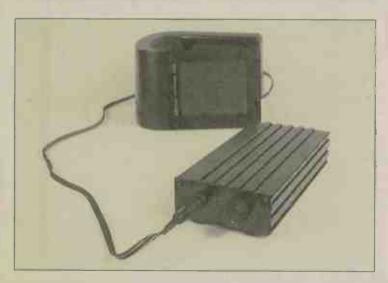


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BOOK REVIEWS THE WILLIAMSON AMPLIFIER
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FREE D.I.Y. SUPPLEMENT No. 9

World Radio History



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Valves amplifiers sound better still with CVC PREMIUM valves!

D.I.Y. Supplement

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All that's new on the DIY hi-fi scene this month.

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AUDAX DRIVE UNITS

Want to get your hands on the latest drive unit technology? Well here's your chance. There are ten super drive units to choose from including Carbon Fibre, High Definition Aerogel (HDA), and doped paper, as well as three soft dome tweeters.

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Following numerous letters from readers about the circuit for a single-ended, Class A headphone amplifier, published with Richard Brice's April column, we've decided to give you full construction details.

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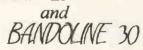
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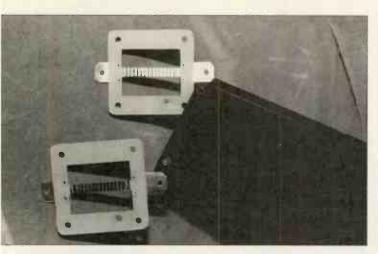
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KIT NEWS



GOOD NEWS FOR USERS OF DECCA RIBBON TWEETERS

Dismayed to learn about the demise of replacement ribbons for Decca DK30 and London ribbon tweeters, electronics engineer H Dawson has taken the matter into his own hands. Mr Dawson has produced tooling to enable hand manufacture of these spares to the original mechanical and electrical criteria. A service is offered to readers who would ike to keep their Decca ribbons in service, prices as follows: London/Kelly Ribbon Insert £15-00 each inc. P&P (outright) (£2-50 discount for old insert returned with outer frames re-usable.) Will fit F.O.C. if owner stands postage both ways or brings the drive units in (by prior arrangement). All spares come with printed instruction sheet/care tips.

C.W.O., cheque or P.O. Delivery 10 to

14 days (small numbers only).

Write to:
Mr H. Dawson
16 Copeman Rd,
Aylsham,
Norwich.
NR11 6||L

RETURN OF THE CONSTRUCTOR SERIES

KEF are making available three plans for new 'speakers to be built by the DIYer, based on the commercial Q60, Q80 and Q90. All three use KEF's 8inch uni-Q driver which will be available separately, along with their 8inch bass driver and 8inch passive radiator (ABR).

KEF Audio Tovil, Maidstone, Kent. MEI5 6QP Tel: 0622 672261

THE SPEAKER CO.

The Speaker Co. now have prices for the Audax range of HDA units, which they will have available shortly. The 5inch midrange unit will be £46, the 6.5inch bass/mid £51, and the 8inch bass/mid £61. Other new units include the hi-fi range from professional

manufacturer Precision Devices. The Speaker Co. will be stocking one 10inch, one 12inch and two 15inchs including the 600watt power handling 95dB efficient PD157. They will also be stocking a massive £620 21inch driver, telling us that most people buy them to use in cars!

Following the review of the Boxcalc package in our April Supplement, a demo version is now available for interested parties. Send an SAE to:

The Speaker Co. Unit 9, Waterside Miil, Waterside, Macclesfield, Cheshire. SKII 7HG Tel: 0625 500507

HART ELECTRONICS

Hart Electronics, keen to entice more and more people into the DIY hi-fi scene, have put together a soldering practice kit for beginners. The kit includes a practice circuit board solder and full instructions explaining the techniques behind soldering. Suitable for the absolute beginner, the kit costs £4.99 + £1.50 p&p.

Also from Hart, reprints of the original articles describing the Simple Class A amplifier designed by J. Linsley Hood in 1969 are now available. The eight page A4 reprint costs £2.50 + 50p postage.

Hart Electronic Kits Penylan Mill, Oswestry, Shropshire. SY10 9AF Tel: 0691 652894

TABULA RASA ON DEMO

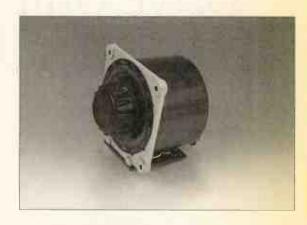
Ever expanding, Tabula Rasa have now appointed two dealers where their range of equipment can be auditioned. Covering the South East is Crawley Audio (Tel:

0293 531190) and the South West by Bugle Brand of Exeter (Tel: 0392 79217).

Richard Dawson of Crawley Audio is responsible for the design of Tabula Rasa's new loudspeaker stands. There are a range of standard size stands to suit Tabula Rasa's range of kit loudspeakers, along with a custom design service. Just complete a simple form and drawing and a quote for a custom built stand will be returned. Prices for custom stands are said to be no more than that you would pay for a similar 'production' stand.

Also in the pipeline are tripod style equipment racks with 10mm glass shelves, and a grille re-covering service.

Tabula Rasa 136 Kilnwood, High Wycombe, HP14 4UR Tel: 0494 565116



SOFT START FOR PROJECTS

A variable transformer may not instantly appeal to the DIYer, but for those who build their own valve amplifiers and other electronic projects they are extremely useful. Maplin have just introduced two, variable from 0-270volts and with either 2A or 8A current capability. They are especially useful when switching on your electronic project for the first time, as the mains can be smoothly increased up to 240V, highlighting problems before full power is reached (we use one, 'cos it beats going into the Anderson shelter before switching on). Prices are £29.95 for the 2A and £49.95 for the 8A version.

Also new from Maplin is a 70W power handling titanium composite tweeter. Priced at just £13.95 it is idea for budget kit loudspeakers.

Maplin Electronics P.O. Box 3, Rayleigh, Essex. SS6 8LR Tel: 0702 554161

Three -Way Carbon Fibre Drive Unit Loudspeaker



Dominic Baker uses a computer,
spectrum analyser, saw and his grey
matter to build a superb
floorstanding loudspeaker.

ur third loudspeaker design, KLS3, was partly prompted by our 300B zero feedback valve amplifier. Whilst this amplifier gives terrific stage depth and detail, because of the higher than normal output impedance it is affected by variations in the load the loudspeaker presents.

Most loudspeakers do not have a steady 8Ω impedance over the audio band. Instead, the load they present an amplifier varies with frequency. If, for example a loudspeaker with a high

impedance in the bass and low impedance in the treble was used with a zero feedback amplifier, it would sound unusually dull. So an important aim for this loudspeaker, as with the High Definition 'speaker (KLS2), was a reasonably flat impedance curve.

But KLS3 needed more than just a flat impedance curve. 300B has a power output of just 28watts, so these speakers had to be sensitive too. We wanted a minimum of 90dB for a nominal watt (2.8V) input at Im. It also had to use modern, low colouration, super quality drive units, to be able to bring out the very best of 300B. Finally, the speaker had to have a flat frequency response, especially across the critical midband.

A 'speaker with high sensitivity and a flat impedance curve is an extremely easy load for any amplifier. This has several benefits, even for solid state amplifiers. The harder you work an amplifier, the more distortion it will produce. This loudspeaker will actually reduce the amount of distortion your amplifier produces for the same sound level. This is one of the many advantages of a high sensitivity loudspeaker.

These design criteria would have been very hard to meet even a few years ago, but the advent of high technology cone materials has allowed us to actually improve on the targets we set ourselves at the beginning of this project.

THE DRIVE UNITS

Audax have been researching and producing new materials at a rate of knots over the last few years, now offering drivers with paper, TPX, Kevlar, glass fibre, carbon fibre, HDA and HDI cones. For this reason we looked to them for the drivers for our latest kit design. We do plan to design a 'speaker using the HDA units within the next year, but for this project the carbon fibre units were best suited.

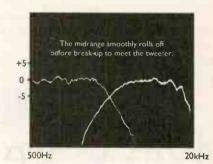
These have a high impedance, making it easier to design the overall loudspeaker for a flat impedance curve. They are also extremely light and stiff, giving them the high sensitivity needed. This modern material has improved break up characteristics over a paper cone, giving a smoother sound.

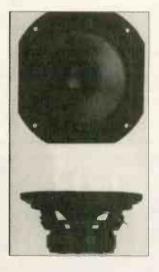
As with KLSI, we felt it important to keep the cone materials of each driver as similar as possible, to avoid obvious character changes, keeping tonal quality as even as possible. So a dedicated 4inch mid-range carbon fibre unit was teamed with an 8inch carbon fibre bass cone. A three way design was preferred for its superior mid-range clarity and projection, together with good bass drive and kick. A soft dome tweeter was considered to be the best tonal match to carbon fibre. Good soft dome tweeters also have the detailed and natural sound which we wanted.

The tweeter we picked again came from Audax. It was featured in the December '93 supplement, having a smooth response, high impedance and high sensitivity. It is a very nicely

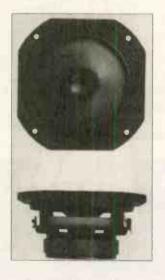
built unit, having a replaceable diaphragm and voice coil assembly should you do any damage. Being from the same manufacturer as the bass and mid-range units also makes it easier for the home constructor to obtain them.

Midrange and Tweeter Drive Unit Frequency Response

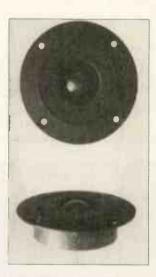




Audax HM210CO 8inch bass unit.



Audax HM130CO 4inch midrange unit



Audax TW025M1 25mm fabric dome tweeter

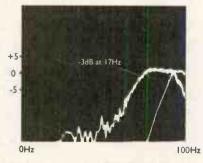
CABINET DESIGN

The Bass Enclosure

The cabinet was designed to give good, powerful low bass, hence its generous proportions. The bass cabinet is around 55 litres internal volume and is tuned to 40Hz using two 38mm diameter, 85mm long ports. I used a computer aided design package to come up with the initial dimensions and port size, which gave a good, but rather sterile bass quality. Using a combination of listening tests, and observing the changes altering the port size made on our Hewlett Packard HP3561A Spectrum Analyser, we were able to tune the bass to give exactly the character and bass quality we wanted.

You can see from the plot below how the ports extend the response from the front of the cone down to an impressive 17Hz at -3dB. Of course a close eye on the impedance curve was also important.

Port Output/Low Bass Response



The Midrange Enclosure

The midrange driver sits in a sealed chamber, the walls lined with felt carpet underlay. The cavity is lightly stuffed with long hair wool which, in combination with the carpet felt, absorbs most of the sound reflected off the internal walls. I made the midrange chamber volume 3.5 litres, which rolls off the midrange unit acoustically at low frequencies. The rising

impedance of the midrange unit towards low frequencies prevents it drawing power in the bass, so power handling is not affected. This makes the crossover simpler and more efficient.

It is important to seal this enclosure very welf, using plenty of PVA glue in the joins and to block the hole the internal 'speaker cable passes through

Midrange and Bass Drive Unit Frequency Response



VACUUM TUBES are BACK... and they sound better than ever!

Glass Audio is a quarterly journal designed for dedicated music lovers who've always known tube equipment sounds better than solid state.

The articles have special emphasis on construction with projects ranging from simple modifications of existing equipment, to restorations, to construction of the most sophisticated designs available today. The projects include schematics, parts lists and instructions. An annual feature is a world directory of international tube dealers and manufacturers.

Here's a sampling of recent articles: ST-70 with Solid-State Regulation, Rebuilding Tube Amps, An Electrostatic Headphone Amp, Greening the ReVox G36, Restore your Scott Tuner, Soft Start for Tubes, 70 Watts of McIntosh Power, Output Transformerless Amp, Vacuum Tube Voltage Regulator plus Vacuum Tube AC Feedback Amps.

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THE CROSSOVER

The crossover for this 'speaker had to be simple. More complex crossovers take power from the drive units, reducing sensitivity. Second order filters (6dB/octave) use few components (just two) and give a usable rate of roll off that,

with careful alignment, is sufficient for good quality drive units.

