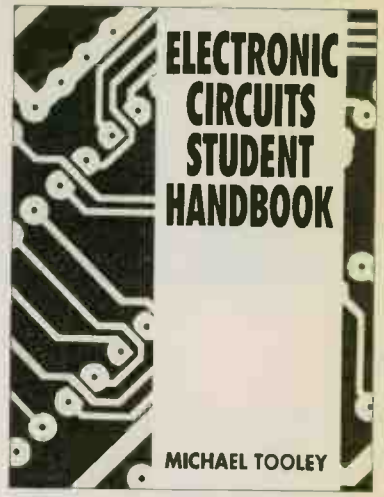
Hi-Fi WORLD

NO.30 AUGUST 1997

SUPPLEMENT

BOOKS



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D.I.Y. Supplement

Contents

KIT NEWS

RIBBON DRIVEN

If you're taken by the crisp, fast sound of ribbon tweeters but have found the prices slightly less attractive, then Tandy have some good news. They have made available the Optimus ribbon tweeter, used in their Genexxa LX5 Pro stand mounters and more expensive models.

This driver is a dipole unit which comes with its own crossover, rolling its response off at a relatively low 2.5kHz, making the Optimus suitable for use in two-way systems. Cost is £39.99 each and power handling 50watts. While no sensitivity figure is given with the tweeter, we hope to be putting it through its paces in a forthcoming supplement.

Tandy
Leamore Lane,
Walsall,
West Mids. WS2 7PS
Tel: 0500 300666

PRECIOUS LINK

Cambridge Scientific Supplies, suppliers of specialist silver wire, have added to their range with a heavy gauge cable, which they say is ideal for loudspeaker wiring. This cable is succinctly named CSS045 x 19AgCu and is rated at 38A continuous. 19AgCu comprises 19 strands of 0.45mm silver-coated OFHC copper with heavy PTFE insulation. Pre-terminated lengths with protective black nylon braid are available at a cost of £24 per stereo metre, with cable at £3.50 per metre.

Cambridge Scientific Supplies
12 Willow Walk,
Cambridge CB1 1LA
Tel: 01223 811716

FALCON EXTEND THEIR WINGS

The Norwich based specialist component supplier Falcon Acoustics is adding to the range of components it can supply to 'speaker builders. Now available are 0-10mH air cored inductors wound with 1.25mm wire and tapped at 1mH steps as well as 0-1mH air cored inductors tapped at 0.1mH intervals. And joining the 630V Solen line-up is a 0.68mF capacitor.

Falcon Acoustics
Tabor House,
Norwich Road,
Mulbarton,
Norwich,
Norfolk NR14 8JT
Tel: 01508 578272

UPGRADE AHOY

New for summer '97 is a fresh Catalogue from Russ Andrews, containing a smorgasbord of audiophile capacitors, resistors, inductors, cables and kits. The separate Accessories booklet has also been updated and contains a range of ready-made cables, contact enhancers and CD cleaners, for example. Last in this literary flowering is the Loudspeaker Upgrade Handbook, which has details of how to modify crossover components and drivers for best results. The Handbook costs £9.95.

RATA
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Skelsmergh,
Cumbria LA8 9AS
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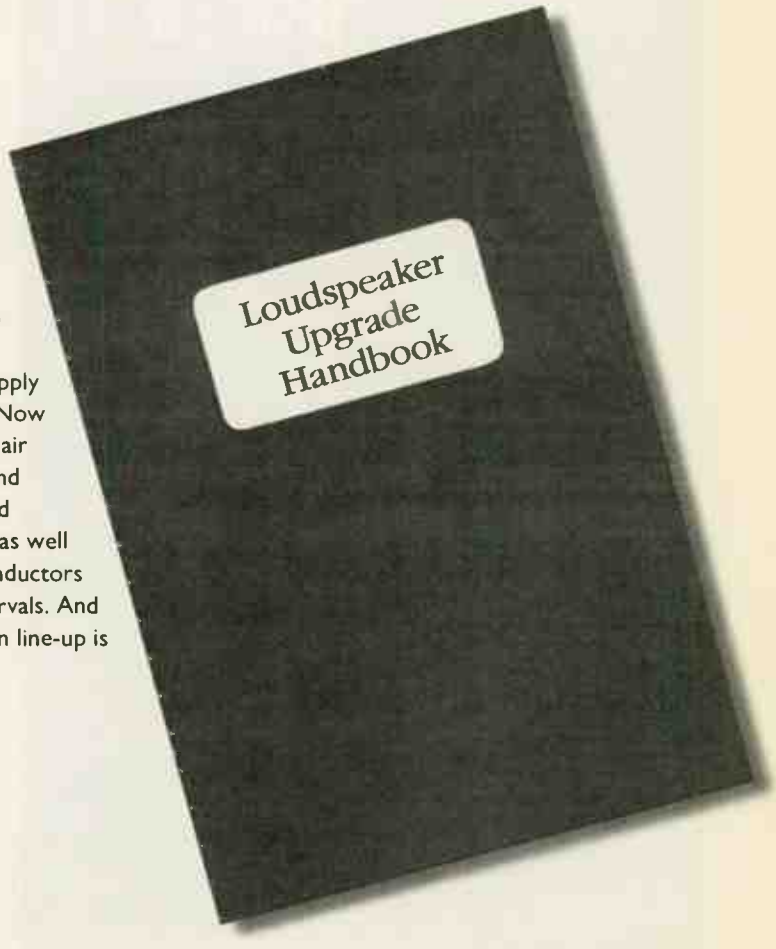

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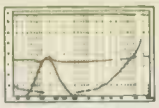

As Featured In the Hi-Fi World DIY Supplement No,s 22 & 23 (June, August 1996). Still available to Hi-Fi World readers at the Reduced price :- **£89-00 Inc** Plus £5-00 P&P

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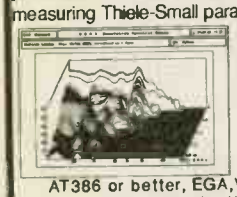

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ANOTHER BIG HIT!

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

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

For more information on any of our products, please call, write, Fax or E-mail us and we will be happy to assist you.

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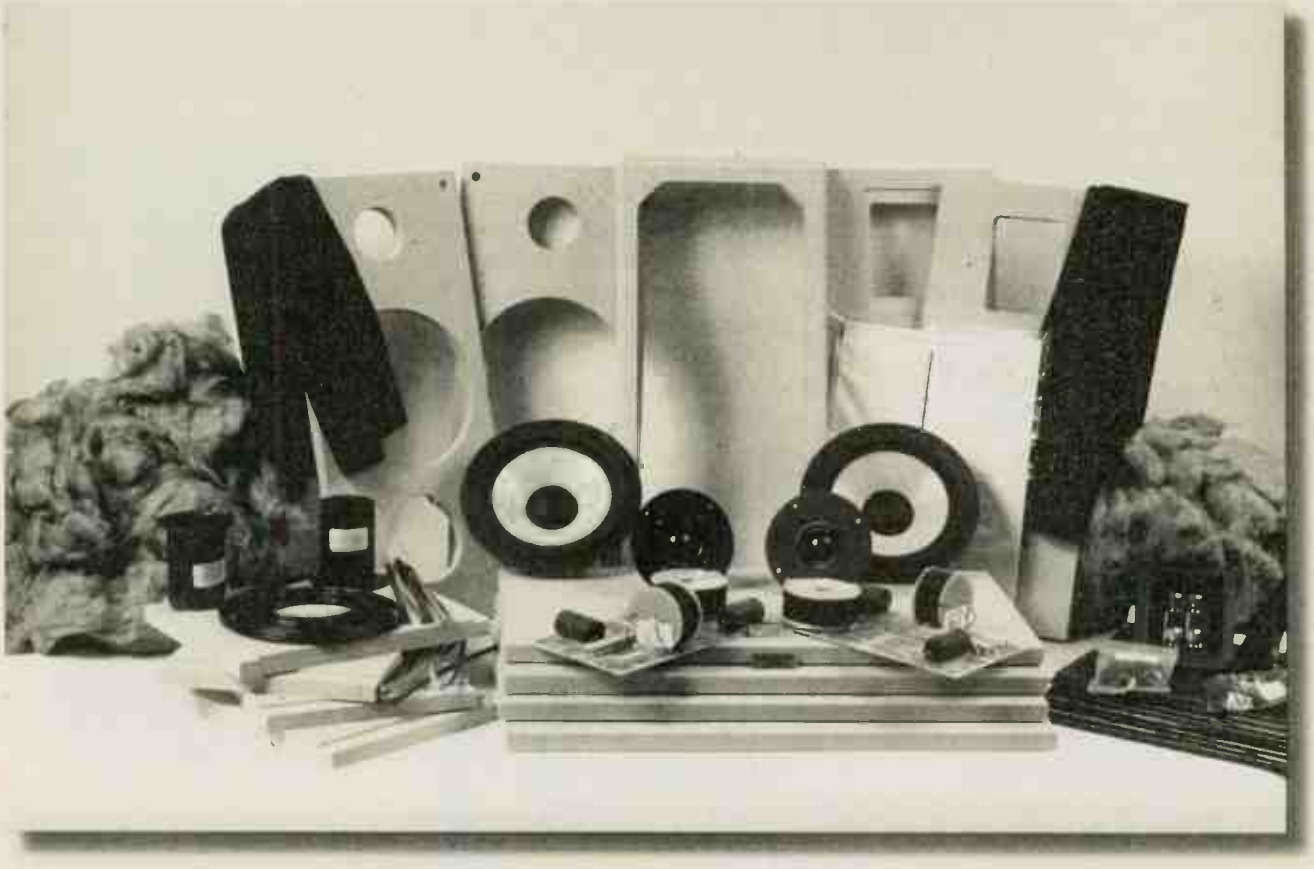
Captivated by KEVLAR

Nick Lucas, 'speaker builder extraordinaire, gets to grips with Wilmslow Audio's £420 Kevlar 1 loudspeaker kit.

