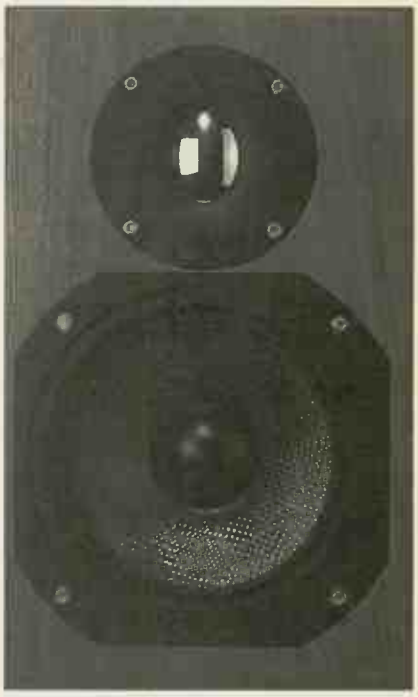
Hi-Fi WORLD

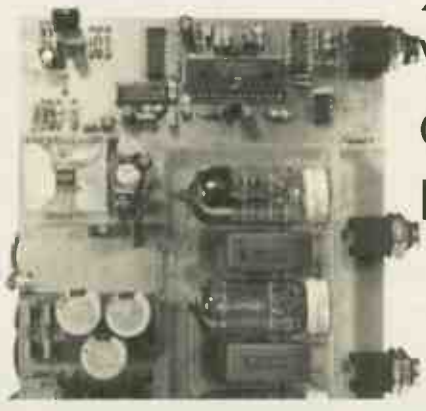
Hi-Fi WORLD

NO.37 JUNE 1998

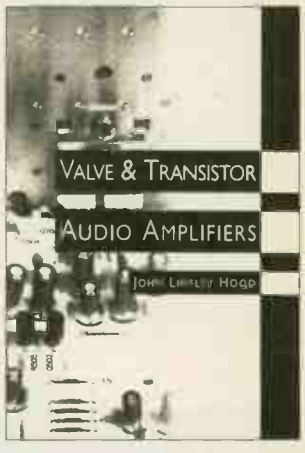
SUPPLEMENT

KLS10 HIGH-TECH MINI MONITOR WITH GOLD DOME





24-BIT DAC WITH VALVE OUTPUT STAGE, PART 2



DIY BOOK REVIEWS

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PRICE VALIDITY TO END MAY 1998 - ASK ABOUT ANY TYPES NOT ON THIS LIST

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D.I.Y. Supplement

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KIT NEWS

CROSSING OVER

In addition to the Two-Way Electronic Crossover (Maplin part number DR66W, designed for in-car use but suitable for home hi-fi) mentioned in some of our previous Supplements, Maplin stock more complex active crossovers.

If a three-way 'speaker is your idea of transducer heaven, then a three-channel crossover is called for. GK10L offers 12dB/octave roll-offs, each crossover point switchable from a choice of four different settings. Price is £46.99.

Another option is DR67X which is a five-way unit. This has more flexibility for adjusting crossover points, the ranges including 40Hz to 90Hz, 90Hz to 1kHz and 1kHz to 8kHz. Priced at £64.99, this crossover has a claimed 0.01% distortion and a signal-to-noise ratio of 100dB.

Maplin
PO Box 777
Rayleigh,
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SS6 8LU
Tel: 01702 554002

BOXING CLEVER

South Coast Speakers are offering a design service for budding loudspeaker builders. They can help with cabinet design by calculating the ideal enclosure volume, port size and length on reflex designs for your chosen drivers. The service costs £25 + VAT.

Also offered is crossover design, where given drive units can be matched to a suitable crossover, again for £25 +VAT. If the chosen driver does not have a spec sheet, or if a finished loudspeaker needs to be assessed with a measured performance, this can also be undertaken, with phase, impedance and Thiele/Small parameters calculated for £5-£10 + VAT.

Speaking of drivers, SCS are going to be selling a new line-up of mid/bass units and woofers from Canadian company Loudspeaker Research and Development. These eight new arrivals with their polymica cones all boast high power handling thanks to Kapton voice-coil formers and five vents behind the cone, which gives them their Max Pentivent name. Prices vary from £22 for the 4in. to £85 for the 250watt 12in.

South Coast Speakers
326 Portswood Road,
Southampton,
Hampshire
SO17 2DT
Tel: 01703 559312

WOUND UP

IT Electronics of Germany make a range of high-grade inductors wound with 99.99% High Conductivity Oxygen-Free Copper wire. Available exclusively from AudioCom, the air-core range are made in values from 0.10mH to 6.8mH, priced between £1.77 and £12.39 depending on value.

These air-cored coils are claimed to outperform both ferrite and regular air-cores due to their low-resistance, high-purity copper.

Another option for enhanced performance is the Corobar range, which uses an iron-dust core to maximise inductance with fewer turns, thus allowing for further reduced resistance. The Corobar come in values from 0.10mH to 12.0mH, priced between £7.24 and £19.84. For close tolerance applications or where unconventional values are required, specific inductances can be created in-house by winding down from the next highest value.

AudioCom are also stocking an upgrade kit for use on most CD players - the Superclock module. This smart little device enhances the player's in-built crystal-oscillator clock with precision high-grade components, all neatly encapsulated within a black box. Relatively simple to fit, the basic kit costs £145, or there's a deluxe version with

pure silver hook-up wire at £155. For the soldering iron-shy, the deluxe can be fitted for £185 inclusive.

We hope to be testing both Superclock and HC-OFC inductors in forthcoming supplements.

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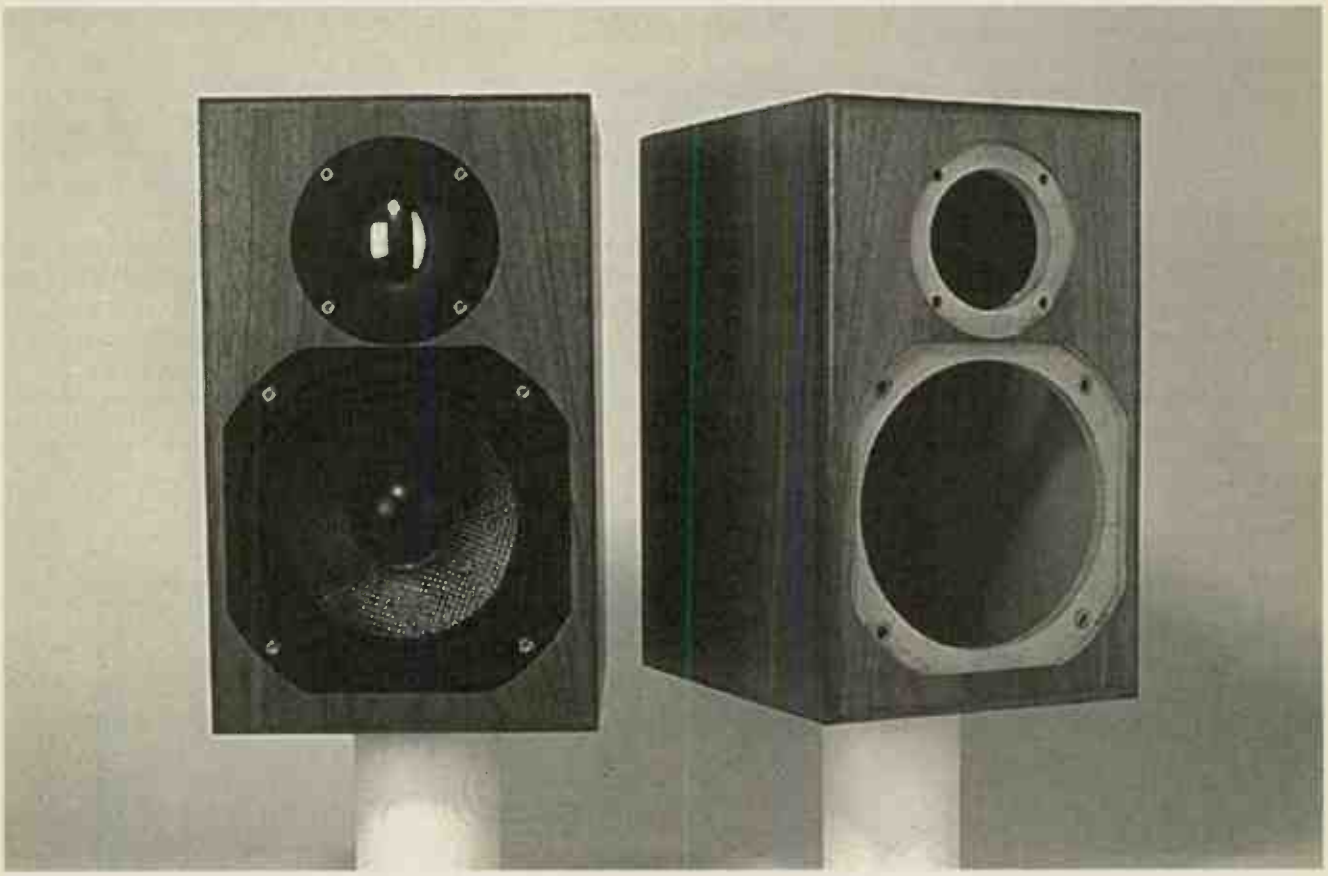
KLS10 GOLD

A high-performance mini-monitor based on our popular KLS3 Gold MkII floorstander. It uses the unique Audax piezo-electric gold dome tweeter. Noel Keywood on the FFT, assisted by designer Gary Holland.



Our KLS3 Gold MkII kit loudspeaker has been popular - people like the idea behind it. But not everyone can accommodate a big floor stander in their home. "What we want", many readers have said, "is a mini version". So here it is: KLS10.

KLS3 was originally conceived to give the classic advantages of a three-way, brought up to date with modern, high-technology drivers. I placed emphasis on midrange clarity and projection because there's no doubt that a loudspeaker able to project clean, cohesive and strongly embodied images of singers and instruments into the room, a few feet in front of the loudspeaker, is captivating to listen to. The superb carbon-fibre-cone Audax HM130CO midrange unit achieves this with some ease, sounding smooth and free from raggedness. That's because the small, light, stiff cone reaches up high before its response starts to roll off, covering the human vocal range using a well-controlled area of cone behaviour.

Small cabinet dimensions in themselves make for good imaging, so even before considering engineering details, I expected KLS10 to be good in this area. Just bear in mind though that counterbalancing this is the fact that compact monitors are space savers designed for use close to a rear wall, or perhaps on a shelf. Both positions degrade imaging a little so there is an inevitable compromise here.

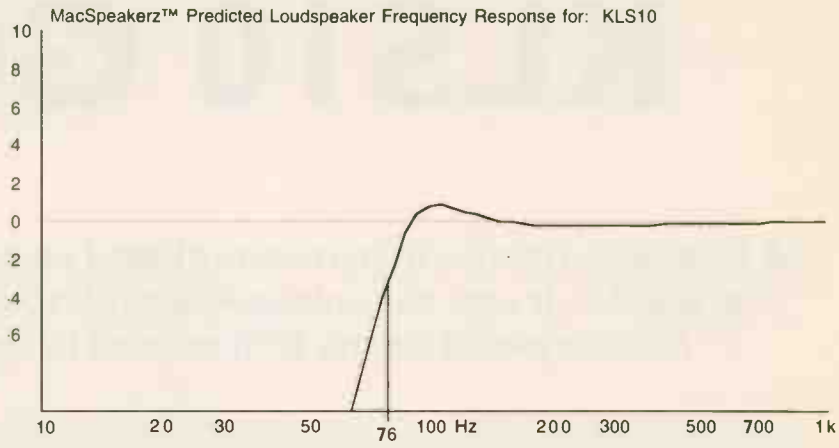
To retain the sense of relaxed clarity the carbon-fibre cones of KLS3 provide, I chose to use Audax's carbon-fibre HM170CO. This is a 170mm (6.5in.) unit with enough cone area to generate good bass without excessive cone excursion and distortion. Otherwise it is similar to KLS3's smaller midrange driver, displaying the same excellent midrange clarity. There is, too, an absence of hardness or coarseness that comes from paper cones, or the slightly bland and occasionally quacky sound that arises if a better-damped plastic cone is used. Carbon fibre exhibits the strengths of both without falling prey to the weaknesses of either. So