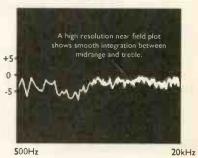
The tweeter is fed from a second order high pass filter as shown in the circuit diagram below. The capacitor should be a high quality polypropylene,

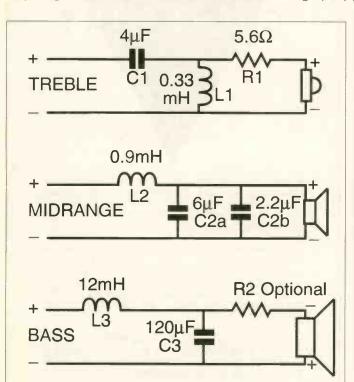
and the inductor air cored for cleanest and smoothest sound. A 5.6Ω resistor is used to attenuate the treble level down to match that of the midrange and bass, and it also helps to give a smooth impedance characteristic through the treble. This resistor gives a flat response to the loudspeaker, but it can be varied between 4.7Ω and 6.8Ω to suit personal tastes. The lower the value the brighter the treble will be.

Because the midrange cabinet was designed to mechanically roll off bass, no series capacitor is needed to filter any remaining bass from it. At the top end, a second-order low pass filter is used to roll off the upper midrange to match the tweeter. Use a high quality 2.2µF polypropylene capacitor in parallel with a 6µF Alcap for best results, along with an air cored inductor.

The bass driver is fed from a second order low pass filter. Both components have high values, so a reversible (bipolar) electrolytic capacitor has to be used, along with a high power ferrite cored inductor. If you find the bass too heavy in your listening room, a low value series resistor can be used to reduce the bass level, say between $1-3\Omega$.

Midrange-To-Treble Integration Frequency Response





TWEAKING KLS3

Apart from the crossover tweaks already discussed, there are several other things that will affect the overall sound.

Firstly, the reflex ports can be made either longer or shorter to change the box tuning. Making the ports longer moves the tuning frequency downwards, giving a flatter and deeper bass response. But this will tend to excite small rooms, resulting in a boomy or overblown sound. In smaller rooms the ports should be shortened, which reduces bass depth and peaks bass higher up, giving more subjective speed and punch.

Spiking the cabinets to the floor with a suitable spike kit will improve bass definition too. Spike kits are available from most kit loudspeaker suppliers and from stand manufacturers such as Apollo and Target.

The tweeter used has a very wide dispersion characteristic.

This gives them a spacious sound, but cleaner, more precise treble can be had

SOFT FOAM RING

by glueing a thin piece of soft foam around the dome of the tweeter to restrict its dispersion and lessen reflection

of walls and ceiling. Images will also come into better focus

Being a three way speaker, KLS3 can be either single, bi or tri-wired. We'd recommend bi-wiring, connecting the tweeter and midrange together and driving the bass with a separate cable run. But for those with plenty of spare cable around, tri-wiring will bring a subtle improvement.

Good quality internal cable should be used to connect the crossover to the drive units, and because of the small quantity used it makes sense to use silver solder. We do not advise you to solder the wires to the tweeter however, as a touch to much heat will damage it.

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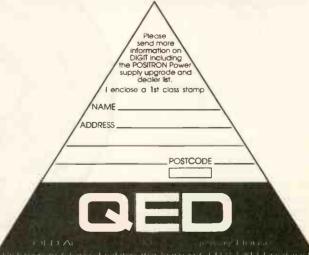
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CONSTRUCTION

The cabinets are constructed from 25mm MDF, which results in a very solid and inert enclosure. It is easier and far quicker to cut all holes for drive units, ports, terminal dish etc before you start to glue the cabinet together. It also reduces the amount of dust inside the cabinets which can find its way into the open voice coils of the drive units. I glued all panels to produce a permanently sealed enclosure, subsequently inserting all items through the drive unit holes.

The plans below show the general construction. The speakers can conveniently be built up on one side panel, laid flat. After the front, rear, internal top and bottom panels are glued into position, I put on the other side panel and held it down with weights until

the glue set. Remember to do a dry run first to check that all the panels fit snugly together. In my case, even though the MDF was cut by a professional woodworker, it had to be sanded to size for a perfect fit.

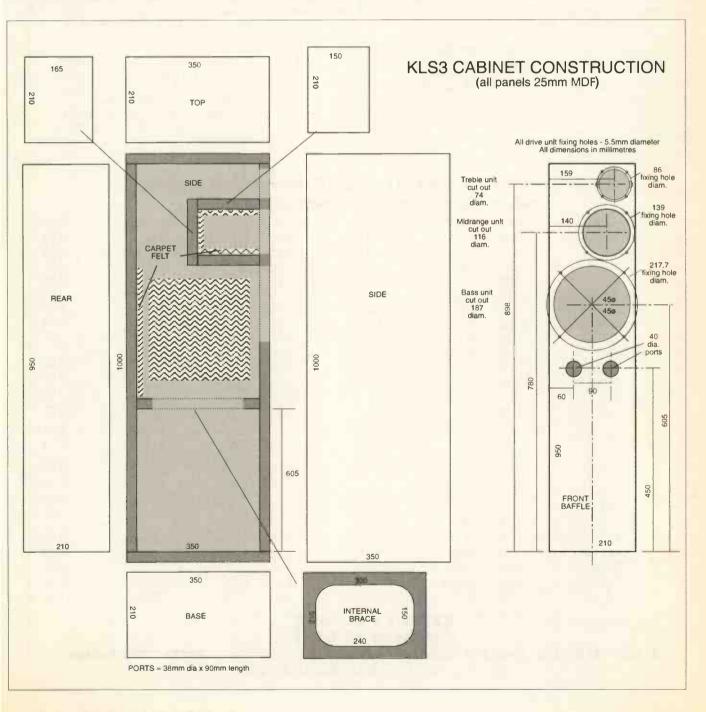
Using Evostick Resin-W, apply the glue to the edges of the panels. They can then be slid into place, their 25mm thickness being enough to stand steady without panel pins. Any excess glue that oozes from the joins can be wiped away lightly with a damp cloth.

To ensure that the panels are firmly pressed together, either place suitable heavy implements on top of the cabinet, or use thick, stretchy carpet tape wrapped around the cabinet to pull the pieces together. After this last step, check that the cabinet is square and that all the sides are square. The glue should still be

wet enough to allow the panels to be gently pushed into line.

Once the cabinets are dry - ovemight is normally enough for the glue to reach full strength - they are ready for the internal damping to be fixed into place. Small squares of carpet felt should be glued to each of the surfaces in the midrange chamber, and onto the sides and back of the main bass enclosure. This helps to absorb the majority of the sound wave that would otherwise be reflected off the rear wall of the cabinet and back out through the drive unit.

The whole cabinet, including the midrange enclosure, is then lightly stuffed with long hair wool, to further absorb reflections and reduce the effects of standing waves. Of course, you are free to experiment with other forms of panel treatment: BAF and Deflex pads for





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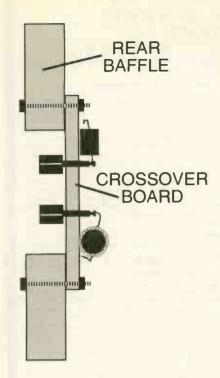
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example. But we find that the combination of soft carpet felt glued to the panels together with long hair wool stuffing to be extremely good, as well as being cost effective.

Mount the crossover as shown in the diagram above. Because inductors, being magnetic components, have a field around them, they need to be spaced well apart and at right angles to each other to minimise inductive coupling. Again, a recommended layout is shown below.

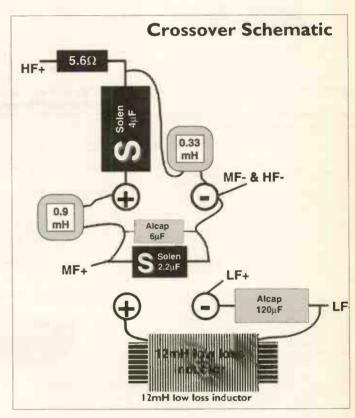
The components can be fixed to the crossover board with PVA glue, but I find a holt-melt glue gun holds them in place just as well, but the glue is more easily removable.

The wires for the midrange unit have to pass through a small hole in the midrange chamber. It is very important to seal this hole either with hot-melt glue or PVA. The drive unit can now be soldered to these wires and screwed into the front baffle. The tweeter should have wires attached using slide-on terminals to

prevent heat damage from a soldering iron. The tweeter can then be fitted in, the wires passing down over the back of the midrange enclosure to reach the crossover positioned against the input terminals. A foam gasket made from draft excluder (you can get it in any hardware shop) should be stuck to the rear of the drive unit frames where they mate with the cabinet, to give a good airtight seal.

TESTING

A simple test to reduce the risk of any damage to your amplifier when you first plug in, is to check that the impedance of the loudspeaker with a simple multimeter. Using the resistance setting they should measure around 4Ω (their DC resistance) across the terminals. If there is a short anywhere, this simple test will show it with a reading below 1Ω .



SOUND QUALITY

An independent view by David Harris

On seeing the impressively large speakers which Dominic recently designed my initial feelings were that they would sound pretty dramatic, especially using high quality drive carbon fibre drive units. The lowest bass was reproduced with remarkable ease, possessing a nice, warm, rounded sound yet controlling the huge orchestral bass drum resonances heard on Stravinsky's Fire Bird suite extremely well. The bass remained both tuneful and rhythmic all of the time.

Vocals were handled very naturally, coming across as life-size with a nice crisp, dry edge to them. Seal could be visualised within the room when

performing Whirlpool from his debut album, the KLS3s putting almost no strain on his vocal talent. Choral work also had a wonderful openness about it; Mozart's Mass in C carried such atmosphere that the listening room expanded towards concert hall size with the '3s keeping a tight focus on soloists throughout the piece. The sheer breeziness of their overall character was excellent.

Listening to a Ronnie Cuber Live at the Blue Note (CD) highlighted another of these speakers strong points - rhythm. They kept a tight, foot-tapping pace going relentlessly, cymbals crashed with quartz-locked accuracy leaving you to play 'air drums' from your armchair!

The KLS3s have a sweet, open sounding treble which gives a high

definition to the midrange, painting a clear picture of the music. It could however be a little lightweight at times, cymbals occasionally lacking in body and depth, but all-in-all a welcomely inoffensive, delicate sound was produced.

Imagery was particularly good. Vocalists and instruments had pin-point focus, generating a believable sound-stage of excellent depth. On Seal's hit Killer the keyboards drifted their way in from about ten yards behind the speakers, as did his backing vocals, the sound filling the entire room.

To sum up, the KLS3s can best be described as a very open sounding speaker possessing excellent qualities of imagery and rhythm and give the listener a good deal of insight into the scale of the music being played.

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1992/94 248 Pages. 247 x 190.

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All the linformation you need to build the loudspeaker system you a diways wanted but could not afford. Easy ways to pick the exact box size, the ideal drivers, and the correct way to feed the music to your new super loudspeaker system. Over 140 pages packed with important design data.

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LOUDSPEAKERS; THE WHY AND HOW OF GOOD REPRODUCTION. G.A. Briggs This easy-to-read classic, last revised in 1949, introduces the reader to concepts such as Impedance, phons and decibels, frequency response, reponse curves, volume and waits, resonance and vibration, cobinets and baffles, horrs, room accoustics, transients, crossovers, negative feedback, Doppler and phase effects, and much more. A provocative survey of the right questions about sound reproduction.

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WARNING

Be extremely careful when screwing drive units in and out of the cabinets. One slip with a screw driver and they're useless. We recommend using cross head screws which reduce the chance of this happening.

Do not try and solder wires to the terminals on the tweeter. They are mounted on plastic which will melt if too much heat is applied, and the fine wires connecting the voice coil will vaporise, rendering the unit useless. Use small push-on receptacle clips.

PARTS LIST

Drive Units

Tweeter Midrange Bass Audax TW025MI Audax HM130C0 Audax HM210C0

Crossover

RI R2 C1 C2a C2b C3 L1 L2 5.6Ω*/5W, non-inductive I-3Ω*/10W 4μF polypropylene/50V min. 6μF Alcap/50V 2.2μF polypropylene/50V min. I 20μF Alcap/100V 0.33mH air core (0.71mm wire) 0.9mH air core (0.71mm wire) I 2mH ferrite core (0.5Ω)

*RI can be raised or lowered to set treble level to individual taste. R2 is optional and can be used to attenuate bass in rooms where it may become overblown.

Impedance

Reflex Ports

38mm diameter x 85mm length.