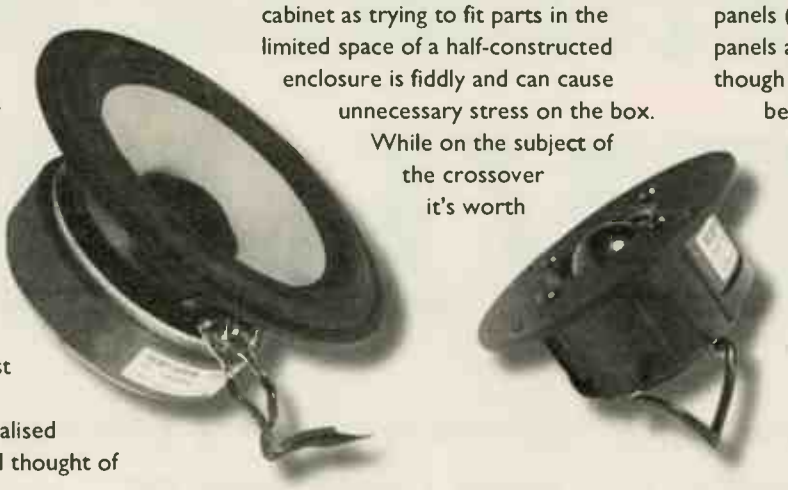


If DIY happens to be your middle name and 'speakers are your game then one company you'll probably be familiar with is Wilmslow Audio. They've been around for over 30 years now and have a range of kits that runs to over 25 different loudspeaker designs. One of these is the Kevlar 1, which we chose to build because it uses, surprisingly, high-technology Kevlar coned mid/bass drivers similar in sound to the Carbon Fibre we've come to know and love.

The Kevlar 1 is a front-ported two-way stand mounter, measuring 27cm x 22cm x 48cm (including grille). The driver line-up consists of a 28mm textile dome tweeter and a 7in Kevlar mid/bass unit housed in a cast alloy frame which sports a seriously substantial magnet. Both units come from Danish manufacturer Scan Speak. They specialise in high performance drive units which put in appearances in Spendor, Linn and Wilson Watt 'speakers, to name but a few.

The simple crossover relies on a second-order filter in both high and low frequency sections. The components used are standard high power ceramic resistors, good quality Ansar polypropylene capacitors and Volt air-cored inductors.

On opening the 30kg box and cross-checking components against the parts' list provided I soon realised that Wilmslow had thought of everything.



The Kevlar 1s use high quality drivers from Scan Speak; a mid/bass unit with woven Kevlar cone and oversize magnet and a soft dome tweeter.

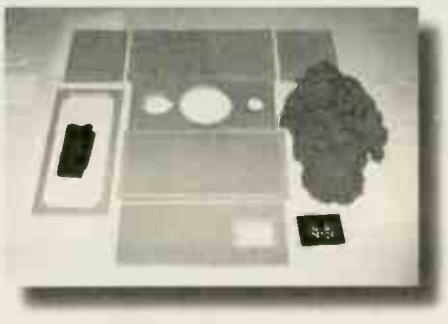
Contained inside were the drive units, assembled crossovers, reflex tubes, Dedshete panels, gold-plated bi-wireable binding trays, grille fixing studs with black fabric, GAW (Garnet Acrylic Waste) fibre for internal wadding, multi-strand copper 'speaker cable, sealing strip, screws, instructions and a 15mm MDF flat pack set. The only thing I had to provide was Evostick Resin W glue, 10mm steel tacks for mounting the grille fabric to its frame and five metres of Fablon self-adhesive vinyl for that quick and easy Mahogany veneer finish.

The assembly instructions contained a parts' list, assembly procedure, a diagram of the crossover board (clearly labelling all link points) and an exploded view of the cabinet. In my view, instructions should never be too lengthy. For example, Heath Kits used to publish instruction books to accompany their kits, a very detailed format that never leaves much to the imagination. In my experience DIYers feel a sense of achievement if they can work things out for themselves. So if you are expecting pages and pages of diagrams and text you will be disappointed in this case. The only instructional shortfall was a lack of technical data - driver data sheets, the measured performance of the finished product and a crossover schematic would have been useful.

The assembly steps generally followed a common sense sequence, though I found it easier to screw-mount the crossover PCB prior to gluing the cabinet as trying to fit parts in the limited space of a half-constructed enclosure is fiddly and can cause unnecessary stress on the box.

While on the subject of the crossover it's worth mentioning that even though the board is assembled it is up to you to attach the cabling. The 'speaker wire length dictates the orientation of the PCB with respect to the drive units and binding post trays. Careful attention also needs to be paid to the diagram of the PCB as this is a multi-purpose unit and comes etched with some markings which don't relate to the Kevlar 1. No fixing holes are provided so all soldering is carried out track side.

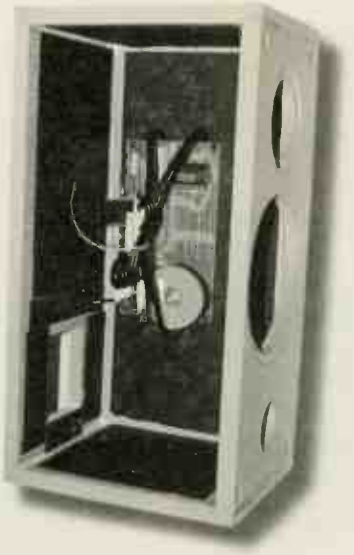
As is standard with Wilmslow kits, the cabinets when supplied in flat pack form are fully rebated, which makes construction easy. The cabinets fitted together perfectly. I used one of the side panels as a base, thus exposing all joins for easy removal of excess glue.



All of the enclosure's panels come rebated which makes assembly quick, accurate and easy.

Instead of good old felt lining, Wilmslow have opted for Dedshete panels (2mm thick bitumen sheets). The panels are self-adhesive so fixing is easy, though warming up the adhesive beneath a lamp or with a hair drier before fixing makes it tackier. If you forget to warm it up the sheets have a tendency to fall off.

The front panel and grille frame provided come pre-drilled with holes for the fixing of the studs - a blessing, as any kit builder will tell you. The only tricky manoeuvre is attaching the cloth to its frame. I used 10mm steel tacks and a needle and thread to achieve a good tension and to line up the tiny perforations horizontally. Once they were tacked in place I trimmed the cloth and applied glue around the fabric edge to prevent fraying.



It's a good idea to build the cabinet up on one of the side panels having already screwed the crossover in place.

Connecting the studs to the frame required a little extra work. I had to open up the holes with a drill bit and push the studs into the holes as far as they would go before finishing off with a few light taps around the base with a hammer and a flat head screw driver. Never try hammering the 7mm

The grille cloth can be held in place on its pre-drilled frame with 10mm steel tacks.

diameter plastic extension directly as it will snap very easily.

Once the cabinets were constructed and lined internally with Dedshete, all that remained was applying the decoration, fixing the ports and a bit of soldering.

I opted for a Fablon self-adhesive vinyl Mahogany finish, costing around £2.00 a metre. I needed five metres to finish off both 'speakers. Fablon is quick and easy to use but won't stand the test of time as well as a true veneer. Application is relatively straight forward though a scalpel is essential to trim off the excess. Any holes should be cut out when the Fablon has been applied, cutting 15mm in from the edge. The borders around the hole can then be folded over and stuck down.

When fixing the ports, tap them into place with a wooden block so as not to damage the plastic. Ample wadding was supplied for damping - the quantities are actually measured out for you in two plastic bags.

Soldering the drive units and binding trays to respective leads is straight forward enough as long as your flying leads are well marked. As the drive unit cut outs were rebated the units fell into place snugly. The flange head screws supplied were a touch on the weak side - one actually broke. I would prefer to have used T-nuts for a stronger join.

As long as the flying leads from the drivers are long enough, soldering on the binding post tray poses no problems.

The Fablon should be applied and cut to shape before the drive units are screwed into their rebated holes.

Once finished, the Kevlar 1s certainly look impressive, but do they work? After a quick DC resistance check (both 'speakers read around 6ohms) I plugged them in and found the answer was yes. A 40-hour running-in time is recommended so I will leave it up to our reviewing team to make an assessment.

Wilmslow offer 'speakers in various forms to suit everybody's needs. The kit we received (all parts plus the flat pack) cost £423.00. All the parts except for the cabinets go for £373.00 while a pair of fully constructed and veneered cabinets plus all the parts costs £535.00. Wilmslow also sell rolls of iron-on veneer with four finishes: Ash, Oak, Teak and Mahogany. These cost £6.75 a roll and for Kevlar 1, two rolls are required. £15.00 for postage and packaging needs to be added to each order as well.

Both Terry and Sean at Wilmslow are happy to answer fax and telephone queries and they can receive e-mail.

Thank you Wilmslow for 12 hours of enjoyable build time and an overall presentation that gets the thumbs up from me.

SOUND QUALITY

When the finished Kevlar 1s arrived in our listening room they certainly looked professional, with their driver and binding post tray rebating, along with those eye-catching Kevlar mid/bass cones. They felt the part too, I realised as I hefted the weighty enclosures onto a pair of Atacama SE24 sand filled stands.

A first listen demonstrated the Kevlar 1s' clarity, Chaka Demus and Pliers' vocals coming over with crystal clarity. What also became clear, however, was that with the amount of stuffing supplied as standard in the kits the 'speakers were a bit short on bass. A quick glance down the Wilmslows' ports revealed the fact that there was so much wadding in the cabinets it was actually blocking the ports, stopping them working effectively.

Unscrewing the mid/bass unit on each Kevlar 1, I removed about two-thirds of the fibre wadding that filled the entire enclosure volume. Infinite baffle (sealed box) loudspeakers tend to be stuffed to about half their internal volume for best sound quality although the exact amount varies according to tuning. Ported loudspeakers on the other hand need little wadding, because the air inside must act as a spring. Wadding acts to suppress "springiness", by applying resistive damping.

The Kevlar 1s sounded a lot happier in the bass on their reduced fibre diet, basslines which had previously sounded emasculated now benefiting from a bass that possessed excellent control and transparency. In terms of positioning,

the 'speakers were now about 1.5ft into the room and toed in so their axes crossed in front of the listening position (which gives the same listening angle as having the 'speakers firing down the room but reduces reflections off the rear wall and thus sharpens imaging).

Hooked up to Roksan's Caspian integrated amplifier the Wilmslows duly put together one of the most accomplished and stirring renditions of Tori Amos' Boys For Pele album I've heard in a long time. A DIY 'speaker costing about £400 should be able to compete sonically with a ready built commercial 'speaker at £800-£1000. The Kevlar 1s certainly succeeded here, combining the kind of clarity and imaging precision of a loudspeaker like Harbeth's £1000 HL-K6s with the tonal sweetness that characterises Kevlar and Carbon Fibre cones.

Boys For Pele also showed the overall even-handedness of the Wilmslows. This album tends to sound either fat and bloated through bass heavy loudspeakers or shrill and cold through 'speakers with rising treble and dry bass. The Kevlar 1s struck just the right balance, avoiding emphasis of sibilants and packing a taut, extended bass punch that gave piano weight and definition without slurring its lower registers.

Returning to Chaka Demus and Pliers I discovered Tease Me now had the bass muscle it needs to hit the spot and basslines had the kind of speed and transparency that comes from a very capable mid/bass driver in a good, solid cabinet. From the position of the Caspian's volume control though, it's obvious the Kevlar 1s like to be driven quite hard - the sound stage really opens up when they're being fed a bit of power. I suspect a hefty 50watter is the minimum necessary to get the best out of these 'speakers.