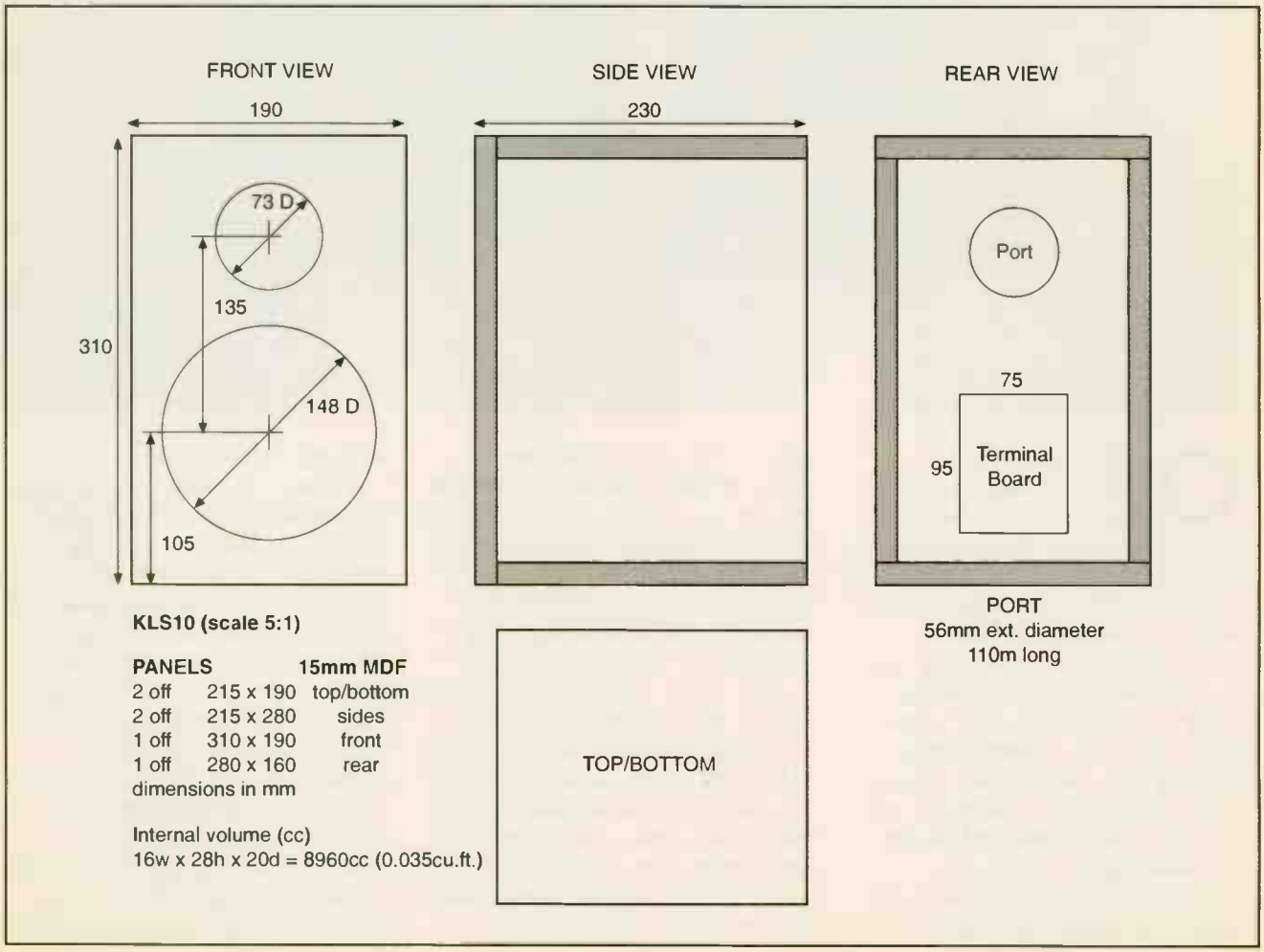
the HM170CO is used as a mid/bass drive unit in KLS10 in order to provide similar properties to the dedicated midrange driver of KLS3.

A loudspeaker as compact as KLS10 cannot go as low in its bass reproduction as KLS3, but by using a 'speaker like this close to a wall (1ft or so away) it provides fast, punchy bass. A generation of Linn Kan owners got hooked on speedy bass, which you get by eliminating low bass whilst boosting the 'punch' region from 60Hz-100Hz. That's what KLS10 offers. It turned out to be a speed king, much as expected, by our choice of a slightly under-damped Chebychev alignment for its bass loading. This imparts a good sense of bass enthusiasm, or willingness to play a tune, without one-noting. As it's a reflex, constructors can tune port length to suit their room and their own tastes, or even put wool/foam in the ports to damp the bass down by moving toward infinite-baffle operation.

All the same, some prefer seismic bass and for this minis are best paired with a subwoofer, since it can be made reasonably compact. We're only at the head-scratching stage with this one, but it would likely comprise a single, large twin-coil bass driver in a reflex cabinet. Because the Audax carbon-fibre range use 8Ω voice coils it could run in parallel with KLS10s without becoming an excessive load for an amplifier.

To retain the essence of KLS3 Gold MkII we had to retain the unique Audax HD3P piezo-electric tweeter in KLS10. It's so expensive few manufacturers can afford to use it, but this tweeter is arguably the best in the world today. Apart from being technically impressive in all areas, it has the rare but invaluable property of sweetness. I have yet to meet anyone who didn't like it and loudspeaker engineers in particular - a hard group to please - all praise the HD3P. Its appeal seems to be universal, about the strongest endorsement you can get for





KLS10 (scale 5:1)

PANELS		15mm MDF
2 off	215 x 190	top/bottom
2 off	215 x 280	sides
1 off	310 x 190	front
1 off	280 x 160	rear

dimensions in mm

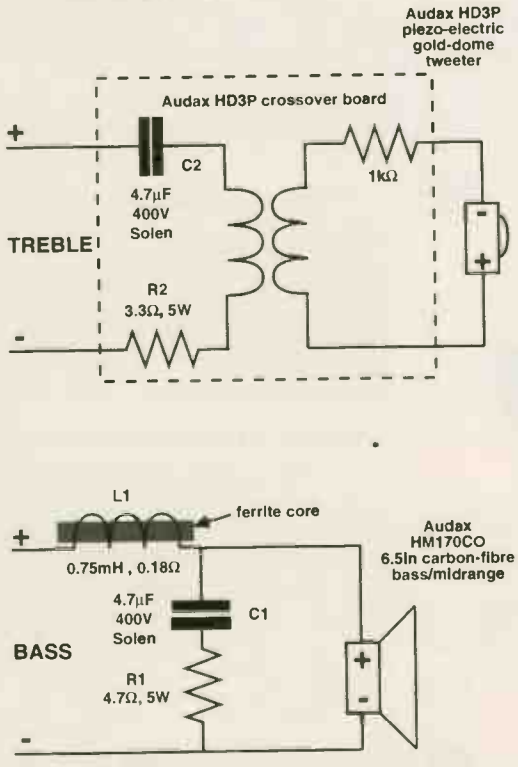
Internal volume (cc)
16w x 28h x 20d = 8960cc (0.035cu.ft.)

any hi-fi product.

Take it for granted that the HD3P produces great treble: clear, highly detailed, incisive in a pleasant way - not cutting. Even the great Tonigen ribbon tweeter (no longer available) has to bow to the HD3P, since the latter is sweeter and has better dispersion. It reaches down further too, working from 4.5kHz up to 20kHz. The Tonigen worked from 6kHz up to 20kHz so it had to be used with a high-performance midrange unit in a three-way arrangement - few and far between these days for reasons of cost (a cheap three-way is not worth having - see my column this month).

Here again you can see how trade-offs and price (ie performance) enter the scheme of things. With cheap mid/basses you can opt for a well-damped synthetic cone that should be rolled off by the crossover at around 3kHz to avoid quack from break-up modes. Try and integrate this with the HD3P and you will get a midrange dip that will introduce softness to the sound and loss of detail. It's not a bad solution, but not ideal. A lightweight paper cone will go higher but they can get really nasty at high-ish volume levels. Both types of driver are relatively inexpensive and low-tech nowadays.

KLS 10 CROSSOVER



For a few dollars more you can get a good, modern synthetic cone which exhibits greater consistency and better damping. Manufacturers are slowly moving to Audax's High Definition Aerogel (HDA), used in our KLS9 for example. Others are now turning to carbon fibre. So a loudspeaker like KLS10 gets you into the high-performance picture easily and at little cost.

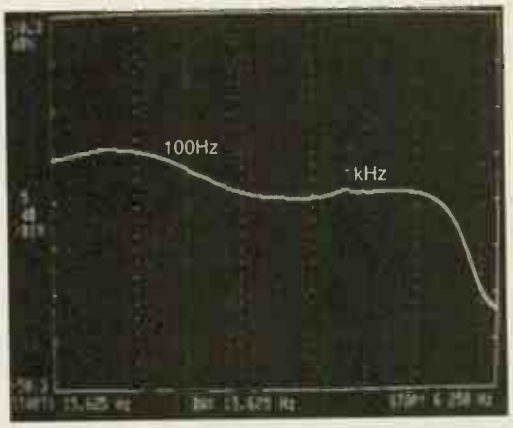
CABINET

From the above you can see how I chose drive units for KLS10. This process is crucial, because you can't hope to produce a high-quality loudspeaker by using cheap drivers. No amount of sophisticated engineering can compensate and I have to say that this penny-pinching approach hampers a lot of commercial loudspeakers, which use drivers costing just a few pounds.

We do not stray away from Audax's best for our kits and this has served us well by giving constructors a pleasant surprise for their efforts. But of course you can mess things up by putting good drivers into a poorly-engineered system. This is where experience comes in, plus our superb Fast Fourier Transform analyser, which can measure all aspects of loudspeaker behaviour in real-time - a killer development tool.

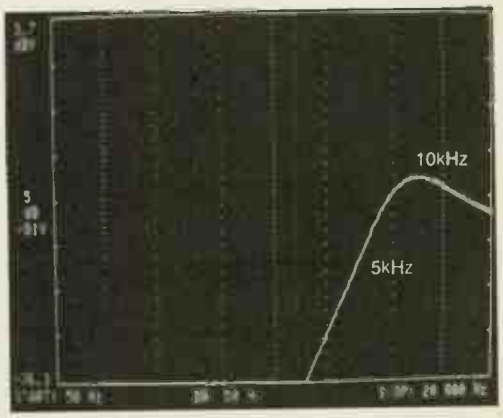
Sorting out box volume is, these days, just a matter of plugging Thiele-Small parameters into a computer programme. That's what I did for the HM170CO, built the box and found it didn't measure as predicted. Rats.

Box optimisation is time consuming and also where experience is needed to avoid insidious problems. Smelling a



Filter response of the low pass section feeding the bass/midrange unit, showing gentle low frequency lift response shaping.

hidden problem I contacted freelance designer Gary Holland. I'm not especially keen on using outside 'experts', because too often they are far from that, but having measured some of Gary's designs and heard praise for his abilities I asked him to sort this problem, because my time



Filter response of the high pass section feeding the tweeter, showing very rapid attenuation below 5kHz.

allocation had run out. He has done an excellent job.

It turned out Audax had changed the HM170CO's properties. Gary re-measured the Thiele-Small parameters, plugged them into the computer and - bingo! - we had a box volume of 8 litres. I decided to increase this to 9 litres on the grounds that you can easily reduce volume by putting anything from a block of wood, wooden cabinet braces or even a brick inside. but you cannot increase volume. Since a 9-litre cabinet is not unduly large the increase carries no penalty.

A 9-litre cabinet peaks up around 90Hz by 2dB or so and this is a bit much. You will get plenty of bass but it is likely to be

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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 01455 286603, speak to Shaun or Terry.

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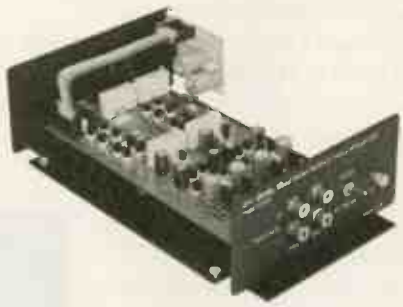
SHUNT FEEDBACK PICKUP PREAMPLIFIER



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Max. Music Power	300W
Impedance	4Ω
Freq. Response	29 - 30,000Hz.
Crossover Frequency	450Hz, 3KHz
Mean Sound Pressure	88dB
Box Volume	100Ltr. & 7Ltr.
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Width	300mm
Depth	360mm

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W200S 20cm. Long Throw Drive unit.
Part No. 9030 . . . . . **£36.68**

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An alternative design by David Purton, from his little "Coupled Cavity Handbook", using the same drive unit but requiring a bit more woodworking skill as the speaker is set on a baffle in the middle of the box. The total box size is even smaller than the ASM T20 at only 418 mm high, 303 mm wide, and 344 mm long.
Construction Drawing. **£1.50**

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This program aids the design of bass enclosures by allowing you to model how a speaker will sound in a variety of boxes and then modelling the maximum loudness of the speaker/box combination. It then helps to calculate the dimensions of the box and port, if vented. Needs Windows 3.1+, DOS 5.0+, 386 or better, 4MB RAM and 44MB hard disk space. With easy-to-use printed manual. Shipping Wt. 450g
SOF-BAS **£87.50**

BASS HORN DESIGN. A.L.Senson.
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a bit one-note. All the same, there's nowt like taste; some might prefer it like this. With the box as dimensioned you at least get this option, and I know from readers' letters that most like to have the opportunity to experiment. I would suggest a block of wood, up to 1000 cubic centimetres in volume, glued inside onto the cabinet's base, will reduce bass output and improve bass damping to the right level. Bear in mind that the HM170CO and the crossover intrude into the basic box volume, so a little less than 1000cc will be best.

Readers often ask if they can re-proportion our cabinets to suit their own requirements. The answer is yes, within certain limitations. The length/depth/height dimensions must not only all be different, they must also not be multiples or sub-multiples of each other. Get this wrong and standing waves will produce box honk.

Furthermore, the box should be kept deep so that energy reflected off the rear wall is attenuated by distance. Otherwise this energy will disturb frequency response and also be heard as a coloration, since reflected sound from the rear wall passes out through the cone.

