets in the appropriate holes at the rear of the main chassis. Here, you need to make sure that the insulating washers are in the right places and that the pins which the three twisted-pair wires (previously joined to the circuit board) solder onto are facing up so as to make connection easier.



through the holes. This leaves you with a lot of messing about to get them to fit. All the soldering on the circuit board is done on the underside leaving a neat finish when viewed from above.

Connecting the mains input socket is the next step. Its leads are cut to size, stripped, tinned and then connected to the board. The input socket is noteworthy because it has an AC EMI/RFI filter built into it. In fact, the AC input socket is responsible for the only complaint I have against the instruction book. Let me explain.

The following construction step affects only those with a mains supply of between 220-240 volts; i.e. everyone in this country. The motherboard as it comes is factory set for a mains supply of 100-120 volts. To convert it to our mains level you need to desolder and remove two jumper resistors which are near the transformer on the circuit

of its three wires and being relatively heavy with its built in filter, it makes handling the circuit board just that bit more difficult than it should be. Secondly, the position of the two jumper resistors makes them difficult to desolder and remove without causing damage.

In my opinion it would make things easier if a third resistor was supplied. If the step-up conversion was needed, then the two jumper resistors already on the board could simply be cut out and this third resistor soldered into the appropriate place. To make this step easier I would also be inclined to fit the

All the last few steps entail is securing the motherboard to the chassis, soldering the three pairs of wires to the correct sockets and mounting the mains input, BNC and TOSLink sockets on the rear of the casing.

Finally the front panel and lid are fitted. Take care to ensure that the front panel LEDs line up with their holes and all the wiring is rechecked and correct before closing up.

That's it. Having completed the kit, all that remained was to see if it actually worked. One odd thing about this DAC is that it hasn't got a Power On light. Therefore, the first time you connect it to the power supply, all you will see is the HDCD light flash on and off briefly. This is a little disconcerting. It makes you think something's gone wrong. It's only as you connect up to a transport that there's a more permanent sign of life when the signal lock indicator goes on. Now all we had to do was to listen and see if all my efforts had been worthwhile. So, what does it sound like? Read on.

ANOTHER BIG HIT!

Following in the path of the original and extremely well received Assemblage DAC-1, the DAC-2 appears to be another big hit with customers and reviewers alike. The DAC-2 builds on the strengths of the original DAC-1, with its dual Burr-Brown PCM 1702 20 bit DACs, Crystal CS8412 input receiver, toroidal power transformer and Analog Devices based output stage, but adds HDCD capability with the PMD-100 digital filter chip, an extra co-ax digital input on a 3NC jack, a phase invert switch, three more power supply regulation stages with greatly increased power supply capacitance, and improved parts quality in the analog output stage. The best news is that all these improvements come with a very small price, the DAC-2 digital processor kit is \$499.00 U.S.! Of course, the DAC-2 also comes with our 30 day satisfaction guarantee, two year limited warranty, AND our assembly guarantee, (If you can't get it to work, we will!).

For those of you with the upgrade bug, we also have a parts upgrade kit available for the DAC-2. This kit includes Caddock resistors and MultiCap capacitors for the analog output stage, Kimber silver and Illuminati hook-up wire, EAR and Soundocat isolation and damping materials, Linear Technology voltage regulators, and more parts that make a significant improvement in the performance of the stock DAC-2. The parts upgrade kit is available at a special package price of \$149.00, which makes it even more good news!

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SOUND QUALITY

The DAC-2 was given a baptism of fire, being slotted straight into our reference system alongside Pink Triangle's Da Capo DAC. Whilst this might seem a bit unfair, using it in such a system would give the DAC-2 a chance to show what it is capable of.

I put the first disc into Teac's P-30 transport, sat back and waited to be impressed. Once the music started I was surprised and also to be perfectly honest disappointed. The appearance, construction and quality of manufacture had led me to expect something special. What I heard was a compressed, grainy, monochromatic sound which was, well, drab. After this initial anticlimax the DAC-2 was left to warm up and run in over a number of days. As time passed, the sound grew better and better, reaching the optimum point after about four days. It was then that the serious listening started.

First in the drawer was Caron Wheeler and her album *Beach of the War Goddess* which is smooth soul in the manner of *Soul II Soul* but with an African slant. Here the sound was smooth and sweet whilst still maintaining plenty of drive and attack. The stonkingly deep basslines were reproduced with a power that had the *Sextets* working hard for their living. The really good news was that there's nothing annoying about the sound - it wasn't bright, aggressive or fatiguing as a lot of digital equipment I've heard can be. A good range of tonal colour was present and Caron Wheeler's silky voice was reproduced in all its glory.

I felt it was time to show the DAC-2 some culture so next on was the Royal Philharmonic Orchestra playing Tchaikovsky's symphony No.6. The ebb and flow of the piece and the interplay of the strings with the horns made for a riveting listen. The tension was palpable as the orchestra built up to the climax. I was totally engrossed and at one stage was doing Yehudi Menuhin impressions, which I admit is scary.

Next I decided to test the HDCD performance out. I have to admit, despite all the hype surrounding HDCD, I was a touch sceptical about whether it would make much of a

difference to what was already a fine sounding DAC. Within seconds of putting on Eric Bibb and *Needed Time's Good Stuff I* had my answer though. With the HDCD decoder now working for its living the sound became even clearer, crisper and more natural. Detail retrieval improved but most importantly, all the good things the DAC-2 was doing before were even more obvious.

As listening continued I was happy to find the DAC-2 never disappointed. Most telling was that there was no urge to replace it after long listening sessions. Taken on its own terms, the DAC-2 is a very good product. To find any great short comings you would have to compare it to more expensive ready-made DACs. Switching back to the Da Capo showed better dynamics and detail resolution but so it should. The Da Capo costs £1400 and for that money you can have the DAC-2 and a trip to the Tropics.

JON SAYS

First port of call, to find out if the DAC-2 could handle thick, heavy mixes without becoming confused, was *Barkmarket's Lardroom*. Imagine if you can *Status Quo* turned axe maniacs and playing at five times normal speed and you'll get an idea of what this CD offers. The DAC-2 handled this sonic assault without even breaking into a digital sweat. Instead, it gave each instrument and voice its own space, producing a sound stage with decent depth where most cheap one-box players and DACs just put out a mushy, indeterminate mass of noise. There was even some tonal colour to be had from cymbal strikes and frenetic guitar.

Well, clarity and separation are two of the DAC-2's fortes, but what about everything else? Turning to the *Spice Girls* (resistance is useless), I found a booty-swinging bass focus and drive that gave basslines real impetus. Timing was close to spot on, although switching to the Da Capo proved there was even more funk to be had from this album. But where the finger can so often be pointed at things digital, namely tonal colour, the DAC-2 acquitted itself well. All five *Spicettes'* voices were clearly

audible as they crooned together, giving the sound breadth and power. Slower numbers like 'Two Become One' had the kind of involvement that gets a stadium full of teeny boppers swinging and swaying along.

Moving on to a representative of the classical genre, I wheeled in Mozart's *Haffner March* for orchestra in D Major. This piece demands real smoothness and control if it's to be pulled off properly. With the DAC-2 in the hot seat there was a slight hardness across the midrange which was most obvious on loud string passages. This never became unpleasant enough to have me reaching for something less demanding, but it did reveal a few more of the DAC-2's weaknesses. In absolute terms, detail was being glossed over and the sound stage was wider than it was deep, but the DAC-2 is certainly not alone in either of these.

Nigel North with his *Bach On The Lute Vol 3* CD confirmed the DAC-2's listenability. Room ambience, which also comes across strongly on this recording, was well dealt with, if rather diffuse compared to the Da Capo.