MEASURED PERFORMANCE

Using our standard third-octave analysis with a pink noise test signal the frequency response shown below is very flat and smooth. There is a small dip around 1kHz which can be seen more clearly on the high resolution near-field plot on page 9. It is not a crossover dip, more likely a cancellation caused by the rubber cone surround of the midrange unit

This kind of smooth and flat frequency response was obtained by first using computer crossover and cabinet analysis packages, and then fine tuning with our FFT spectrum analyser. Of course, tuning was combined with listening tests to ensure that the result was subjectively an improvement.

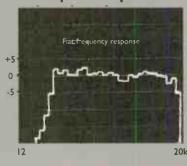
The second frequency response plot shows the effect that driving KLS3 with a high output impedance (6 Ω) amplifier would have, such as our own 300B zero-feedback valve amplifier. The midrange is pushed forwards slightly because of the impedance hump at this point, but still remains essentially flat.

The impedance curve is again very smooth, part of the aim of the design. This ensures that response variations due to high amplifier output impedance is kept to a minimum. The overall impedance figure of 9Ω and high 90dB sensitivity show what an easy load KLS3 is to drive.

KLS3 is suitable for a wide range of amplifiers including specialised designs with

zero feedback. I'd suggest a minimum of 20watts for good sound level in a normal sized listening room. **DB**

Frequency Response with Low Output Z Amplifier



8 0 10 20 50 100 1k 20k

Smooth impedance curve

Frequency Response with High Output Z Amplifier



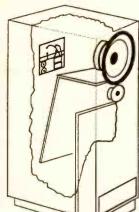
A pack of KLS3 drive units is available for £220. See page 17 for details.

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FISHER SA-100



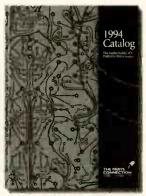
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High Technology Drive Units From Audax

At last, a chance to get your hands on the latest drive unit technology and materials. We'll be stocking a small range of quality drive units from specialist manufacturer AUDAX, including the carbon fibre units and fabric dome tweeter used in the kit KLS3 design in this supplement. All of the units selected below have been picked for high performance in domestic hi-fi loudspeakers. The cone drivers have solid cast chassis and gold plated terminals.

All of the units are supplied with full specification sheets complete with suggested bass alignment. Most units are held in stock for fast delivery. (Please phone to check).

TWEETERS

TW025M0 (25mm) £15
Sensitivity 92dB
Power 55watts
Recommended range 1kHz-20kHz
Comments: Good for two-way systems
with 8inch bass units.



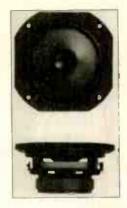
TW025M1 (25mm) £16
Sensitivity 92dB
Power 70watts
Recommended range 2.5kHz-20kHz
Comments: Suitable for three-way
systems or with 6.5inch bass units.

Tw034X0 (35mm) £25
Sensitivity 93dB
Power 70watts
Recommended range 700Hz-20kHz
Comments: Use in sensitive two-way
systems with 8-10inch bass units.

CARBON FIBRE UNITS

HM130C0 (4inch)
Sensitivity
Power
Recommended range

£40
90dB
50watts
100Hz-5kHz



Comments: Excellent mid-range unit in three-way systems.

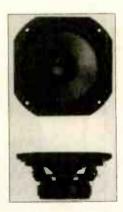
HM170C0 (6.5inch)

Sensitivity

Power

Recommended range

Comments. Modern driver for high quality two-way systems.



HM210C0 (8inch) £55
Sensitivity 91dB
Power 70watts
Recommended range Bass-1.5kHz
Comments: Light and fast driver suitable
for two-way or as dedicated bass in
three-way systems.

HIGH DEFINITION AEROGEL UNITS

HM130Z0 (4inch) £45
Sensitivity 93dB
Power 50watts
Recommended range 200-5kHz
Comments: Ultra stiff and light midrange unit for three-way systems.

HM170Z0 (6.5inch) £50
Sensitivity 92dB
Power 60watts
Recommended range Bass-3kHz
Comments: Modern light and fast unit for two-way systems.

HM210Z0 (8inch) £60
Sensitivity 91dB
Power 70watts
Recommended range Bass-2kHz
Comments: Crisp and dynamic bass for two- or three-way systems.

DOPED PAPER UNIT

HM170G0 (6.5inch)

Sensitivity

Power

Recommended range

Comments: Cast chassis doped paper
unit with smooth response.

AUDA	X DE	RIVE	UNITS

0 0 0 0 0	PRICE LIST AND ORDER FORM
	Qty £15.00 TW025M0 (25mm) £16.00 TW034X0 (34mm) £25.00 HM130C0 (4inch) £40.00 HM170C0 (6.5inch) £45.00 HM210C0 (8inch) £55.00 HM170Z0 (6.5inch) £50.00 HM170Z0 (6.5inch) £50.00 HM210Z0 (8inch) £60.00 HM170G0 (6.5inch) £35.00 KLS3 Driver Pack £220.00
	All prices are exclusive of postage & packing. For U.K. please add £5.75 for a pair of tweeters or one chassis unit, and £10 for anything above. Overseas please contact us for rates.
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Wilmslow Audio





s any discerning sound engineer will tell you, the ATC A scM50 and 100 are the ultimate in accurate low distortion professional monitoring. But what they may not know is that self assembly versions based on these classic monitors are now available from the UK's leading speaker kit supplier, Wilmslow Audio, at a fraction of the seady built price. ATC and Wilmslow Audio have worked very closely on the cabinet and crossover design to ensure that the completed kit lives up to the very high standards associated with the ATC name. As with all Wilmslow products, the ATCK50 and K100 kits come complete with precision machined cabinet panels. crossovers, and all necessary

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THE WILLIAMSON AMPLIFIER

A compilation of original articles describing a classic valve amplifier, reviewed by Noel Keywood.

Theo Williamson worked for M.O. Valve Co after the war. He designed his renowned amplifier in 1947 and modified it in 1949, its claim to fame being very low distortion - a magical 0.1% figure - for what was, then, high power output (15watts). The output tubes are KT66s, Kinkless Tetrodes from

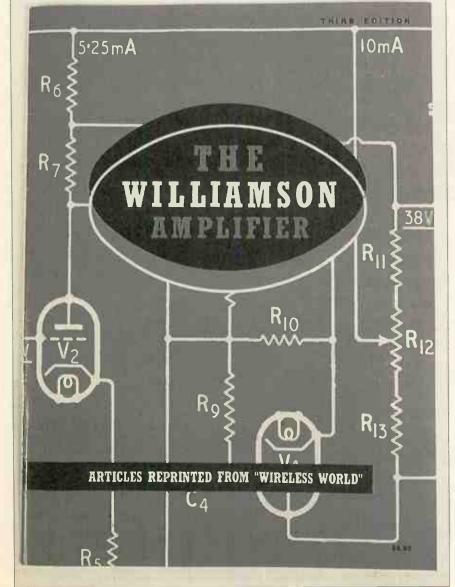
GEC now made in China and available from P.M. Components. The design was published in Wireless World and became relied on the use of negative feedback globally applied, being one of the first amplifiers to do so. As such, it was something of a pioneering design,

well known in both America and Britain. It

discussing concepts such as open-loop gain and stability criteria, doubtless helping a lot of design engineers reach an understanding of such matters in the process.

This 40 page book reprints his original design and a later modified version, plus answers to readers queries, circuits for tone controls, a radio feeder unit and even a cartridge pre-amp. It's the discussions of theory gathered together in one compact source that makes this book valuable and absorbing. Williamson also includes some transformer design equations, as well as winding data and section connection details - rare but valuable information that I've otherwise seen only in the increasingly costly and rare Radio Designers Handbook (long out of print). Since the real secrets of a good audio transformer lie in the way its sections are arranged, something we pore over for hours here to ensure our inhouse designs reach high standards, especially in the notoriously difficult interstage driver transformer for example (300B), this book carries some real nuggets.

However, many people will also want to know what sort of amplifier they will end up with, should they build Williamson's design. In my view, it isn't ideal for beginners; Mullard came up with a simpler equivalent in the later 5-20 and we've produced an even simpler and more robust design in K5881 that also delivers 20watts at 0.1% distortion from kinkless tetrodes with global feedback. However, whether you do or do not intend to build the actual amplifier - and I know many people who've enjoyed doing so, even if one did gripe about latent instability and the difficulty of optimising phase compensation to avoid oscillation the book itself is a delight from the period. It contains quantities of valuable information not now available anywhere, except in treasured hoards. So in reprinting this information, Old Colony Sound Lab of the States have made available the wherewithal for audio enthusiasts to once again get really involved in their pastime - and that's why we've chosen to sell this book in Britain



Available from Hi-Fi World, see page 101.

Audio Note

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offer the following "indus	trial grade" ceramic y	alve bases
Туре	Mounting	Price Ex. UK Vat.
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9-pin for ECC83, ECC88,		1.40
5687, 6350	Chassis with shrou	1.85
	O THE SHOULD	100

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If any of you reading this have possession of any books which contain information relevant to the subject of Audio Design and which would be useful to be subject of Section (and the Section of Section (and Section Section

Circuits, valvedata & Basic Technical Information

If you would like some suggestions which to base a future project around, then we shall be happy to provide you with a circuit pack containing good circuits like ONGARU, KEROMYASSAI, MERIO, DAKU-ON pitus several other power amplifier circuits and the MTube pre-amplifier shinch is line best pre-amplifier circuit and the MTube pre-amplifier shinch is line best pre-amplifier circuit with where come across. Just send a stamped self addressed At-sec meredope, together with 5.00 pounds in small denomination, or if you live outside the UK a USS 15.00 in \$ bifts will do, please do not send informational Response Couptors or International money orders, as they cost more to cash than their value.

We can also supply a set of data sheets for the most commonly used valves. ECC82, ECD88/5922, T2AV7/6072A 7025/12AV7/MA/CC033, 6087/, 3008, 21/11/47, 648, E348/667, 243, 546, 1436, 6244/584, E184/6805, 6/9667, 6,565, 588/16.6/9/GC/11/66, Apian send a stamped set addressed An elevelope together with 4- 400 in small denomination stamps or if outside the UK another US\$ 15.00 will suffice.

Since nothing really exists which gives a reasonable background to the subject of valve amplifier circuit design, Guy Adams and I have written and assembled a number of articles and extracts from old books which give some background to the subject, on one teged to become an instant expert. but it will serve as a useful interence for the beginner as well as the more advanced, the have expanded his limit-peach to include even more useful information, so if you have already bought the old pack, just send § 200 or USS 5:00 For the half pack a small charge is required, this time £ 7.00, in small denomination stamps with a stamped self addressed envelope, or outside the UK, please send US\$ 25:00.

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This is one type of freedback that we are not entirely against Positive Feedback is the club magazine for the Oregon Triode Society with aspirations towards greatness, not unifiee the great underground magazines of the 1 970's. It is a quarterly publication of they, controversial commentary, by in-house writers, members, as well as various industry doyers on the subjects of music, audio, bechnology and the quest for musical sufficiently. If or music, audio, bechnology and the quest for musical sufficiently. If or music, audio, bechnology and the quest for which tends to view the world in the content of what new products is available right now, without giving much perspective backwards. Positive Feedback is available at 6:00 per issue.

COMPLETE KITS

Al the current moment the following kits are under development, and should be available during 1994, the sequence of introduction may be different from the number, as we expect the IXIT THREE to become available in March 1994.

each OUTPUT TRANSFORMERS Specif (cations . PP = Push Pull PPP = Parallel Push-Pull SE = Single-ended PSE = Single-ended Parallel UL signifies 43% ultralinear taps . as a general rule we do not condone the us of UL-taps , as we consider these detriment to sound quality - • Dynaco

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products are designed to criteria which are and will be understood or they are listened tof

broad to the part istened to in addition to the output transformers offered below, we offer a design in addition to the output transformers offered below, we offer a design acrovice, where we can supply almost any requirement for wideband transformers, institute for interophones, moving coil carriidges, line input, praise splittler, interstages, driver or power output, we design and manufacture prototypes in-house, the cost for this page design is 1 200.00, prototype cost is calculated on a per case basis. We can also produce producing outputies.

Sizes are given as Wwitth/Height/Depth, where depth is the depth of the coil it set and width is the length of the core.

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3H/250mA for ONGAKU/Cu		24 00
5H/150mA		21 00
5H/400mA		31 00
10H/125mA	63x74x76 mm	26.00
10H/200mA	98x65x83 mm	33.00
20H/50Ma	68x56x58 mm	24 00

Unio NOTE PAPER IN OIL COPPER & SILVER FOIL SIGNAL CAPACITORS.

