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### KIT NEWS

These pages contain the latest information concerning products and components in the world of DIY.

### ORIGIN LIVE TURNTABLE KIT

£145 won't buy much in the way of quality vinyl spinners, but it will buy you this turntable kit from Origin Live which promises analogue bliss. Does it deliver, asks Jon Marks.

### KLS3 GOLD GOES MkII

KLS3 Gold, our top of the range kit speaker, just got better. Noel Keywood guides you through the improvements.

### BOOK REVIEWS:

#### ANALOG ELECTRONICS

In his book Analog Electronics, Analog Circuitry Explained, Ian Hickman is as good as his word, as Haider Bahrani found out.

#### AUDIO ELECTRONICS


### DIY Q&A

Whether it's a simple DIY problem or a high-powered theoretical debate, Q&A can help.
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<td>EL34 Chinese tested - guaranteed 50 pieces @ £200.00 [£4.00 each]</td>
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**BETTER CONNECTED**

The Parts Connection, based in Oakville, Canada, has just released two new amplifier kits on the market. The first is a valve line-level pre-amplifier radically named the Assemblage L-1. This kit is claimed to be sonically reminiscent of the acclaimed Sonic Frontiers SFL-1 pre-amp and contains a hybrid FET/tube circuit. The Assemblage L-1 features a fully regulated power supply, four line inputs, one tape loop and two paralleled outputs. Zero global negative feedback is claimed for the design, which offers approximately 20dB of gain and good drive because of its low output impedance. The complete package includes all valves, pre-punched chassis, face plates, knobs, hardware and of course instructions. The price is $499.00.

The second new arrival to be announced is a stereo power amplifier called the Assemblage ST-40PP. This uses a triode input stage followed by a long-tailed, differential-pair driver stage, which feeds matched pairs of EL34/6CA7s in a push-pull configuration. Price for the ST-40PP is set at $699.00.

The Parts Connection
2790 Brighton Road,
Oakville,
Ontario,
Canada
L6H 5T4
Tel: (001) 905 829 5858

**NEW MAPLINS CATALOGUE**

Maplins has launched a new edition of its bi-annual catalogue and in the process introduced in excess of 2000 new products. The new catalogue covers audio-visual, computers, security, radio communications, electronic and electromechanical components. The catalogue also comes complete with a section of in-depth 'How To' guides on a wide range of topics from soldering to computer peripherals and networking.

Maplins MPS
PO Box 777,
Rayleigh,
Essex SS6 8LU
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**REMOTE POSSIBILITIES**

Scunthorpe-based component supplier Audio-Links have developed a module that will allow the owner of any pre-amplifier or integrated amplifier to have the luxury of adjusting the volume by remote control. The module comes completely built and tested. The price to bring all this control to your finger tips is £62.10 plus P&P.

Audio-Links
7 Fairmont Crescent,
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North Lincolnshire DN16 1EL
Tel: 01724 870432
If you're a vinylphile who's handy with a spanner and a soldering iron, Jon Marks reckons you owe it to yourself to check out Origin Live's Standard turntable kit and Rega RB300 tone-arm modifications.

Imagine the situation: you're trying to track down a kit for a turntable. The response from the suppliers you've tried so far will probably have been, "Amp kit, DAC kit, 'speaker kit, sir? We have those. No turntable kits, I'm afraid." Step forward Origin Live and their two kits for record decks, the Standard and Ultra.

We first took a look at Origin's higher spec. kit back in August 1993's Supplement where we went for the complete Ultra kit of parts which cost £350 back then. At the time, Jonathan Jordan thought this was money very well spent. Now we're moving into budget territory with the Standard kit where novice constructors should find themselves more at home. This kit will set you back £125 for the bearing, platter, motor, belt and basic power supply.

THE TECHNOLOGY
The bearing itself is the heart of any turntable. Most lower-priced decks tend to have low-tolerance bearings where the cost-cutting shows up as play - if you grasp the spindle and move it gently from side-to-side, you'll notice some movement. The results this has on sound quality are usually fuzzy imaging and a general lack of crispness and definition; speed stability and rhythm can also suffer.

Origin Live win themselves brownie points for not skimping on bearing tolerance. Technologically, OL's bearing toes the traditional line with a non-inverted design, unlike, for instance, Pink Triangle's predominantly inverted designs (which can be more difficult to manufacture and lubricate reliably).

The main housing is actually a large engineering bolt with its head cut off and a shaft sunk down its centre. At the bottom sits a small ball bearing (replacements are available from bicycle shops at around 75p for a pack of 10). Rotating atop this ball is the shaft, made of case-hardened, ground steel, which supports the grey PVC sub-
platter. Finally, resting on the sub-platter is an 11mm-thick glass platter with three small felt discs glued on to it to decouple the record.

Driving the whole assembly is the sort of AC synchronous motor you'd expect to find in decks like Linn's LP12, Pink Triangle's PT Export and Systemdek's 2X2. This is good news for tweakers because it means Linn's own Valhalla power supply will work with the Standard kit, according to Mark Baker, director of Origin Live.

If you decide to opt for a ready-made plinth to get you up and running, OL do a simple, solid one for £20. This consists of a slab of MDF pre-cut and drilled to take a Rega RB250/RB300, which was supplied. But this is no normal RB250. Mark has modified this budget favourite and claims its performance would give even super-arms like SME's Series V and Linn's Ekos pause for thought.

What makes this arm special are three tweaks. The stub that carries the counterweight is unscrewed and replaced with one that is held onto the arm-tube with a high-tensile steel bolt. This is claimed to give a much more rigid structure than before and, because the stub no longer screws into the end of the arm-tube, improved decoupling between it and the arm tube.

The second change is threading the weight to take a grub screw to hold it much more firmly onto the stub than the rubber o-rings normally fitted. In maximising rigidity like this, OL's RB300/RB250 mimics SME's Series V, where rigidity is paramount. Finally, the Rega is re-wired with silver Litz cable.

To find out what the Standard kit and revamped Rega have to offer, we decided to try out the Standard kit in two guises: with OL's own solid plinth and AC motor, as well as with a battery-powered DC motor.

**SOUND QUALITY**

Since it’s a solid-plinth deck, the Standard will need to be sited on something more stable than a bookshelf. A dedicated wall-shelf is one idea, as is a low coffee table like the Lac from Ika.