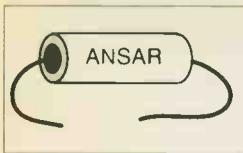
Not even *Kula Shaker's K* album, with its recorded-at-the-bottom-of-a-bucket production could phase the DAC-2. Drive, rhythm, timing and enjoyability were all present and correct, as was intelligibility. This last is no mean feat considering *Crispian Mills* sounds like he's singing with a mouthful of socks on this CD. This worked a treat on 'Govinda', where I could make the words out though couldn't understand what they meant. Mind you, it's subtle abilities like this which add up to a superior DAC, and at \$500, that's exactly what the DAC-2 is.

Assemblage DAC-2 \$ 499.00

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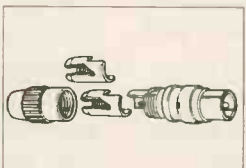
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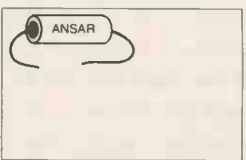
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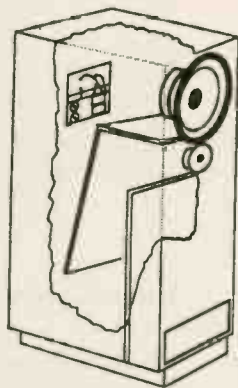
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PREPARE 4 TERMINATION

Audiophile on a budget Ketan Bharadia selects four interconnects from component suppliers Maplin and solders his way to quality cables.

If you're a regular reader of Hi-Fi World, you'll have noticed that over the last few months we've been carrying out a series of interconnect and 'speaker cable tests. Having started off as shoestring DIYers ourselves, we knew that one reliable source of such components is the Maplin catalogue. This contains a variety of cables which, once correctly terminated, we suspected might rival some of the commercially available offerings hopefully at a lower price. So over the next few months we plan to do a series of tests on these DIY cables to find out just how good they are and unearth some as yet undiscovered bargains.

As a reference interconnect we decided to use Apollo's Black Velvet Standard (£30/m terminated) which was one of the best in our January 1997 group test. One thing to remember is that although each of the Oxygen Free Copper cables on test here costs between 50p/m and £1.50/m, you'll need two metres for a metre stereo pair and a set of good quality phono plugs. In total that's about £8-£10 in materials' costs plus however long it takes to accomplish the occasionally fiddly task of soldering the four phono plugs on.

Just one other point. When you're making the cables it's worth using a high quality solder such as Wonder solder to give the good joints vital for best sound quality.

SHARK WIRE HIGH GRADE OVERALL SCREENED PAIR (MAPLIN CODE XS40), £1.45/m.

Out of all the interconnects on test, the Shark Wire is the most visually

impressive, looking a lot more expensive than it really is. This metallic blue cable also turned out to be one of the sonic stars of the group. Rhythmically it was spot on, with a good sense of speed and dynamic contrast. Stereo focus was the best of the group as was bass depth and power. Adding to the burgeoning list of positives is the fact that while this cable is fairly neutral it still manages to pack a good dose of tonal colour into the proceedings. Detail retrieval was high on the achievement list as well.

But hold on before you ditch all the cables in your system to replace them with this one. There is a few shortcomings in the Shark Wire's otherwise impressive performance. Upper midrange and lower treble have a hardness to them which can be mildly off-putting and the bass, despite all its good points, did have a tendency to sound slightly loose and flabby. Taken overall, the Shark Wire is a fine cable though.



Shark Wire High Grade Screened Pair cable.

VAN DAMME INSTRUMENT/GUITAR CABLE

(MAPLIN CODE VU39), 99p/m.

This is an extremely flexible red cable designed to link musical instruments to their associated amplifiers. With its



Van Damme Instrument/Guitar cable.

OFC cabling, it looked like a promising choice and most interesting it proved too.

As soon as the CD started playing my attention was drawn to the fact that this cable has a very peculiar tonal balance. It was as if someone had applied a treble cut and bass boost simultaneously - I ended up checking the tweeters and discovered they were fine.

Midrange detail was good although it tended to get swamped by the overbearing bass. Treble, ignoring the fact that it was too low in level, turned out to be pretty good and the bass end passed muster as well. Whilst this cable wouldn't suit any normally balanced system it might be useful for toning down overly bright components.

VAN DAMME BALANCED PATCH CABLE

(MAPLINS CODE VU89), 99p/m.

This cable is the second star of the group. While its tonal balance veers marginally towards a dry presentation this isn't a problem as there's plenty of punch and weight in the bass. In this respect it was second only to the Shark Wire, though it betters the latter when it comes to control.

Where the Patch cable really excelled was in providing an impressive sense of space around instruments and performers. Percussion sparkled enticingly and instrument timbres and vocal textures were very well handled.

There's no doubt this is a very good cable - the choice between this and the



Van Damme Balanced Patch cable.

Shark Wire comes down to personal preference, it's that close.

VAN DAMME INSTALLATION CABLE

(MAPLIN CODE VU53), 49p/m.

This thin green cable was almost as individual in its sound as the



Van Damme Installation cable.

Instrument/Guitar cable, except here it was a case of turning the bass down while leaving the midrange and treble untouched. This tonal slant gives the cable a lightweight balance, though the treble was particularly clear and detailed without even the slightest hint of harshness.

Because the bass was lacking in power, the midrange tended to sound a bit thin. On the other hand, vocals and especially percussion instruments were very well detailed and had an impressive amount of space and ambience around them. This is a cable which once again wouldn't work perfectly in a well balanced system but might be the ideal solution in a bass-heavy set-up.

Conclusion

It's pretty obvious that the winners here are the Shark Wire and the Balanced Patch. It was with baited breath that I compared them to the reference Apollo Black Velvet Standard. Although neither bettered the Apollo, they were both fairly close. The Apollo possessed better dynamics, smoothness and detail and showed up a slight grain in the sound of both Maplin cables. Putting this into perspective, the Apollo does cost £30 compared to less than a third of the price for the DIY Maplin cables. Anyone looking for a budget solution to the interconnect question would be well advised to try these two candidates.

TUNING KLS9

Noel Keywood explains how to adjust our latest DIY loudspeaker, KLS9, to suit your tastes and how to tweak it for higher performance.

In the April 1997 issue DIY Supplement we published plans for our new KLS9 two-way, floor standing loudspeaker. By using Audax's HM210ZO High Definition Aerogel bass/midrange drive units in large-ish cabinets this loudspeaker produces a clear, uncoloured midband and plentiful deep bass. The HM210ZO crosses over to a TWO25MO fabric dome tweeter, which extends output up to 20kHz.

The idea behind our KLS9 DIY loudspeaker was that it should offer great results at a low price (just £230), a goal it successfully achieves. It is a relatively large (93cms high) floor stander that can be fine tuned according to taste.

The 'speaker is sensitive to port dimensioning, giving constructors the chance to vary bass quality from rich and fulsome to dry and tight. KLS9 goes very low as well and can really shake the room. The precise quality of bass it produces can be adjusted, which is an interesting experience. It is one I performed taking into account comments from other listeners, by the way. I say this to underline the fact that although our test equipment provides a comprehensive picture of low frequency behaviour, allowing performance to be adjusted at will, there is virtually no literature relating operating conditions to perceived sound quality. And very difficult it would be to provide too. This being the case, bear in mind that no equation can give a notionally correct



result. This is a misunderstanding, as I will explain.

Unfortunately the wrong tweeter phasing was printed in the first article. The tweeter must be connected in-phase, not out of phase as originally shown.