We still use MDF for our boxes, and 15mm MDF (or thereabouts) is thick enough. Because there is concern about the dust being carcinogenic, and the glue exuding formaldehyde fumes, some constructors prefer block board or solid hardwood these days. I opt to use a face mask when cutting MDF.

Use Evode Resin W glue to hold the panels together. DIY shops are often able to cut panels, leaving you to glue them together and do the finishing work. Look for a cabinet maker to do all this if you want top-quality veneering. Routed-in hardwood edges are a nice touch, especially if they have a radius on them. Radiusing the edges also improves stereo imaging. The drive units can be inset into the front panel too, which also improves imaging. Again a router is handy. The idea is to avoid sharp edges and discontinuities, which improves high frequency dispersion, providing more assured images.

The way the panels fit together is not critical. We arrange it to a common pattern where panel seams are only visible on the sides. You can glue in the back panel, or screw it in against battens. The HM170CO cut-out is big enough to allow front access if the rear is glued.

Reflex loudspeakers must not be over-filled with wool, since this influences port behaviour. It is best to line the cabinet walls with thick natural carpet felt or Deflex panels and leave it at that.

CROSSOVER

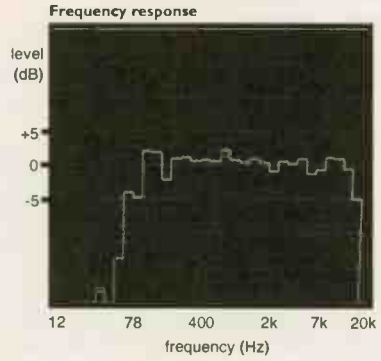
The crossover is relatively simple, because the HD3P tweeter comes with its own high-pass crossover network attached to a small circuit board. The basic tweeter unit behaves like a capacitor, because signal is applied to front and rear gold conducting layers, which are plated onto a piezo electric film which forms the dome. It takes this form under pressure from a gas chamber behind it. There is no voice coil or magnet. As a result the diaphragm is twenty times lighter than the dome of a conventional tweeter, giving it the ability to accelerate rapidly and so reproduce high-frequency signals faithfully.

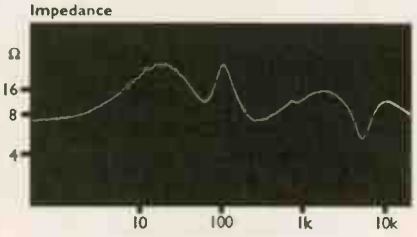
It flexes under piezo-electric forces generated by the applied voltage from a small step-up transformer that is supplied with the tweeter on the circuit board.

Note that the phase of this assembly is reversed in KLS10. You can connect the positive input wire to the negative side of

MEASURED PERFORMANCE

The art of a good loudspeaker is to balance all parameters and make sure that they all reach a high standard. It's easy to get flat frequency response, for example, if you ignore a loudspeaker's impedance characteristics, since filters can lift or attenuate response anywhere needed, by drawing more or less energy from a constant voltage source (conventional solid-state amplifier). But then the amplifier has to deal with a difficult load. We aim to avoid this sort of thing.





KLS10 has the sort of flat frequency response we like to achieve, one which is generally accepted as popular. It has a little lift at low frequencies to ensure good body and warmth to the sound. The tweeter is set flat with the crossover as shown. Its level can be adjusted though, by resistor R2.

An important feature of KLS10 is its lack of a dip in the crossover region. This ensures it will deliver good amounts of detail. Because the HD3P does not reach down as far as conventional tweeters this is a potential problem with any application and, doubtless, another reason the HD3P is not in common commercial usage. Partnering it with a high-performance carbon-fibre driver is the key to success here.

Bass output reaches down to 80Hz, the port suppressing forward output below this frequency. It is tuned, here, to 60Hz, meaning rear port output is at 60Hz, effectively extending frequency response downward to 50Hz or so. The loudspeaker is designed to be used close to a rear wall, toed-in to face listeners. Positioning will affect both the amplitude and phase of port energy reflected from a rear wall and should be optimised by experiment. Room conditions are so varied it is impossible to say precisely what will work best, but a foot or two in front of a wall usually offers a good compromise between imaging and bass boost.

The loudspeaker is extremely sensitive for a miniature, producing 89dB SPL from a nominal watt of input (2.84V). Having a high overall impedance of 10ohms, KLS10 draws little current from an amplifier and is a light load. The volume control will need to be kept down a bit.

This is the basic target performance of KLS10. As I mentioned earlier constructors expect to tune to taste, so I am going to cover this topic, which requires some space, next month in a concluding feature. NK

the board, or alternatively just reverse-connect the tweeter unit, since it is electrically symmetrical.

The HM170CO mid/bass is fed from a simple second-order, low-pass filter. Having good sensitivity, KLS10 does not need a lot of power, so a ferrite-cored inductor is used to keep DCR low at just 0.18Ω, to improve electrical damping. The capacitor is a high-quality audio-grade Solen polypropylene type.

The crossover can be built on a tag board or a piece of hardboard. Because signal currents are high it is not a good idea to use a printed circuit board with thin tracks. Commercial loudspeakers use them only for speed and ease of assembly. Components should be glued down and connected together with copper wire.

The crossover can be screwed or glued anywhere inside the cabinet, the base board being most convenient. It is better practice to mount the crossover externally to lessen vibration on the components. It can be housed in a plastic case and screwed onto the rear panel, or even kept separate. If you want to go the whole hog, the crossover can be positioned close to the amplifier and the bass and treble cables run independently. It is usual, when doing this, to use silver-plated single-strand for the tweeter and heavier multi-strand for the bass, but of course you are free to experiment.

KLS10 Gold PARTS LIST (per loudspeaker)

Drivers	
Bass/midrange	Audax HM170CO 170mm carbon fibre cone/cast chassis
Treble	Audax HD-3P piezo-electric gold dome tweeter
Crossover	
L1	0.75mH, 0.18Ω, ferrite cored, 1mm wire
C1	4.7µF, Solen (400V)
C2	4.7µF, Solen (400V)
R1	4.7Ω resistor, 5W
R2	3.3Ω resistor, 5W
Hardware	
Input	bi-wire input terminal panel
Damping	a little long haired wool (0.5 lb)
Port	55mm diameter, 110mm long
Wire	PTFE silver plated copper

POWER HANDLING

The power handling of a loudspeaker is not a measure of how loud it will go. It is solely the maximum power it will take before suffering damage, thermal from the voice coil overheating or mechanical from the cone hitting its end stops hard. I mention this because many believe power rating is all-important; it is not. Sensitivity must be taken into account as well.

The maximum power KLS10 can handle is the rated power of the HM170CO, which Audax quote as 60watts. Since it has a Kapton voice-coil former I imagine this is fairly conservative, but all the same it is best to be safe. You can use a more powerful amplifier: how much power goes into the loudspeaker depends solely upon how loud you go. Because KLS10 is sensitive and high in impedance it does not draw much current and, therefore, power. Nor does it need much. It produces a loud 89dB SPL from 1watt, so will produce 108dB SPL at one metre from 60watts, which is pretty loud.

TUNING

KLS10 can be tuned in a variety of ways. Tweeter level can be varied by adjusting R2 to give a bright or soft sound. As set the 'speaker measures flat and is technically correct. However, those with hearing loss may well prefer a brighter sound (lower value of R2), whilst others with better hearing and a small, lightly-furnished room may prefer less treble energy (increase the value of R2).

The port can be tuned for frequency by adjusting its length. It is currently set at 60Hz. Increasing length will lower this. When port frequency exactly coincides with the bass unit's resonance, maximum acoustic and electrical damping on the cone will be applied, something I will discuss next month.

If you make a 9-litre 'oversized' cabinet, decreasing volume to 8 litres by putting wood inside will progressively lessen bass output and increase bass damping.

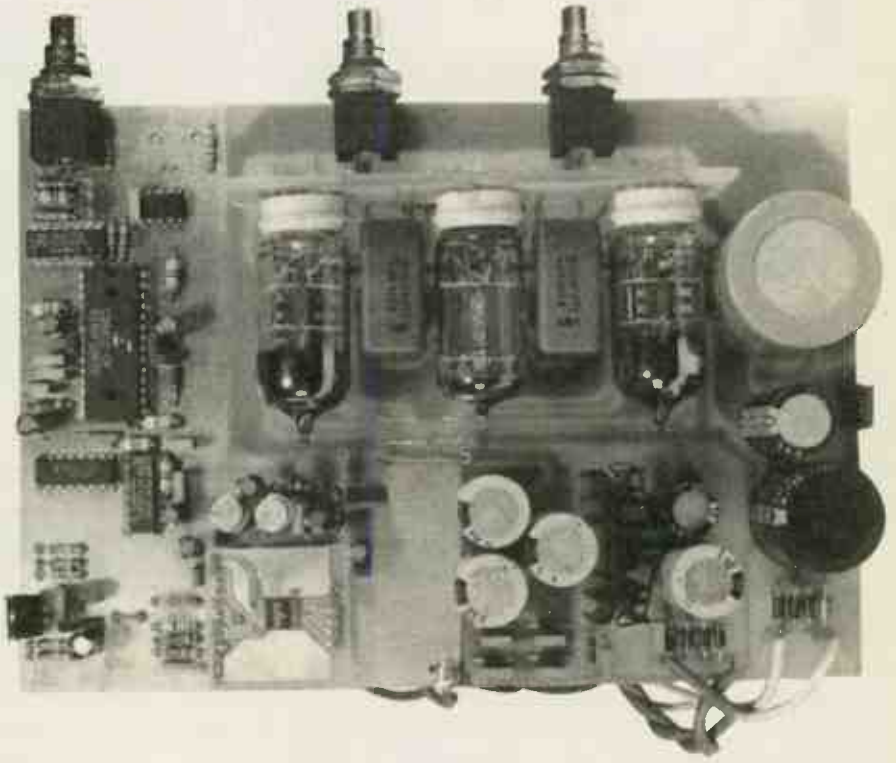
Finally, various absorbents can be used to line and fill the cabinet. We will discuss these tuning techniques next month

AUGUST ISSUE

We will conclude this feature in the August issue DIY Supplement with details of port tuning, tweeter level adjustment, internal damping and related sound quality.

CRYSTAL CLEAR II

In April's DIY Supplement, Chris Found detailed the design of a 24-bit 44.1kHz DAC with a valve output stage. This month he explains how you can actually build the convertor.



The whole main unit is built on three printed circuit boards - the mother board, the valve output stage and the DAC module. Silk screening with component numbers is a good idea as any mistakes in component placement can be easily seen.

Everything except the mains transformers, power switch, IEC mains socket and input selection switch is placed on the motherboard. The digital inputs and audio outputs are PCB-mounted, as is the input selector switch. This allows for easy voltage testing outside of the case, if necessary, and providing that care is taken not to touch the high-voltage stages, there should be no real problems.

There's a specific sequence for building the main board which ensures that small components can be held properly in their position while soldering and reduces the number of cosmetic touch-ups that might be necessary later.

First to go on the board are the resistors, starting with the small 1/6watters in the digital section before moving on to the large resistor in the power supply. Next come the rectifier diodes in the PSU, whose correct orientation is vital - make sure you check this carefully.

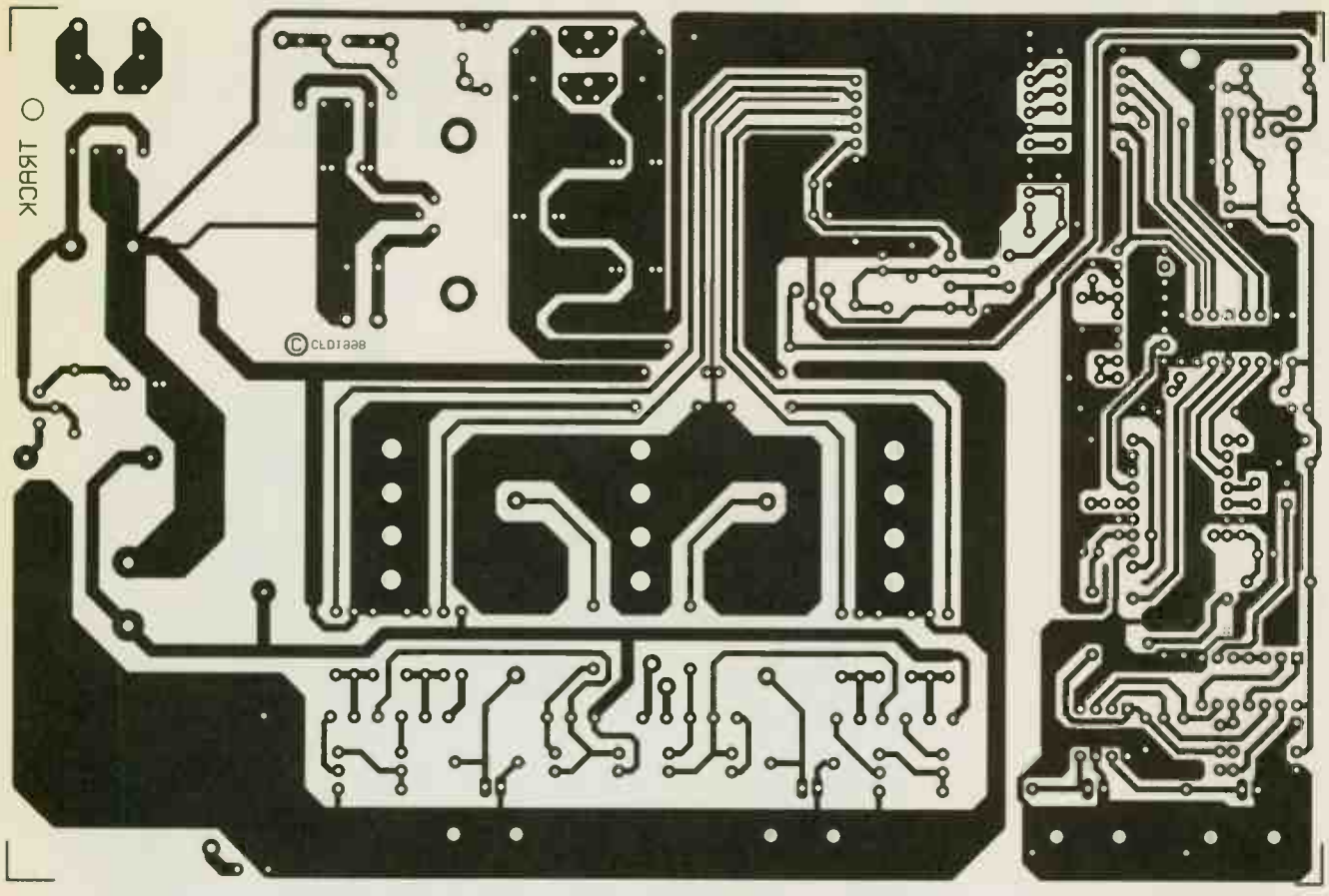
All of these components except the large resistor have a 10mm pitch, so they can be folded in one go. When you mount these parts, bend the leads that protrude on the lower track side of the board slightly to hold the component in position while it is being soldered and so avoid burnt fingers. This technique allows more than one component to be soldered at a time and greatly reduces build time. Just double-check each component's location as you put it onto the board.