We are currently developing a two further ranges of paper in oil capacitors where instead oil using alum inium foil as in the above paper caps, in the first range we use an oxygen tree copper foil with 99.99% put is solid silver lead out wires, these coopperfoil paper signal capacitors are considerably bettler than the standard offenings. Secondly to "bridge" the price qualify gap between the more standard paper/oil caps and the Japanese hardrands Chiler foil signal capacitors, which are prefly staggering in qualify, even if I have to say this myself (as I am the only one with other heard the samples so far) the silver foil caps will also have solid silver lead not writes. To start with there will be a lew values/vortages of each mariable.

AUDIO NOTE COPPER FOIL PAPER IN OIL CAPACITORS

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0.15mF	630 vo	35x22 mm	16 45
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0.47mF	630 voit	56x38 mm	27.45
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AUDIO MOTE !	SILVER FOIL PAPER IN	DIL CAPACITORS.	
047mF	630 volt	14x46 mm	41.00

Price ex UK Vat.

AUDIO MOTE	SILVER FOIL PAPER IN	DIL CAPACITORS	
0.047mF	630 volt	14x46 mm	41.00
0.1mF	630 voit	16x46 mm	74.00
0.15mF	630 voit	22x36 mm	101.00
0.22mF	630 voit	19x46 mm	135 00
0.47mF	630 volt	25x46 mm	196.00
ImF	630 volt	38x46 mm	486 65

AUDIO NOTE SILVER FOIL SIGNAL CAPACITORS AUDON MOTE SIL VER FOLL SIGNAL CAPACITORS
Best signal capacitors available, quily really speaks for liselit, used in amplifiers like ONGAMI, KEGON, CAKIL-ON and MTTube Silver, handrande in revigilimeted quantilises of Audio Nabes Selicity in Tolyro, Japan. These capacitors use a fine myter film dialectric, and are manufactured using considerable resistent on the foll and dialectric to give the best possible contact and the least scope for internal resonance.

Value	DC Voltage	Price ex UK Val
0.01 mF	500 volt	177 00
0.02mF	500 volt	211 75
0.05mF	500 volt	346 75
0.1 mF	500 volt	645 75
0.2mF	500 volt	995 75
0.211	DUD AOK	995 75

AUDIO NOTE PAPER IN OIL RESERVOIR CAPACITORS Mainly

Value	DC Voltage	Size Price Ex	UK Vat.
2mF	400 volt	30x40x55 mm	26.75
2mF	630 volt	35x45x72 mm	33.65
2mF	1000 volt	45x45x72 mm	41.75
2mF	1600 volt	50x70x72 mm	45.95
4mF	1000 volt	45x45x1 20 mm	49.95
4mF	2500 voit	70×70×120 mm	265.75
10mF	1000 volt	70x100x100 mm	96.75
12mF	1000 volt	70x100x120 mm	109.95
12mF	1600 volt	100x100x120 mm	136.75
12mF	2000 volt	100x100x220 mm	159,75

POTENTIOMETERS.

Best available from sound	quality - price viewpoint, made by N	oble in
Japan, high quality condu	thre plastic film. Volume Controls Im	pedance
Construction Price Ex. UK	Val.	
1 00KOhm Stereo	Frame type, PCB mounted	3.45
	Encapsulated type, PCB mounted	12.65

A better alternative is the KO-ON volume controls which are used in priamplifiers like the M7Tube, M7Line, and in a mono version on the in the NEIRO, KASSAI KEGON and GAKU-ON, these are very good sour

Impedance	Construction	
IOOKOhm Stereo	Encapsulated	32 2
100KOhm Mono	Large Encapsulated	70 65
100KQhm Stereo	Large Encapsulated, high quality	107 45
Balance Controls		
1 00KOhm	Frame type, PC8 mounted	3 96
100K0hm	Encapsulated type, PCB mounted	14 15
KO-ON also makes a ve	ry good quality 100KOhm balance contr	
to the encapsulated 100	K pot, this costs f 32 25	

AUDIO NOTE PRECISION CARBONFILM RESISTORS.

In addition to the non-magnetic tantalum resistors, we are going to stock a range of precision golopistic carboritim resistors, in many cases the carboritim resistor is preferable in jour are building an amplifier based on an old dirout, like for example the WFSI or another circuit of similar withape with sall be socioling values suitable for projects here the WFSI in 1/2 and 1 wait values, these resistors are made especially for us by a major

They cost for the	1/2 watt	£3 30 each	
		1 watt	£4.85 each
		2 watt	£6.89 each

In most hardwired valve power amplifiers it is frequently difficult to get the HT and heater raits property suspended and separated, safely and neatly from the chassis, this especially applies when building amplifiers using the realty high voltage diretary heater fronces (EE, 21, VT-42, 845, 843, 304TL, OATO) etc. When planning design like this, it is important to incorporate suitable layout from the start and the AUIDI NOTE stand-orth South German or less mandatory in that posters. They are screw-in type with steatile insulator and either a wrap-round turned "head" on the single way version or separated solder sides on the main-law version.

Type No	Number of Tag	s Hebht/Length	Solder Connection	Chassis Fixing	Price Ex. UK Vat
AN-421	1	25.5 mm	Wrap-round	Screw-in boll	1.41
AN-422	1	17.4 mm	Wrap-round	Screw-in bolt	
W-423	1	22 6 mm	Solder slot		1.41
AN-452	2	Adjustable, 1 7mm	Solder slots	Screw-in Oual bolt screw-in	1.41
AN-453	3	Adjustable, 24mm	Solder slots		2.42
N-455	5	Adjustable, 32mm	Solder slots	Dual bolt screw-in	3 05
N-458	В	Adjustable, 58mm	Solder slots	Dual bolt screw-in	4 04
W-460	10	Adjustable, 72mm	Solder slots	Oual bolt screw-in	5.79
W-476	6	25mm/45mm	Solder slots	Oual bolt screw-in	7 31
N-479	9	25mm/66mm	Solder slots	Screw-in bolts	5 35
		23/14/00/11/1	20/06/ 2/0/2	Screw-in bolts	7 53
AUDIO MOTE	AUDIO QUALITY OUT	DIST TRANSCORMENS			

AUDIO MOTE AUDIO C Single-ended Circuits	DUALITY OUTPUT TRANSF	ORMERS			
Suggested Valve EL84/ECL86/6V6 3008/Z83/684G EL34/ECA7 2A3/684G 588/8/466 211NT4C 211NT4C/845 3008 845 21 NT4C	Max C1 A Power 20 warts 25 wats 30 warts 30 wats 50 wats 50 wats 50 wats 50 wats 50 wats 75 wats 75 wats	Prim-Sec. Impedance 2K6 – 4/8 Ohms 2K5 – 4/8 Ohms 1 K5 – 4/8 Ohms 1 I/25 – 4/8 Ohms 1 I/25 – 4/8 Ohms 1 I/25 – 4/8 Ohms I/X – 4/8 Ohms I/X – 4/8 Ohms I/X – 4/8 Ohms 5K – 4/8 Ohms	Size/Weight 117x98x90 mm 117x98x90mm 115x98x95mm 98x82x95mm 115x98x95mm 117x98x100mm 112x134x1-50mm 13xx1434x1-50mm 13xx1414x1 30mm 13xx14x145 mm	Max Current IIOmA PSE 90mA SE 1 80mA PSE 1 30mA PSE 1 40mA PSE 150mA SE 150mA PSE 1 80mA PSE 2 40mA PSE	Price ex. UK VAT 87 00 91 00 113 00 97 00 106.00 114 00 151 00 172 00 237,00
New SE Product			10/12 10/11/10/11/11	Z-MAN F SE	2

EL34/6550/KT88 300B/2A3/684G 6L6G 107 00 Push-Pull Circuits 8K-4/8 Ohms 6K-4/8 Ohms 5K-4/8 Ohms 6K6 -4/8 Ohms 3K -4/8 Ohms 6K8 -4/8 Ohms 6K8 -4/8 Ohms EL84/ECL86/6V6 EL34/6L6G/5881 88x73x80 mm 59 00 63 00 88x75x80 mm 108x91x90 mm KT88/6550 PP PPP 98x82x83 mm 108x91x90 mm KT88/6550 KT88/6550 125×100×1 13 mm UL PP UL PP/PPP Pure Silver V/fired Outputs 300B/2A3/ 6B4G 211NT4-C/845 2K5 - 4/8 Ohms 10K - 4/80hms 117x98x90 mm 112xt34xt50mm

The AUDIO NOTE silver wired outputs listed here are de ONGAKU or the KEGON, but they are exceptionally expe ver wired outputs listed here are designed and made in the UK, we can supply the AUOIO NOTE Japan manufactured outputs for the DN, but they are exceptionally expensive, as you would expect from items that take upwards from 100 hours each to make, for example an output transformer for an ONGAKU costs £16,500 on.

This range relates to our finished products mains transformers are notoriously difficult items to offer as the number of permutations of HT and Heater voltages are almost endiess. We have added mainstransformers for making replicas of the KASSAI and DNGAKU as there has been considerable call for these, filterable are preparing mainstransformers for me MEQ 1 described in Sound Practices issue 1, we shall continue to expand the range as opportunities and our experience with your requirements improve.

Primary Voltages	Secondary HT Windings	Secondary Heater Windings	Price Ex. LIK Val
Dv/100v/1 10v/120v	0v - 230v al 350mA	Ov-12.6v at 1 Amp	34.00
0v/220v/230v/240v		3.1 5v-0v-3. 1 5v at 4 Amp	34.00
120v/1 10v/100v/0v	0v - 230v at 0.4 Amp	0v-12.6v at 1 A	44.00
0v/100v/110v/120v	2007 01 017 1219	3.15v 3.15v at 4 Amo	41 00
120v/1 10v/100v/0v	300v - Ov- 300v at 60mA	12 6v — Ov at 1 5A	
1 00v/11 0v/1 20v	3007 - 01- 3007 at 00104	6 3v Ov at 600mA	46 00
		6 3V UV at buuma	for M7Tube Pre-amp
			with 50H choke input
Ov/100v/110v/120v	0v 290v at 40mA		filter
0v/1 00v/1 1 0v/1 20v	UV - 29UV BE 4UITIA	12 6v-0v at 1 5A	26 00
0v/l 00v/l 1 0v/l 20v		Ov - 6.3v at 300mA	
0v/1 00v/1 1 0v/1 20v	3 1 0v-244v-0v-244v-3 1 0v at 3, 1 5		72 50
1 20v/11 0v/1 00v/0v	320mA	1 2.6v at 1.5 Amp	
	0v-920v at 1 60mA	0 - 1 Ov at 4 Amp, 0v-6 3v at	98.00
0v/I 00v/I 1 0v/I 20v	1 50v-1 50v at 50 mA	1.5A, 0v - 5v at 2.5A	
120v/1 10v/100v/0v	390v-0v 390v at 200 mA	3 15v-0v 3 15v at 1 2Amp, 7v	86 70
0v/l 00v/l 1 0v/l 20v	1 70v at 50mA	at 3A, 7v at 3A, 5v at 2A	
120v/1 10v/100v/0v	425v-0v-425v at 220mA	3,15v-0v-3.15v at 2.5A.	96.60
100v/l 10v/120v		7 Ov-Ov at 2A, 7 Ov-Ov at 2A.	for KIT ONE a KIT
		5 Ov-Ov at 3A.	THREE MONO channel
		3.1 5v-0v-3. 1 5v at 750mA	THE WORLD CHANGE
1 20v/11 Ov/I 00v/0v	390v-0v 390v at 200mA	1 70-0v at 50mA, 7 .0v -0v at	1 07 .00
1 00v/l 1 0v/l 20v		3A, 7 0- 0v at 3A, 5v - 0v at	101.00
	_	0110 01 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2A
For KASSAI replica			ZA.
		3.1 5v-0v-3. 1 5v at 1. 2A	
1 20v/11 Ov/I 00v/0v	380v Ov 380v at 200mA	1 50v-0v at 1 50mA, 1 0v-0v	4.00.00
1 00v/l 1 0v/l 20v	0.000 11 20011	3.25A, 1.0v-0v at 3.25A.	1 37 ,00
			F: 0
		5v - Ov at 3A, 5v - Ov at 3A,	For ONGAKU replica
		5v - Ov at 3A, 5v - Ov at 3A	
		6 3v - 0 6.3v at 1.25A	

We also have a mainstransformer/choke kill for the WE91 power amplifier as shown in Sound Practices, this combined with our single-ended output transformers with SIOhm primary impedance, will make a very fine replica of this classic amplifier.