Bass sound quality was much as expected but I've been pleasantly

surprised at how low this 'speaker will go. KLS9 plays bass lines cleanly and evenly, separating them from a mix with ease. It does so at low volumes too - this is not a 'speaker that demands huge amounts of power. Whilst bass quality can be changed significantly by reducing cabinet volume, I believe most people will find the variations produced by port tuning adequate.

It's wise to bear in mind that when fine tuning bass subjectively you are not only working from your own tastes and expectations but are also listening to the combined behaviour of KLS9 and your listening room. Any 'speaker which goes very low (i.e. lower than 60Hz) will excite room modes strongly. If you tune the port so it hits a room mode, you'll get mighty bass at this frequency. It will only be apparent when an instrument hits and holds for a small time the particular frequency which coincides with this mode. So what I heard will not necessarily be what you hear because your room may be very different to ours.

If you think this confuses the whole issue of loudspeaker bass quality in a room, then you're right! And that is yet another benefit to tuning your 'speakers subjectively in your own listening room.

Which brings me onto one quick but important point. Some technically minded readers seem to regard theory as a way of achieving practical

ROOM MODES

$f_1 \text{ mode} = \frac{172}{\text{length (m)}}$

EXAMPLE

Length of room = 5metres (16.4ft)
 First mode (f_1) = $\frac{172}{5} = 34.4\text{Hz}$

perfection. This isn't so. Because equations give an apparently 'intelligent' result does not mean the result is a truth. The result is valid only within the particular presumptions and simplifications which allowed the equation to be derived in the first place.

So there is no one 'correct' cabinet volume or port size, as some appear to believe. There are various target values that come about in response to certain design criteria. You can, as I did, calculate port length for KLS9. It turns out to be around 3in. (7.5cms), according to the equation used. Audax on the other hand suggest 3.6cms. These are useful approximate values that get us into the target area.

We know a port of this length should give decent results - and it did. But no port at all, just a hole in the cabinet, also gave very interesting results. Alternatively, a 6cm port with a small amount of wool damping gives another useful result. As does a port stuffed with wool whereupon KLS9 becomes an infinite baffle loudspeaker. All this goes to show how complex and variable port tuning is.

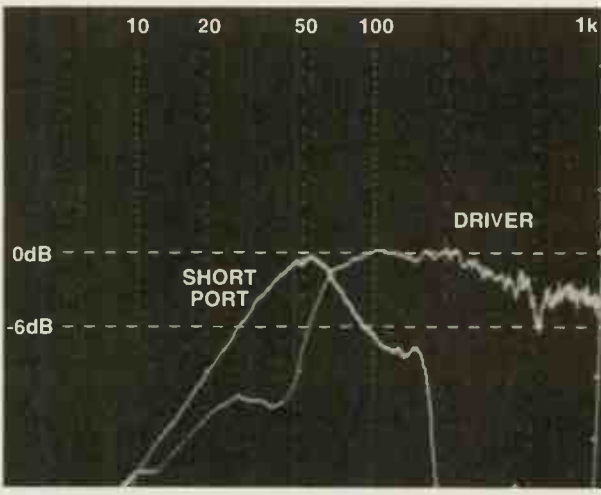
For the purposes of this article I measured and listened to a short port, an optimal length (6cms) port and a long port (19cms). Port and cabinet damping were varied too, using Long Haired Wool. The general view is that reflex cabinets should not be internally damped since this reduces the effectiveness of the port. Like most 'rules' concerning loudspeakers, this contains a lot of truth.

As always though the situation is sufficiently complex to defy simple rule making. In all cases below, our prototypes were lined throughout with half-inch thick fibrous carpet felt to absorb high frequency energy.

1) Short Port

This comprised an 8cm diameter hole in the cabinet wall (19mm thick).

With no cabinet damping it gave massive bass but there was a bit too



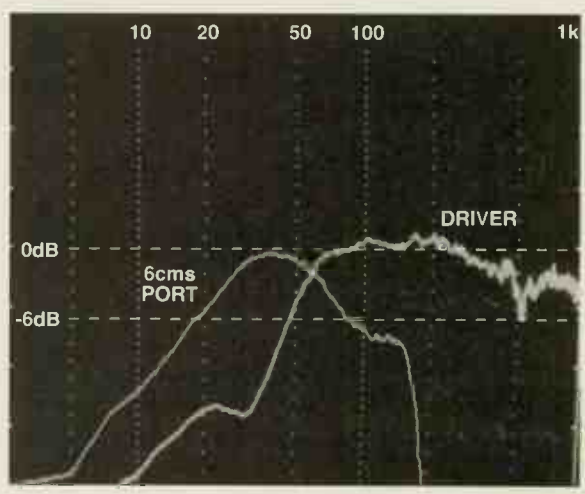
much of it we felt and control was lacking in the lower registers. However, some people might well like the massive impact this gave drums and bass lines.

Our analysis shows forward radiation from the HM210ZO reached down to 60Hz before diving downward rapidly. Port output forms a fairly high Q peak centred at 50Hz and its output extends down to 30Hz or so (-6dB).

2) Ideal Port

This comprised a 6.6cm diameter port, 6cms long, the size given by various equations. Audax also suggest it is the right size. So what did we get?

Bass again seemed a little too prominent and it was more resonant and less apparently controlled than the other options. However, just a small



amount of wool in the port drastically damped down bass level and cured its boomy quality. Putting wool in the cabinet had a similar effect and gave a slightly cleaner overall sound.

Measurement showed this port gives a rounded peak centred at 38Hz, extending port output down to 20Hz (-6dB), a very low value. Forward radiation from the HM210ZO rolled off less steeply, allowing the unit to reach down to 50Hz.

3) Long Port

This comprised a 6.6cm diameter port 19cms long. Some authorities, like Vance Dickason, recommend using long ports.

This gave the best results in our situation. We were looking for bass of a sensible level that had good definition and control. Adding wool to the bottom 20cms or so of

the cabinet usefully reduced internal standing waves at 180Hz and 480Hz, attributable to the cabinet's height and depth dimensions respectively. This made the 'speaker sound just a fraction cleaner. Putting more wool in gave an unpleasantly boofy quality to the bass though.

A small amount of wool in the port also helped control bass level and

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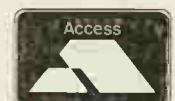
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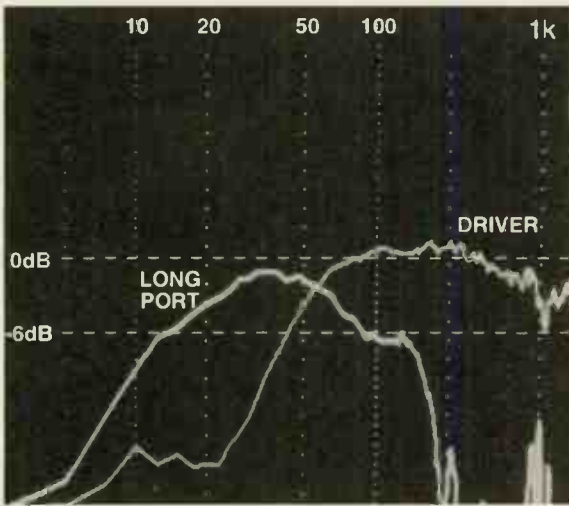
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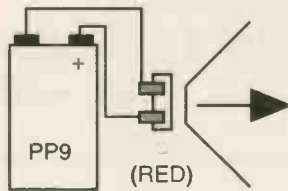
though, which is somewhat confusing. The position of the tags changes too; some are 180degrees apart, some 30degrees. This is why we left out clearance holes in the original cut-out diagram. Drill 'em when you've got the tweeters!