Once the resistors have been soldered in place, the integrated circuits can be mounted. Again, diligent checking is a must here - make sure the orientation of each device is correct and confirm that all of the pins have gone through the board before soldering each IC individually. You will find that the ICs' legs are pushed out at a slight angle; these can be easily straightened with care.

Then it's the turn of the rest of the small components - polyester capacitors, T05 and the tiny ZTX transistors. Try not to push the transistors down too far, otherwise the legs could bend apart further than intended.

Once that's finished, fit the larger components, observing the polarity of electrolytic capacitors where necessary. Finally, solder the valve bases onto their PCB before mounting it on the motherboard and connecting the wires for the heater supplies.

Once the boards are connected together and the



The underside of the main PCB is reproduced here at 75% of full size. It can be blown up to 100% on a photocopier.

transformers wired up, you can now run a series of basic tests on the PCBs. However, DO NOT fit the DAC module yet.

The initial testing of the DAC is done after one last check that all the components are in the right places. This is very important as a mistake could damage some of the parts and cost a substantial amount of money to put right. To test the unit you will need either an analogue or digital voltmeter.

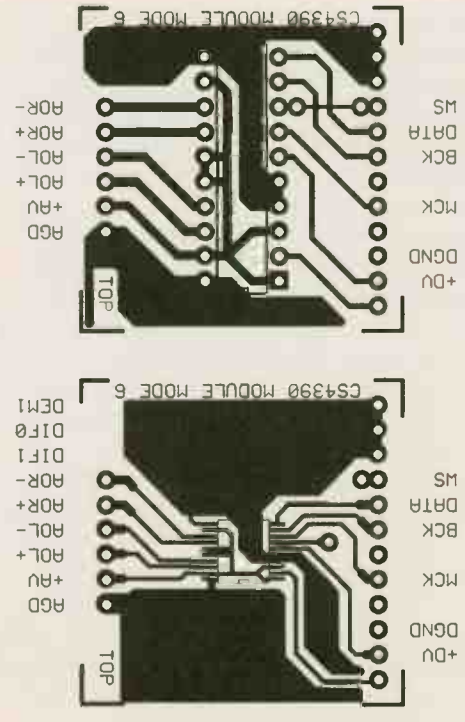
When you are satisfied that the boards are correct, apply power to the unit. Give it some time to warm up while you look and smell for any strange happenings. After a few minutes you can begin taking measurements to confirm you have built the DAC correctly.

Start by setting the voltmeter to a range of 20VDC to 30V DC and testing the digital power supply and its regulation. There should be 5VDC +/- 0.3V on the left side of L1. For a ground point use one of the digital input sockets' outer rings. Simply clip a ground wire terminated with a crocodile clip onto this.

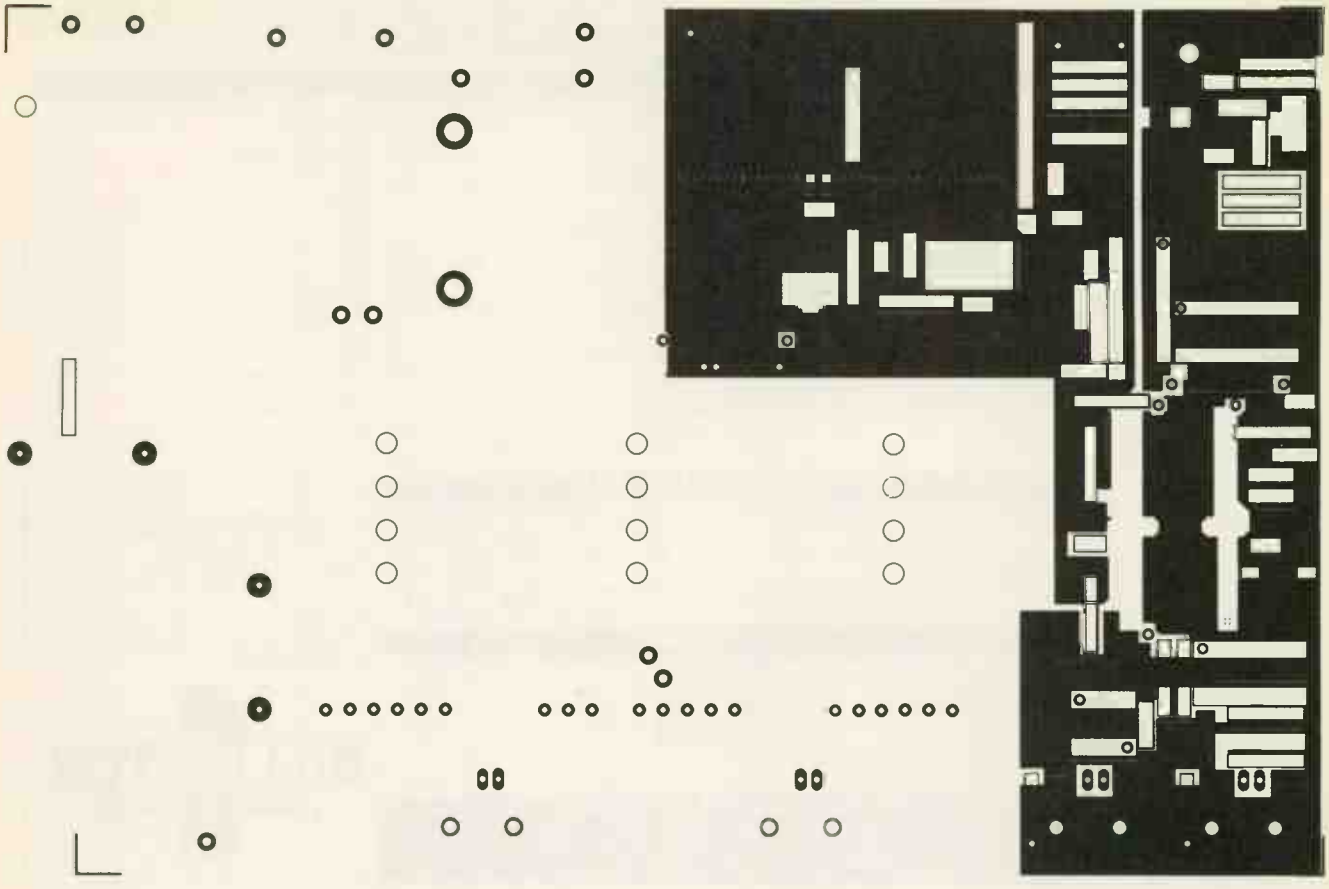
If these voltages are correct, test the supply rail to the DAC module on one of the cans of the 2N2219 transistors, where there should be 12VDC. On the top of R34 there should be 5.6VDC +/- 0.3V.

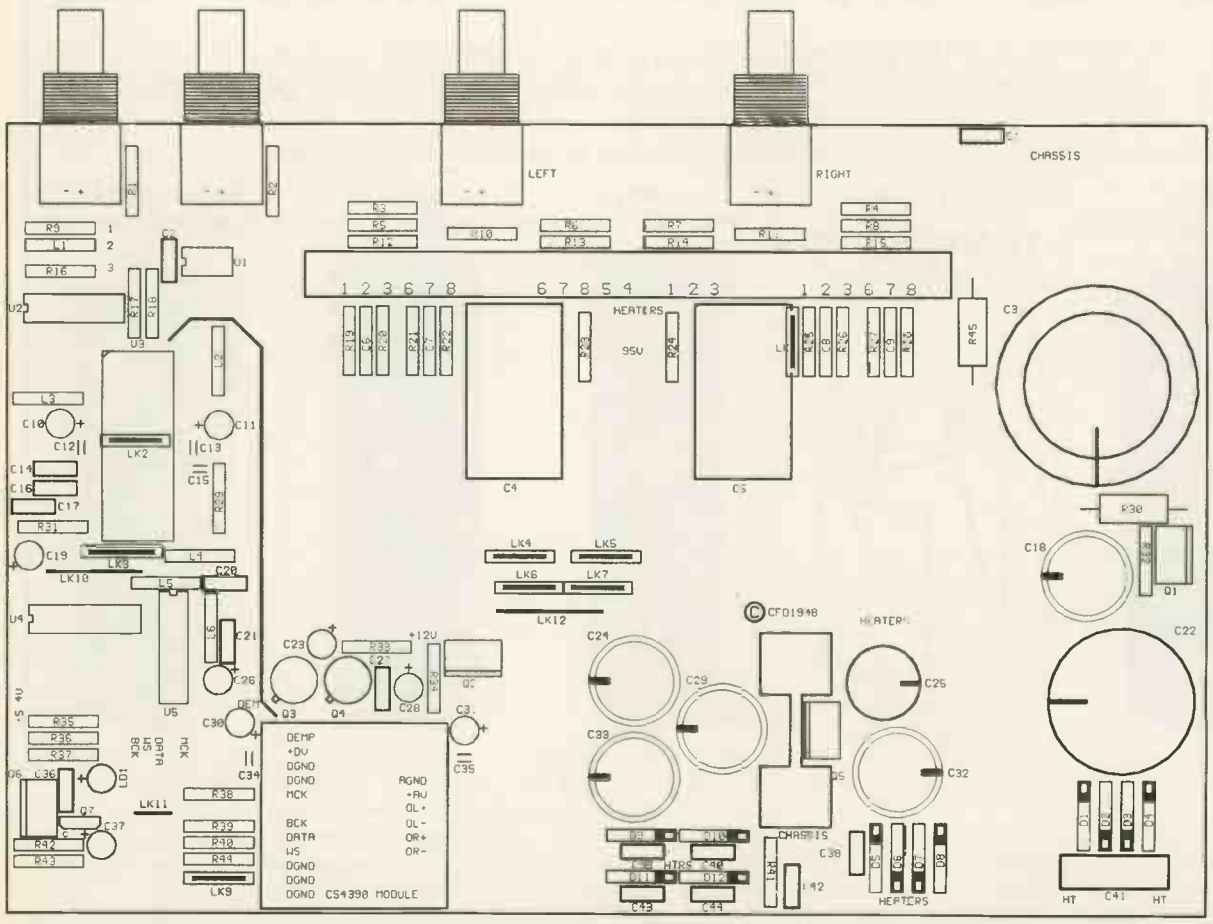
The following step are the valves' heaters. As these heaters are floating until all three valves are placed in their holders, you need to check at the heater pins near C25 and the large heatsink at the front of the motherboard. Place the black probe on the pin soldered to the same track as C25's negative terminal and the red probe on the other pin, which should give you a 12VDC reading.

Now you have checked the main supply voltages and nothing has blown up, you can safely assume that the board is built correctly. All that's left to do after the unit has fully cooled down is mount the DAC module and the valves and begin listening to all your favourite CDs through your new convertor.



The two PCBs to the right include one (top) for the non-surface-mount version of the DAC chip and one (bottom) for the smaller SM type. These are printed here at full size.





Above is the layout for the upper side of the main PCB. Below is the component positioning diagram which can be silk-screened onto the PCB to aid construction. Both are at 75% of full size.