AUDIO NOTE PAPER IN OIL SIGNAL CAPACITORS

AUDIO BOTE PAPER IN OIL SIGNAL CAPACITIONS
These handmade signal capacities as onically superior to any of the plastic or other paper types we have come across. If you have never experienced the difference that a realty good paper/oil capacition can make in a valve amplifier, then you really should try. Our specially made paper/oil caps have a life, colour, lack of hardness and eventess of dynamic behaviour across the frequency range, which is guaranteed to brighten up your day! Recommended as replacements in old and new valve amplifiers alike (and need in the event in the odd transistor amplifier), and essential for DIV projects. In line with environmental standards, all AUDIO BOTE paper in oil capacitors contain only non-look, biodegradative expetable oil, the paper is a specially treated and impregnated by a method that enhances longevity and sound qualify, to ensure optimum performance all round.

Value	DC Voltage	Size	Price ex. UK Val
0.015mF	400 voit	21x9 mm	2.85
0 022mF	400 volt	35xlOmm	3.75
0 047mF	400 volt	32xl 1 mm	4 10
0 082mF	400 volt	33x14mm	425
0 12mF	400 volt	33x14 mm	4.75
0.18mF	400 volt	32x16 mm	5,15
0.22mF	400 volt	35×18 mm	
0.33mF	400 volt	43x18 mm	5 85
1 4mF	400 volt	70x24 mm	6.75
0.001 5mF	630 voit	1 7x9 mm	14.95
0 022mF	630 volt	20xi0 mm	2 85
0 056mF	630volt	33x15 mm	3 25
0.082mF	630 volt	33xi 6 mm	4.25
0.18mF	630 volt	43x18 mm	4 55
0 22mF	630 voli		5.45
0.33mF	630 voit	52x19 mm 52x22 mm	5 75
0.39mF	630 volt		7 25
0.47mF	630 volt	52x26 mm	7.95
0 22mF	1000 voit	52x26 mm	8 85
0.39mF	1000 volt	56x26 mm	6 95
1.2mF	1000 voit	61x26 mm	11 65
0 22mF		72x40 mm	16.75
0.22mF	1600 volt	60x26 mm	9 65
All Almin MATE paper in all a	2000 volt	70x29 mm	11.55

All **Autoro motts** paper in oil signal capacitors are availype. We are presaring a range of very small picolarad value paper in oil capacitors at the moment in addition to the above. The range of **AUDIO MOTE** paper in oil signal capacitors is steadily expanding, so ask for values that you do not see

UDIO NOTE ACID & CLORIDE FREE SILVER SOLDER

he best solder we have been able to find, does not contaminate the inction, which over time increases junction resistance. Used in all our rightiers from OTO to the GAKU-ON.

Win gri Aleasure	
	Price Ex. UK Vat
50 grammes or about 8 meter 1 mm diameter	19,95

AUDIO NOTE CABLES & WIRES
We are proud to offer the AUDIO NOTE range of high quality copper and silver cotins, speaker and wining cables, which, depending on the overall price of the project, will do justice to any hit system, regardless of price.

Solid 9	9 99%	Pure	AUDIO	HOTE	Silver	Wire

Gauge	Insulation Material	Price per Meter Ex. U
Val		
0.05mm	Polyurethane	16.75
0.2mm	Polyurethane	22 7
0.35mm	ML	24 9
0.6mm	ML	27 8
0 8mm	ML	31 7
1 mm	ML	36 7

The above solid silver wires are suitable for inductors for speaker crossovers, both active and passive or for internal wring in tonearms, arrol fiers

AUDIO	NOTE	Coax	Interconnect Cable	S

Type/Colour code	Construction	Price per Stereo Meter Ex. UK Vat
AN-A yellow	symmetrical 6N	45.00
AN-C red	copper litz coax symmetrical OFH	15 32
NA-C 100	Copper Luz coax	29 79
AN-S dark grey with	symmetrical 99 99%	
y illo v stripe	silver litz coax	84 25
AN-V « grey w	symmetrical 99 99%	
sq tts wo w	s, Iver litz coax	152 35
AN-Vx silver grey	symmetrical 99 99%	
	silver litz coax	382 98

382.9 Coax cables as internal witring cable, this is what we do in amplifiers like the ONGAKU, MYTube etc.

AUDID NOTE Speaks		
Type/Colour code		e per Mono Ex: UK Vat
AN-D green	sunate core 6N copper speaker wiring	6.85
AN-B blue white writing	double strand, screened 6N speaker wire	12 34
AN L blue	doubte strand, screened	
black writing	6N lifz copper speaker wire	25 11
AN SP silver	single core 15 strand 99 99% litz silver speaker wire	106 38
AN-SPx silver	single core 20 strand	
	99 99% litz silver speaker wire	382 98

99% hits silver peaked Vorpor Wiris

We can also provide less explinishe writing wires for hard writing circaits, these PTE insulated silver plated copper wires are 19 strand of 0.15 mm write and come in brown black, blue, print, red, green, orange, violet, white and cred white, Tally cost E 1.60 per meter in any colour.

AUDIO NOTE HIGH QUALITY STEPPED ATTENUATORS & SWITCHES AUDIO 9012 HIGH CUMULT STEPPED ATTENDATORS & SWITCHES These handmade elementators and switches are mandatemed by a friend of Mir Kondio of AUDIO 907E, and represent the best available volume controls and switches you can use in your pre-amplifier, the attenuctor is 45 steps and with sitver/findition pitated contacts/brushes made with an array of bantalum film resisors: The switches feature silver pitated contacts and settlicents.

Type	Value	Price Ex. UK Vat
Stereo Potentiometer /Attenuator	50KOhms	198 75
Stereo Potent armeti	100KOhms	207 75
2 Channel switch	6 - way adjustable	78 75
4 Channel switch	6 - www adjustable	101.75

AUDIO NOTE SELECTED AUDIO VALVES

nound with Extention AUDIO VALIVES.

Our valves are associated from the best variable sources and are tested to the same stringers sandrads that we apply in the production of our own amplifiers, they fall into hor categories, standard production interns and raire, mostly NOS (New OIG Stock) valves which are no longer in production. We have compiled a spacial lest of the NOS tems, which is invaliable on request, bewere the valves on this list are NOT cheep. Standard Stock stores.

Standard Stock Items,		
Type No	Type Price Ex	UK Var
ECC835/12AX7	,,,,	
WA/7025	daubte triode	2 95
E86CC/6922/6DJ8WA/7308	double triods	3 95
EF86/6267/Z729	pentoda	2 45
ECC82/1 2AU7/581 4a	double triode, mil spec	5 75
65N7GT	double triede, U8X base	1 75
65L7GT	double triode, UBX base	2 85
65,17	pentode	1.75
5687WA	double triode very powerful	4,55
6350N/A	dauble triade	4.75
EL84/6805	smail power pullode	1.55
EL84NV6BQ5WA	small power perviode,	
	mil spec version	4.75
6V6GT	small power pentods	2 45
61.6G	medium power pentade	2 75
5881/KT66/6L6WGC	medium power tetrade	4 95
EL34G	power pentade	7.45
6550/KT88	large pow 1 rode	12 45
6C33	powerful regulator	
	indirectly heated triode	2465
6A57/6080	strong regulator,	
	nd rectly heated triode	6 45
	Elizabeth Acceptable and I	
2A3 4-pin	directly heated smail	17.95
2000		57 95
3008	d rectly heated power thode HT-rectifier	3 25
5U4G	HT-recitier	2 25
5Y3GT	HT-rectifier	2 25
5V4GT	HT-rectifier	8.75
GZ34/5AR4	HT-rectifier, very good for	0.73
6X4	pre-amplifiers	2 65
	hic.mining ₂	E 00

RESISTORS

We offer three quality levels of resistor quality, all are 1%, starting will his Beyschlag metalfilm, which are slightly magnetic (as are the vast majority of other mates of metal film resistors), but nonetheless very good sounding as useful on all our UK-made ampfillers up to quality level 3 (the MEISHLIPS) no-feedback triode ampfillers.

Beysch'ag 1 watt 1% resistors up to 500KOhm, f 0 11, above 500KOhm f 0 13 each

HOLCO

Better sound quality can be achieved with the H2, 1 watt, 1 % non-magnetic resistors, which we regard as the best "industrial grade" metalfilm resistors shallable. They have one small drawfapit, as they are quite tragit, and require careful handling, do not bend the legs too daga to the body, they may become noisy.

HOLCO resistors type H2 50PPM coal f 0.36 each from 1000hm to 500KOhm, higher and lower values are all £ 0.63 each

AUDIO MOTE HIGH QUALITY CERAMIC VALVE BASES.

All of our valve bases are of the halbest possible of	quality made from steatite ar	nd using the best metal parts from alloys which retain	their spring tension
around the valve put to longer. They are recommen	used as upgrades to most old	valve amplifiers and should be an essential part of any	y DIY project
Type	Maunting	Plating	Price Ex UK Vat
4-pin LDX4 for 3008/2A3/801A	Chassis	Gold	8 25
4-pin UX4 for 3008/2A3/801A	Channe	Neko	7 25
1-pin UX4 WE-type for 300B/2A3/ED1 A	Chassis	Silve	14 75
4-pin Jumbo 4 for 21 I/VT4C/845	Chassis with bayonet	Silher/chrome	159.95
5-pun UY5 for 807	Chassis	Gold	9.75
7-pin B7 for 6X4 OA2	PCB	Silver	6 15
7-gan B7 for 6X4 OA2	PCB	God	7 85
7-pin B7 for 6X4, OA2	Chassis from above	Silver	6 75
7-pin B7 for 6X4 OA2	Chase's from above	Gold	7 95
8-p n U8X für (B.34, 6550, 5U4G)			
GZ34, 6L6G, e c	Chassis	Silver	5 65
8-pin U8X for EL34, 6550, 5U4G			
GZ34, 6L6G, etc	Chamile	God	8.65
9-pin B9 for ECC83 ECC88, 5687, 6350, etc.	PC8	S liver	3.85
9-pin B9 for ECC83, ECC88, 5687 6350, etc	PCB	Go d	5.75
9-pin B9A for ECC83 ECC88			
5687, 6350 etc etc	Chassis from above	Silver	4 45
9-pin 89A for ECC83, ECC88,			
5687, 6350, etc. etc.	Chassis from above	Gold	6 75
9-pin B9A for ECC83, ECC88, 5687 6350 etc	Chassis from below	Silver	4 95
9-pin B9A for ECC83, ECC88, 5667, 6350, etc	Chassis from below	Gold	7 15

Topicap For 807 pintode inc. Nividel 9.75 You may want to start your project with less overall cost, and for this purpose we can ofter the following

Type	Mounting	Price Ex. UK Vat	
8-p.n for EL34, 6550, KT66, 6L6G	Chang a with bracket		1.4
a to page FOOM SCOT OUTO	Character to the second		1.8

In most hardwilled valve power amplifiers in its frequently difficult to get the HT and heater rails properly suspended and separated, salely and neatly from the chassis, this especially applies when building amplifiers using the really high violage directly heated trodes fille 211, VT4C, 845, 849, 304TL, Date of the White planning design filter that is, it is important to incorporate suitable layout from the start and the AUDID MORE stand-oils bound be more or less millimitary in that contact. They are screw in type with stoutile inequalitor and either a wrap-round turned "head" on the single way vorsion or separated solder stots on the multi-vary versions.