Bearing a Goldring 1042 Moving Magnet cartridge and working into Audio Analogue's Puccini SE integrated amp, this vinyl front-end had my jaw heading towards the floor with the solidity and transparency of the music it was making. Spinning a copy of Ray Charles and Betty Carter running through a selection of classic numbers, the Standard came up with crystal-clear images set in a broad sound stage. Stage depth was a little disappointing by comparison, but that width really was an unexpected bonus. Another was the obvious rhythmic ability of this turntable/arm combination, with upper bass notes crisp as a freshly ironed £50 bill giving whatever LP was sitting on those three felt discs a pleasantly upbeat feel.

The flip-side of this presentation was that bass had a slightly lower profile than usual which could make music sound a tad insubstantial at times. This didn’t stop the Origin Live putting together a captivating performance with Ray and Betty, the mellow orchestral backing and laid-back mood of this LP undiminished. From an emotional point of view, the Standard/RB250 left CD as dead as the proverbial dodo - even our Teac P-30/Pink Triangle Da Capo, a communicative digital source, sounded lacklustre next to this analogue pairing.

With a Mobile Fidelity Sound Lab audiophile pressing of Muddy Waters' *Folk Singer* there was that expansive sound stage and superb separation which made the Origin Live's imaging so convincing. Again, the only area not quite up to par was stage depth, which was mildly compressed. Still, for a turntable kit and arm that tip the scales at only £465 without a cartridge, this set-up looks and sounds like great value for money.

Sporting a cartridge of the Goldring's calibre, the Standard also proved that old maxim, "Less is more" by displaying a total lack of sibilance and dynamic compression. And with surface noise on an LP like the Muddy Waters' merely incidental, you can forget about it and concentrate on the music.

With its platter under Grace Jones' *Warm Leatherette*, the Standard continued on its roll. Again, in spite of the fact that basslines were a touch lightweight, their individual notes were just that, individual, making it possible to follow exactly what the bass player was doing. The powerful percussion on Warm Leatherette failed to provoke this deck into any brash nastiness, hi-hats remaining smooth and powerful in spite of a little groove damage on this old slab of the

---

**Diagram:**

- **Cross Section of Arm End**
- **Threaded Insert**
- **Allen Bolt**
- **Rega Arm Tube**
- **High Tensile Thin Bolt**
- **Counterweight Rigid Attachment by Bolt Adjustment**
- **Replacement Rear Stub**

Inside the end of the arm tube a threaded insert holds the stub bolt in place under tension. This, along with the grub-screw mounting for the counterweight, gives a very rigid connection between arm stub and counterweight.
The mounting plate is designed to work with OL's solid plinth. black stuff. Even when faced by the Spice Girls on a rather rough pressing full of background warblings and clicks, the Origin Live showed its mettle by delivering polished results on a recording that can take your head off on the wrong turntable.

You can take things further than this with minimal outlay though. Try adding some mass to the counterweight, for example. You can do this by Blu-Tacking some small change to it and moving it in closer to the arm's pivot, which means the weight has less inertia as it swings around on the end of the arm, producing better perceived tracking, smoother treble and deeper, more precise bass.

Golden Oldie No2 is slipping a 20m. diameter bicycle inner tube (about £3.75) under the deck, sandwiched between two MDF shelves. This takes off a few remaining rough edges and yields truly three-dimensional imaging and sound staging. It can also lower background noise by reducing the amount of external vibration that gets into the deck.

With all these mods in place, the Standard kit sounds good enough to worry some of the turntable/arm/cartridge competition at up to about £800. I have to say the Rega modifications turn this humble arm into a real giant-killer. Gone is the rather grey, sterile sound of the cooking Rega. Instead, tonal colour is fresh, dynamics have great speed and impact, and the sound stage is huge.

So, is there yet more quality to be squeezed from this kit? You bet!

**MOTOR MANIA**

The AC motor that comes with the kit is the same as the one used in Linn's LP12. The advantages of a motor like this are that it's easy to set up - it just takes a 0.15pF capacitor and two 6.8kohm resistors - and its speed stability is controlled by the mains, which gives fair if not amazing wow and flutter. The disadvantages are that you'll need a more complex power supply or a stepped pulley if you want to sample the joys of 45rpm, and that this basic motor puts out a lot of noise. The answer? Go DC, as Pink Triangle have done.

Finding a quiet, cheap DC motor is not always easy. I've managed to get some reasonable results from parts cannibalised from old record-sleeve-sized Midi-system turntables picked up for a few pounds because they're not otherwise working.

One company I've used in the past is Greenweld (tel: 01703 236363), who are based in Southampton. Stocks vary as most components are surplus, and once they're all sold, that's it.

If you're prepared to spend a bit more money on the motor - and motor quality is absolutely critical - I'd recommend splashing out on a costly but impressive motor from Airpax who also make the bulk of AC synchronous motors used in turntables. This Airpax is actually the non-tachogenerator version of the unit Pink Triangle rely on in their Anniversary deck. It's available from McLennan Servos of Camberley (tel: 01276 26146) for a price of £39.80 inclusive of VAT and P&P. Please quote Hi-Fi World when calling as this price is set for the next few months in spite of currency fluctuations which normally affect pricing.

Be warned though. When fitting the pulley the end of the motor's shaft must be supported, otherwise the delicate commutators will either be damaged or destroyed. The same goes for removing the pulley - it mustn't simply be yanked off the end of the shaft.

**PULLING POWER**

You'll need to finish the motor off with a suitable pulley and mounting plate (see diagrams). Probably the easiest material to make these out of is brass. Take the motor with you when you get the pulley made (at a local engineering workshop) because it needs to be gently but firmly press-fitted onto the motor's spindle. The top-plate will need to be mounted on spacers to raise it about 5mm off the

The heart of this simple PSU is the LM317T regulator.
plinth so the pulley sits at the right height.

**A QUESTION OF SUPPLY**

While an AC motor can work happily from an extremely basic PSU consisting of a mains supply, a capacitor and a couple of resistors, its DC brethren requires something a little more complex. A PSU for the Airpax can be constructed around the classic LM317T variable voltage positive regulator (see diagram).

Capacitor C1 acts as a storage device to help out the LM317T when current is drawn from it, and it reduces the amount of ripple on the IC’s output. C2 bypasses the adjust pin which sets the output voltage. With C2 in circuit ripple levels are further lowered. This is very important because the symptoms of excessive ripple are wow, flutter and raised background noise - three things you definitely don’t want in your turntable.