COMPONENTS LIST

Resistors
(all 1/6W, metal film unless otherwise specified)

R38 22R 1off

R39 33R 1off

R40,R44 47R 2off

R1,R2 75R 2off

R37 220R 1off

R23,R24 820R 2off

R29 1k 1off

R34 2k 1off

R13, R14, R3, R4
2k2 2off

R12, R15, R5, R8, R33
2k4 5off

R16, R17, R18, R35, R42, R43, R9, R36,R19,R22,R25,R28
3k3 12off

R6,R7 10k 2off

R30 15k (1W Metal Oxide) 1off

R20,R21,R26,R27
22k 4off

R31 39k 1off

R32 56k 1off

R10, R11 100k 2off

R45 100k (1W Metal Oxide)1off

Capacitors

C6, C7, C8, C94
Axial Polystyrene 470pF 160V 4off

C12,C13
2.5mm 22nF Polyester 63V WIMA 2off

C14,C16,C17,C2,C20,C21,C27,C36,C1,C38,C39,C40 C42,C43,C44
5mm 22nF Polyester 63V 15off

C15,C34,C35
2.5mm 47nF Polyester 63V WIMA 3off

C41
10mm 0.1uF Polyester 400V 1off

C4,C5
2.2uF Polypropylene 400V 2off

C10,C11,C19,C26,C30,C31
10uF Low ESR Electrolytic 50V 6off

C18 33uF Electrolytic 350V 1off

C23,C28,C37
47uF Electrolytic 25V 3off

C22
100uF Electrolytic 400V 1off

C3
220uF Electrolytic 400V 1off

C25
1000uF Electrolytic 35V 1off

C24,C29,C32,C33
3300uF Electrolytic 25V 4off

INDUCTORS

L1,L2,L3,L4,L5,L6 Axial 470uH

SEMICONDUCTORS

D10,D11,D12,D5,D6,D7,D8,D9
1N4002 8off

Dl,D2,D3,D4
1N4007 4off

U1 DIL 8 UA9637A 1off
U2 DIL 14 74HC00 1off
U5 DIL 16 74HC153 1off
U4 DIL 16 74HC173 1off
U3 DIL 28 CS8412G 1off
U6 CS4390 DAC Module 1off
Q1 TO220 TIP50 1off
Q2 TO220 7812 1Amp 1off
Q3,Q4 TO5 2N2219 2off
Q5 TO220 78S12 1off
Q6 TO220 TIP29 1off
Q7 Zetec ZTX653 1off
LD1 5mm Green Led 1off

VALVES

V1,V3 B9A 6922 2off
V2 B9A ECC82 1off

MISCELLANEOUS

LK1,LK2,LK3,LK4,LK5,LK6,LK7,LK8,LK9
10mm links 9off

CN1,CN2,CN3
Black PCB-mount RCA sockets 3off

CN4
Red PCB-mount RCA socket 1off
HS1 25mm Heatsink 1off

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Part no	Value	Price
CW100N	CAP PROPYL 100nF	£1.25
CW150N	CAP PROPYL 150nF	£1.25
CW220N	CAP PROPYL 220nF	£1.25
CW330N	CAP PROPYL 330nF	£1.25
CW470N	CAP PROPYL 470nF	£1.25
CW680N	CAP PROPYL 680nF	£1.25
CW1U0N	CAP PROPYL 1µF	£1.25
CW1U5N	CAP PROPYL 1.5µF	£1.50
CW2U2N	CAP PROPYL 2.2µF	£1.50
CW3U3N	CAP PROPYL 3.3µF	£1.85
CW4U7N	CAP PROPYL 4.7µF	£2.00
CW6U8N	CAP PROPYL 6.8µF	£2.50
CW10UN	CAP PROPYL 10µF	£3.50
CW15N	CAP PROPYL 15µF	£4.50
CW22U	CAP PROPYL 22µF	£6.50
CW50U	CAP PROPYL 50µF	£9.95
CW100U	CAP PROPYL 100µF	£20.00

Low value capacitors are extensively used in amps & preamps (especially in tone control, bass & treble etc) By changing to polypropylene you can enjoy an enhanced lighter brighter sound especially in the treble and mid bass range, and a transparent lower bass improvement. Close tolerance & high stability ensure that both channels can be very closely matched

Part No	Value	Voltage	Price
CPP47P	CAP PROPYL 47pF	250V	£0.35
CPP100P	CAP PROPYL 100pF	250V	£0.35
CPP150P	CAP PROPYL 150pF	250V	£0.35
CPP220P	CAP PROPY 220pF	250V	£0.35
CPP330P	CAP PROPYL 330pF	250V	£0.35
CPP470P	CAP PROPYL 470pF	250V	£0.35
CPP1N0	CAP PROPYL 1nF	250V	£0.35
CPP1N5	CAP PROPYL 1.5nF	250V	£0.35
CPP2N2	CAP PROPYL 2.2nF	250V	£0.35
CPP4N7	CAP PROPYL 4.7nF	63V	£0.50
CPP10N	CAP PROPYL 10nF	63V	£0.65
CPP22N	CAP PROPYL 22nF	63V	£0.85
CPP47N	CAP PROPYL 47nF	63V	£1.00

Low Impedence High Temperature (105° C) Radial Electroytics ± 5%

Superior electroytics at affordable prices. The low impedance and resistance maximises signal purity whilst the superior temperature characteristics allow the capacitor to remain very stable under the most varying conditions.

Part No.	Value	Voltage	Price
1H50	LO Z HI TEMP 1µF	50V	£0.25
2U2H50	LO Z HI TEMP 2.2µF	50V	£0.25
4U7H63	LO Z HI TEMP 4.7µF	63V	£0.25
10H63	LO Z HI TEMP 10µF	63V	£0.25
22H63	LO Z HI TEMP 22µF	63V	£0.30
47H63	LO Z HI TEMP 47µF	63V	£0.35
100H63	LO Z HI TEMP 100µF	63V	£0.50
220H50	LO Z HI TEMP 220µF	50V	£0.75
470H63	LO Z HI TEMP 470µF	63V	£1.25
1000H35	LO Z HI TEMP 1000µF	35V	£1.50
2200H50	LO Z HI TEMP 2200µF	50V	£2.25
4700H25	LO Z HI TEMP 4700µF	25V	£2.50

Trobo Solder Lug Reservoir Capacitor 10,000µF 80V

Choosing the right electrolytic for power supply use is very important in keeping down hum whilst allowing maximum current flow for good transient & bass response. Elna capacitors are respected the World over for their exceptional audio attributes.

Part No	µF/Voltage	Price
10000BC80	CAL ELNA10000µF/80V	£11.00

Monacor Air Cored Inductors.

A range of professional air cored inductors for 8Ω or 4Ω crossovers/filters for use up to 300W. 1.2mm enamelled copper wire wound on air spaced plastic bobbins.

Part No	Specification	Price
P15	150µH 0.15Ω 8x19mm	£2.00
P22	220µH 0.15Ω 48x19mm	£2.50
P33	330µH 0.2Ω 8x19mm	£3.00
P47	470µH 0.25Ω 50x19mm	£3.50
P68	680µH 0.35Ω 59x19mm	£4.50
P100	1mH 0.4Ω 59x19mm	£5.50
P150	1.5mH 0.5Ω 70x30mm	£6.50
P220	2.2mH 0.6Ω 70x30mm	£8.00
P330	3.3mH 0.75Ω 70x30	£10.00

Monacor Ferrite Inductors

A range of professional high efficiency ferrite coiled inductors with very low ohmic losses for 8Ω or 4Ω crossovers or filters for use up to 400W 1.4mm enamelled copper wire (1.3mm on F1000) wound on plastic bobbin.

Part No.	Specification		Price
F220	2.2mH 0.15Ω 400W	55x31mm	£6.50
F330	3.3mH 0.2Ω 330W	65x39mm	£9.50
F470	4.7mH 0.25Ω 140W	65x30mm	£11.00
F680	6.8mH 0.35Ω 120W	65x39mm	£12.00
F1000	10mH 0.45Ω 100W	65x39mm	£13.50

High Quality Valves

Part No.	Description	Price
6550C	OUTPUT VALVE	£26.00
6L6GT	OUTPUT VALVE	£4.50
6SN7GT	OUTPUT VALVE	£4.50
6V6GT	OUTPUT VALVE	£3.95
ECC81	TRIODE	£4.50
ECC82	TRIODE	£4.50
ECC83	TRIODE	£4.50
EF86	LOW NOISE PENTODE	£9.90
EL34	OUTPUT VALVE	£8.50
EL84	OUTPUT VALVE	£3.50
GZ34	RECTIFIER	£6.50
KT88	OUTPUT VALVE	£20.00

Valve Holders - High quality valve bases. Chassis mounting with screw fittings.

Part No.	Description	Price
B9AC	B9A VALVE HOLDER CERAMIC	£1.50
CC	SCREENING CAN	£2.25
OCTC	OCTAL VALVE HOLDER CERAMIC	£2.00
OCTP	OCTAL VALVE HOLDER PHENOL	£1.50

Fully Gold Plated Phono (RCA) Plugs with spring coil cable grip.

Part No.	Description	Price
PPG5A2	PAIR GOLD PLUGS for up to 5mm CABLE	£1.50 pair
PPG8A2	PAIR GOLD PLUGS for up to 8mm CABLE	£1.50 pair

Very High Quality Phono (RCA) Plugs

Very high quality satin grey metal with heavy gold plated connections. Top collet cable grip & PTFE insulators. Very low noise.

Part No.	Description	Price
PPG6H2	GOLD PTFE PLUGS for up to 6mm CABLE	£3.50 pair
PPG8H2	GOLD PTFE PLUGS for up to 8mm CABLE	£3.50 pair

Extra High Quality Gold Plated Phono Oxygen Free (RCA) Leads (pairs)

Available in 2 colours & 3 lengths. Highly flexible oxygen free cable with extra moulded-in control / grounding wire.

Part No.	Length/Colour	Price
LPP1QG	0.8 Metres/Green	£5.50
LLP1QV	0.8 Metres/Violet	£5.50
LPP2QG	1.5 Metres/Green	£6.50
LPP2QV	1.5 Metres/Violet	£6.50
LPP5QG	5 Metres/Green	£11.00
LPP5QV	5 Metres/Violet	£11.00

Bass Reflex Tuning Ports

A range of adjustable plastic ports for use in various sizes of loudspeaker cabinets. d=diameter L=adjustable length (mm)

Part No.	Dimensions	Price
R3S	d=35L=110-210	£2.50
R5O	d=50L=150-280	£3.00
R7O	d=70L=128-245	£3.50
R1OO	d=110L=160-122	£5.50
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VALVE AND TRANSISTOR AMPLIFIERS

By John Linsley Hood

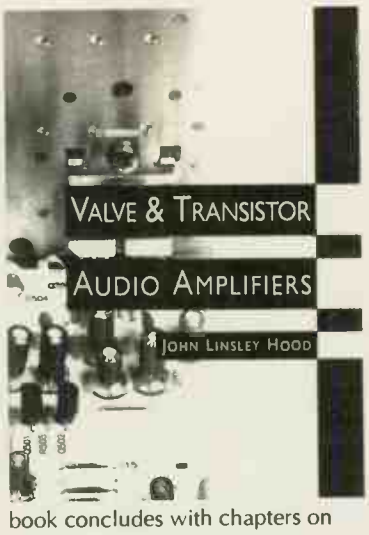
Reviewed by Noel Keywood.

Unlike many books I review, which are idiosyncratic in structure, Valve And Transistor Audio Amplifiers keeps to its aims in covering a lot of territory evenly, albeit with some unconvincing fly swatting when the author leaves his chosen subject to flail around at imaginary foes, especially the hi-fi press and other designers.

Valves (tubes) are a mysterious area to most solid-state engineers who weren't around in the valve's heyday. John Linsley Hood however was there: he tells us in a footnote that he had, "the great privilege of aquaintanceship with Mr Radford", and was "invited to his home in the early 1970s. . . as a consultant". Valve amps were moving toward apparent extinction in the late 1960s and a consultant at that time would have been very much aware of the debates around new fangled transistors, which possessed their own set of unique problems. It is this vantage point that gives the book the benefit of experience, and the credibility that comes from it. John Linsley Hood methodically and comprehensively works through the basic theory of operation of valve stages, identifying their particular difficulties and the solutions used to overcome them.

Chapter 6, entitled 'Valve-Operated Audio Power Amplifiers', concludes the valve section by looking at the workings of a wide range of commercial designs, including old faves like the Williamson, Quad and McIntosh, plus a few lines on Leak's successful and venerated TL12.

Maintaining an historical outlook helps lend this book a clear structure. Hood moves from valve amplifiers onto solid-state devices, including FETs, and then to early transistor amplifiers and their problems. This alone gives makes the book unique, and there are plenty of references to Wireless World articles of the time which discuss such problems in detail. The



book concludes with chapters on 'Contemporary Power Amplifier Designs' and 'Power Supplies'.

In keeping with the usual approach of starting at the beginning, I ought to mention that the first two chapters cover active then passive components, with some interesting insights into capacitor construction and various effects that might explain their impact on sound quality. Which brings me to the many opinions expressed.

I valued the engineering information presented in this book but not Hood's opinions. If opinion is to be taken seriously then other views need to be gathered and presented, putting the case for and against different approaches. Hood's own views are shallow rhetoric from a distant place. Other designers, Martin Colloms, the dreaded hi-fi press and various other ogres on the author's personal landscape all figure, with no counterbalancing arguments. Because Hood has not, as a consultant, worked at length inside the industry or the press, unlike Stan Curtis or Andy Grove for example, both of whom design and write, he's not especially well informed about those he swipes at - including "hi-fi publishers" like myself! Having heard it all before I tend to ignore this sort of thing, but it is at times misleading, as well as a lost opportunity to offer a broader view on various circuit techniques.