Type No	Numlier of Tags	Height/Length	Sol or Connection	Chassis Fixing	Price x UK Vat
AN-421	1 -	25.5 mm	Wrap-round	Screw-in bolf	1.41
AN-422	1	17.4 mm	Wrap-round	Screw-in bolt	* 41
AN-423	i	22 6 mm	Solider s.ci.	Screw-in	1.41
AN-452	2	Adjustable 17mm	Soldo siots	Dual bolt screw-in	2 42
AN-453	3	Adjustable 24mm	Solder slots	Dual bott screw-in	3 05
AN-455	5	Adjust 32mm	So an slots	Dual bolt screw-in	4.04
AN-458	8	Adjustacle 58mm	Sol or slots	Dual bolt screw-in	5 79
AN-460	10	Adjustable, 72mm	So aw slots	Dual boil screw-in	7.31
AN-476	6	25mm/45mm	Solder slats	Screw-in bolts	5 35
AN-479	9	25mm/66mm	Sorder sicts	Screw-in balts	7 53

BLACK SATE ELECTRON TRANSFER, High Performance, Graphile Electrolytic capacities.
These are very tille audio parts that promise a quantities of represents when replacing practically my other part, but this is what the BLACK SATE capacitors are considered to the promise and application of the crossover of a speaker will greatly improve seared quality.
We are working on some guidelines acto where, how and which specs of black Gates to use in different circuits, the first such schnical qualifier 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 MOTE Level 2 Signature products use Black 6-16 t-ection Transfer in critical

gnal/power supply junctions.
Is very timportant to note that all BLACK GATE capacitors take time to charge-up or stabilize, when first pull in circuit, depending on type and application.

this "maturing" time can be between	100 and 300 hours			
Value	Voltage	BG-Typu	suggested Use Price E	x UK Vat
47mF	25volt	PK	Anywhere	1 65
33mF	35vott	PK	Anywhere	1 75
0.47mF	50 igh	PK	Anywhere	1 05
1 mF	50volt	PK	Arrywhere	1 12
2 2mf	50volt	PK	Anywhere	1.23
3.3mF	50valt	PK	Anywhere	1 38
4.7mF	50volt	PK	Arrywhore	1 68
1 OmF	50volt	PK	Arrywhere	1 87
22mF	50volt	PK	Anywhere	2 68
100mF	50volt	Standard	Arrywhere	5 47
1 00mF	1.00volt	Standard	Anywhere	7 75
1.000mF	1 6volt	Standard	Anywhere	8 22
1000mF	50volt	Standard	Anywhere	24.55
220mF	1 6volt	Standard	Anywhere	4 35
470mF	1 Gyott	Standard	Anywhere	6.35
2200mF	50volt	Standard	Anywhere	13 45
10.000mF	80voit	Standard	PSU smacth r q	234 65
4700mF	1.6vo?!	Standard	Arrywtiere	14.25
47mF + 47mF	500vott - 550v surge	SK-Type	PSU1 iter capacitor	85 95
100mF + 100mF	500vott - 550v surge	SK-Type	PSU filter capacito	101 95
100mF	500roit - 550v surge	SK-Type	PSU liter cap c in	72 75
220mF + 220mF	350volt - 400v surge	SK-Type	PSU litter capecito	92 65
100mF +	100mF-350volt - 400v surge	SK-Type	PSU filter capacito	75.35
22mF	350volt	VK-Type	Decoupling or fitter capacito	18 95
220mF	1 6vp3	F-Type	Low ESR viirsion	6.75
220mF	1 6volt	FK-Type	Ultra few ESR version, comparable to film caps	9.95
1000mF	50volt	FK-Type	As above use anywhere	43 95
2200mF	50volt	FK-Type	As above us anywhere	98 85
2.2mF	50y01	C-Type	For circuits with DC patential difference	2 07
4.7mF	50volt	C-Type	For circuits with DC potential difference	3 35
1 mF	50vot	N-Series	Bipolar for use in negative feedback circuits sto	4.95
4.7mF	50volt	N-Series	as above	5.75
10mF	50volt	N-Series	as above	6.95
47mF	50volt	N-Series	as above	13 75
100mF	50velt	N-Series	as above	18 95
6. BrmF	50valt	Bupolar	For louds with crosss or networks	8.95
10mF	50volt	Bipolar	as above	10.85
22mi	50volt	Bipolar	as above	17 45
47mF	50 volt	Bipolar	as above	27 95
220mF	6 3volt	BG-NxTypu	For super low noise PSUs	11.85
1.00mF	1 6vott	BG-N Typu	For super low noise PSU's	24 65
470mF	1 6volt	BG-N Type	as at ove	28 95
4700mF	35 volt	BG-N Type	as above	210A5
4.7mF	50volt	BG-N Type	as above	6 65
1000mF	50volt	BG-N Type	as above	99 95
2200mF	100volt	BG-N Type	35 3bove	423 35

component list you will hind a listing of all available Black Gate values, together their sums best usage of we can supply a range of more modestry prices components, still good qualify, but more industrial grack stly prices components, still good quality but more industrial grade, if you like

AIKOH Tantalum Film Resistors

This is dimitely the best sounding insident mouble, longer the VISHAV, which may be ok in high feedback transistor amplifiers, but in our opinion calls uncompliment by to the qualities of real Autho Amplification (i.e. derety) header those amplifiers manifely feedback in early and active are in anglo-amplified Class A), this is where you will need the tanalum film resistor for the best

The 1/2 west Shinkph tantalum resistors are non-magnetic and cost f 2 06

Up to now the tandalum film existions have been extremely difficult to get, however, after much persuation and against a minimum quantity, guarantee from Audio Net UK, the much disturbe size a greated to wide the surple of 1/2 will a on introduction that is wall maps which become an inclusive range for AUDIO BOTE, we consider this to be major breakfinitionly, since without a it much improve or major breakfinitionly, since without a firm or improve at the 1 wife or got it is primy difficult to get the very best out of the best circum. An wife in the distance of the properties of the production of the first of ingrain be given long on some values, so be prepeted to wall if the value is not in stock.

The AUDIO NOTE 1 watt 19 tantalum resistor values are 13.70 each

We shall now be working orrocting the 2-waft tantalum resistors made available as well, and who lower perhaps we will be able to build amplifiers in a year's time that have all tantalum resistors in all parts of the ovcul

STANDARD TYPE SWITCHES.

This switch is adjustable 2-6 —way, it has gold placed contacts and a stainless stell ball for best possible corrosion protection and contact, price

Again, KO-SN offers a very nice quality sealed switch 6 way 2 channel at 1 90 65 each

STANDARIS ELECTROLYTIC CAPACITORS. Good quality standard industried hypes Value Voltage Sue Price Er UK Val. 10-volt 18x6 mm axial, 1 tx7mm industriil hypes Value Voltage 100mf 10volt radial 0.23

15x6 mm arrial 0.29

220mF	16vp	Ibx8 mm radiai	0.31
220mF	40volt	13xIO mm radial	0.42
100mF	63volt	13xd0 mm radial	0.47
4700mF	16101	38x18 mm radial	0.82
2200mF	50 o	35x18 mm radial, 4	1x16 mm
aviol	0.87		
10mF	160volt	15xi0 mm radial	0.56
22mF	350volt	25x12 mm radial	1.25
22mF	450 a	41x16 mm axial	1.89
47mF	385/0	25x21 mm radial	2.16
56mF	400volt	30x21 mm radial	237

385 of	5%30 mm radial can	4.45
450noh	48/30 mm radial can	5 85
550valt	112x35 mm radial	
	enny terminals	27 65

RCA BNC BANANA PLUGS RCA SOCKETS SPEAKER & GROUND

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RCA Plugs	
Standard Gold plug	1 55
AN-C God p in	3 65
AN-GP AUB O NOTE go d plug	8.51
AN P AUDIO NOTE Silver plug tellen insulated, non-magnetic	25 53

Type	Most Pr E	E UK Virt
RCA socket pared	Charles d	0.41
RCA socket go'd plated	Chass s mounted	0 65
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BNC Plugs & Sockets

Туре	Price ex. UK Vall	
Standard BNC plug	3 45	
RMC Silver nisted sneket chassis mounted	2.05	

Banana Phugs, Loudspeaker Cable Spades, Chassis Loudspeaker

Type Price Ex	UK Val
Banana plug-gold plated, spring loaded termion	2 45
AUDID NOTE Loudsonniker Cable uptitle sine plated	
non-man c	4 65
AUDIO NOTE AN-STSpeaker Terminal, chassis mounts,	4.05
n.chm' , and red or black	1 85
AUDIO NOTE AN ST/G Speaker Terminal, chass a mounts	2 75
go'd plant if d or linek AUDIO NOTE AN-STR Sometim Terminal, chrisis mounts,	213
fully gold piled no in gnine red or bil 144	75
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FERRITE RINGS

In many systems, especially ones using frame or based amplifued in there is often a problem of incoming RF mixing in oither to day a freep especially from community to the control of the con

AUDIO NOTE COMPLETE KITS.

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Based around the justly famous 3008 directly host ad triod, we see this kill as the introduction to real Audio Array Totalian as 1 cm important aspects of design intertextry Silign Finded No. Finded

Kit One has one 3008 per channel running at 420 voits with 75mA current giving 9/10 waits of the cleanest power you will wer hear, the inputstage Kill One has one 3008 par channel nunning at 420 volls with 75mA currenging 970 was to the clearest borse you will — the hoci, the niputStape core as of a SSNTGT with a 5687 counte hands drive unity number SSPP. The porent supply as a capacitor charter cannot be \$1846 MT rediffer, the heaters are AD heated Component quality as 1 and 1 or 1 central hands of products AUDIO NOTE quary in 1 see SSNTGT with 1 to or 1 central hands of the size of the s

Price 1750 00 incl. Vat., which includes all valves (yes all legal 2 x 3008 needed) but not postage/packing which to UK customers is £12 00, topcover is 199 00 extra. The Kit One is available now.

KIT TWO.

Kit Two features a single 6650WA Sovials telepade running in Single-Ended mode, yielding isome 17 wells of pure Cless A view remission of HT for the output stage stereo chassis and 651-7GT input and 65H7GT SRPP driver stage, componently and chassis as Kit One

Price f 599.00 incl. Vat. includer valves, but not postage/packing cover is extra at 1.99.00. Available in June 1994.

KIT THREE.

Kit Three features 2 x 2008 pe channel running in ling and purelly yelling 16/17 writts in pure Clu. A. this till is on this monitor chassis with valve rectified HT supplies no signal tautack, it uses a 65/HZT double tricde as input valve and a pair of 5687 double tricdes mining in SRPP as

The KIT THREE is as initially a mono version of the KIT ONE with doubte the police, the same component choices and on two chassis instead of

The KIT THREE costs 11,450,00 and will be available in March 1994

AUDIO NOTE (UK) Ltd. Unit 1, Block C. Hove Business Centre, Forthill Road, Move, East Sussex, BNS 6HA. England, Telephone 444 0273 22051 1, fax 444 0273 731498. Direct Line to salem 444 0273 88551 1

HUNGARY puese contact, Merlin Audio 54 U Raday tsz 2 H-1092 Budenest HUNGARY, Te/Fax 01 215-2612

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THE ART OF LINEAR ELECTRONICS BY JOHN LINSLEY HOOD

At last! A book devoted to hi-fi design.

Noel Keywood gets reading.

s good books on audio gradually become scarcer, new ones of merit grow commensurately more valuable. The Art of Linear Electronics has many unusual attributes that mark it out as unusual and, nowadays, peculiarly valuable.

The author, John Linsley Hood, has been involved in audio design all his life, starting off with valves, he told me. Since much of this was within industry, the book is studed with valuable insights into

apparently obscure practical concems such as 'properties of switch and connector contact metals', in chart and discussion form. Not interested? Well, hold on. He builds on this by discussing capacitor and resistor construction, which is of growing importance in real hi-fi as we find that this factor, in conjunction with the materials used, has quite a significant affect upon sound quality in any circuit that is otherwise working well. Future engineers also need to be aware of such

practical concerns as switch contact oxidisation, which can blight a production run by warranty claims just a few years after purchase as products become unuseable.

Pondering on the way mass produced Oriental amplifiers seem almost by magic to go wrong after two or three years, whether this is deliberate in order to stimulate sales and what sort of long term damage may result in terms of perceived reliability, I value Linsley Hood's coverage of this topic. It's one important way in which his book differs from others, especially the otherwise superb Foundations of Wireless and Electronics by M.G. Scroggie.

Few modem electronics books bother to cover valves, yet this one penetrates quite deeply even into valve construction, coating materials, etc which was another surprise. And it includes valve amplifier theory and circuits, discussing with circuit diagrams the Quad II, McIntosh and Williamson circuits, for example.

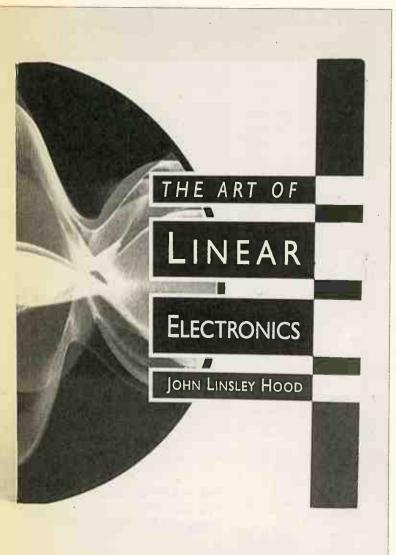
However, Linsley Hood understandably and correctly in my view dedicates most of the book to modern solid state engineering techniques in audio, devoting an entire chapter to 'Feedback, negative and positive', for example. It is in this way that the book reveals its strictly audio perspective, hi-fidelity being very much to the fore, rather than just functional Consumer Electronics.

