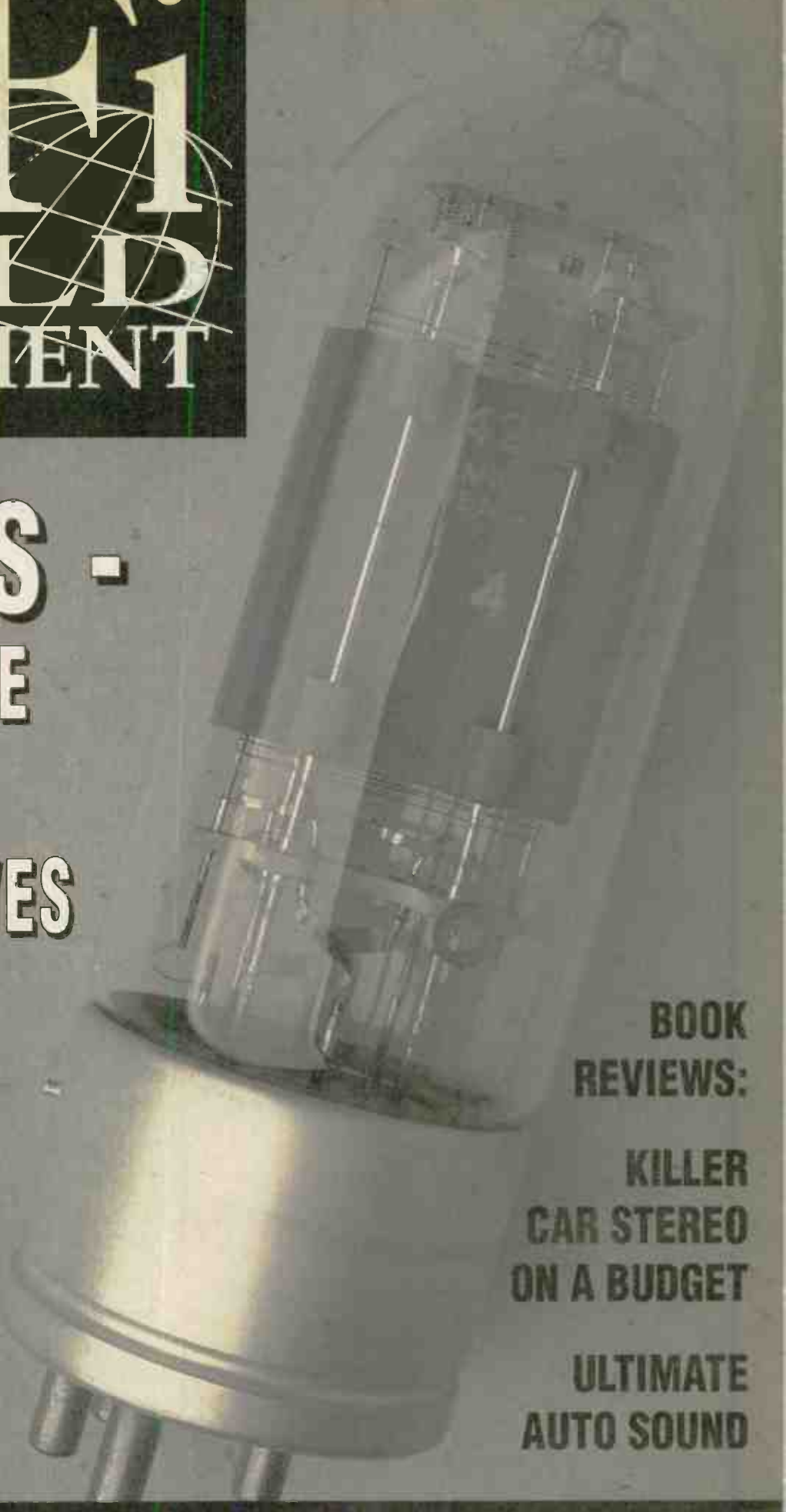
Hi-Fi WORLD SUPPLEMENT

No. 21 APRIL 1996



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BOOK REVIEWS:

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FREE D.I.Y. SUPPLEMENT No. 21

CHELMER VALVE COMPANY

for

High Quality Audio Valves

We offer below a selection of our CVC PREMIUM range of audio valves. These CVC BRAND valves are from selected world wide sources, processed in our special facility to provide low noise/hum/microphony PRE-AMP valves and POWER VALVES burnt-in for improved stability and reliability. Use this sheet as your order form. If you require matched pairs, quads or octets etc. Please allow £1.00 extra per valve for this service and mark alongside the valve type number 'M2,M4, M8' etc as required.