The next spell of mettle-testing took the form of Iain Simcock performing a selection of Bach's organ works on Bach is Back. Here the Kevlar 1s proved they were well able to play at high levels without sounding harsh or compressed. And while they missed out on the kind of lower octaves reached only by a subwoofer or a floor stander really worth its salt, they had impressive bass depth and control for a 'speaker of this size. The light, stiff Kevlar cones made their presence felt here, with upper organ notes wonderfully crisp and clean. The same weight and speed were evident on Rimsky-Korsakov's Scheherazade, where Samuel Magad's solo violin floated holographically in front of the spread of the orchestra and crescendos burst with truly explosive power.

Wilmslow have come up with a good alround loudspeaker in the Kevlar 1 that's sure to win fans. Building it is a pleasure rather than a chore, it can be decorated to match any domestic environment (not something to be sniffed at) and it sounds great to boot.
JM

Measured Performance see p103

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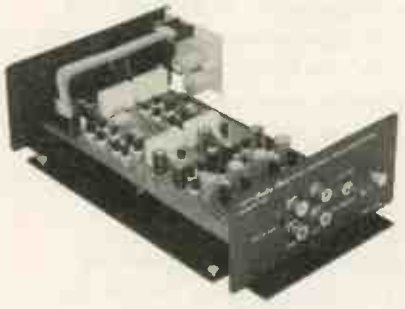

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review

CABLE QUEST

This month finds Ketan Bharadia soldering up three more bargain DIY interconnects from Maplins.

High Grade Audio Pair (order code: EL 12), £3.49/m.

Seeing as it's the most expensive in the group, I was expecting this cable to turn in a good performance. I'm pleased to say it obliged.

Choral music enjoyed a sound stage that was both wide and deep, with choristers' voices well focused within this framework. Tonally it was slightly bright overall but not enough to cause any problems in a well balanced system. Detailing, tonal colour and texture also impressed and, even when the musical going got tough, the Audio Pair didn't get confused.

Switching to Rock showed dynamics were sprightly and bass had plenty of weight and power. Still, for all their substance, the lower frequencies sounded faintly blurred and loose. This didn't impair the rhythmic flow that helped make this cable enjoyable to listen to.

The Audio Pair is the best all rounder of the group and fully justifies its cost. Used as a 1m interconnect, its performance is comparable to ready-made cables costing £20-£30.

Van Damme Star Quad Professional Microphone Cable (order code: VU 31), £1.49/m.

The "Quad" in this blue cable's name refers to the fact that it has two pairs of multi-strand conductors making up its innards, which results in a dramatically different presentation to the cable above. The Star Quad's overall tonal balance was far closer to neutral, deviating only in the higher frequencies, which were just a touch more prominent than they should have been. Dynamics were very good, as was bass weight and power.

Where this cable started revealing its weaknesses was in a lack of fine detail when compared to the other two cables on test. And whilst tonal balance was good, tonal colour itself was 'bleached', vocal and instrumental textures losing out here. In addition to this there was a lack of projection to the music which prevented it breaking free of the 'speaker cabinets. In terms of value, the Quad Star is on a par with the Professional Microphone below - which one you use is down to system matching.

Van Damme Professional Microphone Cable (order code: VU 17), £1.29/m.

The first piece of music this cable faced was Daboa's From The Gekko, which is highly rhythmic World music. The van Damme made a good first impression, its presentation full of tonal colour and expression. Instrument and vocal textures were very well portrayed and had a pleasant richness. This was, in part, due to the fact that the treble was rolled off fairly steeply, though this effect wasn't severe enough to make the cable sound dull or bass heavy.

Unfortunately, there was also a down side to this cable's sound. Dynamics were noticeably restrained, so music tended to sound rather flat and undemanding. And when orchestral works were in full flow, things could become muddled. In spite of this, stereo information was capably presented and sharply focused in both depth and width planes.

This cable has a smooth, relaxed sound which is well detailed but don't expect any dynamic fireworks.

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Technical specification: dual mono construction, 40W/channel, 12Hz to 25kHz power bandwidth, distortion <0.1%, five line level inputs, tape output, 230/240V mains input.

Stereo amplifier circuit board : board only £49.50; component pack (including valve bases), add £63; populated board £125; full valve set, add £45. Power supply board : board only £20.50; component pack, add £44; populated board £66. Input board : board only £15.50; component pack, add £16; populated board £33.

The output transformers are configured for the McIntosh connection and have excellent low frequency response and a primary reflected impedance of 3800Ω. Full connection instructions provided. Price £70. The mains transformer is wound for dual mono construction, as this gives superior isolation between channels which sharpens imaging and eliminates inter-channel ground loops in the amplifier. Primary 0-230-240V. Secondaries 2x295V@0.25A (0.4A int.), 2x70V@30mA, 2x6.3V@5A. Price £60. Other primary voltages can be supplied to special order. Data sheets giving connection diagrams, specifications, as well as circuits for using each transformer, £2.50 each.

The chassis, comprising main chassis and transformer cover, is hand polished, welded 1/16" stainless steel - NC machine tooled for a perfect fit and clean finish. Each kit also includes a mesh valve cover and baseplate, finished in semi matt black. Price £310. Also available in mild steel finished in black, £195. For those who wish to use one of these high quality chassis for their own projects, details of the chassis are given in the 4040 reference manual, £6.50.

Connector kit: twelve gold plated phono connectors, two sets of loudspeaker terminals, an IEC mains socket with integral fuse and switch, and an IEC mains lead with fitted 13A plug. £51.50. Cable kit: all cables required for the 4040, £6.

The Riverside P2 phono preamplifier is designed to partner the Riverside 4040 for those who enjoy the vinyl sound. Equalization is provided for moving magnet output to line level. The P2 features a high accuracy feedback RIAA equalization circuit, ensuring a natural tonality, a regulated high voltage supply per channel and cathode follower outputs. 3xECC83, 1xECC81, 2xECF80. Full details and circuit diagram in the P2 reference manual, £6.50. Kit £225, fully assembled £275.

Technical specification: 47kΩ input impedance, 1kΩ impedance output for driving long interconnects.

Stereo circuit board: board only £25; component pack, add £37.50; populated board £70; full valve set £20.

The mains transformer is wound for dual mono construction and is toroidal for low leakage flux. Primary 0-230-240V. Secondaries 2x295V@20mA, 2x6.3V@0.45A, 16V@1A. Price £30. Other primary voltages can be supplied to special order. These transformers are also suitable for power supplies in preamplifiers and other line level valve circuits - see data sheet for details, £ 2.50.

The chassis (main chassis and transformer cover) is made from mild steel. Each kit comes complete with a mesh valve cover and baseplate, finished in black. Price £110. For those who wish to use a high quality chassis for their own projects, details of the chassis are given in the P2 manual, £6.50.

Connector kit: four gold plated phono connectors, IEC mains socket with integral fuse and switch, and IEC mains lead with fitted 13 A plug, £15.

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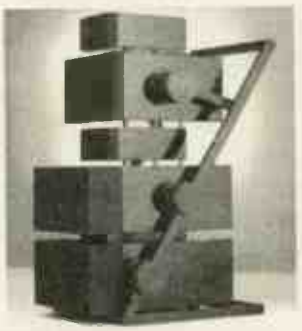

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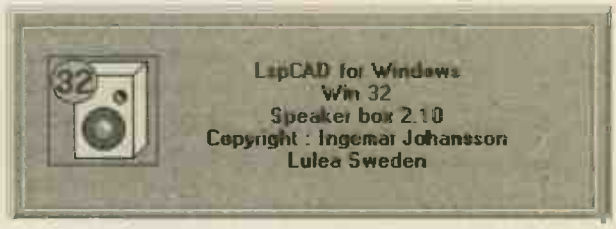
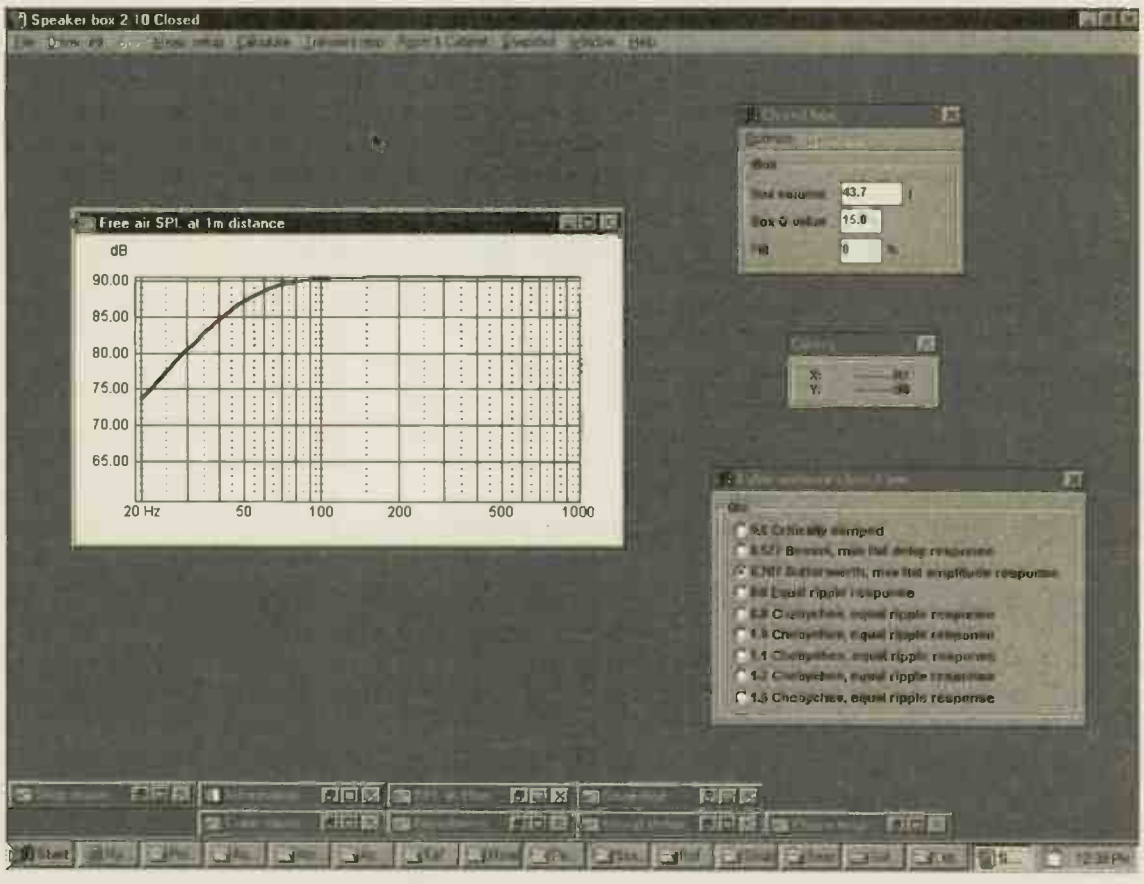


LOUDSPEAKER DESIGN SOFTWARE

Reviewed by Noel Keywood.