The topic of feedback is a good enough illustration. Working designers like Rob Watts (DPA) and Andy Grove (Quad/Leak/Wharfedale) keep a fairly open mind on the subject. The notion of producing an amplifier good enough not to need feedback is challenging to modern-day designers, leading to interesting techniques being aired by Douglas Self, and working products from Onkyo (Japan) and now Mission. None of this current interest and activity makes it into Valve And Transistor Audio Amplifiers. Instead, I see one particular MOSFET circuit used to suggest that low levels of feedback make things worse not better, based on distortion as a sole criterion, plus the view that lots of feedback is a good thing.

Hood tells us that "an amplifier block employing negative feedback, where this is applied correctly in a properly-designed system, will be substantially superior to that of a system without NFB. The fact that claims are sometimes made that the performance of an amplifier without negative feedback is superior to that of one using this technique seems to be due principally to the lack of design skills of those in respect of whose designs this claim is made".

This is a trite and unfortunate conclusion. If feedback is applied to improve performance then, ipso facto, performance without feedback must be unsatisfactory. So are we designing basically unsatisfactory amplifiers? Why not try and design an amplifier that is good enough not to need feedback? It is an interesting idea that could do with a more balanced airing than Hood is prepared to offer, which is a pity.

All the same, Hood has a lifetime's practical experience and an enduring interest. Both contribute to making this an interesting and potentially valuable book for any designer interested in the thinking behind a wide variety of circuit arrangements●

Valve And Transistor Audio Amplifiers
£19.99

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DIGITAL AUDIO SIGNAL PROCESSING

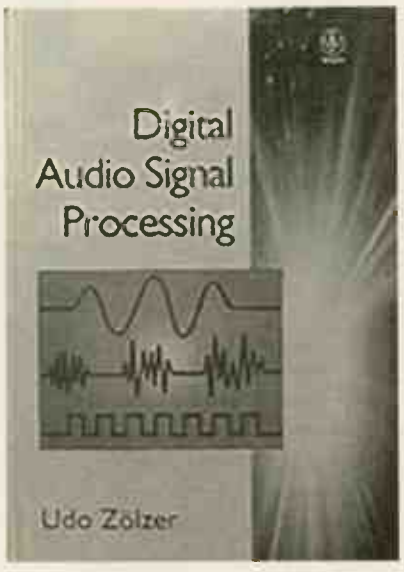
By Udo Zolzer

Reviewed by R. Casadei.

Digital signal processing is definitely here to stay whether you like it or not. As an audio designer I have gradually been accepting this fact and have since been burning the midnight oil trying to understand the concepts and make them work for hi-fi reproduction. Having been through several dozen books on the topic, ranging from those by Babani to John Watkinson's, Digital Audio Signal Processing (DASP) by Udo Zolzer is the latest addition to my reading list and it is probably one of the most technical reads I have yet to come across.

If you, as a hobbyist, bought this book after reading the back cover, you'd be excused for thinking it might be fairly technical but would still help you to understand most of the subjects mentioned herein. On reading the Preface things are already getting rather serious, however. It begins by stating that Digital Audio Signal Processing provides the basis of an advanced course in DASP for research students and professional audio engineers alike (ie the real ones!) So if you can actually understand the topics described in the contents page, then you are likely to be a technically well-informed individual. Unfortunately, when you turn over to the book's main sections, you'll be left in no doubt that you'll have to be either a die-hard research student of Udo Zolzer or Udo Zolzer himself to take in any of it! This book is H-e-a-v-y! If it were a car then it would handle like an eighteen-wheeler doing a three-point-turn on Kilburn High Street with no power steering, if you know what I mean.

Digital Audio Signal Processing is divided into two main parts. The first four chapters present the basis for hardware DASP, beginning with a brief description of studio technology, digital transmission



systems, storage media and audio components at home (but not as we know them, Jim!) Some good information is provided here on the different sampling rates used in the various types of storage media and broadcast systems, together with specifications for CD, R-DAT, DCC and DAB, leaving them all open for us mortals to pick holes in. (But who would argue about the pros and cons on DPSK modulation technique in DAB, eh?)

Then what you get is FFTs (Fast Fourier Transforms) and more FFTs, so much so that you are beginning to create your own versions for the meaning of the acronym "FFT"! Finally the book comes back to earth on digital amplifier concepts, with a clear and concise description via a few easily comprehensible diagrams and some plain English.

The following chapter concerns itself with Quantisation, Dither, Noise Shaping and Numerical Representation (Fixed Point and Floating Point). This section, like most of this book, is filled with hard-core mathematical formulae and frankly it's not for the faint-hearted. Yes, they are all real and they are the theory behind the world of DASP, but I do think they are far too theoretical for most people and there are lesser books around that can offer simpler ways to explain them.

Analogue-to-Digital and Digital-to-Analogue conversion are the main topics covered in Chapter Three. Most of us interested in the topic would find half of each section to be informative on A/D and D/A conversion. That would be the right place to stop as well, unless you want to become either a researcher or totally confused; you have been warned!

From Chapter Four onwards you are on your own. Here you'll discover the dense mathematics and formulae for DASP techniques, digital filtering and digital equalisation, room simulation, dynamic range control, sample rate conversion and data compression. It is here that you can start calling yourself a Doctor or Professor, if you understand all this, and no one would ever argue with you. You would probably qualify for a seat in the Audio Engineering Society too, but then you probably wouldn't believe different interconnects or 'speaker cables can sound different and BluTack will remain just a good way to ruin your bedroom wallpaper.

Digital Audio Signal Processing is full of solid facts and theories that explain and prove how all the electronics should work, but not how good it will sound. As an audio enthusiast with electronics ability, I would recommend a lighter read for the hobbyist. For the die-hard, no-holds-barred audio researcher, then this book is the one to go for. But after digesting its contents, do try swapping your interconnects for better ones and get your 'speakers off the bookshelf and put them on some decent stands (and don't forget to the BluTack!)

Digital Audio Signal Processing £45.00

ISBN0-471-97226-6

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Audio Note Kit Amplifiers -

Power-Amp Kit

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Based around the justly famous 300B directly heated triode, we see this kit as the introduction to *real* Audio Amplification, as it covers all the important aspects of design necessary, Single Ended, No-Feedback, Class A, Directly Heated Triode, to become a member of this exclusive club of amplifiers.

Kit One has one 300B per channel running at 420 volts with 75mA current giving 8-9 watts of the cleanest power you will ever hear, the input stage consists of a 6SN7GT with a 5687 double triode driver stage running in SRPP. The power supply is capacitor-choke-capacitor configuration with a 5U4G HT rectifier, the 300B's have a DC filament supply for hum-free operation whilst the other valves are AC heated. Component quality is similar to our Level 2 finished products, **Audio Note** paper in oil signal capacitors, Beyschlag 1 watt 1% metal film resistors, good quality electrolytics *(sorry NO Black Gates!)* and a simple, attractive stereo chassis in black paintwork. We have several component and cosmetic upgrades available for **Kit One**, please ask for details.

The Kit One has recently been awarded the title "The Greatest Audio Bargain of the Twentieth Century" by Dick Olsher (ex-Stereophile) in a review on the Internet - this is just one of many rave reviews, copies of which we can supply on request.

Price: £799 incl. VAT, which includes ALL parts & valves *(yes, also the 2 x 300B's needed)* but not postage/packing which to UK customers is £12.

KIT ONE ORDER CODE: AN-KIT-001

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Kit Two costs £599 incl. VAT, includes valves, but not postage/packing.

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The **Audio Note** Kit Three

Kit Three features 2 x 300B's per channel running in single-ended parallel yielding 16/17 watts in pure Class A. This kit is on two mono chassis with valve rectified HT supplies, no signal feedback, it uses a 6SN7GT double triode as input valve and a pair of 5687 double triodes running in SRPP as drivers. The **Kit Three** is essentially a mono version of the Kit One with double the power, the same component choices and on two chassis' instead of one.

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Audio Note manufacture a range of high quality copper and silver coax, speaker and wiring cables, which, depending on the overall price of the project, will do justice to any hifi system, regardless of price. Please call for prices and details.

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All of our valve bases are of the highest possible quality materials. Ceramic, Teflon and gold and silver plated. If you want the best look no further - they are the ultimate!

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Audio Note endeavour to stock the entire E12 range of all the different makes of resistor, since most are used in our products stock is generally available within four weeks.

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AUDIO NOTE Precision Carbon Film Resistors
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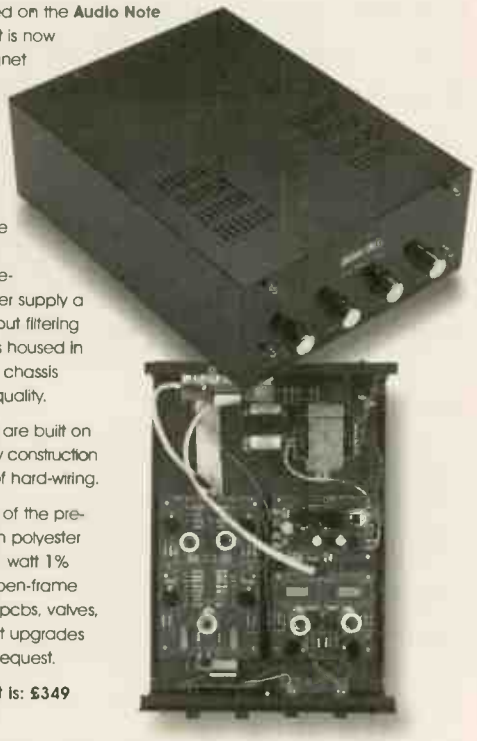
Components & Valves

Pre-Amp Kit

The Audio Note Pre-Amplifier Kit *(illustrated)*



A complete kit loosely based on the **Audio Note** M7Tube pre-amplifier circuit is now available. The moving-magnet compatible phono stage consists of a cascode input, with passive RIAA equalisation and anode-follower output using the 12AX7/ECC83. Line buffer/amplification for the four line inputs consists of an ECC82 configured in parallel anode-follower mode. For the power supply a valve rectifier and choke-input filtering are employed. All circuitry is housed in a non-magnetic aluminium chassis giving the very best sound quality.

Both phono and line stages are built on 'track-less' pcbs allowing easy construction but with the sonic benefits of hard-wiring.

The standard-quality version of the pre-amp kit includes Roederstein polyester film capacitors, Beyschlag 1 watt 1% metal film resistors, Noble open-frame style potentiometers and all pcbs, valves, wire etc. Various component upgrades are available, details upon request.

Cost of The Pre-Amplifier Kit is: £349 incl. VAT but not delivery.

Audio Note Black Gate Electron Transfer, High Performance, Graphite Foil Capacitors

Audio Note is currently the sole source in Europe that holds any significant range of values in stock, we use literally 1000's in production, as we were the first company to realise the tremendous benefits that Black Gate capacitors offer, and we are to date the only high-end audio company in the world to incorporate Black Gate capacitors consistently in our finished products.

There are very few audio parts that promise a guaranteed improvement when replacing practically any other part, but this is what the BLACK GATE capacitors actually do. Exchanging any electrolytic capacitor anywhere in the circuit of an amplifier or in the crossover of a speaker will greatly improve sound quality. We are working on some guidelines as to where, how and which types of Black Gates to use in different circuits, the first such technical guideline is available now and is called "Improving your CD-Player" and can be obtained by sending a stamped addressed envelope to us requesting this leaflet. All AUDIO NOTE Level 2 Signature products use Black Gate Electron Transfer in critical signal / power supply junctions.

Audio Note Cerafine Powdered Ceramic Electrolytic Capacitors

We have at long last secured a reliable source for these fine power supply filter capacitors, a must in any single-ended project. The Cerafines really cover many of the Black Gates values and where the prices for the BG's are prohibitive the Cerafine is a fine sounding alternative. We have increased the range of Cerafines we stock quite recently, and strongly recommend all the Cerafines as a far superior replacement or substitute for ordinary electrolytics, and at the prices offered that should be within most budgets. All power supply Cerafines are supplied with a capacitor clamp and are upright mounting.

Audio Note Potentiometers

The best available from a sound quality / price viewpoint, made by Noble in Japan, utilising high quality conductive plastic film. However a better alternative is the KO-ON volume controls which are used in pre-amplifiers like the M7 Tube. M7Line, and in a mono version on the input in the NEIRO, KASSAI, KEGON and GAKU-ON, these are very good sounding pots by any standard.

Audio Note also carry large quantities of STANDARD TYPE SWITCHES, STANDARD ELECTROLYTIC CAPACITORS (good quality industrial types), RCA, BNC, BANANA, PLUGS, RCA SOCKETS, SPEAKER & GROUND TERMINALS & LOUDSPEAKER SPADES.

Audio Note Moving Coil, CD Line & Input Matching Transformers

Audio Note now offer moving coil, CD and input matching transformers for general sale. Common to all of these small signal transformers is that they come in a mumetal screening can with a threaded spindle with a nut for mounting.

Valves

The Audio Note AV300BSL *(illustrated)*

Audio Note is proud and happy to announce a joint venture with Mr Alesa Vaic of AVVT in the Czech Republic, under the agreement reached Alesa Vaic's company will be making a range of directly heated triodes for small signal, driver and output stages exclusively for **Audio Note**. This will with time allow us to explore hitherto uncharted territory in the field of Single-Ended Audio Amplifier design, by putting us in a position to design and manufacture triodes specifically for a given purpose, something which has not been within our reach in the past, where we have always had to settle for the best amplifying devices available, but which good as many of them are, were generally made for other purposes.