Price list and Order Form for CVC PREMIUM Audio Valves

PRE-AMP VALVES	Unit Price	Qty	Total Price
ECC81/12AT7WA	5.00		
ECC82/12AU7WA	4.50		
ECC83/12AX7WA	5.00		
ECC85	5.00		
ECC88	4.50		
ECF82	5.00		
ECL82	5.00		
ECL86	5.00		
EF86	4.50		
E80F Gold Pin	9.00		
E81CC Gold Pin	6.20		
E82CC Gold Pin	6.20		
E83CC Gold Pin	6.20		
E88CC Gold Pin	7.20		
6EU7	6.00		
6SL7GT	4.00		
6SN7GT	4.50		
6922	5.00		
7025	6.20		

POWER VALVES	Unit Price	Qty	Total Price
EL34/6CA7	7.50		
EL34 (Large Din)	8.50		
EL84/6BQ5	4.00		
E84L/7189A	5.50		
KT66	9.20		
KT77	12.00		
KT88	12.50		
KT88 (Gold Special)	19.80		
2A3 (4 or 8 Pin)	14.50		
211	22.00		
300B	50.50		
6C33C-B	27.00		
6L6GC	6.50		
6L6WGC/5881	8.00		
6V6GT	5.00		
6080	12.00		
6146B	10.20		
6336A	46.00		
6550A	11.00		
6550WA	13.50		
6550WB	13.50		
7581A	11.00		
807	8.00		
811A	10.50		
812A	34.00		
845	30.00		
Total carried forward ...			

RECTIFIERS	Unit Price	Qty	Total Price
EZ80	4.00		
EZ81	4.25		
GZ32	7.00		
GZ33	7.00		
GZ34	6.00		
GZ37	6.00		
5U4G	5.00		
5V4GT	4.00		
5Y3GT	3.50		
5Z4GT	3.50		

SOCKETS ETC	Unit Price	Qty	Total Price
B9A (Chassis or PCB)	1.60		
B9A (Ch or PCB) Gold	3.00		
Octal (Ch or PCB)	1.80		
Octal (Ch or PCB) Gold	4.20		
4 Pin (For 2A3, 300B)	3.30		
4 Pin Jumbo (For 211 Etc.)	11.00		
4 Pin Jumbo Gold (For 211 Etc.)	15.00		
5 Pin (For 807)	3.00		
7 Pin (For6C33C-B)	4.50		
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Anode Connecter (For 807 Etc.)	1.50		
Anode Connecter (For PL519 Etc.)	1.60		
Retainer (For 6L6WGC Etc.)	2.00		

MATCHING CHARGES	£
POST & PACKING (UK)	£3.00
TOTAL EXC VAT	£
VAT @ 17.5% (UK/EEC ONLY)	£
TOTAL TO PAY	£

Please make cheques payable to:
'CHELMER VALVE COMPANY' or pay by
ACCESS/MASTERCARD/VISA Please give details:

SIGNATURE: ..... EXP. DATE: .....

NAME: .....

ADDRESS: .....

.....

.....

..... Post Code: .....

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130 New London Road, Chelmsford, Essex. CM2 0RG. Tel: 01245 355296/265865 Fax: 01245 490064

D.I.Y. Supplement

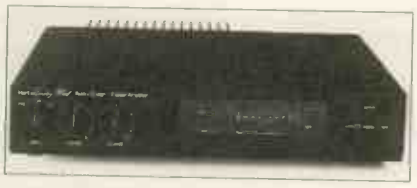
Contents

Hart Audio Kits -
Your Value for Money Route to Better Sound

2 Penylan Mill, Oswestry, Shropshire, UK. SY 10 9AF
Phone 01691 652894 Fax. 01691 662864

Hart Audio Kits and factory assembled units use the very best audiophile components in circuit designs by the renowned John Linsley Hood to give you unbeatable performance and unbelievable value for money.