Introduction

Getting a computer to design things for you is a nice idea. With loudspeakers it is best if you have a good idea just what the design process is all about and what it is you are trying to achieve before you start out with a computer design package like LspCAD (Loudspeaker Computer Aided Design). You also need to be able to spot a flying pig when you see it, for LspCAD throws out some peculiar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Bandpass 1


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results at times. All of which is to say that LspCAD is not really for rank beginners looking for an easy way to design a loudspeaker. But it does offer a lot of analysis at a low price of £60 including VAT and postage. It would suit anyone with a computer and some technical knowledge.

The absence of a crossover network designer (most are rudimentary, but they do get you going) means this package does not offer a total system design solution. But it does have a room effects analyser, which is why I asked to review it.

This is a rare adjunct and potentially a very valuable one because room effects are both complex and disturbing - in every sense of the word. They are disturbingly complex to 'speaker designers, they disturb frequency response severely and they disturb end users who are sonically assailed by their effects, such as 'room boom'. I wondered just how effectively LspCAD could handle this difficult problem, bearing in mind how much this concerns Hi-Fi World readers trying to get the best from their loudspeakers at home.

First thing to consider is what value for money LspCAD offers. The professional packages like LEAP cost considerably more, but there is a slew of inexpensive loudspeaker design programmes, available mainly from the USA for around $60-$100. Most have crossover analysers (for what they are worth), so for the average home constructor they are perhaps more attractive. LspCAD offers a different balance of abilities for a price similar to less expensive packages.

The next consideration is ease of use. The documentation was minimal and largely of the genre "To switch on, press the ON button". In particular I was perplexed by the almost complete absence of instruction on how to use the programme itself. And LspCAD was good at coming up with a blank screen or a Calculate button greyed out. It did not take me long to figure out which menu had to be addressed to move the programme on, but newcomers may end up very frustrated. Such idiosyncrasies do tend to become familiar and acceptable with usage though. I'll explain what I encountered in this respect shortly.

At left, the many cabinet types LspCAD can analyse. Only transmission lines and horns are omitted.

LspCAD takes up 2.5Mb of disc space, so it is relatively modest in its requirements. It is available for Windows 3.11 or higher, Windows '95 or NT. A 286 CPU (minimum) is recommended, plus 3Mb of disc space and 4Mb of RAM. Display resolution is 640x480 minimum, but 800x600 or more is recommended, as is a maths co-processor.

I ran the programme on SoftWindows '95 for a 180MHz PowerMac and experienced no speed or display problems, except that graph axes were slow to redraw, especially on a full 21in screen.

You get not just a 'speaker box size/frequency response calculator programme with LspCAD but also a library of drive units and their parameters. This was comprehensive, with 21 makes covering around 200 drivers.

As a test of the programme I created a file for the Audax HM210ZO HDA drive unit, which meant selecting the type of enclosure to be used: sealed, ported, etc. Calling up this file resulted in a blank desktop. To check that the relevant info had loaded I had to access the Driver menu. Going straight to Free Air SPL threw up a frequency response based on a default value in the box menu of 10litres, again hidden from view. A message should have asked me to enter either a box volume or a set of response limits. LspCAD's user interface is unhelpful, although once learnt this ceases to be a problem.

Most of the drive unit parameters were conventional except for the elusive Cas, mentioned but not defined in the user manual, nor the Loudspeaker Design Cookbook I found. This is the acoustic suspension compliance, from which the equivalent volume of air having such a compliance, Vas, can be calculated (Cas=Vas/Po.C^2). Again, the user manual could usefully be improved to eliminate this sort of omission.

Designing a Loudspeaker

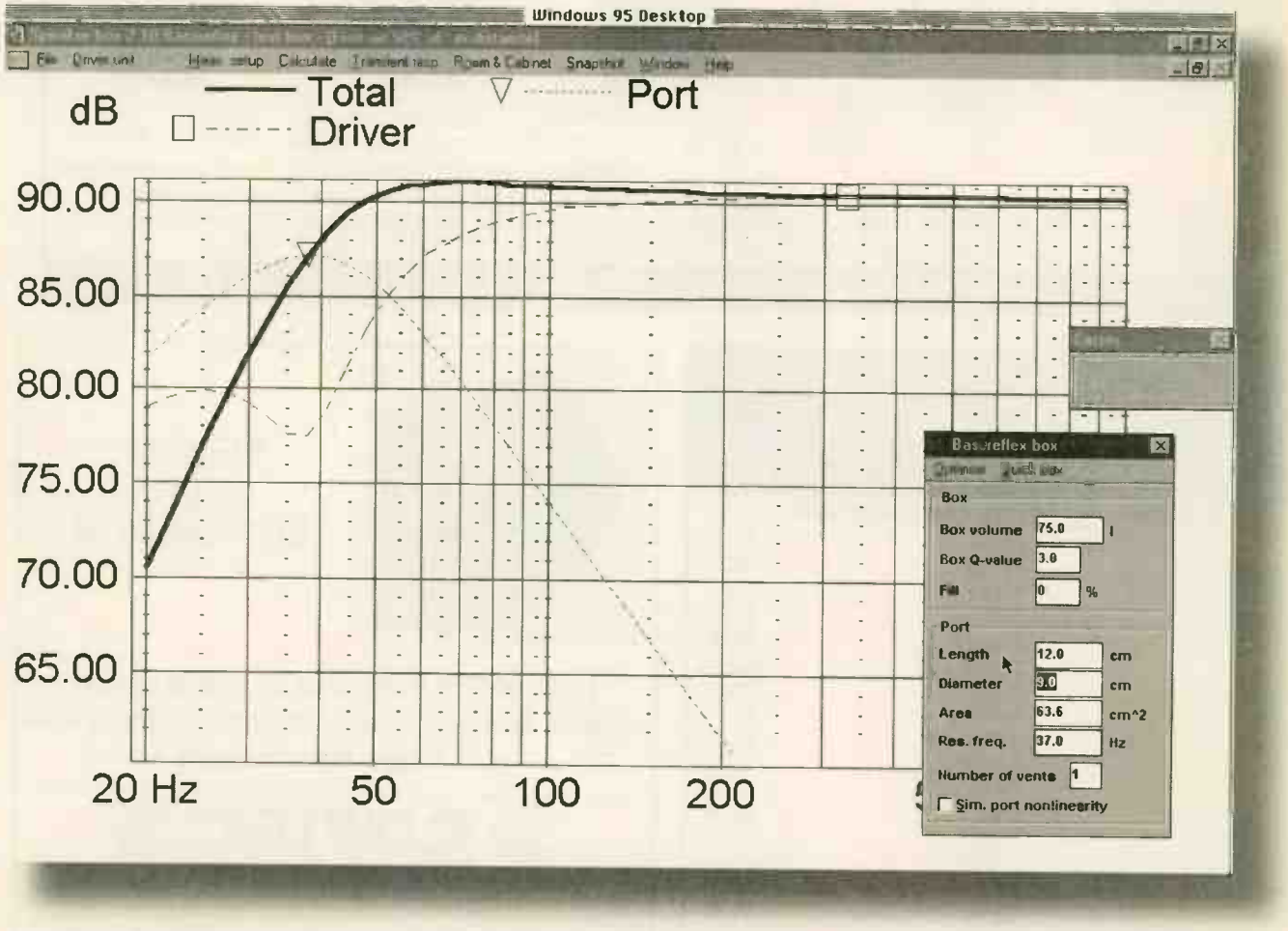
This is a comprehensive programme, that's for sure. It simulates the box configurations shown in the diagrams, which cover most common types except transmission lines and horns. The bandpass types have a high frequency acoustic roll-off (i.e. low-pass) as well as a low frequency limit (high-pass) and are used mainly as bass cabs. for larger 'speakers, as well as subwoofers.

LspCAD will simulate a wide range of measurements too, giving Transient Response, Frequency Response ('Free Air SPL' in loudspeaker parlance), Group Delay characteristics, Acoustic Phase, Electrical Impedance, Port Air Speed, SPL at 1m (anechoic and in-room) and Non-Linearity at high power levels due to voice coil heating and port compression.

Frequency response can be found by typing in response limits and asking the programme to sort out how to achieve it by iterative curve fitting. Sounds good, but I found you get impractical results. Quickbox - a fast calculator - also gave a result that was impractical in my view, suggesting, for example, the HM210ZO needed a vast 150litre ported enclosure. This monster cabinet certainly gave the lowest bass extension, but with an enormous +3dB peak. Few designers would choose this result, because of size and poor damping.

A sensible result was turned up by selecting one from a variety of ported system 'alignments'. These take certain standard forms, in this programme: SBB4/BB4, QB3/SQB3, SC4/C4, with Q values of 3 or 15, which give a sensible set of properties. I wasn't surprised to find they came up with the volume I expected for the HM210ZO - around 75litres. Closed box gave nine response options, from Qtc of 0.5 (critically damped) up to Qtc of 1.5, a peaky Chebychev response.