Audax tell us, by the way, that they check tweeter phase with a 9V battery as they do with bass units. The convention is that when the cone/dome moves forward,

tightness and it was like this that we achieved the best general balance for KLS9.

Measurement showed forward radiation reached down to 45Hz, so there was little change here from the 'ideal' port. That was surprising considering port output changed a lot, the centre moving down to about 34Hz, the -6dB point measuring an amazingly low 12Hz! Our room reaches down to around 25Hz (-6dB) so such downward extends on is a bit lost. I notice many readers have 20-24ft long rooms, 12ft wide. In a room like this KLS9 would have no trouble reproducing 16Hz organ notes at their correct level.

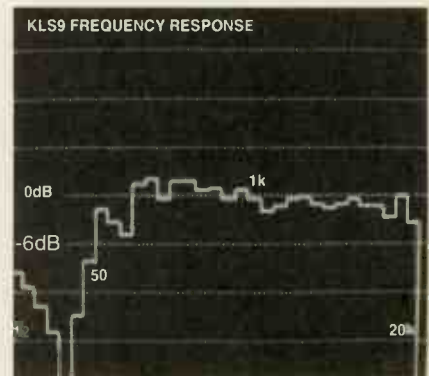
the battery's positive terminal is connected to the driver's positive (red) terminal.



Polarity test - when battery moves cone forward, -ve is connected to 'speaker +ve'. This test can be used with the TWO25MO dome.

THE SOUND OF KLS9

The most striking feature of this loudspeaker is the sheer depth of its bass and the ease with which it reproduces low frequencies. There's little to touch it at present in this area. I can almost guarantee that it will astonish you in this respect but please bear in mind you will only get to hear and feel this in a room at least 15ft long.



The High Definition Aerogel HM210ZO bass/midrange driver offers superb midband clarity and good detailing. A smooth response and absence of crossover suckout gives this 'speaker a very even tonal balance, which is also quite obvious subjectively.

Like all our kit loudspeakers, KLS9 is a very easy load so it will work well with any amplifier. Most of the time I drive it from our K588I MkII valve amplifier, which delivers 20watts per channel. It was run from an Audiolab 8000S during development and for testing but we also used a Roksan Caspian. A 20watt NAD 310 solid-state amplifier was tried as

well and I was pleased to find that it worked perfectly well with KLS9, making the NAD sound like a real power house. That's how it should be. At just £230 KLS9 is a lot of loudspeaker; I'm sure you'll enjoy it.

If you missed the original article, we will be putting it up on our website at www.hi-fiworld.co.uk. I hope we will be able to publish the views of those who build it.

TWEETER PHASE

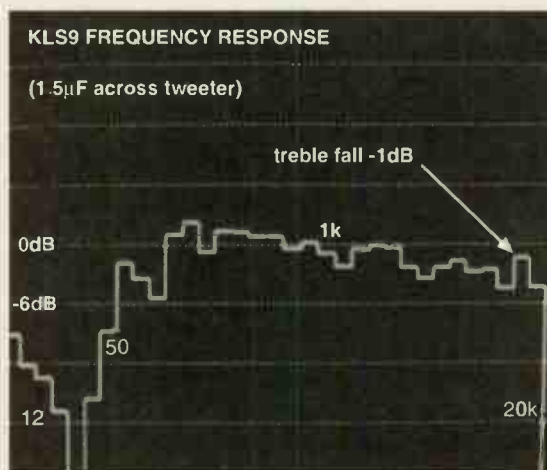
TWEETER RESPONSE

As standard KLS9 gives a flat frequency response with a little bass lift. Treble can be rolled off smoothly, if desired, to give a warmer sound by connecting a 1.5µF capacitor across the tweeter. This will drop output at 20kHz by -1dB or so; not a lot but quite audible all the same.



Positive terminal (+) is marked RED

On page 9 of the April Supplement (No28) the tweeter was shown connected out of phase. This is incorrect; the tweeter should be connected in phase. The error arose because the particular TWO25MO tweeters we used possessed unmarked tags. We assumed that, as with the bass units, the narrow tag was positive. Audax had changed the convention



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HIGH PERFORMANCE AUDIO POWER AMPLIFIERS

By Ben Duncan

Reviewed by Andy Grove.

Ben Duncan is a respected expert who specialises in the professional side of audio electronics. He's written articles for periodicals and those who have an interest in audio power amplifiers will be familiar with his work. *High Performance Audio Power Amplifiers* is an overview of the development of the solid-state power amp up to today's advances in the high-tech PA and studio world.

Ben starts the book by examining the basic requirements for amplifying musical signals, and here the book becomes immediately interesting because he actually takes sound quality as an important ingredient. This should be the case in all books of this kind but generally authors of such works concentrate on improving one tiny area.

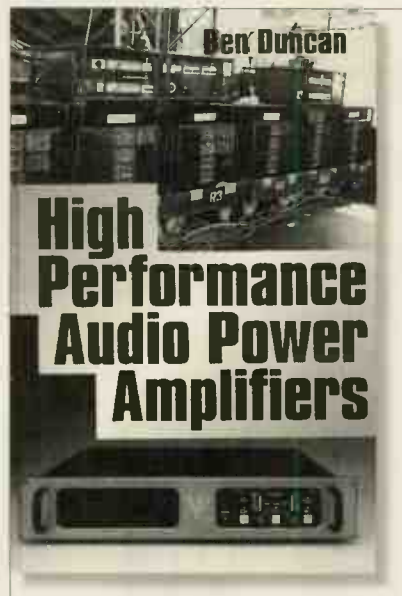
This book is different. Ben even lists the adjectives commonly used to describe sound quality and tries to relate them to the amps' electrical performance. The subject of bandwidth and especially bass extension is important for much of today's high-energy music. Ben believes that low bass and subsonic information play a vital role in the overall vibe of the music - Reggae fans will no doubt agree.

The interface between the power amplifier and 'speaker, and the pre-amp and power amp is vital, and these areas are fully covered. The loudspeaker's crossover and even the cables are taken into account. Ben is talking about real-life amplifiers which have to work with all sorts of equipment and loads. As this book has a professional slant we are looking at amplifiers that get dropped, get wet, get hot and have to drive kilowatts through long cables and still work, let alone sound good.

Portal filtering and clipping protection are then brought into the arena. These subjects are vital for high power amplification to avoid amp blow-ups and 'speaker damage.

In chapter four we start to see just how boring and mundane hi-fi designers

can be. Normally it's a case of regurgitating second-hand knowledge and circuits. But here some of the many possible classes of output stage operation and circuit topologies are introduced, and the inventiveness of the world's top designers is revealed. Of course, a lot of the topologies described enhance efficiency and power output but it goes to show that the classic topology is just one of many possible variants. Truly imaginative designers play with



adaptive power supplies, the latest generation of solid-state devices, and powers and voltage swings which make the average hi-fi tranny amp look no more up to date than the SE valve amp.

The output stage is examined in more detail in the following chapter. Real operating conditions of the output stage are taken into account - how much current, how much voltage and how fast can it do it? Again we are heading towards amps whose specifications are far in excess of what is usually considered adequate for home use.

Ben then moves from the output stage to its power supply. Standard capacitor inputs are looked at, but that is only the start. Switch mode units and even supplies which actively adapt to the

incoming signal are examined. Again, this is more important for high efficiency in the megawatt output range but shows that there's more to life than a simple cap input PSU.

Chapters seven and eight go into the meaning of amp testing and how it should be done to reflect real-world situations. Remember the amps that go bang if you use more than 1cm of 'speaker cable, or if it's the wrong make? Ben's tests are designed to put the amp through its paces, and even include listening tests.