And that's another way in which the book is unusual - there are many books of a tutorial nature that discuss audio amplifier design, but with no special emphasis on designing for optimum sound quality. With his background in designing audio circuits for Wireless World magazine, John Linsley Hood is well acquainted with audio angst and argument, although the book keeps its feet on the ground in sheer engineering terms; silver foil capacitors and cables don't enter the picture.

MOSFETs are discussed, although I see a comment to the effect that they possess "relatively high linearity", whereas audio designers of considerable experience - notably Tim de Paravicini (EAR) and Stan Curtis (Cambridge, Wharfedale, et al) - tell me otherwise. MOSFETs, I am told, have to be swamped by negative feedback, to which they are amenable due to their excellent gain/bandwidth product, before looking at all decent in audio terms. The book doesn't quite reach this level of detailed analysis and argument, but then that was doubtless not in its remit. It does cover an immense amount, including test equipment, noise and hum, tuned circuits and radio receivers, power supplies, component marking conventions and circuit impedance and phase angle calculations using the J operator.

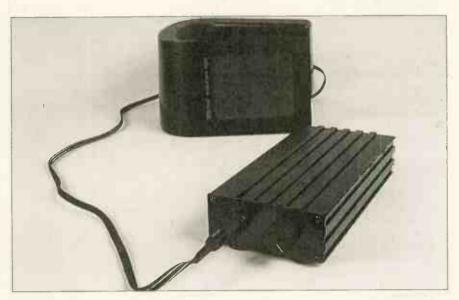
Because of its rare, almost unique nature - I know of no other dedicated hi-fi design book - The Art of Linear Electronics is, for engineers or budding engineers, invaluable. At £16.95 (soft cover), when nearest equivalents lie in the £30-£80 range these days, it's also an extreme bargain in my view ●

Available from bookshops or Hi-Fi World, see page 101.



HIGH QUALITY HEADPHONE AMPLIFIER

A high-quality, single-ended Class A headphone amplifier designed and explained by Richard Brice.



igh-quality loudspeakers deserve a high-quality amplifier to drive them. In just the same way, highquality headphones deserve their own dedicated amplifier designed to furnish them with the cleanest signal that it is practically possible to supply. Sadly, headphone amplifier stages in hi-fi separates, where they exist at all, are often engineered with an eye to simplicity and low cost, rather than with a view to providing an exemplary minipower-amplifier. Because that's what a headphone amplifier really should be and it ought, therefore, to have as much care and attention-to-detail lavished upon it as a designer would when developing a state-of-the-art loudspeaker power amplifier. In fact, arguably more so, because the signals which headphones require are smaller in relation to the amount of distortion products certain amplifiers produce. This article describes my own design for a stand-alone, singleended, Class-A transistor headphone amplifier.

CLASS ACT

I must confess to a personal liking for valves. This isn't so much based upon sound quality judgements as more general aesthetic considerations - bluntly, they look great! You'd have to have a heart of cold steel to not admire serried ranks of glowing tubes. They look - and feel - hot as if they are really doing something. By comparison a solid-state circuit looks lifeless and a bit dull. But looks can be deceptive and a number of my own circuits, which have particularly delighted me in sound-quality terms, have been Class A, solid-state designs. With care, I've discovered you can combine many of the virtues of both valve and transistor circuitry. (Incidentally, this was a discovery which led me to re-design my own recording studio with an entirely Class A, solidstate signal path!)

Unfortunately, the great penalty in the choice of Class A semiconductor circuitry is the necessity of removing heat fast enough from the transistor junctions to prevent them from destroying themselves. Sadly, all transistors are potential suicide cases: push them too far and they'll crumple beneath their deep quantum urges and revert back to the sand from which they sprang. The transistors in low-level signal stages have an easy enough life and are rarely brought to a "time of hard testing". Not so the poor power transistor in a Class A loudspeaker power amplifier. These highly-strung personalities demand the services of the electronics, mechanical

and heating engineer to keep them stable! A fact which, no doubt, accounts for the relatively few Class A, solid-state power amplifiers on the market.

A headphone amplifier lies somewhere between the two extremes of a signal-level stage and a true power-output stage. Happily, for the enthusiast, it is quite possible to employ Class A circuitry at this level which, although requiring power transistors, does not require unwieldy heat sinks to ensure the equipment remains thermally stable.

Having made the decision to employ a low-efficiency topology for the headphone circuit, I decided to "go the whole hog" and opt for a single ended circuit of lower efficiency still! This choice confers two important advantages: it is simpler to build, and single-ended is widely regarded as the ultimate circuit configuration for audio signal handling.

I first suggested a Class A headphone amplifier circuit in my Recorded Message column a few months ago. The circuit shown in Fig. 1 incorporates a number of improvements and embellishments over the original circuit and is sensitive enough to be fed from most sources, including cassette decks. Firstly, the output transistors are buffered by an extra PNP emitter follower which raises the input impedance seen by the op-amp driver and removes the need to fiddle with the bias resistors to achieve an optimum quiescent point, which was an awkward job required in the original circuit.

Secondly, and much more unusually, I have introduced an optional, secondary signal path through op-amps U2a and U2b. In order to understand the effect of this extra circuit, it's necessary to take a sideways look at some obscure psychoacoustics. In a nutshell, the extra circuit inverts the phase of the signal fed to one ear and the brain interprets this as a frequency-dependent delay effect.

The result is that the stereo image, normally centred in the middle of the head, seems to spread out to fill the whole head with sound. Also, due to an effect known as binaural masking level difference, it is possible to detect

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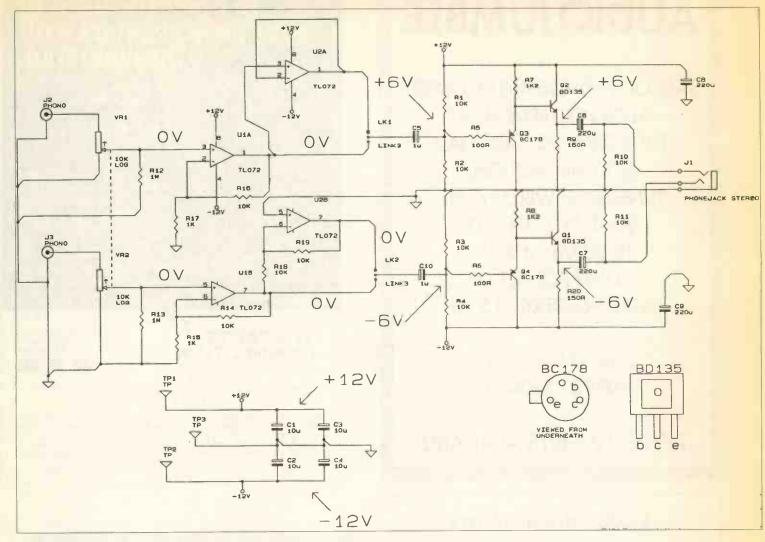
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instrumental lines at very low levels within the mix that would be inaudible if the signals arrived at the ears in-phase. The circuit may be used (and/or built) ignoring this phase-shifting circuit by ensuring LK1 and LK2 are fitted in the lower positions on the diagram. If LK1 and LK2 are fitted in the upper position, the phase-shift is introduced. The inclusion of this link arrangement means constructors can be perceptual psychologists too and experiment for themselves!

A high-quality, glass fibre, printed-circuit board will be available from the Hi-Fi World offices for this circuit. The circuit requires a well-smoothed power supply of +/-12V d.c. at about 200mA per rail. A convenient and technically excellent solution would be to buy a complete, encapsulated power supply from Electromail (Tel: 0536 204555 Order No. 591-102, price approx £60).

WARNING

A final word of warning. When you have built the circuit, don't be tempted to get those headphones on and start to boogie before you have checked the voltages shown on the diagram above. Above all, don't fiddle with the circuit board, the

components or power supply when you are wearing headphones which are plugged in. Accidentally moving or unseating a component might cause

plops, bangs, cracks and thumps in the headphones which would subject your ears to high acoustic intensities and possibly damage your hearing

HEADPHONE AMPLIFIER PARTS LIST				
ltem	Quantity	Reference	Part	
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	2 1 2 3 4 2 12 2 2 2 2 2 2 2 2 2 2 2	UI,U2 JI LKI,LK2 TPI,TP2,TP3 CI,C2,C3,C4 C5,C10 RI,VRI,R2,VR2, R3,R4,R10,R11, R14,R16,R18,R19 R5, R6 R7,R8 R9,R20 C6,C7,C8,C9 QI,Q2 R12,R13 R15,R17 J2,J3 Q3,Q4	TL072 PHONEJACK STEREO LINK3 TP 10µ 1µ 10k 100R 1K2 150R 220µ BD135 IM IK PHONO BC178	

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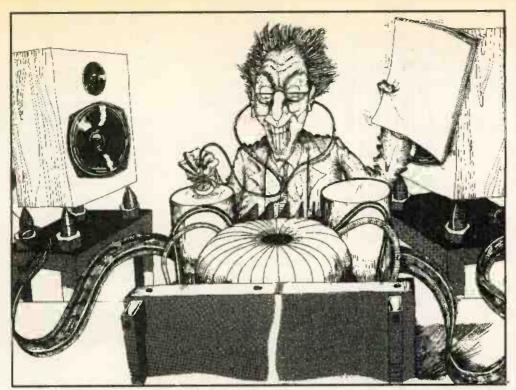
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D.I.Y. Letters

LOOKING FOR A SYSTEM

Earlier this year I built a pair of IPL M3 speakers. They not only look good, but knock my old Mordaunt-Short MS20s for six! I've since built speaker stands to suit the IPLs, but unfortunately my 21 month old son does not allow me to leave the IPLs permanently setup.

Secondly, I'm after your advice. Not concerning my son's desire to damage speaker drive units, but on the harder subject of CD players. The rest of my system comprises Pink Triangle LPT, Roksan Tabriz, Sumiko Blue Point, Audiolab 8000A.

I am pleased with the current performance from vinyl using the IPLs. The music is more often detailed and tuneful, with the individual instruments being more clearly defined when compared to the MS20s. The sound is not

forceful in presentation - I like to 'relax' when listening to music

I would ideally like a CD player capable of complementing my tumtable. Am I asking too much? I have previously borrowed sub-£200 players and found them lacking. Unfortunately, my budget for this purchase is only £400 maximum. You have previously reviewed players like the Yamaha CDX-870 and Aura CD50 (black). Are these possibilities and do you have any other suggestions?

Andrew J. Dean Milverton, Somerset.

Unfortunately you are asking the impossible if you want a CD player for £400 to match the performance of your £600+ turntable. I'd suggest that your best bet would be to go for a budget CD player for the time being and then

add an external high quality D/A convertor at a later date as your CD collection increases. The Yamaha has a very smooth and neutral sound, and is possibly the closest in terms of tonal balance to the Pink Triangle turntable.

When the time comes

DPA's Little Bit II convertor would make a good choice, or maybe Pink Triangle will have a £300 DAC available by then. But as you've already taken an interest in DIY hi-fi, you could have a go at one of Audio Synthesis' superb kit DACs. These are tricky to build, and you'll need to have plenty of experience, but they do sound superb. **DB**

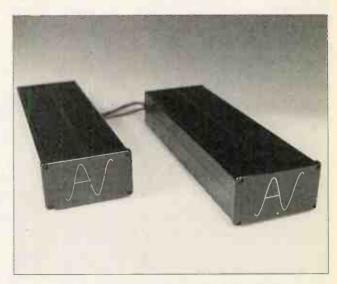
AFFORDABLE DIY

I have been a regular reader of your Magazine since the issue with DIY Supplement No.2. which I must admit is the reason I began buying it. I have been following with some interest the development of your amps and loudspeakers. Being, at the time of writing, unemployed, I sympathise with a recent correspondent who enquired if the (cheaper) amplifier kits from Maplin are worth considering. I thought that he and maybe others in a similar position might be interested in my experiences.

My system is as follows.

Main source is a Thorens
TD I 60 turntable fitted with an
SME 3009 arm and Ortofon
VMS 20E (which is due to be
replaced by a Goldring
I 0 I 2 GX when funds permit).
This was bought second hand
around 4 years ago. I also use
an elderly Pioneer CT-200
cassette deck, but as yet no
CD player.