The port seemed to have an unusually large effect upon reflex enclosure response. This struck me as a bit unrealistic; in practice, port size has less effect than the programme suggests. But then I did get the impression that this programme had been compiled from all the maths available for loudspeakers, irrespective of its efficacy. I only use these loudspeaker programmes to



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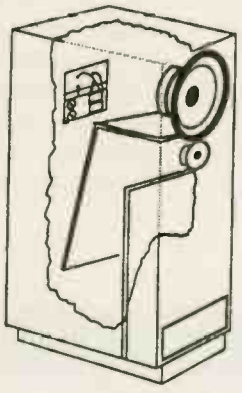

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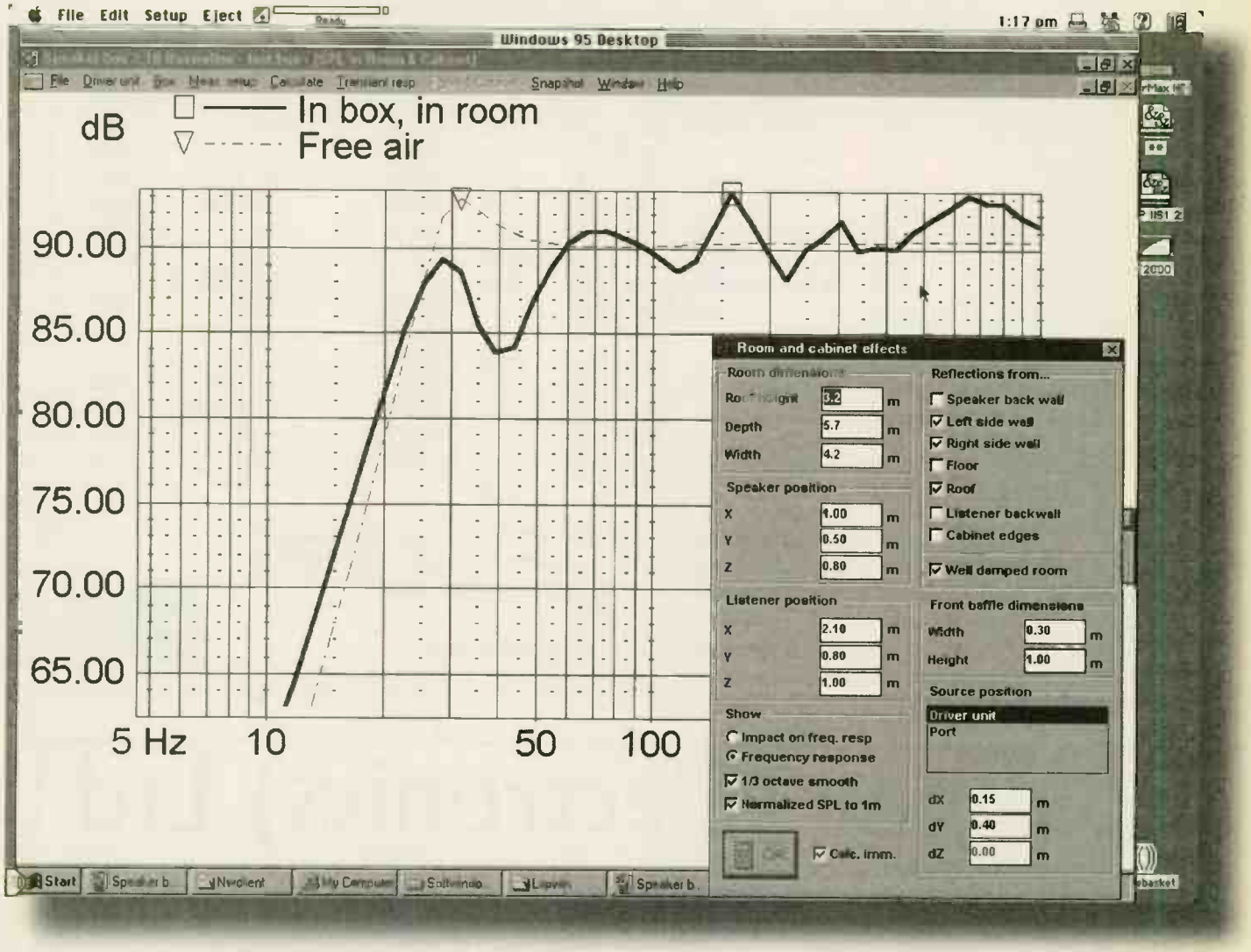

The room analysis programme can handle reflections from six walls, including the ceiling ('Roof' to the Swedish!). There is an option to increase the damping (rate of loss of energy), plus a third-octave smoothing mode. The programme can only cope with reflections up to 40mS (one cycle at 25Hz), since this is the limit of its time window. Equivalents suffer the same limitation. Listener position is entered into the analysis, as well as 'speaker position, so the impact of seating position is shown too.

provide target figures after which experimentation starts, so mediocre correlation with practice does not worry me. It is best to bear in mind that these programmes should not be treated as offering absolute truths when it comes to loudspeaker design.

That this is so became more apparent with the room programme, where the theoretical response of a room is compared with a measured response, demonstrating the efficacy of the method and the maths used. I was impressed by this. The result for our own listening room mimicked our measurements.

Even better, LspCAD not only showed loudspeaker in-room response but the impact of the room upon this response. This type of analysis nicely complements a DIY idea I have had, where a loudspeaker is designed to peak gently just below a room's natural roll-off point so as to extend bass response downward. This means a loudspeaker must be tailored for a specific room (which is how it should be by the way).

Another bonus is that LspCAD shows the effect listener position has too, a vital component in the equation. It can account for six reflective surfaces (i.e. four walls, ceiling and floor) and only fails to comprehensively model absorption and dispersion characteristics. To do this, however, would take Finite Element Analysis, replete with mathematical models of settees - definitely one for the boffins!

Conclusion

I felt the room programme analysis of LspCAD alone was sufficiently powerful, accurate and informative to justify the programme's price. Since it can be used independently of the 'speaker design functions, to show room behaviour on its own, this is a great option for fervent DIYers. Irrespective of my gripes about the user interface, flying pigs and skimpy instructions, LspCAD offers a lot of analysis for the price; I was impressed. But it is for the technical of mind and it should be used in conjunction with The Loudspeaker Design Cookbook or similar, if misleading results are to be avoided.

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ELECTRONIC CIRCUITS STUDENT HANDBOOK

by Michael Tooley

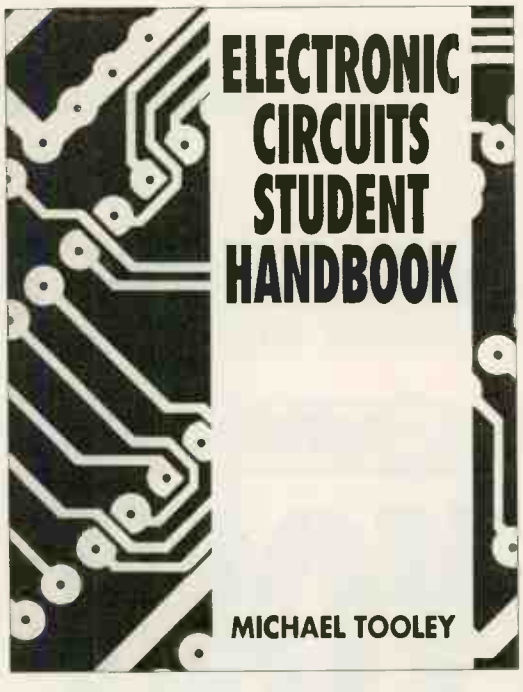
Reviewed by Noel Keywood.

In the preface to this book, author Michael Tooley, Dean of the Faculty of Technology at Brooklands College, states the book assumes, "little previous knowledge" other than an ability to cope with simple maths. He also claims the book is ideal for students following formal courses, such as GCSE, GNVQ, etc, in schools, sixth form colleges and further/higher education colleges. Bearing this in mind I was surprised to be confronted by an example question on the very first page dealing with flux density in Wb/m^2 at a point when the Weber (Wb) hadn't even been mentioned! And so it went on.

This book has not been structured to lead a reader from first principles succinctly explained into progressively more complex electronics. It puts the cart before the horse by diving into, for example, reluctance and permeability before it has even mentioned Ohm's Law, and lumping magnetic properties into the opening chapter entitled Electrical Fundamentals.

I found all this peculiar. Even the permittivity of free space gets a look in, and where I expected to find the usual explanation necessary to make a link between Joules and the Kilowatt Hours of your electricity bill, there was nothing. I should have known better - it was posed as a question at the end of the chapter, without the benefit of previous explanation.

To be fair, I suppose this book does follow a reductionist academic logic where the properties of the universe first have to be elucidated before any sense can or should be made of their workings. It surely isn't how human beings learn things, though, and seems to me an intimidating way to start a book aimed at people "with little previous knowledge". As an accompaniment to lectures however, perhaps this book forms a useful background reference and should been seen in such a context. It's thorough enough in cataloguing all the primary relationships in electrostatics, magnetics and electrics, all with clear diagrams, but there is no serious attempt to work explanations through, and few helpful analogies.



The second chapter on passive components looked more friendly, but even this seemed peculiarly positioned in the overall scheme of things, capacitors being explained in some detail before electric current, AC or DC, had been referred to. Nevertheless, all the usual explanations, such as capacitors being charged by a DC potential, were rigorously assembled and well diagrammed.

After dealing with DC then AC circuits, the book moves on to discrete semiconductors in Chapter Five, with diodes, transistors and FETs. Chapter Six stays resolutely sensible but comprehensive in its explanations of amplifiers, usefully concentrating on determining the DC and AC working conditions for single-transistor circuit stages.

Operational amplifiers come next, then oscillators and finally, but usefully, logic circuits. By moving into logic the book takes a first step into digital from analogue, with truth tables, logic gates and what have you. This is just enough to give a student a good idea of the sort of view one has to take when dealing with digital and how far removed it is from analogue in most senses, even if all digital signals are analogue in the end, as transmission line problems in data busses remind us.

This book is no great read. Nor does it attempt to cover anything other than the usual academic electronic syllabus. It was comprehensive and rigorous within these limits and presumably offers an effective reference source for students. While any student who ends up with a good grasp of all the many equations in the book would be in possession of a lot of useful knowledge, those with a more casual interest might find it perplexing and hard work ●

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PRACTICAL ANALOG ELECTRONICS FOR TECHNICIANS

By Will Kimber

Reviewed by Noel Keywood.

I was surprised to find this book claims to be for much the same group of students as the other book reviewed in this month's Supplement. Yet it differs significantly in its approach and its coverage. Author Will Kimber seeks to explain the action of electronic circuits through practical example. Whilst I have seen many forms of practical approach before, I have never encountered a book that contains nothing other than practical exercises. In this case they comprise small circuit blocks (usually one active device) to show how DC bias conditions are established as well as why and how this affects AC performance. Sensibly in my view, the author uses simple active devices like BC109 transistors, which are cheap and commonly available.

There are drawbacks to this approach. In places there are circles with the letters CRO inside, meaning Cathode Ray Oscilloscope. At £350 apiece - and that's a cheap one - oscilloscopes might be beyond novices' reach, even though they're all but essential when engaged in practical work. Students may well have access to a 'scope at college, but others will not. The only alternative is to get a second-hand one and hope to be able to keep it going. For years as an impoverished engineer I maintained a huge Schlumberger valve 'scope. It had 64 valves, needed two men to lift it and was disastrously unreliable, but it did the job. If you adopt this approach, you'll need a service manual.