Ben uses Audio Precision test equipment which is out of reach for the hobbyist. But for the hobbyist sound quality is the deciding factor and a scope and signal generator will give a good indication of whether or not the unit is functioning correctly.

High Performance Audio Power Amplifiers is generally excellent, but it covers such an immense field that, for example, advanced amplifier topologies don't really get a look in. The book's tone is very down to earth and amusing though. It is not a barren wasteland of a textbook full of irrelevant equations.

Ben's experience in the professional field holds important messages for the modern designer - the measured performance vs sound quality issue and how it is possible to achieve good results in both areas. Any student who has sat in an electronics lecture which followed the usual, "Audio power amplifiers are like this. . . Blah. . . Class A, blah. . . Class B, waffle" would be advised to get a copy of this book immediately if they value their sanity ●

High Performance Audio Power Amplifiers £40.00

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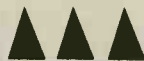
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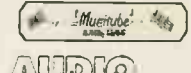
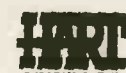
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PRACTICAL ELECTRONIC FAULT FINDING AND TROUBLESHOOTING

By Robin Pain

Reviewed by Haider Bahrani.

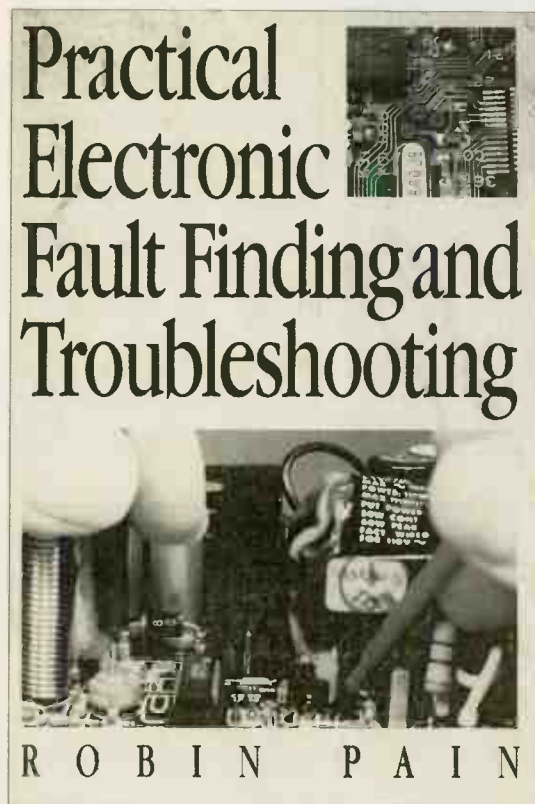
Imagine: a city of transistors and capacitors standing over rows and rows of resistors, diodes and wire links. Everything looks fine but the circuit just doesn't work. Even the most experienced of hobbyists and engineers have spent hours, if not days looking for a fault in a circuit and then kicked themselves when they realised how simple it was. I doubt such experiences are ever easily forgotten but every now and then a bit of text comes by to help us all along with such arduous tasks.

Robin Pain's book is derived from experience rather than theory and he makes this painstakingly clear in the introduction. He also points out that some of his explanations may seem patronisingly simple while others are very complex. Mr Pain apologises for neither as this book should be treated as a handbook and not a study text.

The book itself is effectively split into two parts. The first of these deals with fault finding in analogue electronics and is billed as a precursor to all forms of fault finding. Hence the first six chapters which make up the analogue section are given the collective term 'Basics'.

Following a brief introduction to the concept of fault finding in chapter One, chapter Two brings in the concepts of voltage, current and resistance. The down-to-earth approach the book takes in these early chapters not only serves as a good introduction to circuit behaviour but also as a useful aid to all those 'can't see the wood for the trees' problems faced by professionals. From the basics of parallel resistances to the

inherent drawbacks of test instruments, just about everything is explained in all the necessary detail. Examples are slotted into the text neatly verifying the explanations.



Chapter Three follows suit and covers capacitance, inductance and impedance. Fundamentals like charging up capacitors and the behaviour of high and low-pass filters are looked at briefly as are the problems of DC offsets and leaking dielectrics in electrolytic capacitors.

The two chapters that follow delve into active component territory. Here Mr Pain invites us to trust the human ear, an argument few experienced audio engineers would disagree with.

The next eleven chapters focus on digital fault finding. The first seven of these could be considered a 'bluffer's guide' to microprocessor systems. The approach is strictly hardware oriented, with the fault finder assuming the software is tried and tested so the problem is on the circuit board. Serious fault finding doesn't take place until chapter Sixteen.

Right at the end of the book are two chapters which are perhaps as vital to the fault finder's work as any of the preceding chapters. The first of the two explains the use of dual trace oscilloscopes and the anomalies that are inherent in them. Probes should be treated with due care as they can often disguise a problem or even create one that doesn't exist in the equipment, a theme that can be picked up throughout the book.

The final chapter concerns the replacement of ICs (integrated circuits), with a few handy tips on how to remove the little blighters from the PCB without tearing the surrounding components apart.

Practical Electronic Fault Finding And Troubleshooting is derived from a wealth of hands-on experience and would make a useful addition to any electronics library. It's easy to read and could serve as an introduction for any reluctant would-be electronics buff. Serious work should always be carried out using a book like this as a reference only in conjunction with a good theoretical text and neither should be taken verbatim. It's rare for anyone to say that they have enjoyed an electronics tome, but in this case I certainly did. John Grisham beware!

Golden Dragon

KT66 - R

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Specifications: KT 66-R

ultralinear, 40% taps, Class AB1, cathode bias

(typical operating conditions)

Heater voltage	6.3V
Heater current	1.3A
Anode voltage (DC)	450V
Screen Voltage (DC)	425V
Negative dc grid voltage	-15 to -40V
DC cathode current	65mA
Anode dissipation	22W
Screen dissipation	3.5W
*Anode+ screen dissipation	26W(max)

*Triode or ultralinear operation

The specifications conform exactly to the original GEC/M-O valve and can be reproduced on any new Golden Dragon KT66-R.

Newly available this month, Golden Dragon launches the classic KT66-Rs from the 'Retro' range of tubes. This valve combines the same shape and style of the original GEC and M-O valve designs with modern materials and manufacturing techniques. These are audio tubes of unsurpassed quality and reliability, not to mention their musical abilities.

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The tube's measured electrical performance matches the original GEC and M-O data exactly, and they have been specially branded in the style of the originals.

The KT66 was widely regarded as the best valve of its type. Famous designers to have used it include Peter Walker (of Quad fame) in the revered Quad II, Williamson and HJ Leak. Since GEC ceased production of the KT66 prices for original examples have rocketed. Golden Dragon now brings the original performance back at an affordable price.

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D.I.Y. Letters

A CLASS ACT

My system: LP12/Ittok/Asaka, Audiolab 8000A, KEF Reference 102. I recently built Hart's K1450 PU amp, intending to follow it with their power amp, but after reading your magazine and sending for details of your kits, I'm wondering whether I should go valve. I have a few questions:

- 1 - First and foremost, you say your kits are not for the inexperienced. I have some experience but I wonder whether specialised equipment is needed, an oscilloscope for example.
- 2 - I understood that Class A meant that the positive and negative parts of the signal were not split and amplified separately. From what you say, however, this is single-ended operation, so that one can have push-pull Class A amps like your K5881. What exactly is the difference?
- 3 - In the article on your SE Mosfet design, you say that as the "level goes down so does

distortion", as opposed to "push-pulls which suffer rising distortion at lower levels". Presumably, then, it would be best with SE amps to bi-amp 'speakers (especially three-ways) so that the amps idle along at a few watts, whereas a purely Class A design needs running at a higher level for best sound quality?