R1 is one half of the potential divider that determines the voltage fed to the adjust pin and, therefore, the output voltage. The other half is a pair of variable resistors (R2 and R3). Through S1, the switch, these give you separate pitch controls over each of the two speeds, 33rpm and 45rpm. If you’re using an 8mm diameter pulley on the Airpax motor, you need to set R2 to 141-142Ohms (33rpm) and R3 to 190-191Ohms (45rpm).

Seeing as the motor draws relatively little current (40mA-50mA) heatsinking is not necessary. If the LM317T gets hot when you switch it on, check for wiring errors.

I wouldn’t even bother thinking of running the PSU from a mains supply - battery power is the only way to go. If you want to experiment you can actually run the circuit from a 9V PP9 for an hour or so before it goes flat. A better bet because of its lower internal impedance and greater current capacity is a rechargeable 6V lead/acid type. You can get these from Maplin (tel: 01702 554000) or Electromail (tel: 01536 204555). For example, Maplins’ XG70M costs £13.12 and is rated at 4Ah (Amphours). This would keep the motor spinning for around 60hrs between charges. An appropriate charger would be the GLO08 at £29.99. This adds up to a total of £43, which is less than the cost of the high-quality toroidal transformer, Schottky rectifiers, audio-grade reservoir caps and various regulators needed to come close to equalling a battery PSU’s performance.

There’s a few refinements you can make to the basic LM317T circuit. First of these is to bypass C1 and C2 with film capacitors to lower their impedance. 2.2µF to 10µF would be worth trying. Alternatively, you could make C1 and C2 Sanyo’s Os-Con aluminium electrolytics which would give a clearer, firmer sound than industrial-grade types. Then there’s Linear Technology’s higher spec. version of the LM317T, the LT317AT which can be obtained from Audio-Links (tel: 01724 870432) and AudioCom (tel: 01834 814660). Going for bulk-foil resistors from the same two sources would also be a good idea. With all these goodies in place, the Standard would give turntables at the £1200-£1400 mark a hard time.

**THE LAST WORD**

And that’s not all. While Origin Live’s simple £20 solid plinth makes a fine starting point, there’s vast extra untapped potential still in the kit. A four-plinth deck in Perspex or marble would offer outstanding sound. The motor could be mounted in a cylindrical block of marble or brass sitting on three spiked feet with their matching cups glued to the marble base plate. This method of decoupling motor noise from the plinth is similar to that used in Michell’s massive £2000+ Orbe.

The main bearing could then be bolted to another larger slab of marble on its own spikes and cups, again sitting on the base plate. The arm gets its own spiked marble board as well. An arrangement like this would not only look gorgeous, it would sound it too, with very low background noise, razor-sharp dynamics and real rhythm and scale. The only limit is your imagination, and remember, hi-fi doesn’t have to be a black box!

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If you would like to hear this incredible amplifier in action then arrange a visit to Wilmslow Audio's new premises at Broughton Astley, near Leicester. Their phone number is 01206 266033, to speak to Shaun or Terry.

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DIY Feature

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It uses a unique piezo-electric gold-dome tweeter and high-tech. carbon-fibre drive units. This is our top loudspeaker - and we’ve improved it again.

Noel Keywood cranks up the FFT.

The beauty of this loudspeaker remains untouched. It lies within the sweet sound of the high-technology Audax carbon-fibre drive units we use, topped off by the superb Audax HD3P gold-dome piezo-electric tweeter. It delivers treble that I can only describe as liquid honey, as pure and fast as the beautifully incisive Tonigen ribbon tweeter, but without reminders of Wilkinson Sword.

So why am I improving this combination? Broadly I decided to reconfigure the crossover in light of experience and others’ views, as well as to tune the HD3P into the HM13000 carbon-fibre midrange even more tightly in terms of phase response - a minor obsession. KLS3 remains an elegantly proportioned large floor stander, however, using separate bass and midrange units, plus what is arguably the world’s best tweeter. Like any good three-way it has a sublime midband - great for vocals, which are projected right out of the ‘speaker. It remains sensitive, needing little power and, as always, impedance has been kept under tight control to make sure it gets the best from any amplifier, transistor or valve.

The revised HD3P tweeter is still expensive, but at £130 apiece much less so than before. Audax tell us that enough are now being purchased to warrant full production, replacing the specialised assembly methods used initially. High price makes the HD3P a rare bird in commercial loudspeakers, where drive units are usually budgeted to cost no more than £10 or so, but it is appearing in up-market French loudspeakers (Audax are French) costing around £5000 or more.

THE MODIFICATIONS
There’s nothing like a good three-way. My ideal conception for this arrangement is to view the midrange unit as the bit that does most of the work and which must be, therefore, top quality. Small cones reach higher up the audio band more smoothly than the bass/midrange of a two-way loudspeaker, which must have a cone at least 6in.-8in. in diameter to produce decent bass. Trouble is, large cones ‘break up’ lower in the audio band, making vocals, violins, etc sound coarse.

The compromise between satisfactory bass output and clean midband behaviour faced by two-way loudspeakers is avoided by a three-way design. The HM13000 midrange unit of KLS3 uses a 5in. cone (130mm) made from woven carbon-fibre mat impregnated with a polymer resin that is baked hard. This light but very stiff cone, with its polymer dust cap, reaches smoothly up through the part of the audio band, 2kHz-6kHz, in which bass/midrange drivers ‘break up’. So the HM13000 has a critical and important task to perform.

A couple of experienced industry engineers have suggested that it would benefit from handling less low-frequency content, for in the original design we decided to rely only upon an acoustical roll-off of low frequencies. This made the crossover simpler, which DIYers appreciate, but drives the HM13000 harder and can produce a little chestiness, according to the effectiveness of damping used in the midrange chamber.