That's just one way the 'scope problem can be solved. A good DC and AC voltmeter is necessary too, but today's multimeters are often able to measure AC from 10Hz to 10kHz without too much error. With these instruments wave forms can be seen and graphs of DC operating conditions drawn up. If this all sounds like intense work, you'd be right. For this book to be really useful quite a lot of time-consuming practical work needs to be undertaken. The maths has been kept simple yet effective and in this area the book scores strongly I feel. Too many books dwell on theory at the expense of the simple basic equations and views of a circuit needed to get it up and running. As first-step guidance on such matters, Practical Analog Electronics for Technicians is very strong and unusual for being so.

I found the sequence of topics a bit peculiar. The first chapter deals with DC power supplies, an unusual way to start out. It has some merits, introducing transformers, for example. But I would have thought Small Signal Amplifiers, with an introduction to the transistor and the notion of amplification, was best as a starter, yet it is Chapter Two in this book.

Most books dealing with Small Signal Amplifiers go on to deal with Large Signal Amplifiers next, but not this one. It doesn't cover them at all, so there is no discussion of output stages, heat sinks, thermal stability in such stages and what have you. There is, however, plenty of good, solid stuff on load lines, biasing and circuit basics, but only in the form of build and investigate exercises. I found this a somewhat barren approach as I expected to see some discussion on limitations, alternatives and the like. But the book sticks to its unusual style, which is good for reference purposes perhaps, rather than general reading. A valuable feature of the book is that all the circuits can be built, component values being clearly listed.

Audio amplification is clearly a major interest, since there's a chapter on Logarithmic units and another on Feedback. This is followed by Operational Amplifiers. I don't quite know what to make of a chapter on Feedback that obdurately ignores phase shift at spectrum extremes and the need for gain to be unity or lower for stability to be maintained. It would have been easy enough to make some mention of the fact that applying excessive feedback makes an amplifier unstable. Some engineers even believe feedback=stability, when the reverse is true. It's a pity that this most crucial understanding is not mentioned. Feedback phase gets an airing in a chapter on oscillators, but the connection with amplifiers is still not made. This underlines the non-discursive nature of the book and the way it sticks firmly to basics. After Oscillators come chapters on Test and Measuring Equipment (brief) and Fault Finding.

This book is valuable for its circuit basics. It is very practical and should allow anyone with an ability to add, subtract, multiply and divide to get a circuit up and running. This is quite rare; those who write books are too often far removed from such practicalities. I found its style of curtailed discussion peculiar and at times perplexing though. It has a well focused but narrow approach and really needs to be accompanied by an 'expert audio' tome, such as Linsley Hood's excellent Art of Linear Electronics, to raise important issues this book ignores ●

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D.I.Y. Letters

SOUND OF SILENCE

A while ago I made the Richard Brice headphone amplifier which was included in the DIY supplement a couple of years ago. I put together a simple power supply using cheap 12V regulators to achieve the +/-12V supply. This worked but there was always a low background hum which I couldn't seem to eradicate.

A while later (February 1997 DIY Supplement), there was a diagram in the letters pages showing a schematic for a choke smoothed power supply, so I ordered some chokes and had a go at soldering it together. It worked fine, but when measuring the voltages under load the supply was now giving +/-6.7V to the circuitry. The text said the regulation offered by the chokes would be much better than that from the cheap IC regulators so that was OK, but I was still left with the question of how to get +/-12V.

I decided to experiment a bit, and removed the regulators from the circuit. This gave a power supply output of about +/-25V under no load. Seeing as the circuit dropped the power supply voltage by about half, I then took a flyer and hooked up the circuit again.

At switch-on it didn't blow up, and measuring the voltages showed that I now had +/-11.7V, which is close enough. However, since I am a relative novice in electronic theory, I would like to know if there is any recognised way of working out how much a circuit will load a power supply, so I can predict how much the voltage will drop when a circuit is connected up to a power supply.

Incidentally, removing the cheap IC regulators also removed the hum and now the circuit is completely silent. I had read that it is possible to 'hear' the power supply through the circuitry, but I didn't realise it was so obvious! One thing which has been mentioned a few times in the DIY Supplement is a discreet component voltage regulator based around power transistors and zener diodes (I think). If you are looking for articles to include in future Supplements then that would definitely be of interest to me.

Mungo Beeston
Winchester,
Hampshire.

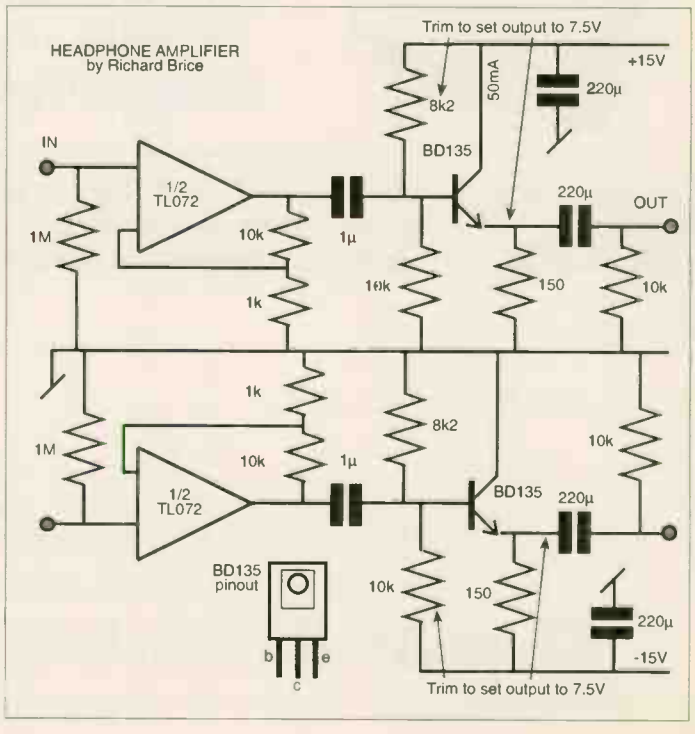
One other approach which seems to work well with low power circuits is battery power. Seeing as the circuit you're using draws little power, a pair of rechargeable lead/acid batteries would work very well I suspect. You wouldn't need to use any regulators, capacitors or chokes. As you said, it can be surprising how much a component's sound is influenced by its power supply and running from batteries should give an eminently quiet, clean sound.

Maplin stock a range of suitable batteries - XG77J (12V 6Ah) costs £24.05, and you'll need two of these. You will also need the correct charger - car battery types shouldn't be used under any circumstances with rechargeable sealed lead-acid batteries like these. Maplin's DX20W at £24.99 would work well. JM

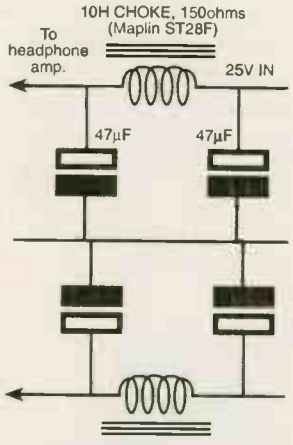
I would guess that in the original circuit you fed the output of the transformer directly to the regulators, relying upon them in effect to provide hum rejection, which they will do. Ideally, you should have put a smoothing capacitor between transformer and regulators as a first step to reducing hum (ripple), then the caboodle should have been hum free.

Chokes do not provide good regulation, except in comparison to 'smoother' resistors; they provide good noise rejection. That is why they sound good. Regulators put noise onto the line and it is hard to eradicate. Since ultra-tight regulation is less of a priority in audio than absence of noise and interference, chokes are usually a better choice than regulators.

You simply need to make a few measurements to sort your circuit out. First, using a multimeter, measure the D.C. current being drawn by the



headphone amplifier. It should be around 50mA per rail. Then, using the same meter, measure the D.C. resistance of the choke. Voltage drop across the choke is then simply found by multiplying the



resistance by the current (in amperes) E = R x I. You can find an IC's current draw in advance by consulting its data sheet.

I wonder about your chokes. They appear to have around 240ohms DCR by my calculations, when you really should expect 80-150ohms DCR. The Maplin ST28F we recommended has a DCR of 150ohms (quoted) and this would give around 7.5V voltage drop passing the 50mA or so demanded by the headphone amplifier. With transformer losses this might add up to 10V or so, giving you the 15V the circuit requires. NK

TRANSFORMER IMPEDANCE

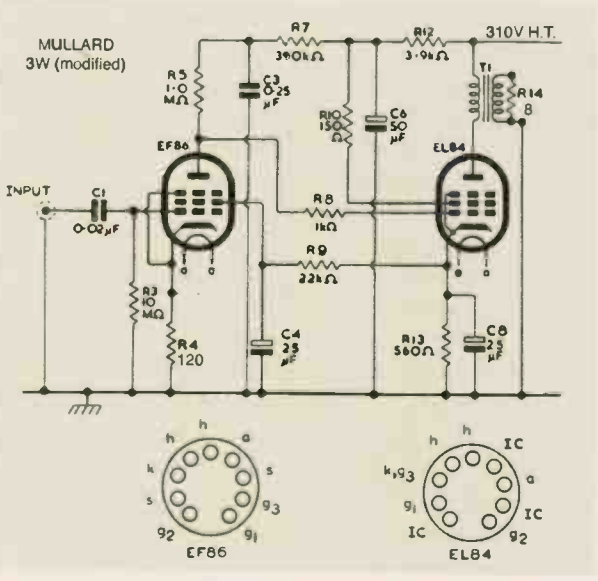
Ever since your magazine began to expound the virtues of valve amplifiers I have been fascinated by them. Over the last few years I have collected sufficient components to now be dangerously close to embarking on a construction project. There is one particular problem I have not been able to resolve and it is to do with output transformers. I have several push-pull transformers (including an ultra linear I believe) in my possession, but unfortunately they are unmarked. Can you tell me how to measure the load resistance of these devices? I do have access to test equipment but am only lacking the 'modus operandi'!

Can you recommend a text book that deals with lab type measurements such as THD, frequency response, signal to noise ratio, power output etc.

Your advice would be greatly appreciated.

Bruno Sirignano
Cheltenham,
Gloucestershire.

Because the inductance of a transformer is affected by DC current passing through it, to assess impedance you should measure voltage across the primary with a current passing through it that is close to working conditions. With a 6kohm primary having a high DCR, plus something like 30mA, you end up needing to use high voltages. The best way of organising this is to put the transformer in a simple basic output stage and pass an AC signal through it at 400Hz or 1kHz. Measure current through the transformer and voltage across it, then the impedance is equal to the voltage divided by the current in amperes (Z=V / I). If you don't fancy measuring AC current, put a 1ohm or 10ohm resistor in series with the primary, measure the AC voltage across it and calculate the current through it, which is then the current through the transformer primary. A good circuit for this is Mullard's (now Philips Components) 3W design, which I've reproduced here, in modified form. Loop feedback has been removed, since this would give a false result. An eight ohm resistor has been put across the secondary (important) and you'll need to cobble up a power supply able to give 310V for the H.T. You may be able to do without the first stage if you have a signal generator with a healthy output, say 1V or so.NK



SPEAKER SELECTION

With a bit of luck, over the next months I will be able to replace my ancient budget hi-fi for something better. I will probably start my search for new equipment with the CD players and amplifiers that you have recommended, such as the Aura VA80SE-x, Rotel RA-970BX and Denon DCD825. The problem as I see it will be with the 'speakers. My listening room is large at 6m by 4m and I would like a pair of floor standing 'speakers. One obvious choice would be the Celestion Impact 23 but being a capable DIYer I am sorely tempted by the likes of KLS7 and KLS9.