We have always led the field for easy home construction to professional standards, even in the sixties we were using easily assembled printed circuits when Heathkit in America were still using tagboards! Many years of experience and innovation, going back to the early Dinsdale and Bailey classics gives us unmatchable design expertise in the needs of the home constructor. The current range of Hart kits is designed to give you all the components for a matching ensemble of audio excellence.



K1100 AUDIO DESIGN 80 WATT POWER AMPLIFIER.

This fantastic John Linsley Hood designed amplifier is the flagship of our range, and the ideal powerhouse for your ultimate hifi system. This kit is your way to get EK performance at bargain basement prices. Unique design features such as fully FET stabilised power supplies give this amplifier World Class performance with startling clarity and transparency of sound, aided by the famous HART quality of components and ease of construction. Useful options are a stereo LED power meter and a versatile passive front end giving switched inputs, with ALPS precision Blue Velvet low noise volume and balance controls. Construction is very simple and enjoyable with all the difficult work done for you, even the wiring is pre-terminated, ready for instant use! All versions are available with Standard components or specially selected Super Audiophile components at £29.60 extra per channel, plus £2.40 if you want to include Gold Plated speaker terminals.

K1100B Complete STANDARD Amplifier Kit	**£395.21**
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A1100SC Factory Assembled	**£422.62**
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A1100M Factory Assembled	**£329.20**
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K1100CM Construction Manual with full parts lists	**£5.50**

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***K2100SA** Series Audiophile version with selected audiophile components*	**£112.46**
A2100SA Factory Assembled and Tested "Chiara"	**£149.46**

***K3565** "Andante" Audiophile Power Supply Kit to suit* **£85.42**
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Special Offer, *Both Units in Kit Form together with SA version "Chiara" with mains and DC Supply lead* **ONLY £184.92**
Factory Assembled and Tested **ONLY £267.88**

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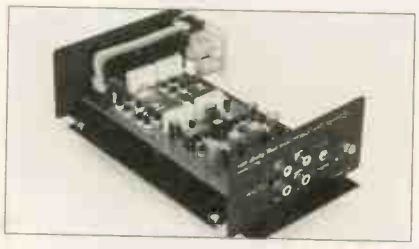
This magnificent kit comes complete with all parts ready to assemble inside the fully finished 228 x 134 x 63mm case. Comes with full, easy to follow, instructions as well as the Hint Guide to PCB Construction, we even throw in enough Hart Audiograde Silver Solder to construct your kit!

***K1450** Complete Kit*	**£111.58**
***K1450SA** Audiophile Kit*	**£133.94**

Why not buy the reprints and construction manual for the kit you are interested in to see how easy it is to build your own equipment the HART way. The FULL cost can be credited against your subsequent kit purchase.



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Now you can throw out those noisy ill-matched carbon pots and replace with the real hi-fi components only used selectively in the very top flight of World class amplifiers. The improvement in track accuracy and matching really is incredible giving better tonal balance between channels and rock solid image stability.

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Hart Super Audiograde Silver Solder has been specially formulated for the serious audiophile. Not only does it give beautiful easy to make joints but it is designed to melt at normal soldering temperatures avoiding the possibility of thermal damage to components or the need for special high temperature irons. A very low residue flux makes perfect joints easy but eliminates the need for board cleaning after use.

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***845-008** 100g Reel Special Valve Grade, 20swg*	**£12.90**
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***845-110** 100g Reel Superfine 24swg for ultra precise control and easy working*	**£21.45**

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Special set toroidal transformers. 2 output & 1 mains for the "Hart Audio Power" valve amplifier design described in the Oct. 1995 issue of "Wireless World". Total Wt 4.8Kg.

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ALL PRICES INCLUDE UK/EU VAT

KIT NEWS

SVETLANA SV6550C

Svetlana Electron Devices Inc. of Alabama, has been testing different versions of the 6550 manufactured in St. Petersburg, Russia.