- 4 - The distortion figure of your K588 IPSE is eight times that of the non-SE version. Is this distortion "purely second harmonic (and therefore subjectively innocuous" as with your Mosfet amp?) And doesn't bass performance suffer from the fact that the PSE only reaches down to 30Hz? What about hum as well - 1.5mV as opposed to

0.4mV?

5 - Would one lose a lot of the benefits of Class A working or single-endedness if the pre-amp was a push-pull design?

The question is: what upgrade path to follow? Should I stick with the mainstream or alternatively go valve? I enjoy wielding a soldering iron but at the end of the day what I want is to listen to music.

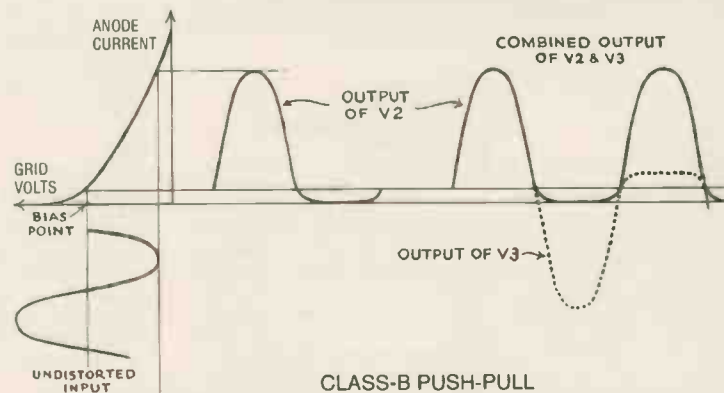
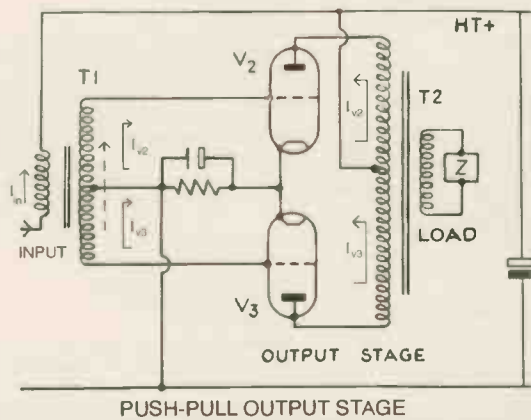
R. G. Pridmore
Cambridge.

Personally, I cannot imagine how any piece of electronic equipment can be built and tested to ensure correct operation

without a 'scope and a meter. But most kit builders have neither a 'scope nor access to one and they manage perfectly well. But then, I forget that I mis-spent my teens building all sorts of valve amps and radios with the aid of a single Japanese multimeter, so it can be done.

Whilst a 'scope, signal generator (CD player with test disc will do) and multimeter are useful, they are not essential.

Otherwise, no other special items are needed. We do not encourage the inexperienced because of the high voltages involved.



PUSH-PULL

The upper diagram shows a transformer coupled phase splitter stage feeding a classic push-pull output stage pair (V2, V3). The input signal is 'split' to become two identical drive signals (I), 180 degrees out of phase, which drive the output devices.

In Class B each device (V2, V3) is biased to handle only one half of the signal (see lower diagram). Their outputs combine in the output transformer.

In Class A the bias point is moved so that each output device handles all the signal.

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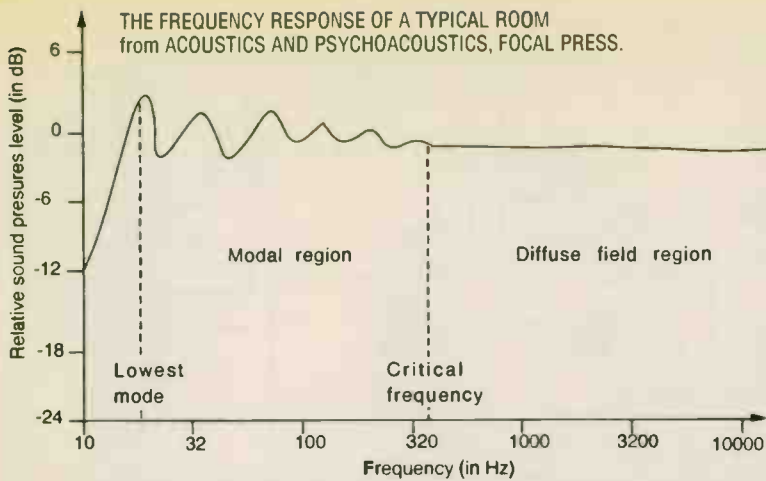
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All single-ended amplifiers are, by definition, Class A. They cannot be anything else, since one output device handles the whole signal cycle. With push-pull amplifiers, if both devices

anything in-between is Class AB.

If you work an amplifier within its limits, so that music peaks go up to full output, then because the peak-to-average ratio is high, average music

ear/brain does take account of time - it will hear a distortion-free sound.

That's the one significant reason low powered amplifiers sound good. It does mean SE

music will swing from, say, 20V down to less than 1V. Typical music levels though are around 2-5V, or 3watts maximum. If an amplifier is linear down in this region, as an SE is, then for most of the time - and the

push-pull (Class B) was valued for its ability to deliver a lot of power, essential for Public Address, which is where amplification started. We can now go back and explore single-ended because with modern, sensitive loudspeakers, power is not such an issue.

If a push-pull amplifier works in Class A or AB then it will (should) be linear at low levels too. Push-pulls do have a different sound though. Generally, they have a lot of grip and go but are less smooth and cohesive than SEs. Classical music, strings especially, is handled a little better by SEs in my view, whilst Rock perhaps is better conveyed by push-pulls, all other things being equal. A lot does come down to the individual design though.

In 4) you are trying to read too much into figures. The way amplifiers distort, a product of their transfer function, defies single-figure measurements. We supply such figures because they are expected and do prove that an amplifier meets a minimum standard. But the distortion spectrum and the way it is correlated with music is most important.

The low frequency limit of a hi-fi system is, in most cases, set by the loudspeakers and the room. In our Supplement this month you will find more details on this. It's not a commonly discussed subject in audio. Those interested can find more in *Acoustics and Psychoacoustics, Focal Press (ISBN 0 240 51428 9)*. The diagram reproduced here is interesting and accurate. A big 'speaker optimally loaded, like KLS9, can get down to 17Hz and a 16ft room reaches down usefully to 30Hz or so.