I fancy the challenge of building my own 'speakers and the chance of ending up with better sound for the same or less money than the Impact 23s. I feel out of the two kits the KLS9 would be the better bet as it would probably fill the room with sound more easily.

Assuming I go ahead with KLS9, I've got a few questions.

1) Are the amplifiers I've mentioned a good match for KLS9? Bearing in mind my budget of £350, are there better alternatives?

2) I would propose to position the 'speakers firing down the length of the room, about 0.6m from the side walls and in free space at the rear. Would this be okay?

3) I can't audition KLS9 living in Birmingham and have really no idea of what to expect from it in terms of quality or tone. Are there any 'speakers commercially available which you believe exhibit similar qualities.

Your help would be much appreciated.

Stan Comley
Birmingham.

Both of the amplifiers you mention would work well with KLS9, which is the option I'd go for. KLS7 is a relatively small floorstander and doesn't possess KLS9's bass extension and power. The Aura would give a warmer presentation than the Rotel which has a firmer, more controlled sound than the VA80SE-x - choosing between the two is a matter of personal taste.

Positioning the 'speakers to fire down the length of the room is fine, as is having them 0.6m away from side walls. One

point worth mentioning is that the KLS9s should be heavily toed-in so that their axes cross in front of you. This will minimise reflections from the side walls which blur imaging. Lots of space behind the cabinets will again aid imaging by reducing reflections off the rear wall and will only produce a slight reduction in deep bass due to loss of wall reinforcement.

Commercial equivalents which have bass as deep as KLS9 are few and far between and tend to have four-figure prices. Tonally the HDA driver is relatively neutral, lacking the sweetness of carbon fibre, the slightly 'quacky' warmth of polypropylene and the hardness of paper. **JM**

BOXLESS BASS

I was fascinated to read your articles on designing a suitable subwoofer for the ESL63s. Currently I have a complete Quad 66/606 set-up working with an old and much loved pair of Spendor BC1s which I now want to replace with a pair of ESL63s. Having borrowed a pair, I know they are tricky to set up and light in the bass but I have never found a subwoofer to match properly.

I didn't find the Gradients impressive (quite apart from being seriously unacceptable aesthetically) and the RELs just seem to 'muddy' the bass. I therefore read your article avidly. Having done so, I had the following observations/questions, upon which I would welcome your comments.

BASS DIPOLE UNIT

Given that the bass unit has to cover a wider frequency range than is normal for a subwoofer, can a high quality bass unit such as the ATC SB75-3I4 be used? This is a fast, revealing unit that can easily work up to 300Hz and excels in its distortion, transient response and power handling.

Do you need two drive units per subwoofer? Presumably if you do, then they must be in parallel and out of phase. Lastly, what sort of mounting (I hesitate to use the word 'cabinet') is needed?

NUMBER OF UNITS AND AMPLIFICATION

Most subwoofer manufacturers would have you believe that only one unit is needed. Is this really the case or do you have to have a pair to work with the ESL 63s? Also, has the 606 got enough 'oomph' to drive a pair of subwoofers adequately or is something like the AVI S2000A needed. If so, will the 66 pre-amp drive it?

ACTIVE CROSSOVER

Your crossover looks fairly simple but does it compare with commercial crossovers such as those produced by Linn in their Tune Box, the Mirage LFX Series or indeed the one provided by Quad for the Gradients? Essentially, is there an existing high quality unit that can be tuned to match the 'speakers?

Finally, you made no mention of phase matching in your article. I have been led to understand that frequency response is all very well, but it is also extremely important to be able to match the phase of the two units to ensure clarity.

I'm a convert to the ESL 63s and am very keen to give them really good bass rather than going for Martin Logans and the need to spend yet more on very fancy amplification. Many thanks for the articles and I look forward to reading the next instalment before diving in with a soldering iron.

Martin Wright
Stirling,
Stirlingshire.

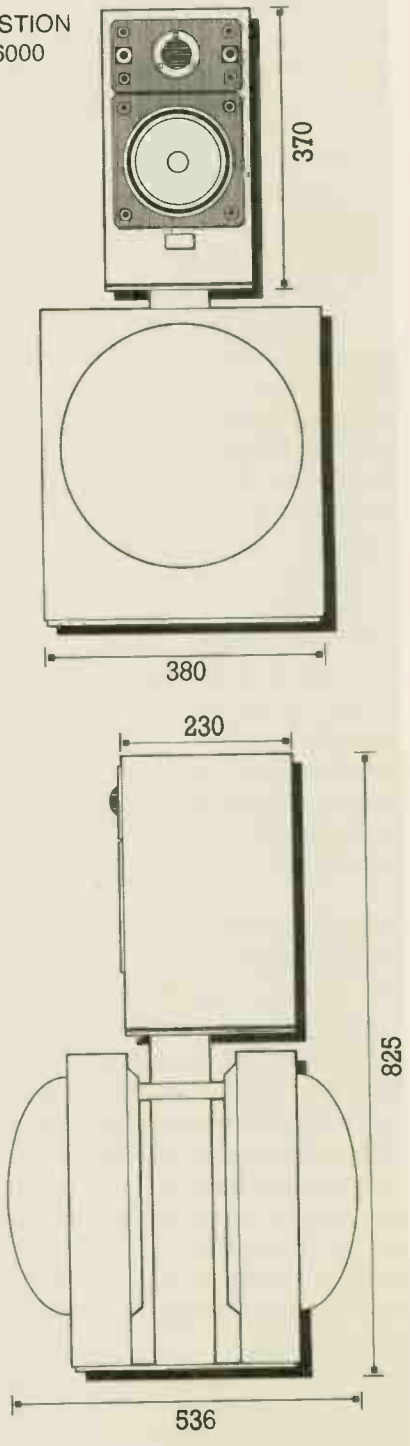
I am not acquainted with the ATC bass unit you mention and have no data on it. Any reasonably sized bass driver will do, but because cancellation compromises efficiency the unit has to work quite hard, so the bigger the better. A 10in unit, or larger, in a flat, open MDF baffle about 15in square is a good place to start. I suggest you use just one unit per channel to start. Two drivers give better power handling and, on the SL6000, placed the acoustic centre of the bass drivers below that of the SL600 'speaker above, Celestion tell me. Out of interest I have reproduced diagrams from an early SL6000 brochure (see below), which show how Celestion intended the SL6000 to match their small SL600. The side view clearly shows the SL600 precisely positioned so its acoustic centre is above that the of the SL6000.

I cannot see why this is important at such long wavelengths (5ft at 100Hz). Better to get the 'speaker running satisfactorily before diving into any more complexity. If you do use two drivers mounted face to face, as Celestion did, then yes, one must be connected 'out-of-phase' so that they end up in-phase (i.e. both cones moving in the same direction at the same time). Since a lot of power is demanded, it would be best to connect two 8ohm drivers in parallel to get 4ohms, then use a chunky power amp.

Orientation to match the room is most important I find. As and when you are happy with results you may like to consider improving power handling, since the high-pass filter feeding the Quads lets them go very loud.

Open baffle dipole subwoofers need

CELESTION SL6000



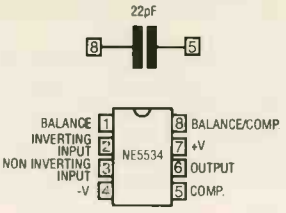
equalisation as well as crossover filtering. No commercial networks offer this except Celestion's and my own design, which went a few stages further by having a high pass subsonic filter to limit cone excursion and improve power handling, plus a high Q peak at 100Hz to "speed up" the sound of the heavy paper cone bass guitar drivers Celestion used.

If the REL did not sound right, it is almost certainly down to tuning. RELs are difficult to tune accurately but once done they offer outstanding bass quality. The procedure is to set volume and bandwidth to maximum, then progressively tune them both downward.

I never liked the Gradients much. Be aware that the open dipole is quite a sophisticated beasty in theory and that a properly tuned REL is very good and a lot simpler. If you would prefer an easy solution then this is the best I have come across by a large margin. A REL Stadium reached down to 10Hz in our 16ft long room - and it felt like it. NK

RE-ENGINEERING II

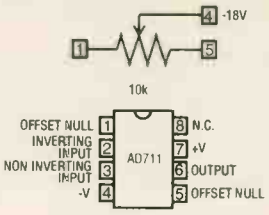
My first letter was published in the June 1997 supplement and outlined mods to my Aura CD100 CD player and VA80SE amp. The biggest



improvement came about when I changed the NE5534 op amps for Analogue Devices' AD711s. With this letter I would like to go into detail about how to bias the AD711.

After taking out the amp's NE5534s, remove the two 22pF capacitors - they are only there for the NE5534s' benefit. The AD711 can work in Class A if the bias current is set at 2mA. The easiest way to obtain this is to put a 6kOhm - 7kOhm resistor between -V (pin 4) and output (pin 6). This value of resistor would be right for the usual +/- 15V supply. Making these changes improves the sound drastically. Unfortunately, because of the power supply arrangement in the CD player, the AD711 can't be biased for Class A using this method.