This has resulted in the SV6550C, combining the best aspects of the versions sampled, which, they claim, has greatly enhanced sonic performance. New features include: increased peak cathode emission from new cathode materials, gold-plated grid and a new tri-plate anode. They are available now, price is expected to be £35 each. The marketing and engineering section, based in California, can be contacted at:

Svetlana Electron Devices
3000 Alpine Road,
Portola Valley, CA 94028
USA.
☎ 415 233 0429

VALVE TESTING SERVICE

GT Audio are now offering a valve testing and matching service. The service has been set up to help enthusiasts who buy new or second hand valves without knowing how good/well matched they are compared to other valves. In some power amplifiers performance gains can be achieved with matched pairs/quartets. Also in the smaller B9A valves like the ECC83 the performance of each triode within the glass envelope can be wildly different.

Prices for testing are 50p for small single triodes and pentodes, £1 for double triodes and output valves. Each tested valve is labelled with values for mutual conductance and current consumption.

GT Audio
5 Upper Road,
Higher Denham,
Bucks. UB9 5EJ
☎ 01895 833099

DEFINITIVE AUDIO INNOVATIONS

Definitive Audio is providing a power supply modification service for Audio Innovations' amplifiers. The replacement power supply uses a GZ37 valve rectifier with a choke input filter and attaches to the Audio Innovations amplifier via an umbilical power lead. This replaces the solid-state, diode-rectified circuit used in the Audio Innovations amplifier but retains the use of its power on/off switch. Price is £550.

Please remember that any modification made to a piece of equipment will invalidate its existing warranty.

Definitive Audio
63 Berriedale Avenue,
Hove, Sussex.
☎ 01273 208649

VINTAGE AUDIO LAUNCHES VA30 MODULE

To be produced in Vintage Audio's new Dyfed factory, the VA30/20 amplifier is based around a VA30 valve manufactured specifically for the company by Richardson Electronics of the USA. Except for the UX4 base being replaced by the international 8-pin octal, the valve is similar to the famous Western Electric 300B.

The main chassis assembly of the amplifier is constructed of silver-plated 2mm and 3mm solid copper. Four 6SL7's are used for pre and driver stage. The single-ended output transformers are manufactured by Gardeners Transformers in Dorset to Vintage Audio's specification.

A matching power supply unit, the VA30/psu, is available. Budget versions of both are on offer, using more cheque-book-friendly off-the-shelf components.

The VA30/20 and the VA30/psu are built to order and cost £1435 and £955 respectively; the economy models are priced at £545 and £358.

The Vintage Audio Co.
Brynhelygen,
Eglwyswrw,
Crymych, Dyfed,
Wales. SA41 3SS
☎ 01239 891448

MARCH MADNESS AT SJS

In double celebration of their second anniversary and their appointment as European representatives of Hovland Musicap, SJS Electroacoustics is having a winter sale.

Until 15th March all cash orders received for their output, interstage and mains transformers, power supply chokes and Hovland MusiCaps will qualify for a 20 per cent discount. Credit card orders qualify for a discount of 15 per cent.

There are fifteen standard designs for single-ended output transformers and twelve for push-pull. Hovland MusiCaps' Film/Foil Polypropylene capacitors are available in values ranging from 0.01µF to 10µF.

A complete catalogue is available from:

SJS Electroacoustics
Ben-Dor,
Lumb Carr Rd,
Holcombe, Bury,
Lancs. BL8 4NN
☎ 01706 823025

FREEPHONE RUSS

Russ Andrews Turntable Accessories has improved its service to mail order customers by providing a freephone number (0800 373467) for orders and enquiries.

AN ACTIVE DIPOLE SUBWOOFER

Dominic Baker describes the design of a subwoofer for Quad's ESL-63 electrostatics

A flurry of correspondence followed our dipole subwoofer project in the December '94 DIY Supplement. We gave details of a unique active crossover that married Quad electrostatics to Celestion's SL6000 dipole subwoofer. But the Celestions are no longer available, so you wanted to know how you could build your own.

We set about designing a system that could be built around modern drive units available today. First we had to find a large, high power driver capable of surviving the huge power required in a dipole subwoofer system. Beyma and Precision Devices sprang to mind, both known for their superb high power bass drivers. But they are expensive too, so much so that it would put the system out of reach for many enthusiasts.