The MkII now has electrical attenuation in the form of a first-order filter to reduce this effect and to lessen cone excursion. Seeing as it’s a bass/midrange with edge-wound, high-temperature Kapton voice-coil former the driver itself has no difficulty handling power, by the way. Audax rate it at 50watts - high for a midrange unit.
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BASS UNIT
We originally used the HM21OCO bass unit as a fill-in driver working only below 100Hz. This under-utilises its abilities, because the 8in. carbon-fibre cone reaches up to 5kHz. I rearranged the low-pass filter feeding the bass unit, rewinding the bass inductor to reduce its value from 12mH to 2.7mH in order to make the HM21OCO work up to 400Hz. The inductor required becomes more manageable and less deleterious in other areas. The 12mH used previously had a resistance of 0.45ohms, whereas the 2.7mH now required has a resistance of 0.21 ohms, which will improve bass control a little with low output impedance solid-state amplifiers.

I should point out that the importance of damping and DCR often becomes over-inflated in discussion. Most damping is applied acoustically by the cabinet, but mechanical damping exists too. Electromagnetic damping makes a contribution, but it is not great - putting foam in the ports has more effect. I simply unwound the original inductor to achieve the new value, so there's no need for KLS3 owners to throw the old item away, providing an inductance meter is to hand of course. If not, let Falcon Electronics supply new items, because they are not expensive.

By running the HM21OCO further up into the midband, cabinet behaviour becomes more critical. Ensure the rear wall behind the driver has a double layer of carpet felt, with the upper layer bunched up to dissipate sound waves, in order to prevent coloration occurring. If you cannot obtain natural carpet felt, use Deadsheet or Deflex Panels.

CROSSOVER
The electrical response curves show that the filters used were, by and large, well damped, having smooth rather than peaky roll-off characteristics. This helps keep the loudspeaker's overall impedance curve smooth, because filters that lift response do so by demanding energy from the amplifier over a narrow frequency band, lowering impedance to achieve this. The result is a wildly gyrating impedance curve with steep slopes and high reactance.

Loudspeaker manufacturers largely remain oblivious to the fact that this exacerbates differences between amplifiers. We have found through experience that KLS3 tends to get the best out of amplifiers, flattering them you could say. Funnily enough, for this reason we never use KLS3 for amplifier assessment, because it gives better results than will be...
DIY feature

The bass section rolls down above 40Hz at -12dB/octave, shown by our analysis here.

The impedance curve is now flatter than before, as our analysis shows, being very flat by the standards for any loudspeaker, but especially a three-way. It has dropped to around 5ohms which, with the inevitable rise at low frequencies caused by bass unit resonance, measures out at 6ohms overall. The crossover needed a few tweaks to achieve this result, including the split high-pass capacitors feeding the HM130CO with a resistor across one, and the resistor/capacitor network across the HD3P tweeter. This tames a rapid impedance rise above 10kHz, characteristic of the tweeter crossover network. It also rolls down high treble above 12kHz, which softens out the tweeter’s sound a little. If desired, it can be removed or lessened in effect by increasing the resistor value (try 20ohms-30ohms). An alternative is to reduce the value of R1 to 2.7ohms, but then a resistive attenuator is needed to reduce tweeter sensitivity. This solution will, however, maintain output flat up to 20kHz.

CABINET PLANS

For those of you lacking KLS3 Gold cabinet plans, published in our December 1996 Supplement (No 26), we are reprinting them again here, with a few modifications. The twin front ports now move to the rear of the speaker and are mounted on a removable panel. This allows them to be changed and tuned for length more easily. The 150mm x 150mm mounting panel also gives access to the loudspeaker and the crossover network, which can be screwed down onto the base. However, it is better to have an external crossover network, bolted onto the rear panel. This removes it from acoustic vibration (important) and makes experiment easier (I’m likely to mod KLS3 again!) Although we specify the
get the dish before cutting the hole  

I will also re-tune the ports in future, showing the differences between small and large. By the way, there is no 'correct' port size, as some readers are wont to argue because an equation gives a set of dimensions.  

Port equations make many assumptions about working conditions and damping. The ports on KLS3 were dimensioned to suit most rooms, a factor, like impedance, little considered by loudspeaker engineers (see our Group Test this month) and not reflected in port equations. I hope to look at alternative ports and what they offer next month. A removable panel makes port size experiments easy to carry out of course and this is probably the best way of tuning a reflex loudspeaker in any case, using listening tests, because it takes room excitation and personal taste into account.

DETAILS

Here are some important constructional details.

The tweeter board is modified by removing the green Seta R82 (0.82ohm) resistor and replacing it with a 4.7ohm resistor, 5W. The capacitor remains standard; do not add 2μF in parallel as before. This raises the crossover frequency a little. The resultant electrical response, with impedance compensation in place, clearly shows a steep roll-off below 6kHz.

Note also that the tweeter has its phase reversed. You can do this by connecting the tweeter unit the 'wrong' way around (i.e. positive to negative), or the input to its crossover board, but not both. The positive terminal of the tweeter is the lower terminal when looking from the rear with terminals at left. A red sticker is used to identify polarity, but it can come off.

I re-tuned the low-pass section of the band-pass filter feeding the HM130CO midrange unit to improve its phase matching to the tweeter. This was aided by a new inter-driver phase measurement technique I have developed for the FFT. The phase matching was close before, but has now improved. The ear is very sensitive to phase in this region and I've noticed that instruments like bells, triangles and cymbals sound more solid and life-like as these drivers move more closely into phase. It's worth wringing every last ounce of performance from the HD3P and HM130CO combination because there's little that can match them. They are technically very advanced but also too expensive to be found in commercial loudspeakers. It would be a shame to just throw them together, which is why a lot of fine tuning work has gone into this crossover. The low-pass inductor decreases in value from 0.5mH to 0.4mH and the 8μF capacitor decreases to 6μF; small but useful changes. Again, you can just take turns off the original inductor if you have the ability to measure inductance.

The HM130CO midrange was also closely matched into the HM210CO bass unit. Note that the bass unit has its phase reversed too. To determine bass or midrange unit polarity, use a small 1.5V battery. When connected such that the cone moves forwards, by convention the positive terminal of the battery is connected to the positive terminal of the loudspeaker.

POWER HANDLING

This is purely a function of durability, mostly thermal, sometimes mechanical. It is not a measure of efficiency or maximum loudness, as many seem to think. The maximum power handling capacity of KLS3 is determined by the HM210 bass unit, rated by Audax at 70watts, so that is what we recommend as a limit for the entire loudspeaker. The HM130CO will not see its rated maximum of 50watts and the HD3P also has plenty of spare capacity.