I've seen reviews in your magazine on programmes which design 'speaker crossovers but not circuit simulator programmes. Looking around on the Internet, I've found the following web sites:



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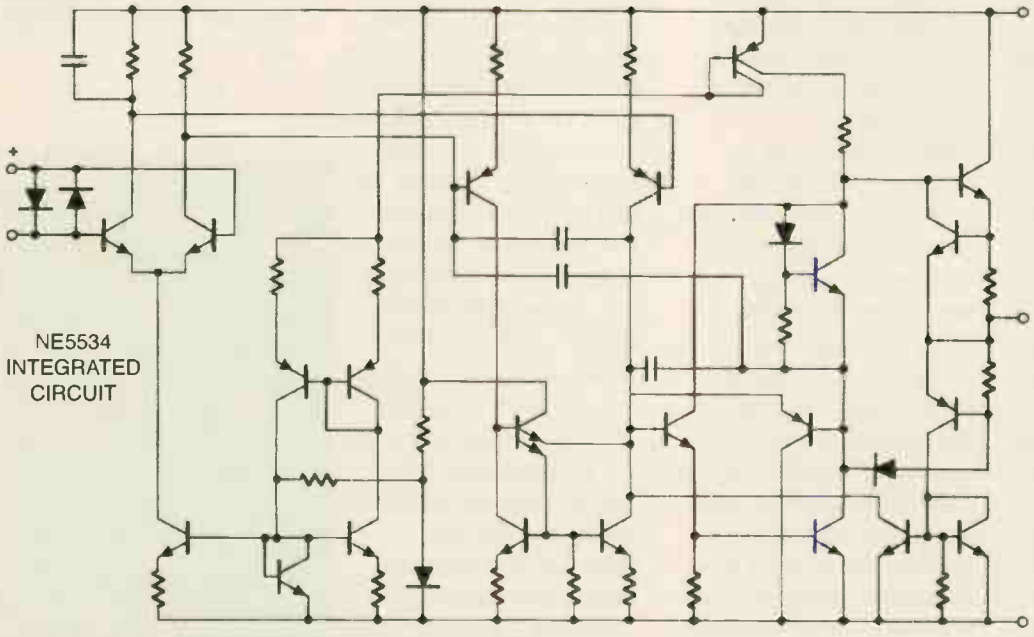
Juan Raul Couto Dominguez
La Coruna,
Spain.

The poor Signetics NE5534 has suffered at the hands of industry cheapskates. It's a great device, with incredibly low noise, good bandwidth and low distortion. But it is cheap - less than £1. I've been told many times it's great for audio, which is true, but not high-end audio. In my experience the 5534 sounds a little grey and grainy, and flat and lifeless (high feedback) against superior chips, but the latter cost more, although the AD711 is available for a modest £1.30 or so.

The NE prefix is used by Signetics, part of Philips, and some useful info on phono pre-amps, etc can be found on Philips' Netsite (http://www.semiconductors.philips.com/). Because it is super low noise, you often find the 5534 at the heart of phono stages.

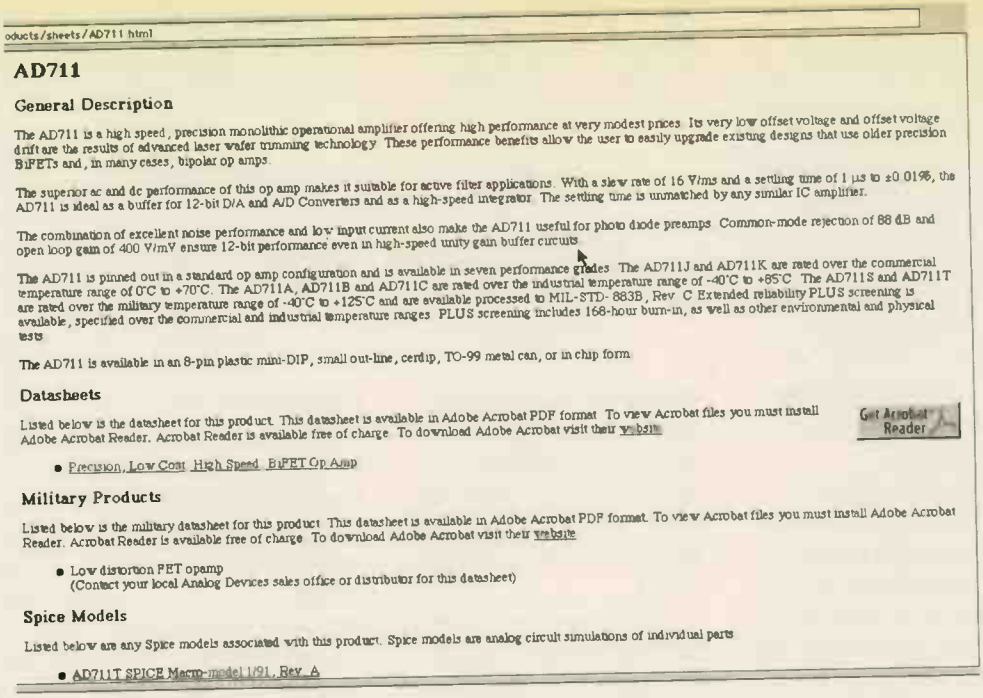
If you look at the circuit of a chip like this however, it is teeming with active devices. The 5534 boasts 22 of them, plus diodes, with two back-to-back on the input to provide overload protection. That's good for robustness and reliability, but it is not quite the stuff of high-end audio, where diodes are avoided because of their non-linearity.



The AD711 has become a favoured replacement for the 5534 and it is 'sort of' pin compatible. Tthe 5534 may have a compensation cap between pins 5&8, and it may also have DC balancing voltages between pins 1&8. If both are present, these may affect the AD711. I do not know if there is any internal connection on the 711's NC (No Connection) pin and of course any balancing voltages on the 5534 will not provide DC offset compensation on the AD711. This will have to be newly cobbled if any small output offset is to be nulled.

The AD711 works up to +/-18V maximum, drawing 3mA or so. The NE5534 takes +/-22V absolute maximum on the rails, so experimenters need to check out supply volts.

Both appear to have an open loop gain of 100dB but the 711 has more bandwidth, so I wouldn't expect problems here. However, the AD711 has more input noise than the 5534, so if a lot of gain is being used, the AD711 will be noisier. This is likely to be consequential in phono stages, but not in output line drivers, etc. Above you can see what Analogue Devices have to say about this chip. I hope this shows you what to look for. Good luck with your experimenting. NK



oducts/sheets/AD711.html

AD711

General Description

The AD711 is a high speed, precision monolithic operational amplifier offering high performance at very modest prices. Its very low offset voltage and offset voltage drift are the results of advanced laser wafer trimming technology. These performance benefits allow the user to easily upgrade existing designs that use older precision BiFETs and, in many cases, bipolar op amps.

The superior ac and dc performance of this op amp makes it suitable for active filter applications. With a slew rate of 16 V/ms and a settling time of 1 µs to ±0.01%, the AD711 is ideal as a buffer for 12-bit D/A and A/D Converters and as a high-speed integrator. The settling time is unmatched by any similar IC amplifier.

The combination of excellent noise performance and low input current also make the AD711 useful for photo diode preamps. Common-mode rejection of 88 dB and open loop gain of 400 V/mV ensure 12-bit performance even in high-speed unity gain buffer circuits.

The AD711 is pinned out in a standard op amp configuration and is available in seven performance grades. The AD711J and AD711K are rated over the commercial temperature range of 0°C to +70°C. The AD711A, AD711B and AD711C are rated over the industrial temperature range of -40°C to +85°C. The AD711S and AD711T are rated over the military temperature range of -40°C to +125°C and are available processed to MIL-STD- 883B, Rev. C. Extended reliability PLUS screening is available, specified over the commercial and industrial temperature ranges. PLUS screening includes 168-hour burn-in, as well as other environmental and physical tests.

The AD711 is available in an 8-pin plastic mini-DIP, small out-line, cerdip, TO-99 metal can, or in chip form.

Datasheets

Listed below is the datasheet for this product. This datasheet is available in Adobe Acrobat PDF format. To view Acrobat files you must install Adobe Acrobat Reader. Acrobat Reader is available free of charge. To download Adobe Acrobat visit their website.

Get Acrobat Reader

- Precision, Low Cost, High Speed, BiFET Op Amp

Military Products

Listed below is the military datasheet for this product. This datasheet is available in Adobe Acrobat PDF format. To view Acrobat files you must install Adobe Acrobat Reader. Acrobat Reader is available free of charge. To download Adobe Acrobat visit their website.

- Low distortion FET opamp
  (Contact your local Analog Devices sales office or distributor for this datasheet)

Spice Models

Listed below are any Spice models associated with this product. Spice models are analog circuit simulations of individual parts.

- AD711T SPICE Macro-model 1/91, Rev. A

ADDICTED TO THE BOTTLE

I have recently refurbished an amplifier. At the time, I did not know its identity and so had to work directly from it to draw a circuit diagram. I have since discovered that this amplifier is a Leak Stereo 60 and I wondered if you could help with the following questions:

1) The Mullard twenty-watt amplifier uses an identical output configuration but adds two 1kOhm resistors in the screen grid supply circuit to improve linearity above fifteen watts. Would the Leak benefit from the addition of these?

2) I have retained the original cathode biasing resistors for this refurbishment as they consist of standard, centre-tapped 880 ohm resistors. I was not sure if they were constructed in this way to couple them thermally or inductively. Would it be advisable to change these for modern precision wire-wound resistors?

3) In your DIY Supplement No28's letter section, AG mentions that it is possible to configure a distributed load output stage to triode operation in reply to A. Proctor's Pentode Passion letter. Would it be possible to add a switch to the Stereo 60 to switch between distributed load and triode configuration?

4) At the moment I am using EL34s. I was just wondering what you would recommend as the most suitable tubes for this output stage? Do cathode bypass capacitors have much influence on sound quality? If so, would you have any recommendations as to which type I should use?

At the moment, my main aim is to build a phono and line level pre-amp from scratch. I am basing this on Shunt Regulated Push-Pull topography, a very similar design to that mentioned in Matt Rowland's letter in DIY Supplement No28. I intend to use a Mu follower for the first phono stage to give me sufficient gain to use a low-output MC cartridge. This has promoted my interests in the following areas:

1) The mathematical consequences of paralleling triodes to lower noise level. I would like to try this in the first stage. I wondered if you could provide me with any information on the subject?

2) A list of useful web sites.

Thanks for your assistance.

John Arrant
John@Arrant.prestel.co.uk

Screen grid resistors can theoretically increase linearity because they introduce a kind of feedback, but they are usually used to prevent parasitic instability. I wouldn't bother changing the configuration you have at present. Leak should have included small value resistors anyway. If not, use 100ohm to 1k 1W resistors and see what happens - you won't blow anything up. Leave the bias resistors as they are, if they don't look fried. It's usually better to leave amps like old Leaks and so on original, otherwise it's like putting lemonade in a vintage wine to make it sweeter.

The cathode bypass caps will probably need to be replaced because they tend to dry out over time. Replace them with Black Gates if you can afford them. If they are too expensive, try Elna Cerafines.

The equation for determining noise is Vn=(4KTRB)^-0.5, where K is Boltzmann's constant (1.38E-23), T is absolute temperature (in Kelvin, 293 is approximately room temperature), R is the equivalent noise resistance, and B is the noise equivalent bandwidth (about 2kHz for a RIAA pre-amp. You can estimate the enr of a triode with R=2.5/gm, but it's usually much worse than this. If you parallel valves, each time you double the amount of valves the noise voltage is reduced by the factor of 1.414 (root two), but the sound will be worse. Use a step-up transformer instead!

AG