LEAK

TL/10 AMPLIFIER



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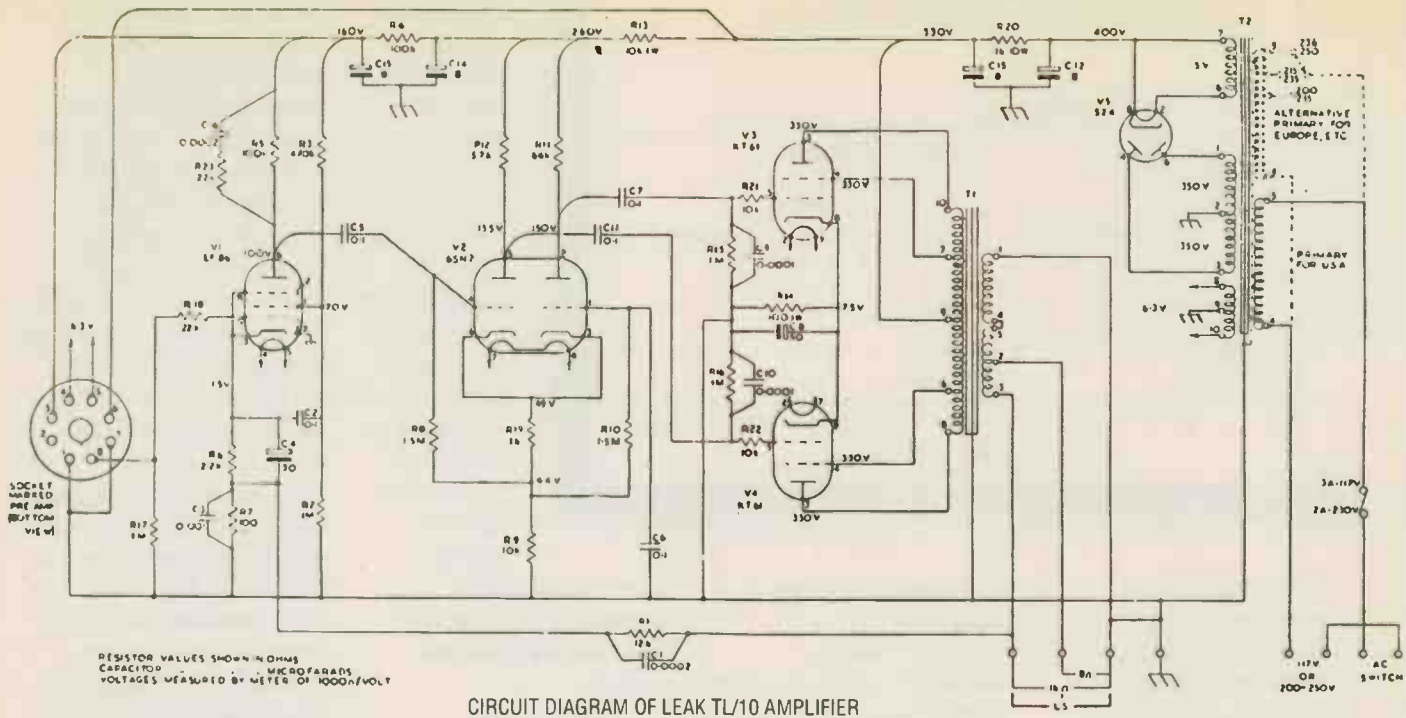
POINT ONE PRE-AMP

(August 1954)

handle the whole cycle they too will be Class A. If each device handles only half of the signal, as in the diagram, then the mode of working is Class B, and

levels will commonly be just a few watts of output. In truth Rock music typically occupies something like a 30dB dynamic range, meaning

amps should not be pushed and, yes, you could use many to spread the load, even if it hits the pocket. It's interesting to read, in old literature, the way



CIRCUIT DIAGRAM OF LEAK TL10 AMPLIFIER

Most commercial stand mounting loudspeakers, however, have difficulty going much below 35Hz. In this context an amplifier that works down to 30Hz will sound little lighter than one working down to 10Hz.

In fact, valve amps work down to subsonic frequencies with ease but we choose to limit ours deliberately to ensure LP record warps don't saturate the output transformers. This is

especially important with SEs because their transformers carry a strong magnetising DC current.

Our target figure for hum is 1mV. Anything less is inaudible. Anything more, up to 3mV, is slight with 'speakers of average sensitivity (87dB). With 'speakers of high sensitivity (>90dB) though, hum will be audible at this level, which is why we aim for 1mV. These target values can alter by at least

50% according to wire layout in critical areas (input valve), so again it is unrealistic to worry about small differences.

Ultimately, valve amplifiers have it in my view. A good one is gorgeous to listen to. NK

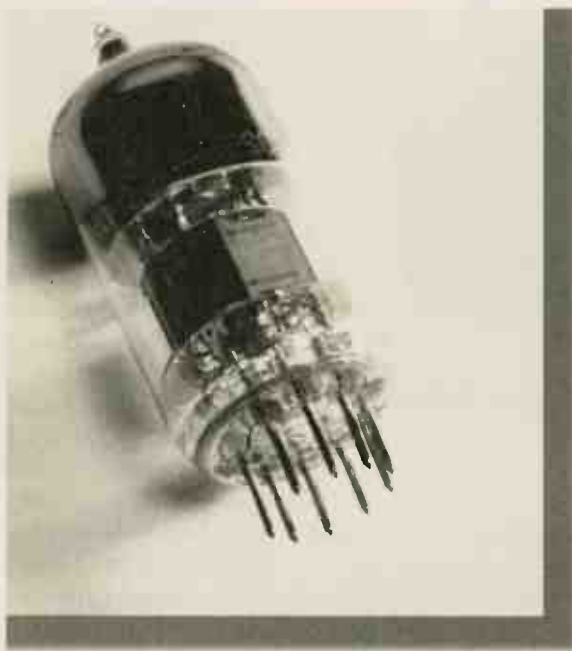
THE ELUSIVE KT61 PART II

With reference to Matt Rowland's letter in the April Hi-Fi World supplement about revalving a Leak TL10's output stage with KT61 equivalents, the only truly 100% equivalent of a KT61 is a 6AG6G - and you try finding one! The factory modification for markets where the KT61 was not commonplace (i.e. everywhere outside Great Britain) was to fit a pair of 6L6 power beam-plate tetrodes instead.

Although the 6L6 is a related valve, it has a larger anode Pa rating. To use 6L6s instead of KT61s,

the following modifications need to be made. If they're not done and a 6L6 is plugged in, damage will occur to either of the irreplaceable transformers.

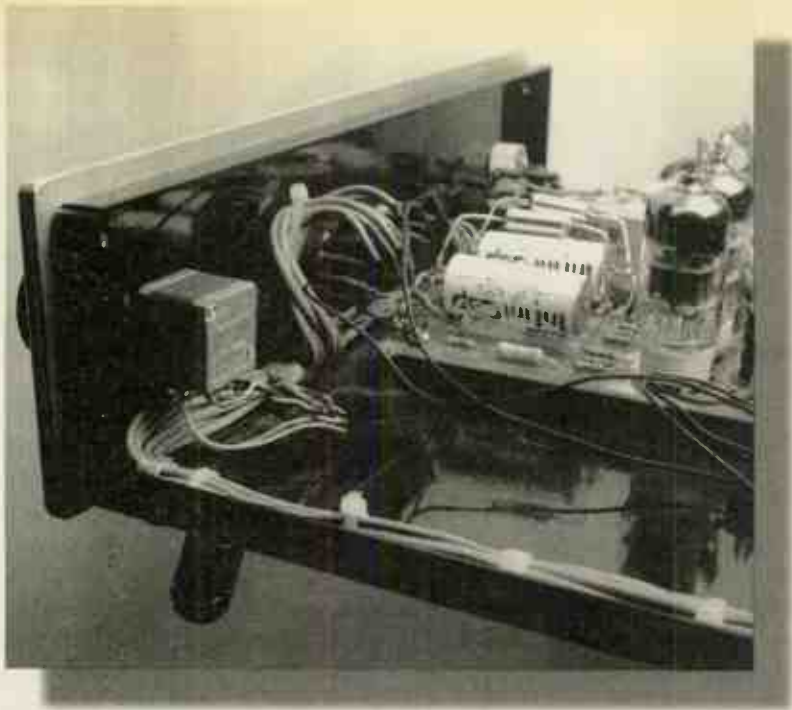
1) Change the output valves' shared cathode bias resistor (R14 on Leak's circuit) from 100R to 300R. Even better, fit a 600R resistor on each valve, with a 50µF capacitor across each resistor rather than the shared single item. In fact, even if sticking with KT61s, it's worthwhile fitting separate 200R cathode resistors. All resistors should have three-watt ratings.



An ECC83 would sit well in the TL10's front end.



The KT61 for a Leak TL10's output stage may be long gone but an alternative (after making modifications) is the 6L6.