All the rest of the system is

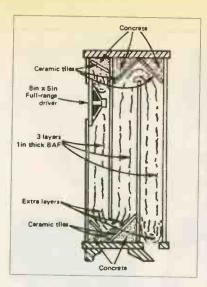


The Audio Synthesis DAC - available in kit form.



home built. The pre-amp is a three-stage Class A design with shunt feedback on the RIAA stage. This is based on a project in E.T.I. in 1982, the 'System A' modular amplifier by Stan Curtis. The power amp is built around a Maplin Project board using the LM 1875 op-amp. Both are supplied by an external power supply that provides 15-0-15 volts for the pre-amp and 17-0-17 volts for the power amp and is built around a large toroidal transformer with a regulated output.

The speakers are single driver transmission lines. See 'An Introduction to Loudspeakers and Enclosure Design' by V. Capel, Babani Books BP256. I modified the design published as follows. The front, sides, top and bottom are made from 18mm MDF, with the sides being in



The Kapellmeister speaker

one piece, not three as suggested. Internal partitions and the back are 12mm chipboard. The cabinet is glued and screwed together and is very solid. The internal partitions are held by a 12mm quadrant glued and pinned in

place. Wadding and speaker cable were obtained from Maplin. I estimate the cost of building these speakers at not more than £50 for the pair. All cables and interconnects are 'whatever I had around that was suitable' mostly rather lo-fi.

Is the result hi-fi? I don't know, but it sounds good to me.
Everyone who has heard it has commented how clear and natural the sound is, one dedicated CD fan swearing that my

records sounded clearer than his CDs. The only criticism that's been offered is that the bass is perhaps a bit light. But I wonder if in fact what is missing is the 'one note' bass thump that some speakers seem to produce, and which is

taken as being 'bass' by some.

The point of this letter is that it is possible to put together a listenable system that is within the reach of almost anyone, if they are prepared to do the sawing and soldering. If anyone would like more information. i.e. circuit/board layouts for the pre-amp, they are available from the E.T.I. photocopy service. Some of the transistors are hard to find now, and I had to find substitutes.

Anthony Maughan Worthing, Sussex.

P.S. I think that my speakers pass the 'Tina Tumer 'Break Every Rule' Test.

BUILDING KLS-I

I thought you may find it of interest to hear from a satisfied

Letter of

DISPLAY CABINETS!

I wrote to you and all the other hi-fi mags when I got my new EAR 834 amp, I was so pleased with it. I got no reply from any of them.

Well, as your magazine is the most interesting, because of the DIY Supplements with valves and DIY loudspeakers, I picked you to continue writing to.

If getting a new valve amp isn't interesting for you, what about a pair of home made transmission line speakers! Please at least read this one, or I will loose heart - I'm a very keen hi-fi nut.

Well, I've enclosed some photos for you - I hope they are O.K. Do you like the old collection of valves?

I had some old MC4s and wasn't happy with the sound. Changing the amp made a big difference, but the small speakers weren't letting all that wonderful sound coming from my EAR 834 through, so I made my

new speakers from a display cabinet (black Ash). It was



hard work, but worth it. I am very pleased now with my new transmission line speakers. Internal wire is van den Hul D352 for midrange and bass, solid core for the tweeter.

Wire from the crossover, which is in a small box at the back of the speaker on the floor, to the amplifier is AQ Midnight 2. The separate black box stand is full of lead shot from work - very heavy. They are spiked of course.

I also got new phono leads made by Keswick Audio Research from my Hi Fi Dealer in Doncaster, the Hi-Fi Studios. He is coming down to see my speakers and hear them for himself

If you want any more detail on my speakers I am only too happy to help. Please let me know what you think!

How come you (HI-Fi

customer (one of many, I'm sure). This is the story of how I became the proud owner of KLS-I three way speakers.

After selling my much loved AEIs in early 1992, it was my intention to put this money towards a pair of somewhat larger boxes. My system comprised LP12, Ittok, Goldring Excel and Lentek integrated amplifier.

Then the plans decided to change without my permission. I just couldn't resist buying a pair of very reasonably priced Naim NAPI35 power amps. The Lentek was put into use as a pre amp and once again I started to save for my speakers.

After a painfully long time the bank balance reached almost usable proportions. Then (I'm still not sure why) I blew it all on a 29" Trinitron, Surround Sound inc decoder and Panasonic stereo video.

More months of saving later, a Teac VRDS-10 caught my ear. I was quite impressed (lucky it didn't catch my eye first, whatever the yardstick may be, it's beauty can at best be described as more Margeret Thatcher than Naomi Campbell). I also heard it connected to a P.T. Da-Capo and bought the VRDS-10 on the basis of its upgradeability and fine performance as a stand alone player.

The following months were spent looking for a speaker that could match the mid-range of the AEIs, but go lower and not include anything that sounded remotely like a metal dome tweeter. Thanks to a very helpful local dealer, Bury Audio, I was able to hear and/or home dem the Shahanian Arc, Heybrook

Quartet, Heybrook Sextet and ProAc Response Is. These were compared with previous experiences of Naim SBLs, Linn Isobariks and numerous others of varying shape, size, type, price etc. The nearest to meeting my criteria was either the ProAc (with REL sub woofer) or the Sextet. Unfortunately one was too expensive and the other a little bit reserved and laid back for my liking.

Well that's the background now down to the real business.

The Tonigen ribbon tweeter produced the most impressive treble of any speaker I'd heard. How was I going to find my ideal speaker with this sort of limitation? Time was running out - I had to do something before some other irresistible goodie forced me into parting with my hard earned cash.

Thank the Lord for Hi-fi
World Supplement No 3 (I
think). A high quality three-way
with deep bass, lucid midrange and Tonigen ribbon for
the treble. All this coupled with
the enjoyment and satisfaction
of home construction sounded
almost too good to be true.

After being a little bit disappointed with the sound at the Penta show, I was kindly offered a demonstration by DB at his abode. This proved most successful and I decided to part with my money without being given any of the usual "hard sell" tactics (thank you).

Although I was capable of cabinet construction. I could not face the possibility of compromising the finished article due to my impatience with the electric plane. So I decided to purchase the full kit and spend all my time on the surface preparation etc. The

The Month



World) are the only mag to be keen on valves and DIY speakers? Glad you are!

Derek Walker Hornsea, Nr. Hull.

It's certainly a novel idea, making your 'speakers from an old display cabinet. We are impressed by your ingenious use of materials. I'm glad you are happy with the 834, it's nice to see products that we have recommended being

enjoyed in the field, and better still when you've built part of your own hi-fi and are pleased with the results. The collection of valves is also interesting, but unfortunately the photo is a little out of focus, I hope that they will be recognisable in the magazine. Please keep up your enthusiasm; we try to answer most of the letters we receive, but there's is only room for so many each month. DB

Everyone on this magazine has tales to tell of youths mis-spent building valve amplifiers and loudspeakers and other contraptions. We are all, at heart, DIY enthusiasts and most of us decided to take up audio engineering for a living as a result. The projects in our Supplements are a great source of enjoyment to us, as well as being a challenge and - importantly - highly educational. Happily, they get easier to produce as we gain knowledge and experience. Two people, designer Andy Groves and his assistant Nick Lucas, work on the projects and the kits full time and both of them are complete valve heads. But Dominic and I don't let them have all the fun. NK



WIN A MAPLIN SOLDERING IRON KIT COMPLETE WITH A LENGTH OF SILVER SOLDER

The writer of the most interesting DIY letter each month will receive a superb Maplin soldering iron, stand, booklet on good soldering practice and a length of high quality silver solder.
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paint job was to be professionally done by a car restoration company. This would cost a further £200 so I felt a little extra effort on surface preparation was fully justified. As promised the machined panels all slotted together perfectly with minimal overhang. The process of assembling all 36 pieces and the crossover boxes was indeed a relatively painless process.

The paint job is wonderful. But the drive home (60 miles) was rather stressful.

All the staff at Hi-Fi World continued to be supportive and helpful at all times. My only complaint would be an over use of the phrase "I promise to call you back" (you never did!). Thankfully for us readers you are enthusiasts first and businessmen second. Although this may contribute to some frustration it is a mild criticism and surely not serious enough to jeopardise my possible success in the "Letter of the Month" prize.

Anyway, all bits were eventually received and the whole caboodle glued, screwed and soldered together. At this point may I offer other constructors the benefit of my experience (mistakes) with a few tips.

l) Work out how you are going to connect the mid/treble units to the crossover before gluing the boxes together. I used Ortofon bi-wire cable and binding posts bolted through the MDF itself. With hindsight the binding posts should have been mounted on a metal plate screwed over a pre-cut hole in the back of the mid/treble enclosure before glueing took place.

- 2) If you intend to use spikes, reinforce the bottom of the bass enclosure in each corner with a triangle of MDF. If you don't, you may drill right through and unseal the sealed design!
- 3) Use decent mounting cones for the mid/treble enclosure. My dealer supplied some interesting brass/carbon fibre items which work well and look very good.
- 4) If you are having the cabinets painted I found that a decent radius on every edge improved the aesthetics no end.
- 5) Beware the dreaded test disc!. Despite the numerous warnings on mine about the high frequency tones, I managed to turn both tweeters into a very short, but irreversible fireworks display. Remember just because you can't hear it doesn't mean its not there.

The sound produced had potential but was far from balanced. The following few weeks were spent

experimenting with crossover values and enclosure stuffing density. A very prominent upper midband is now tamed and the bass frequencies enhanced at the crossover point. After all this experimentation I do feel satisfied that my speakers are better than anything that I've heard for £1000 and probably much more. What adds to my satisfaction is that the finish would normally cost up to £500 extra on your average floorstanders

My remaining doubts are bass depth and slight midrange coloration. However as DB's pair sounded far more expressive and weighty in the lower registers, I guess it must be the system or room. probably a bit of both. The room, which is eighteen foot square with a low ceiling seems to suck out low frequencies. Also the Lentek, although a wonderful piece of British design, is a bit out of its depth and possibly an electrical mismatch for the Naim amps. The mid-range colouration will probably improve with the modifications you describe. further experimentation with stuffing and maybe trying Deflex panels?

In summary, I believe the kit is a very capable design that can produce excellent results. If you're like me and can cope no longer with metal domes and long for a Sextet with balls, then the KLS-I may prove to be your saviour, but please

don't skimp on the finish. Even my cloth eared peasant friends can appreciate that. No matter what people may like to think, I believe the experience of owning and listening to hifi is enhanced if the equipment looks and feels quality.

I hope your magazine continues to provide its readers with more innovative kits and understandable technical information. I would like to dabble with active systems and long for the day when you design and build a high quality and user adjustable two or three way active crossover. This I am sure would enable the KLS-I to reach new levels of performance, If such an animal exists please let me know.

Meanwhile, who let that bloody baby put his grubby mits on my speakers? I don't care if he likes looking at his reflection!

R. Cockman Bury St Edmunds, Suffolk.

Phew! It all sounds as much effort as designing the original - and pretty costly too when two Tonigens go up in smoke. The crossover point problems may be due to component variations, including driver frequency response, something we cannot be certain about without testing large batches, which is obviously impractical.

The bass cabinets go very low and have a good bass punch, so I think you may well be suffering some room imposed limitations here.

The problem of midrange colouration I cannot understand - it is difficult to find an explanation. Neither driver nor cabinet should be responsible. Be careful you have not over-stuffed the chambers, especially just behind the drive unit, because then too much energy will be reflected back out through the cone. Damping needs to be made progressive, loose to begin with, but becoming steadily more dense as distance behind the cone increases. The cabinet walls must be covered with dense carpet felt too. Then you should find the midrange seamless, highly detailed and just about characterless. Good luck - I'm glad you like them. NK



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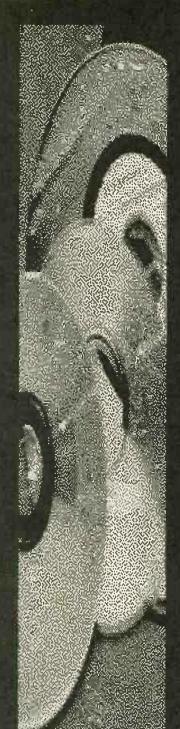
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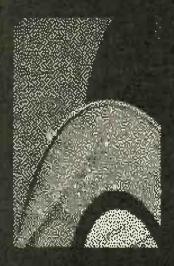
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