This quickly brought our sights to bear on our final target. To keep cost down, a single driver needed to be found to replace the twin-driver Celestion system. A good cost saving could be made straight away, although some output level (volume) is sacrificed. With only one driver per channel rather than a pair, the system is not quite as powerful, but this is not a problem in a medium size living room, where a smaller, simpler system is more appropriate.

We also needed to find a driver with high sensitivity, because dipole subwoofers absorb a lot of power. There would be little point keeping the system simple if powerful and costly amplification was needed. Problem is, higher sensitivity drivers have lighter cones and a higher resonant frequency, which limits bass depth, so there's a trade off here.

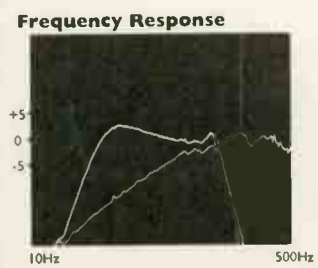
We had to find the best compromise available. Audax's PR330M0, a 13" driver from their professional range, seemed to fit the bill nicely. Sensitivity is massive at 98dB, comparable to the 12" Beyma drive unit which was one of the highest sensitivity drivers I know. But with a slightly larger cone the Audax looked better able to shift air in volume. And the resonant frequency on paper was a low 28Hz; I couldn't find anything of similar sensitivity that could rival this low figure.

Best of all, the Audax driver was considerably more affordable than anything comparable. This looked to be a super driver, so without further delay a set was ordered and experimentation began. Here's how we developed our dipole subwoofer system for you.

TECHNICAL DESCRIPTION

The Dipole Subwoofer

Our dipole subwoofer is effectively a drive unit working in free space, although in practice it is mounted on a compact baffle. There is no cabinet to 'hold in' the energy from the rear of the cone, so the sound pattern behind the dipole is identical to that in front, but out-of-phase. This energy from the rear cancels the front resulting in a 6dB/octave roll-off. Because our practical baffle is small, bass rolls off from around 200Hz down,.



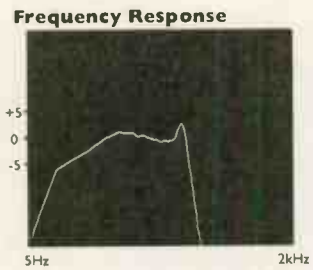
Electronic equalisation lifts the driver's output by 6dB/octave

To counter this bass roll-off, it is necessary to electronically equalise the response with a +6dB lift. If the driver's response on the open baffle falls by 6dB/octave, and you add-in a +6dB/octave lift electronically the net result should be a flat response. You can see the near field response of the equalised driver in the plot above, along with the unequalised response.

The Drive Units

Because we wanted to produce, for the DIY enthusiast, a more affordable speaker than Celestion's SL6000 system we chose a very high quality heavy duty bass driver, a 13" Audax unit. Celestion use two 12" drivers per channel in a double-dipole arrangement, each pair push-pulling together. We chose to use a single, but slightly larger cone to keep cost down. This means that our system works in medium size listening rooms typical in the UK, for larger rooms the drivers could be doubled up.

The PR330M0 bass driver used is from Audax's professional range. It is very powerful, with a high sensitivity of 98dB. Because a +6dB/octave lift is applied electronically to counter the losses of the open dipole, caused by cancellation, a lot of power is needed. Use of a sensitive driver like the PR330MO makes the system suitable for a wider range of amplifiers, although you should still be looking for at least 100watts. The only downside of using a lighter and more sensitive driver is its higher resonant frequency, which limits downward extension.



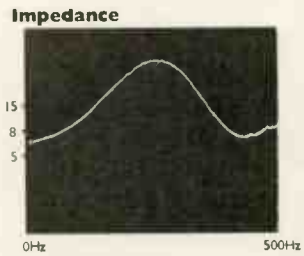
The original crossover for the Celestion SL6000s with our subwoofer. We limited bass extension to improve performance and power handling.