You can use an amplifier of any power, but if, say, it is rated at 100watts, don't run it flat out. Because KLS3 delivers 90dB SPL from 1watt, it will deliver around 110dB SPL from 70watts, which is very loud. Loudspeakers of this sensitivity in practice need no more than 60watts to suit most rooms and needs.

The Audax drive units are beautifully made and very tough. All the same, KLS3 Gold MkII is not a party machine and was not designed to generate continuous high sound-pressure levels
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AMERICAN TYPES

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TO EACH ORDER

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as a primary objective. If you listen very loud and find you blow loudspeakers, the best solution is to get a large multi-driver 'speaker from one of the major manufacturers, because the in-going electrical power and out-going acoustic power are spread over many drive units, lessening the load on each. Continuous high levels produce hearing damage, by the way, which in turn demands high levels - a vicious circle.

SOUND QUALITY

These modifications reduced a little chestiness that could sometimes be heard from the midrange unit, according to the effectiveness of the damping used in the midrange chamber. It also lessens cone excursion and Doppler distortion. Power handling is not really an issue, since the HM13000 can handle 50 watts.

The bass unit now works further into the audio band. It is coupled more tightly to the driving amplifier and its efficiency has increased markedly, since SPL output remains the same whilst the impedance seen by the amplifier has increased. This has improved bass quality. Be aware only that rear-wall damping behind the HM210CO now needs to be paid some attention to prevent a coloration from this source. It is easier to apply damping here than in the limited space of the midrange chamber, one reason the crossover was reconfigured.

The tweeter's contribution has been softened. I have always been in two minds about this, in subjective terms. It is necessary with most fabric-dome tweeters, which commonly sound coarse if extended up to 20kHz. With clean sounding ribbons like the Tonigen or the even more impressive HD3P used here, there's an option between total smoothness and apparent integration as given by the rolled-down response, and a pleasing shine and presence from a flat, extended response. Generally, the former sounds better initially but the latter is more engaging over a period, with some acclimatisation. The quality of the source will influence matters here too.

Otherwise, KLS3 remains big and easy sounding, with superb midrange clarity and projection - especially with vocals. Very few drivers can handle the human voice as well as Audax's HM130CO. The other strong feature of carbon fibre is that it possesses an innately sweet, amenable delivery. Couple this with the extraordinarily fast yet clean and sweet tweeter and you have a loudspeaker that is a delight to listen to. It is also technically better phase matched and has a flatter impedance than most commercial loudspeakers. It was once the most sensitive too (90dB SPL from one watt) but I'm glad to say that now this sort of sensitivity is becoming less rare.

NEXT MONTH: Port tuning KLS3 Gold MkII.

UPDATING KLS3 GOLD TO MKII STATUS

It is possible to insert the high-pass filter (C4, C5, R3) for the HM130CO, and the low-pass filter comprising L2, C3 for the HM210CO bass unit without making any other changes. The HM130CO low-pass section and HD3P mods apply to the latest version of the HD3P, identified by the absence of hex screws on the front.

An upgrade kit will be available by the time this is in print. Please phone/fax Nick Lucas at 0171 221 0691 for details.

UPGRADING KLS3 TO GOLD MKII STATUS

We will be offering kits for this purpose too. Again, phone/fax Nick Lucas at 0171 221 0691 for details.

We do not supply cabinets, but we do supply all drive units, special long-haired wool, wire, components as specified and input terminal dish.

We do not supply natural-fibre carpet felt though, because it has become impossible to get in quantity. Try a carpet fitter or carpet warehouse.

KLS3 Gold MkII is available as a kit from Hi-Fi World.

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Analog Electronics - Analog Circuitry Explained

by Ian Hickman

Reviewed by Haider Bahrani

ian Hickman is a man after my own heart. His expedition through the analogue jungle begins with a quote from the inventor of the smart card, Roland Mareno: "Digital is easy. Analog, that's professional." As a mainly 'professional' engineer, I certainly feel quite at home with this tome. The book, as you might surmise from the subtitle, is quite at home with this tome. The book, stretching the boundaries of its brief a little to cover time and frequency-domain analysis, introducing the reader with a baptism of hot solder to several forms of the graphical representation of circuits and systems. Responses such as pole-zero diagrams, Bode plots (gain and phase representation in the frequency domain) and circle diagrams are dealt with too. Not only is the reader given a crash course in lead and lag networks (phase delay and phase advance compensation networks) but resonant circuits are thrown in for good measure. The author has thankfully avoided a complete Bodal analysis (maths, maths and a little more maths).

Chapter Three takes us into active territory where valves, diodes, transistors, thyristors and op-amps are given the full monty. If you are not daunted by pages and pages of text written in a narrative fashion, then this chapter is a good way of brushing up and will suit the learner who has stamina and good concentration.

Chapter Four focuses on audio-frequency signals. It starts with basics like the gain of a single-ended Class A circuit and moves on to such things as amplifier efficiency, distortion, negative feedback, the Nyquist stability criterion and so on. There's a quick glance over loudspeakers and signal sources too, although the latter is given more comprehensive coverage in Chapter Nine.

The following three chapters are devoted to signal processing and transmission. The first of these deals with passive components. From telephone cables across the ocean to the connection between a CD player and an amplifier, the principles are the same and are well explained here. Capacitance, inductance and aspects of delay and filtration are brought into the frame.

Chapters Six and Seven tackle active signal processing in the frequency and time domains respectively. The former concentrates on the use of operational amplifiers in active filters of various kinds, including Chebychev, Butterworth and Sallen and Key.

Chapter Seven on the other hand is less concerned with frequency response than it is with wave shaping. In this section there is more than a little crossover into the digital domain, which, after all, uses a great deal of analogue circuitry to achieve its ambitions. A vast array of circuit types (those involved in common-mode rejection, noise shaping, integrators, constant-current sources and even low-frequency harmonic generators for putting the harmonics back into audio distortion) is examined. The only straying from the 'official' analogue field is in the interfacing of the digital domain with analogue circuitry, hence some light is shed on ADCs (Analogue to Digital Convertors) and DACs (Digital to analogue Convertors).

The eighth chapter of this book is devoted to radio-frequency circuits, the uses of which stretch far beyond its original brief of information transmission, and include cancer treatment, plastic bag sealing, frequency modulation, amplitude modulation, the super-heterodyne receiver, and those are just for starters. There is actually more coverage of correlated topics here than in most texts and it's more coherent too. Again there is a lot to read through with little opportunity to pause for mental breath.