Currently, we have a super linear version of the 300B available, dubbed The **Audio Note** AV300B SL it is available in limited numbered samples at US $250 each either single, or in matched pairs. We will follow this fairly quickly by a new, more powerful, power triode, the **Audio Note** AV32B SL with 65 watt dissipation for about 18 watt class A in single-ended configuration for an expected price of US $300 each. The **Audio Note** AV52B SL with an 85 watt dissipation for 28 watts of class A operation will be available in early 1998. This will be quickly followed by the most powerful and linear power triode available - the **Audio Note** AV62B SL with 120 watt dissipation for about 40 watt class A in single ended configuration at an expected price of US $500 each, it will help advance the case for SE operation despite the deplorable inefficiency of most modern loudspeakers!!

Audio Note Selected Audio Valves

Our valves are selected from the best available sources and are tested to the same stringent standards that we apply in the production of our own amplifiers. They fall into two categories, standard production items and rare, mostly NOS *(New Old Stock)* valves which are no longer in production. We have compiled a special list of the NOS items, which is available against a stamped self addressed envelope, if you live outside the UK, send US $2. You should be aware that the valves on this list are NOT cheap, but we have stock of original GE, RCA and United Electronics 211, both standard versions and reinforced anode type for the US airforce, 845 Westinghouse, VT25/10/10Y, VT62/801A, WE300B, STC4300A, Mullard GZ34/CV1377, Tungsol 5U4G *(best sounding 5U4G we have ever heard!)*, Chatham 5R4WGY and many others.

Audio Note Recommended Magazines *Full list available on request*

Listener – Review based music & hi-fi magazine that contains some of the best considered & well written articles in print. A very good read £4 per copy.

The Audio Adventure – Well produced publication, a good alternative to the established magazines. Not afraid to be controversial. £4 per copy.

Sound Practices – Our best seller. A must for all DIY projects. Contributors include Audio Note, Herb Reichert and Diego Nardi. £5 per copy.

Vacuum Tube Valley – Specialising in anything to do with audio valves. A wealth of information on specific valves and their applications. £8.50 per copy.

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DIY Letters

STAYING REGULAR

I use a number of QED 'Black Box' components - a Digit DAC, Vector pre-amp, Discsaver phono stage, etc. I find that all of them sound better when powered by QED's external Positron rather than the basic wall-plug type of supply.

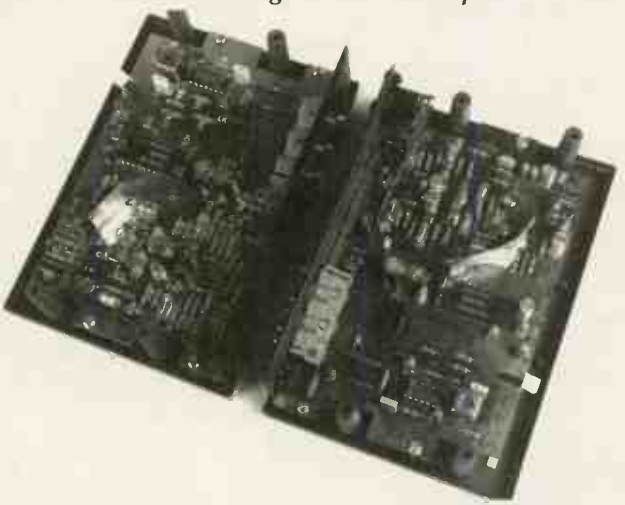
My problem is that I have only one Positron, which QED have now discontinued. The input socket appears to be a standard 12V type, such as would be seen on a portable TV. My question is, do you, or any of your readers, know of a (preferably cost-effective) battery or mains 12V power supply which I could use instead? I remember once reading in Hi-Fi World that some people use a battery supply for the Digit, so I would be grateful for any advice or hints.

James Taylor
London.

You can choose either battery or mains supplies - both are easy to build with off-the-shelf bits and pieces and will give very good results. None of the components you list consume a great deal of current, which simplifies matters.

'Old reliable' in the regulator world is the LM317T variable-voltage positive reg. All you'll need to make a fully-fledged PSU for each of your various QEDs is one variable and one fixed resistor, a couple of capacitors (preferably Sanyo Os-Cons from, say, Audio-Links, tel: 01724 870432), said LM317T and some lead/acid batteries. The circuit is therefore extremely quick and simple to construct according to the diagram shown. Here, R1 can be adjusted to give an accurate 12volts (it should initially be set for approximately 240ohms).

The LM317T requires an input at least 2volts higher than the output in order to work properly. So, by conecting three 6volt lead/acid rechargeable batteries together in series, you have a suitable 18volt supply. Paralleling up an additional three 6volt batteries alongside the originals will double the PSU's overall current capacity - paralleling two 4Ah (Amphour) batteries gives you 8Ah to draw on. Series connection does the same for voltage.



With a proper PSU, QED's Digit DAC can sound surprisingly good.

Maplin (tel: 01702 554000) sell appropriate lead/acids (XG70M, 6V 4Ah, £12.99) and chargers (GU08J, £29.99). I've been using a set to power my DPA 50S pre-amp with fine results.

These parts might not look amazingly cost-effective at first glance, but bear in mind the charger will individually charge as many batteries as you have and the lead/acids should be good for a minimum of 500 recharges. You can either run all your QEDs off one PSU (although the batteries won't last too long like this unless you parallel up two or three sets) or make separate PSUs for each component.

If that's still too much expense to contemplate, perhaps a mains supply would be the answer. The cheapest battery option adds up to £13x3 plus £30, which is £69. Maplin have a 225VA toroidal transformer with 12volt secondaries at £25. A relatively chunky unit like this has superior regulation (ie, a more stable AC output voltage) than smaller alternatives and sounds better. You could follow this with four £1.10 11DQ06 Schottky rectifiers from Audio-Links and three or four 25volt 2200uF Elna RSH reservoir caps paralleled up to

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STRIKING GOLD(RING)

I was interested in the query from Paul Fitzgerald in the April Supplement concerning modifying the Goldring-Lenco GL75. The hole for the tone-arm is, in fact, significantly larger than the diameter of the arm pillar and is an exact fit for a Decca London uni-pivot arm. Not only that, but the hole is within a whisker of the prescribed distance for that arm from the platter centre, so alignment is no problem. The Decca arm has no lifting device but the excellent built-in lift on the turntable works a treat, providing some tape is attached to the arm and/or the lift to prevent the arm from sliding sideways during lowering.

I have dispensed with the turntable mounting springs and bolted the top plate to a solid plinth constructed à la Bastin of layers of thick ply. The whole affair rests on Goldring Perfect-Sound spikes and damper discs. Whilst lacking the assurance of my 401/SME IV combination, the turntable delivers a secure sound using a variety of cartridges and forms the basis of a trouble-free second system.

P. Pascoe
Liverpool.

MORE GOLD(RING)

Much like Paul Fitzgerald of Birmingham, I too am a recent convert to the delights of a mint GL75 (cost £30) and a GL78 (cost £15), the slightly more up-market version of the former. Also like Mr Fitzgerald, I found that one of the turntables had suffered a lifetime of not having all the transportation screws released - no wonder some people claim these lovely bits of engineering suffer rumble.

I bought mine for playing a growing 78rpm record collection but found, with a few minor modifications and a reasonably decent cartridge, it would give my PT TOO (with RB300 arm and Elys cartridge) a run for its money. Indeed, having transferred the modifications to the GL78, and having acquired and used a stylus balance, test record and protractor to set up an Ortofon OM40 cartridge, I'd say in some respects, the GL leaves the PT in a trail of dust! For one thing, its motor rotation is more stable - I checked with a GL proprietary strobe disc. (By the way, I bought the OM40 because its stylus is easily swapped for one to play the 78s.)

Modifications? In fact, these are more 'tweaks' than modifications. For one, my entire hi-fi set up benefits from a purified and regulated power supply, courtesy of a 'late' Radar Electronics hi-fi grade filter and "virtual batteries", plus a hefty ex-Telecom purifier which sits in the power line closest to the wall socket.

I have also mounted the beast on an isolated platform. The GL78 sits on a marble slab which is supported by Sorbothane sandwiched between three Michell cones and its underside.

The next trick is more Sorbothane (I love the stuff! I use it to great effect in other parts of the hi-fi system, too). The underside of the cast metal platter has a covering, which helps eliminate its bell-like ring. There is more Sorbothane on the top of the head shell, some underneath it, and a couple of tiny bits of it stuck to each side of the cartridge.

But what about that awful arm? This too seems to benefit from a strip of Sorbothane curled around the length of it. Also, forget the counterbalance - get a nice, heavy brass one made in its place. Then, use a stylus balance to get close to the stylus pressure weight but don't assume that is spot-on - it may need a bit of fine adjustment to ensure the stylus tracks properly once the bias weights are set. To find this out you will need a test record, such as that from The Cartridge Man. I have found my GL78 with Ortofon OM40 passed the most exacting bias test-track with flying colours (which is more than can be said of the PT TOO/RB300/Elys) once I slightly increased the pressure on the stylus.

Having done all that and used a blob of good ol' BlueTak to secure the record to the spindle (it's cheaper than a turntable clamp), play the black stuff. . . And be amazed!

CDs? Pah! PT TOO? To be honest, there are still records I may prefer to play on the PT TOO - for example, Mary Black's voice is softer and less nasal than it sounds on the GL78. But on the other hand, the midrange tonal quality and transients are better defined on the GL - cymbals zing, ting and tong rather than simply tash, while violins sound like they are made of different woods. But then, with two different cartridges, the comparison is hardly fair.

My only gripe is that I cannot get the GL78 auto-return mechanism to work properly (if at all.) Now, if anyone can tell me what's wrong with it. . .

Graham Nelson
GiroGANelson@compuserve.com

Carry on classic - Goldring's GL75 is an excellent second-hand buy.

CROSSING OVER

Being an avid reader of your magazine for the last 12 months or so, I decided to upgrade my 20-year-old Wharfedale Glendale XP2 'speakers. I replaced the crossover components, terminals and internal wiring with modern equivalents and a large improvement was the result. Having read the DIY Supplements I became interested in making my own.

So I purchased The Loudspeaker Cookbook and Bullock On Boxes and bought a 'scope, an AF signal generator, frequency counter and soon a suitable multimeter. I duly digested the contents of both books. My question relates to the designing of the crossover. Following the procedures in both books is no problem, but the authors seem to make the assumption that the crossover is already designed and finished. I refer particularly to: "taking into account the series resistances" when calculating Rg, the source resistance. After reading and re-

reading the texts my only conclusion is that initially a 'basic' crossover is used, then the enclosure volume found and then the testing and re-testing begins. Am I correct in this assumption of, as Dickason puts it, "the art of 'speaker design" or am I still missing something?

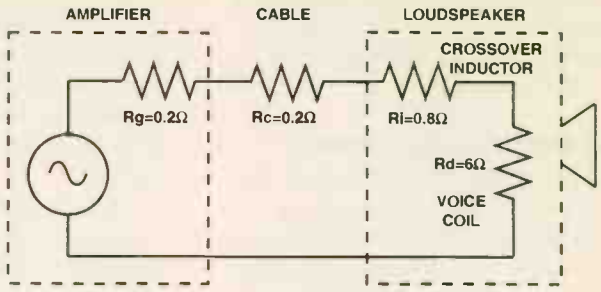
I've also tried to 'reverse engineer' your KLS9s from the crossover point of view but without a great deal of success, so any help would be gratefully appreciated.

Also is there any advice you can give regarding the pros and cons of software for analysis of 'speakers, ie L.E.A.P, Liberty, etc, other than your recent articles in the Supplements? My maths ability starts to get ragged about the level of Laplace, Fourier and Partial Differentiation.

Michael Abbott
mabbott@compuserve.com

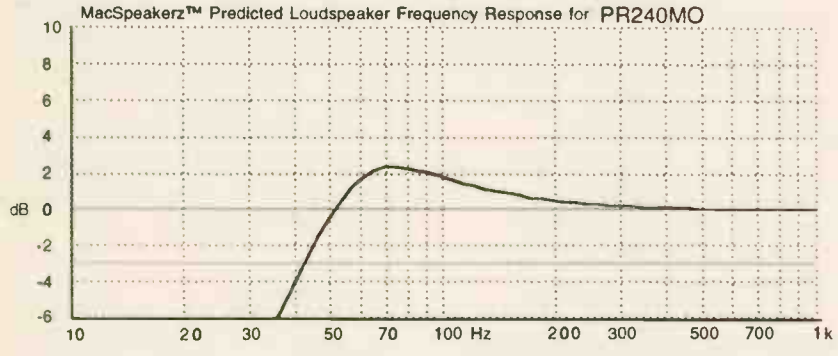
You are not alone in being confused by the crossover. I'm told the first person to write a comprehensible book on crossover design is likely to make a fortune. I've even given it some thought, having done a few in my time, but I just do not know how you explain such a subject in any easy manner. Also, I should point out that most practising loudspeaker designers admit to using theory to start a design, to get into the right ball park as it were, then experiment thereafter - and that includes me.