The Crossover

Our crossover was designed to smoothly integrate Quad's ESL-63 electrostatic loudspeakers with Celestion's SL6000 dipole subwoofer. Because we wanted to offer a more affordable, simpler system for DIYers, a few changes had to be made to the electronics.

When we first fired up the system with the original crossover the results were as I'd hoped: wonderfully deep, clear and extended bass. But really deep bass at high levels on a recording could bottom out the cones, causing distortion. Here there were two problems. Firstly, the single cone was having to work too hard to reproduce the lowest bass, running out of excursion. Secondly, driving the bass unit below its resonant frequency increases distortion.

The solution was to limit lower bass electronically. The original crossover filtered out low bass below around 20Hz to prevent cone flap and 'speed-up' the sound. Measuring the impedance curve of the PR330M0 it was found that the resonant frequency was around 26Hz. By changing the values of C1 and C2 on the original circuit from 0.33µF to 0.1µF, the lower limit was raised from 20Hz to 30Hz, or just above the resonant frequency. The reduction in cone excursion at lower frequencies improved power handling greatly, allowing high levels to be reproduced in a medium size listening room. Bass was also cleaner and faster still, the cone no longer being forced to operate below its resonant frequency.

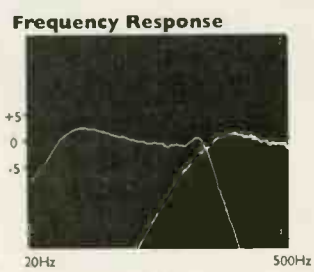


The peak in the impedance plot indicates that the resonant frequency of the driver is 26Hz.

The original crossover had a peak centred around 140Hz. This again added useful speed and upper bass kick in the SL6000 system, compensating for losses in Celestion's bass driver.

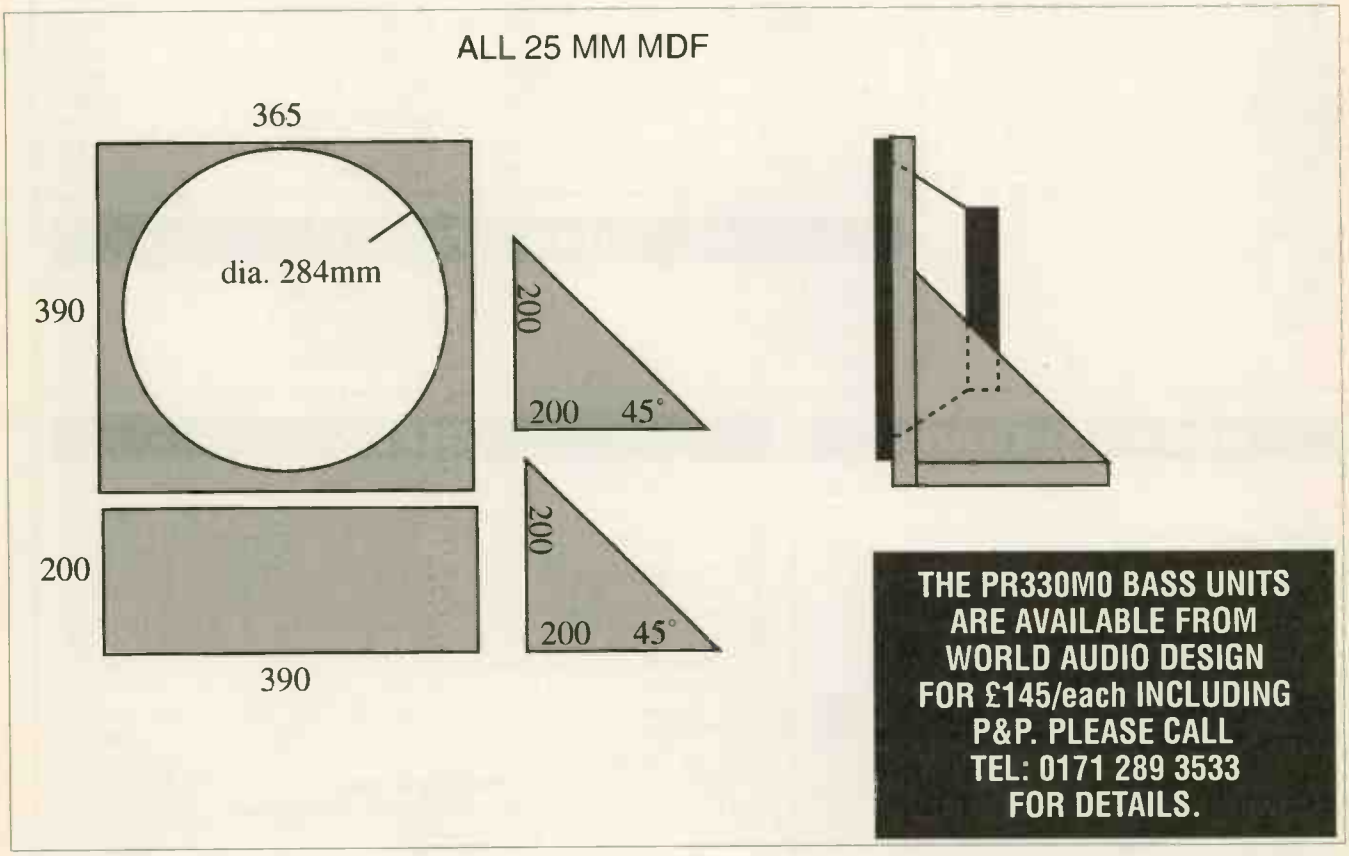
The high-pass section of the crossover was designed specifically for the Quads, the 3dB lift at 225Hz equalising their natural roll-off. If you are interested in building the dipole subwoofer system but aren't using Quads, the 3dB lift could be removed for better compatibility with normal box loudspeakers.