Ian Hickman returns to signal sources in Chapter Nine. Voltage reference sources, sinusoidal and non-sinusoidal wave-form generators are looked at, as are noise generators and voltage-controlled oscillators. This is followed by a chapter on power supplies, stopping off to dwell on batteries, AC supplies, DC supplies and power converters.

The final chapter, 11, is given over to explaining some 'tricks of the trade'. These are partly theoretical and partly practical - all in all a very useful section.

Analog Electronics appeals to me greatly as a source of invaluable information, but my approach is from a position of familiarity with the subject. Refreshingly unconventional in its approach, this book is highly recommended for the serious electronics enthusiast.

Analog Electronics - Analog Circuitry Explained £19.99
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AUDIO ELECTRONICS
by John Linsley Hood

Reviewed by Noel Keywood.

I enjoy John Linsley Hood's writing and Audio Electronics proved no exception. It is as clear and forthright as The Art Of Linear Electronics, also by Hood, but aimed at a different need. Where the former is a bof-up for design engineers or anyone contemplating a bit of audio design work, Audio Electronics is a resume of the whole field. It seeks to provide background on all subjects, from tape recording through radio to Compact Disc. And who better to put them across; Hood has been designing, arguing and writing about audio all his life and his fluency in the subject shows.

One example of this is an easy writing style suffused with confidence, reminiscent of audio's greatest writer, M. G. Scroggie. Hood knows his stuff, like Scroggie, and having designed innumerable circuits for enthusiast consumption, also knows he knows - that's where the confidence comes from. The result is a book freer from obfuscation and technical gobbledygook than most. Witness Chapter 6: The Compact Disc And Digital Audio.

By the third page of this chapter (p235) Hood has reached the horrors of quantisation error produced by digital sampling and the coarse sounding noise it produces. Over the page he quickly identifies the need for no less than 1.4MHz of transmission bandwidth for a two-channel, 16-bit stereo signal that reaches just 20kHz. In other words, digital in this form needs 70 times more bandwidth than analogue, a little-known fact.

It is this ability to alight on crucial underlying principles that distinguishes Hood's writing from most others'. It comes across as lucid exposition free from the irritatingly naive, "Isn't digital wonderful" approach that always suggests to me the author is simply rewriting corporate product data, as so many do. There's no substitute for long-term, hands-on experience; it usefully illuminates Audio Electronics in a way that is becoming increasingly rare.

Chapter 6 on CD is short but succinct and probably one of the best introductions to digital I have read. This underlines the strength of Audio Electronics as an excellent introductory book. It covers a wide range of topics, although some are looking a bit peripheral to high-fidelity these days. Analogue tape recording occupies the first chapter, covering the basics as well as the arcane side of this subject, such as tape MOLs (Maximum Output Levels). A few pages at the end touch on digital recording systems, but not in any detail.

Tuners and radio receivers occupy the second chapter. There's plenty of information on modern synthesiser tuning systems using phase locked-loops and such like, but this chapter remains analogue, not touching DAB. The current view amongst many in audio is that because DAB offers little perceivable benefit over conventional VHF/FM it stands little chance of success, so this is perhaps not a consequential omission, but a few words would have been useful.

Hood is an amplifier specialist, so it is hardly surprising that Chapter 3, entitled Pre-amplifiers And Input Signals should be followed by Voltage Amplifiers And Controls and then Power Output Stages, all amplifier-related topics that together cover a fair expanse of paper.

Practising audio engineers have to get into Test Equipment. Measurement is a whole area of theory in itself, and a vital one, if tests are to clarify rather than confuse issues of performance. Audio Electronics moves its appeal toward engineers here though. I have seen more useful and illuminating explanations, as far as the average experimenter is concerned, about using multimeters and modern budget test equipment, than Hood's explanations of diode stabilising circuits and such like. There's a missed opportunity here, because modern test instruments, including computers, offer incredible ability at low cost compared to that available a decade ago. Only the oscilloscope, with its expensive CRT and power supplies defies this trend, but LCD displays are slowly becoming more common. It might have been better to devote more space to this topic, because there is a lot of important basic theory to be covered when measuring voltages, currents, inductors, capacitors and resistors, etc (as Scroggie well knew). In my view Hood wastes his talents by diving off into circuits here again.

Audio Electronics ends with a short chapter on loudspeaker crossovers, followed by power supplies. Neither are very comprehensive. The book has lost its focus by this stage and petered out. There's room for improvement in a second edition here. This apart, I found Audio Electronics strong in its coverage of audio theory and basic working principles, John Linsley Hood showing his talents and experience here.

Audio Electronics
ISBN: 0 7506 2181 8

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SIZE IS EVERYTHING
I am constantly amused by your references to such things as, "very sizeable 500VA" toroidal transformers (p13, Sept 1997). I thought that you'd like to see a really sizeable transformer. Its 90000000VA and supplies half of Norfolk with electricity. The voltage? 132000V stepped down to 33000V!

Nick Sheldon
Norwich.

TWEAKING TECHNIQUE
As an owner of the Technics SL-1000/MkII turntable and plinth combination featured in July’s Hi-Fi World second-hand feature, I was very interested in the power supply upgrade. Is there any possibility of supplying details of the modifications in the magazine?

David Fellows
Cheltenham, Glos.

There’s a lot that can be done with the SP-10MKIIIP (note the “P” suffix. These mods don’t apply to “A” suffix versions) motor unit and outboard power supply unit to improve their performance. One of the cheapest, swiftest and most effective mods is to fit the main ICs in the crystal oscillator section of the PSU with their own regulators. You don’t need to do this for all the chips, as beyond the five marked in diagram No1 there’s little or no improvement when extra regs are added.

You can get good results with regs like National Semiconductor’s LP2950C 5V regulator may be more expensive than standard 7805 ICs but it brings a higher level of performance for the extra outlay.

National Semiconductor’s LP2950C 5V regulator may be more expensive than standard 7805 ICs but it brings a higher level of performance for the extra outlay.

To fit the LP2950C you need to cut the tracks on the Technics’ PCB which supply +5V (see diagram No1) and then solder the output leg of the new reg directly onto it. Sanyo’s Os-Cons make excellent PSU decoupling caps and are available from Audio-Links (tel: 01724 870432). Don’t worry if you forget to cut one of the tracks, you’re unlikely to do any damage - the new reg will just work alongside the Technics’ own. In any case, the motor unit and PSU are fairly tolerant of wiring mistakes, unlike my Pioneer PD-91 CD player which recently went up in a puff of smoke.