Panasonic's For Audio volume pot and TRT's Infinicap SETI caps as fitted to our modified KLPI.

2) Change the 100kΩ (R5 on Leak's circuit) resistor on the EF86 anode (pin 6) to a 330kΩ, one-watt rating.

3) Change the 470kΩ (R3 on Leak's circuit) resistor on the EF86 second grid (pin 1) to a 1MΩ, one-watt rating.

These mods will keep the amplifier to its original specifications. Incidentally, Leak were pushing their luck a little with the KT61. It was intended for high quality radio sets, not hi-fi amplifiers. The MOV suggested power rating for two valves in push-pull is eight watts not ten. Leak also fudged the 'point one' distortion specs as well. This figure was only applicable to a five watt output rather than the full ten! Nonetheless, it is a very sweet little valve fitted to a sweet sounding little amplifier.

Personally I would be reluctant to fit a SRPP input stage - good new old stock EF86s are not hard to come by (but avoid all current Russian and Chinese-made EF86s, they are absolutely and resolutely awful). Perhaps an ordinary triode stage using an

ECC83 (more correctly half of one) would be a better compromise and more in keeping with the amplifier's pedigree.

Haden Boardman Hindley, Greater Manchester.

TWEAKAHOLICA

I would be grateful for some advice regarding possible modifications to my system. This comprises a Valhalla LP12, RB300, MC 20 Supreme, Musical Fidelity Pre-Amp 3 and PI70 power amp together with their MC4 'speakers.

The pre-amp has Schottky rectifiers fitted, every system input/output is hardwired, the Šfernice volume control is wired directly to the PI70's PCB, bypassing the active stage and each transformer has its own electrical supply for true dual mono.

The 'speakers are damped with carpet and wired with Kimber TC, their crossovers removed to an ABS box and built with Kimber Kaps and HP metal foil resistors.

All of the above has significantly improved detail, transparency and dynamics (which I was seeking) and I don't particularly wish to alter what I suspect is a slightly rich, warm balance.

I am now tempted to replace some of the components within either the disc stage and/or power amp. I'd probably replace the resistors (which appear to be standard metal foils), the capacitors (250V versions of ICW's polyprops) and the small electrolytics within the signal chain with Vishay EE10 or VHS/Ansar Supersound/Elna RSH caps.

However, I would appreciate your thoughts regarding the efficacy of any such actions. Does the equipment justify the effort? Are the components/makes referred to appropriate? And, just as importantly, do you have any alternative suggestions?

I may also have an offer to purchase a second PI70. Would the benefits of bi-

amping be worthwhile, particularly remembering the extra cost of modifying it to a similar standard?

Peter Cuthbert Orpington, Kent.

I would tend to spend more money on high quality capacitors than on resistors as the former generally have a larger impact on sound quality. One brand to go for, as you mention, is Ansar Supersound for coupling caps, although spending more (actually, a lot more) on the likes of TRT's Infinicap SETI caps (from AP Electronics, tel: 01332 674929) will bring big improvements in transparency and imaging along with a smooth warmth that should complement the sound of your system.

Small electrolytics can be replaced with either Elna (RSH or Stargets, with their OFC leads), Panasonic's solid aluminium OS-CONs or Rubycon's PS2s. These are available from Electromail, tel: 01536 204555. If you'd like to try putting in a few more PSU decoupling caps, tantalums are worth consideration. These have a lower impedance than electrolytic types and go up to about 100µF. The only problem is that higher values are limited to a 16V rating.

You might also consider Panasonic's For Audio potentiometer. At £64 a throw it's not cheap but it does make a serious difference to transparency and three-dimensionality. Contact Audio-Links, tel: 01724 870432, for more information.

Bi-amping does make a very big difference to sound quality, giving a deeper, wider sound stage, better bass and dynamics. If you can afford to make



High grade capacitors for an amplifier modification - Elna's Starget Electrolytics.



Aura's VA80 SEx amplifier shows a real improvement when its internal ribbon cabling is replaced with audiophile wiring.

the changes and have the time, I suspect they'd be worthwhile. The alternative is to buy the second P170, leave it unmodified and run, say, the tweeters from it while the other P170 handles the bass. This arrangement doesn't, however, give sound quality as good as that produced by having a separate power amp for each channel. JM

SONIC SURGERY

I own an Aura CD100 CD player and VA80SEx amplifier. Seeing as I'm an engineer I thought I'd take their covers off and take a look inside. The amp had three separate circuit boards, each linked to the others by clip connectors. I replaced the standard ribbon cable with DPA Slink and soldered this on. The elimination of the connectors and the move to better cable made a significant difference. Next, I thought I'd take a look at the CD player.

I replaced the output capacitors (100µF) with Black Gates and the supply

capacitor (4700µF) with an Elna Cerafine. Doing this made a big difference but the most astounding improvement came about when I replaced the NE5534 op amps with Analogue Devices AD711s. I have to say that bearing in mind the scale of the improvement this change brought about, the 5534 is a very poor sounding device.

These modifications are extremely worthwhile and I'd recommend them to anyone.

Ral Cots
(address not supplied).

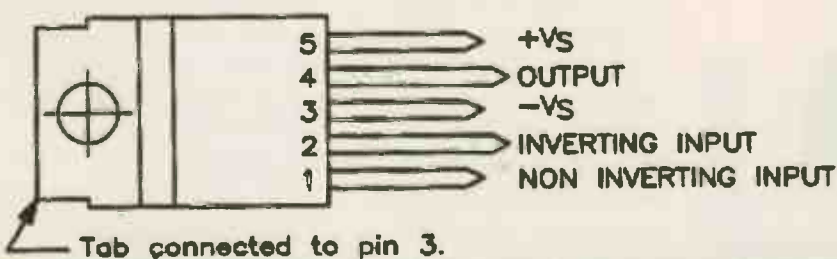
A route to digital delight is, as you say, modifying the power supplies - CD players do seem to need lots of well regulated supply lines if they're to give of their best. One way to improve matters is to use high quality power op amps set at unity gain with precision zener diodes feeding their inputs. Suitable op amps are the SGS-Thompson L165 (Electromail part no. 301-599), although with a peak output current of 3A and a

cost of £2.82 this is perhaps a little over the top. A cheaper alternative is the L272 (Electromail part no. 635-167) with 1A peak and a cost of £2.20. Zener diodes to go with these could be something along the lines of National's LM336 5V reference (part no. 411-876) at just over £1 and Maxim's REF-01CC 10V reference (part no. 371-009) at £2.50. Other voltages can be obtained by either stacking the zeners or taking a look at the other diodes in the Electromail catalogue. JM

Thanks for letting us know about your experiences. The NE5534 is a dedicated audio op. amp. with very low noise (good for phono inputs), minimal distortion, wide bandwidth, etc. It's great - and it only costs 96p. And that's the problem. The audio biz. uses these things everywhere,

indiscriminately as input pre-amps, line pre-amps and output line drive amps., in amplifiers that cost £100 right up to ones costing thousands. Whilst the 5534 ensures a great standard of performance for

96p and 5 minutes of design effort, it isn't appropriate for advanced amplifiers. It's interesting that the chip manufacturers themselves have been keen and quick to produce audio super chips, but the industry isn't so keen to shell out for them, preferring what it knows, loves and pays little for. In my experience, by the way, the 5534 imposes and peculiarly flat and papery sound upon an amplifier. NK



One way to quiet, precise regulation is to use power op amps like SGS Thompson's L165V and L272M.

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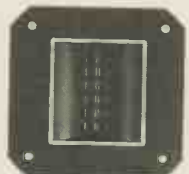
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