However, this will depend on which loudspeakers you have. For example, some small loudspeakers may also need this peak, but KEF's Reference loudspeakers have a natural lift here, so a cut would be more suitable. I measured the response with Harbeth's Compact 7s which are quite flat in the bass and the lift can be clearly seen. Although the results were very favourable, the thickening in the lower midrange was audible. Here a flat filter would work better.



Our subwoofer with Harbeth's HL Compact 7s.

BUILDING THE BAFFLES



THE PR330M0 BASS UNITS ARE AVAILABLE FROM WORLD AUDIO DESIGN FOR £145/each INCLUDING P&P. PLEASE CALL TEL: 0171 289 3533 FOR DETAILS.

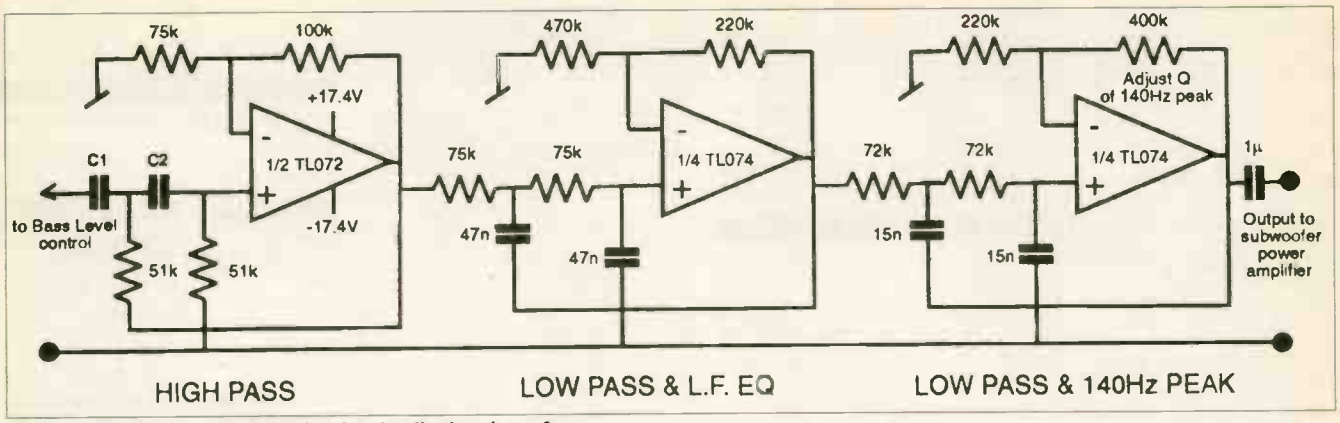
A dipole subwoofer is probably the simplest form of loudspeaker you could ever build. We have provided plans for a suitable arrangement, but being just a drive unit on a baffle, there is a good degree of freedom. There are a few guidelines to follow which will help ensure that you get the best performance possible.