The other areas ripe for regulation are the control and drive circuits within the base of the motor unit. Remove the unit’s bottom cover and you’ll see the control, drive and logic circuits in front of you. The drive board is numbered SFDP102-02A and carries the three pairs of drive transistors bolted onto a small aluminium heatsink.

The drive and control sections run from 32.5V DC supply provided by the main regulator in the PSU case. There is very little decoupling between stages in the motor unit. While the Technics’ original regulator is pretty good, the circuitry really benefits from separately regulated supply lines.

This part of the mod is a bit more complicated than the previous one and, if you forget to cut the right tracks on the PCB, you can end up with a platter that’s either gathering speed as it heads towards about 100rpm or hunting around left and right for the right way to rotate. Both are quite frightening to watch because the Technics’ high-torque motor can spin the 2.9kg platter extremely quickly.

LM317T positive variable voltage regulators work well in this application. Again, these can be bought from Maplin (prices vary with manufacturer, Samsung’s version retailing for 80p, order code: AV30H). As bypass and output decoupling caps on the IC’s adjust pin tantalum capacitors are a good
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choice. These are widely available in 35V ratings up to about 22uF. You can also try larger electrolytics, like

unit's cover and are actually easier to work with in this case than non-surface-mount types. And if you choose to opt for the modifications in place, the SL-1000/MkII produces a much more dynamic, involving and rhythmic sound than before.

National Semiconductor's LM317T regulators can be used to improve the performance of Technics' SP-10MkII direct drive motor unit.

National Semiconductor's LM317T regulators can be inserted at the points marked X to reduce interstage interference in the drive circuitry and improve sound.

Rubicon's YXB, at about 470μF.

The only other parts you'll need are a 180R 1% metal film resistor (R2) and a 5kohm variable resistor (R1) to trim the output voltage for each LM317T. Small surface-mount variable resistors fit easily under the motor LM317T in any other circuits, the output voltage can be calculated from:

\[ V_{\text{out}} = 1.25 \times \left( R1 + \frac{R2}{R2} \right) \]

where R2 is connected between pins 1 (adjust) and 2 (output) and R1 is connected from pin 1 to ground when the IC is viewed from above.

With these LM317T in any other circuits, the output voltage can be calculated from:

\[ V_{\text{out}} = 1.25 \times \left( R1 + \frac{R2}{R2} \right) \]

Background noise is also considerably lower, and there's a solidity, smoothness and definition to music which many belt-drive decks have a hard time emulating. And if you're using an arm like SME's Series V, sound staging is truly holographic, with a front-to-back depth you could almost step into.

RADFORD REVAMP

I read your article in the August issue on the Radfords with interest, having a SC22/STA25. Only one aspect of the design was sometimes considered inferior; the use of solid-state devices in the power supply instead of valves. Despite this I still think it is as good as or better than the Quad valve amp.

However, my STA25 needs a rebuild. Is there anyone who offers a kit of components for this purpose, as there was 10 years ago? I can't see any obvious ones in your ads. I am quite capable with a soldering iron and circuit diagram. Otherwise, as I have reservoir capacitor induced noise, can you suggest a source of suitable smoothing capacitor.
replacements? I think that other components are probably easily available from Maplin or similar suppliers.

By the way, mine runs with KT77s, rather than EL34s, which, on listening, I thought better. It’s quite possible that I was replacing old with new valves, or that I have cloth ears. Not that KT77s seem available nowadays.

Finally, can you give me the name of a supplier of your recommended (World favourites) Ortofon VMS-2E cartridge? I am overhauling a Thorens TD150 turntable for someone with a CD-only system, who is reluctant to spend money, and wants one to put in it. I am fed up with going into hi-fi shops of varying poshness and being treated like an amusing idiot when I ask for one.

By the way, the Thorens TD150 is a good boot-fair buy, at around £5 or less, though the standard arm is dubious. Do you have any tips, ideas or simple mods for the reservoir caps in Radford’s vintage STA25 power amp often fail and should be replaced with modern equivalents.

The STA25 uses a twin-section main reservoir capacitor of 100μF + 100μF at 500V which is very prone to failure. Following this is another 8μF 500V cap. These should be replaced with new electrolytics bypassed with 1μF and 0.1μF film caps. This will give you sound quality close to that you’d get from a polypropylene at a lower cost. Try Electromail (tel: 01536 204555) for these caps.

Henley Designs stock the entire Ortofon range of cartridges, with a brand new VMS-2E costing £13.95. You can contact them on tel: 01753 889949.

If you picked up a copy of the September issue you’ll have seen Haden Boardman’s recommendations on tweaking Thorens’ TD125. Replacing the TD125’s original rubber mat with either a glass mat or a cork one worked well and will do so on the TD150 too. You can also try the old stalwarts of damping the plinth and sub-chassis with car-body damping panels (check this won’t over-stretch the springs though). JM

TACKLING TRANSFORMERS
I write with reference to Mr Sirignano’s question about measuring the impedance of output transformers in Supplement No30, the August edition.

The output transformer is only an impedance-matching device. The anode load is designed valve amp working with modern loudspeakers of useful sensitivity, which are thankfully becoming increasingly common. This combination possesses the kind of powerful, seductive sound that rarely emanates from a solid-state amp. JM

SUGDEN SOUP-UP
I read with interest the article in the June ‘97 issue about Sugden amplifiers by Haden Boardman. I have owned a CSI/IAS combination for the last 25 years and while on a ‘speaker upgrade quest (to Castle Chesters) have had the opportunity to listen to a number of modern amps.

Although many were highly recommended and one was even in the £2000+ bracket, the Sugden compared very well. As stated in your article, the bass is weak - I find that a bit of bass boost (HORROR!!)

Finding out the impedance of an unmarked output transformer is easy with the advice above.
improves things. But this is still the area I wanted your advice on. Would it be possible or practical to replace the output capacitors with better-quality modern components?

My second question concerns my CD player which is an Aura CD-50. As you know the standard CD output is 2V and this is enough to drive the power amp directly without the help of a pre-amp. Can you give me a design using a minimum of components, say a volume pot, perhaps an Alps, and a few resistors to match impedances, or is this too simplistic?