Here's my own entirely conventional and relatively simple approach to loudspeaker design, echoed by many others in the business. You might be surprised that matters such as Rg (amplifier source resistance) don't figure. You will realise why small external variables like this subside virtually into insignificance relative to other matters - especially 'driver acoustic centre' or ZDP - once you get stuck in.



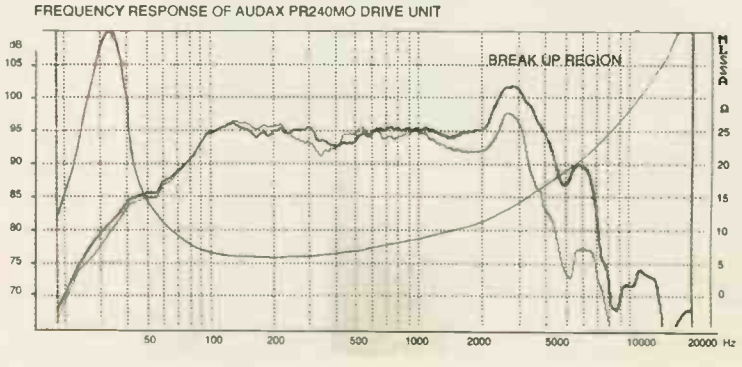
The equivalent circuit diagram for an amp, cables and 'speaker.

1) Sort out your basic concept - what drivers you want to use to achieve what end.
2) In a two-way, obtain the Thiele-Small parameters of the bass/midrange drive unit, plug them into a loudspeaker design programme like L.E.A.P. and find the ideal box volume for the response you hope to achieve.
3) Validate this information by building a quick prototype box and then measuring the frequency response of the bass/midrange driver in it. At this point you need no crossover. You are determining the bass performance, which really means the behaviour of the box acting as a high-pass filter. See the theoretical response of an HM170CO on p8 of my KLS10 article in the Supplement this month.



As instep 3), you need to measure your mid/bass in the enclosure to determine their combined bass response.

You can, if you wish, add a source resistance of 1ohm or so to simulate the DCR of the low-pass crossover inductor. This will make the electrical damping more like that in real life, but it has no great effect. Loudspeakers are damped acoustically and magnetically, as well as electrically. Fiddling around with minutiae at this stage is pointless. And if you use a port, its acoustic damping effects will swamp Rg. Yet in spite of all the theoretical flim-flam around ports there's little agreement on their optimum dimensioning or frequency of tune. It's all a matter of perspectives.
4) Having matched bass/mid to box you must now match in the treble unit - and this really means design the crossover network (I assume your bass/midrange unit in its box measure well). It is usual to roll off the high frequency output of a midrange driver where it starts to get ragged (the break-up region), so that this raggedness and associated problems like coarseness and coloration are not audibly intrusive. I find 99% of bass/midrange units are rolled off at 3kHz. My advice is



All mid/bass drivers become rough in their responses as frequency rises.

to start off with a second-order Butterworth or Linkwitz-Riley; both are popular. You must use measurement to decide whether you have a smooth roll down or not.
5) Now try and match the treble unit to the bass unit. This is where the fun starts. Your bass/midrange response could look pretty smart and you could be thinking "this is a doddle". Start praying. If you are lucky, using a second or third-order high-pass filter to drive the tweeter may give a net flat response and good phase matching, with a reasonably even impedance curve. But there's a 90% chance it won't because of all the variables involved. This is why, in the end, you must experiment. Also, it can be faster than ploughing through theory that only gives a partial result. But of course you must use calculation and then validate your results with measurement. Loudspeakers are too complex to be designed on an ad hoc basis. NK

KITTED OUT

Having become sick to death of the endless search for something approaching 'jouissance' from 'hi-fi' amps in the sub-£1000 bracket I am now researching the DIY option. The most adequate musical reproduction I have enjoyed to date was via a Gamma Acoustics Rhythm, utilising 211 triodes. Is there an integrated kit based around these valves or alternative valves with a similarly neutral sound (preferably at least 17 wpc SE and real bass) well under £1000? Alternatively would I be best off starting from scratch and, if so, what design source literature could you recommend?

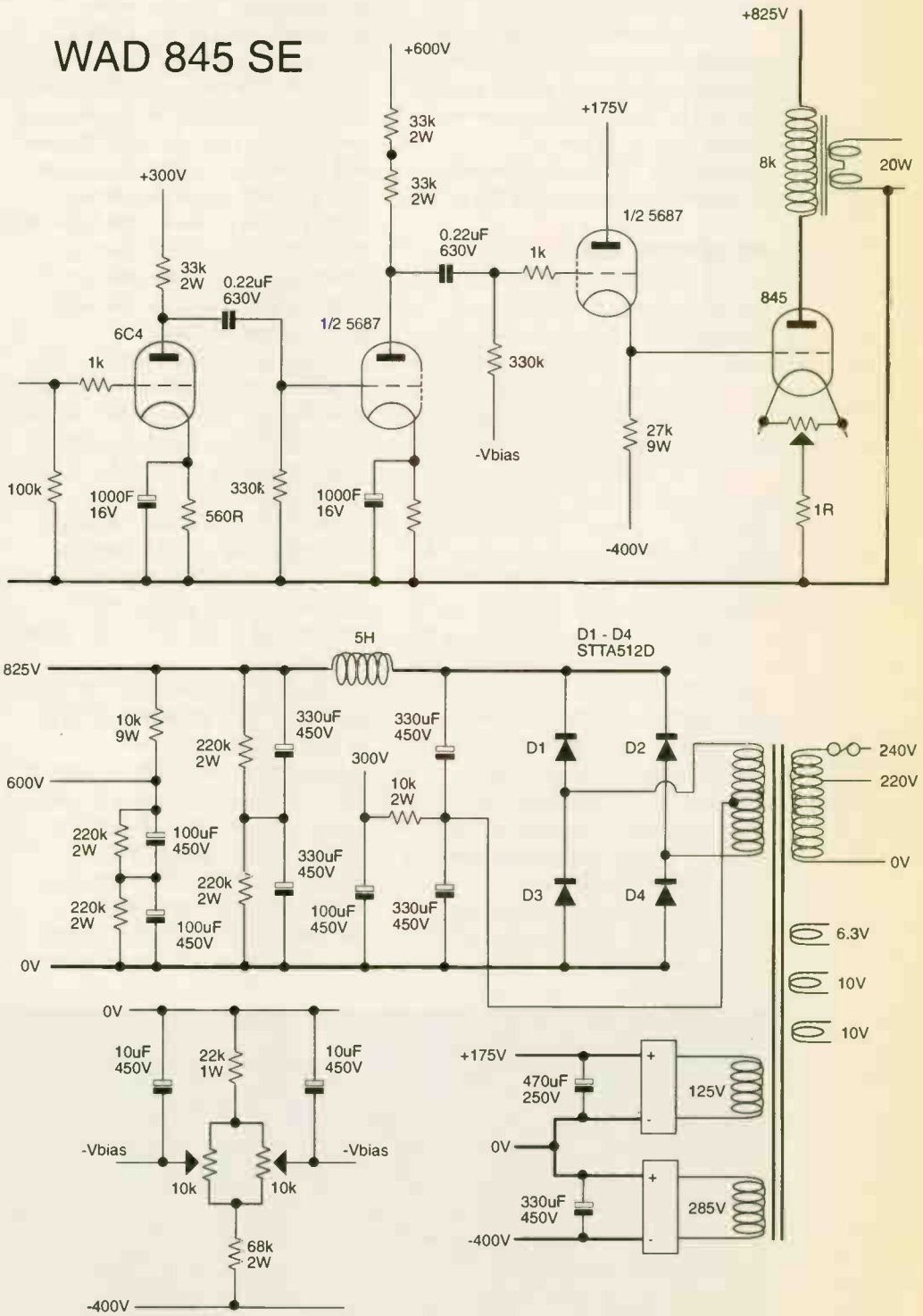
I am also interested in your 'speakers. Would the three-way design be suitable for this sort of power and do you supply ready-cut cabinet board or must this be purchased and cut separately? I am very much a beginner (with more than adequate carpentry skills) who is fortunate enough to have some electronically-gifted friends.

Tim
tim.hicks3@virgin.net

Sorry to disappoint you, but 211 amplifiers are not so easy to build. We considered using the big brother of the 211, the 845, which has a graphite anode capable of 100W dissipation, in a single-ended amplifier. Here is an early circuit for you to peruse. Because of the low conversion efficiency of a single-ended design this amplifier would deliver around 30watts - but look at the HT. voltages! The output valve needs a stunning 825V. At these levels you have to start to consider arcing and tracking along insulators, breakdown in the mains transformer due to surge voltages and, most horrifying of all, primary-to-secondary breakdown across the output transformer. This would do interesting things to your loudspeakers - and the cat would definitely leave home.

We've built an amplifier with 211s and transmitter rectifier valves in the power supply delivering a 1200V HT line for one customer, but decided this was not suitable for DIYers or those without experience. We used a transformer sub-contractor who specialised in EHT

The 845 is a superb valve, but in single-ended mode it runs off a huge 825V HT.



transformers for power transmission. They were confident about safety, but knew nothing about audio. Andy Grove had to give them precise instructions for the complex sectionalising needed for an audio output transformer. This shows you how peculiarly difficult and dangerous such amplifiers are, even if they do sound wonderful when designed and built properly. But there are few people in the world with the necessary knowledge and skills, including your friends I suspect.

Stick to something simple and live a little longer. Our kit valve amplifiers offer great sound quality and can be tuned up even further if you so wish with special components. All our loudspeakers are suitable for valve amplifiers. NK

MOTORING ON

I've just had a similar experience to the one which spurred Nigel Purdy into building what sounds like a top-quality home-made turntable - that is, getting one's jaw bruised from it hitting the floor when enquiring about the cost of hi-fi. I will try to explain as briefly as I can.

I recently bought Goldie's Saturnzreturn and only having the bog standard LP12 couldn't play it (the four records are 45s). I popped to my local hi-fi shop and they advised me that either a Lingo or the little push-on spindle device would solve my problem. On hearing the price of a new Lingo I plumped for faffing about with the spindle for the time being.

Talking to an electronic engineer at work who has the same problem, we decided we could probably muster enough control theory and practical know-how to lash a PSU together but realised we didn't know enough about the LP12 to get us started.

Do you have any outlines for the specifications for the motor in an LP12? What are the pitfalls to be avoided in designing a motor PSU for a record deck? Have you ever covered building a motor PSU in the kit Supplement and, if not, do you intend to? Any advice would be greatly appreciated.

Nick Weston
WESTON_NICK/GB@renishaw.co.uk

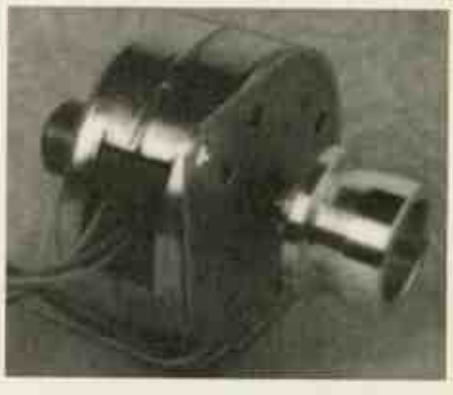
It's not just Goldie fans who need 45rpm these days; there are many new vinyl releases which favour the 7in. single speed. Recent examples we've come across include Roni Size & Reprazents' Newforms on quadruple 12in. 45 and Primal Scream's Vanishing Point on double 12in. 45s. The motor pulley adaptor will do the trick but if, like me, you prefer not to have to fiddle this on and off during a listening session, then a quartz oscillator power supply is the answer. This is because the motor's speed is frequency dependent. To spin the platter at 45rpm requires a higher frequency than the mains' 50Hz.

The Airpax motor fitted to the LP12 is a synchronous 24-pole affair specified for 110V operation on two separate phases, and is designed to work optimally with 50Hz (in most applications a lower voltage, typically 80V, is used to reduce vibration. Any lower brings the motor closer to silent operation, but the lower torque gives trouble overcoming the inertia of the platter on start-up).

To electronically shift to 45rpm requires 67.5Hz ac power. This is not easily done without regenerating a signal from scratch. The traditional technique is to use a quartz-crystal signal generator which pulses precisely at MegaHertz frequencies, step this down with frequency divider networks to 50Hz or 67.5Hz and low-pass filter this square wave to a clean sinusoidal waveform. This can then be phase shifted 90° with a capacitor, with alternate motor coils connected via the red and blue motor lead-out wires. Grey wires can be commoned for motor earth.

Building such a dual-frequency supply requires no small amount of expertise in solid-state electronics; a short-cut to building this kind of project from first principles would be to rebuild an existing single-frequency unit for solely 45rpm use - the Linn Valhalla board may be a useful starting point as they can be acquired second-hand for less than £50, but do beware of the high voltages present on the board. We don't know of anyone who has tried this yet, but it may be possible to substitute a different crystal, or to recalculate and modifying the frequency-divider circuitry. Either way you'll need to adjust the value of the phase shift capacitor at the output stage to give a true 90° shift at the higher operating frequency.

Once a supply is running, pay attention to the suppression of RF noise, a by-product of very high frequency oscillators. You could start by investigating copper shielding on the quartz crystals, or using ferrite-ring RF suppressors around connecting cables and the power supply mains lead. AH



Airpax's ubiquitous 24-pole AC synchronous motor.

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