Following your advice I have used Brasso on all the sockets - as you can imagine they were unbelievably dirty after 25 years. The difference was amazing! I've also put the amp as close to the speakers as possible and then bi-wired. Both these changes gave a better sound. My main source is a Rega Planer 3 with the original S-shaped tone-arm.

Mike Noble
Silksworth, Sunderland.

Audio-Links, tel: 01724 870432). With these mods in place your Sugden should sound superb. JM

BLAST FROM THE PAST
In response to Matt Rowland's letter published in Supplement No28 (April) about KT61 valves and the AS 1 power amp can sound impressive.

CD players are designed to be able to work into impedances as low as 10kohm so the Sugden C51's 50kohm impedance shouldn't be a problem for the Aura.

If you want to take your tweaking a level higher, replace the Sugden's volume potentiometer with a better one like Alps' Blue or Black ones (prices about £15.20 for the former and £27.60 for the latter from Point One Plus’ Pre-amplifier TL12 Power Amplifier

As the EL84 power pentode replaced the KT61, so the TL10 was phased out and the TL12+ introduced.

With a little tweaking to bring them up to date, Sugden's C51 pre-amp and AS1 power amp can sound impressive.

After 25 years' use the output caps on the power amp are likely to be in a real state - electrolytics aren't like wine, they don't improve with age. You could really push out the boat and go for a pair of Elna Cerafine caps which can be bought from either Maplin or Electromail.

These could then be bypassed with smaller value polypropylenes (say, one at about 10uF and one at 1uF for each Cerafine).

These should prove a massive improvement over the caps currently resident in your Sugden.

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Leak TL10 I've a little more information to add.

The TL10 is historically interesting, being an early example of a high-quality, commercial ultra-linear amp. In choosing the KT61 for the driver stage, Leak no doubt adjudged the superiority of the beam-power valve for audio. Uniquely, the service sheet does not give alternatives. Although details are given for modifications to allow use of the 6L6, and it is possible to use EL33, 6P25 and CV2938 as alternatives, as JM rightly says, they do not sound the same.

Reading between the lines, GEC must have been anxious to phase out the 'obsolescent' members of the KT range since the well-known 'Approach To Audio Frequency Amp Design' relegates KT61 to a brief mention whilst EL84, a miniaturised near-equivalent, is plugged unmercifully! Leak himself later produced the TL12+ amp which uses EL84 in an otherwise very similar circuit to the TL10.

What Matt’s enquiry really highlights is the growing difficulty in servicing equipment not 'dead-centre' in the mainstream of vintage audio. Looked at uncharitably, the suppliers seem to have no problems with components still manufactured or those so plentiful that you can practically find 'em in the nearest skip. But just try finding the 'rarities', once-common components made by the million - where have they all gone? I've rung many firms ostensibly catering for vintage needs and finished up doubting my own sanity! 5Mohm stereo pot? .. 600pF 5% caps? .. 100kohm volume-with-mains switch? .. KT61?? .. No mate, sorry!

While I accept the fact that large-scale manufacturers cannot be expected to slow their output for a handful of retro-thinking idiots, 'specialist' ought to imply a recognition that many very
worthy bits of equipment pre-date the preferred-value system that covers components. Such items might just be worth the odd limited-batch, premium-price production run. I can foresee this letter drawing a Righteously indignant response from the new SE class-A-only school; admittedly superb and it is new SE class-A only school; the end makers were side-tracked by Ultra-Linear working and whacking negative feedback as 'the way forward' all those years ago. They did, however, manage to produce some very charming sounding amps which are certainly well worth preserving.

As I listen to these old fossils of a vanished audio civilisation, I wonder if I and any other users should really be obliged to scramble for ever-dwindling supplies of KT61 and (for God's sake!) 57kohm resistors, not to mention pots with 3½/in. shafts. Perhaps I am insane! Be that as it may, I still don't want to compromise the gear for want of such a little thing as a non-preferred wire-wound!

(System: two Leak TL10s, Vari-slope stereo, Lenco L75... God! What a loony!) Richard White London.

A STEP UP

After many years of relying on the MM stage of my Hafler pre-amp and Lentek MC stage for amplification of an Audio Technica AT-F5 (now the last one of a batch bought cheaply when the model was discontinued) I bit the bullet and decided to have a go at building your disc pre-amp.

It has been constructed on a budget of less than £45 using components available from Maplins and the results are stunningly solid, with real attack and tonal colour to the music.

Fortunately the Hafer was designed to have its own optional internal MC stage with power supply capacity for it. Unfortunately it's +/-18V so the ICs used had to be able to withstand the higher supply voltage. I settled on the OP37 and OPA604 op amps, which, according to the Maplin catalogue, are capable of running off up to +/-20V and +/-24V rails.

The circuits were built on Maplin's plugboard YR87U, one per channel, and the whole housed in their aluminium extruded box YNS1F (there is no sign of any RF interference or hum). The circuit boards were laid out with the assistance of TurboCad.

Because of the greyness of the previous sound I had decided to rewire my Rega using van den Hul internal arm wiring, taking the opportunity to fit a socket at the base of the arm so that various leads could be plugged in. As a result of this the silver-plated copper leads from the arm were soldered direct to the PCB so as to have as few connections as possible.

On first powering up the phono stage its sound was fine but there seemed to be too much gain and at high levels there appeared to be overload. So R7 was replaced with 470 ohms to reduce gain through IC2 by about 12dB (there is still really too much gain for many cartridges) but it is quiet with no discernible hiss.

Thanks for an excellent project. I can now hear every instrumental line of my old Captain Beefheart LPs projected with superb clarity! My listening extends to Jazz and 20th-century Classical and the overall effect is much the same for all genres - the impact on the likes of Varese is stunning!

PS - The Hafler has an Alps volume control with improved socketry and capacitors and will probably soon be fitted with better switching!

L. Hopkins Billesley, Birmingham.

If you want to go beyond the standard Alps' blue and black potentiometers, there's a couple of options. The first is Panasonic's For Audio pot from Audio-Links (tel: 01724 870432) which sells for £64. Alternatively, AudioCom stock Danish Audio Contact's CT1 switched attenuator, which is built up from surface-mount resistors. We hope to review the CT1 within the next couple of months. JM

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