One of the most important is to make sure that the drivers are securely and rigidly fixed to the baffle. That 6dB of bass boost means that the driver will be working quite hard, with large excursions. There is a lot of energy being generated by the driver, which will cause the baffle to vibrate. I used 25mm MDF and this seemed to do the job well, with strong M6 fixing bolts holding the driver.

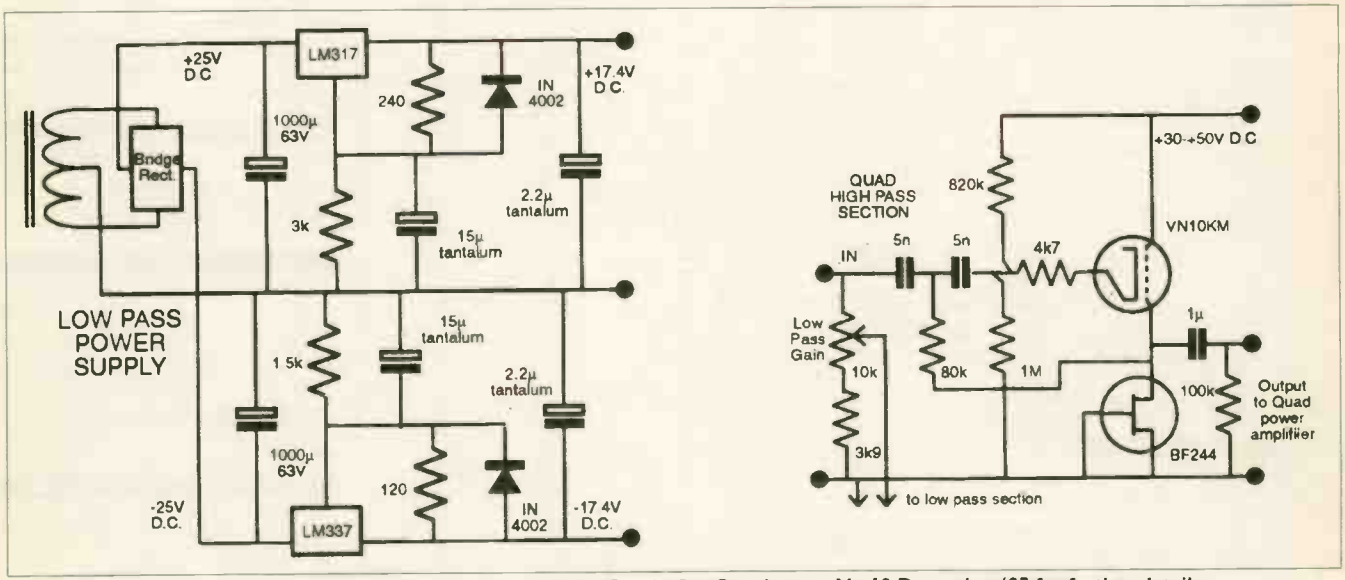
Once the driver is bolted to your baffle the whole structure will shake with every bass note. Luckily, using 25mm MDF and a heavy bass driver makes the subwoofers quite heavy, and once spiked and seated firmly on the floor they become rigid. If you can't use spikes, it may be worthwhile weighting the baffles down. You could use bricks in a compartment beneath the driver.

Again to keep any vibration, which introduces distortion or colouration, to a minimum, the baffle itself should be kept reasonably small. For a given thickness of MDF, a smaller baffle will resonate less. For this reason keep the baffle around the PR330M0 bass unit as small as possible whilst leaving enough wood around the driver cut-out to keep the baffle strong; around 30mm all round should be enough.

If you follow these guidelines, you shouldn't go too far wrong. If you are unsure, follow our plans. You can either get a local carpenter to build the baffle for you, or have the wood cut to size by a timber merchant. If you build them yourself, it is best to use glue (Evostick Resin 'W' is best) and strong wood screws to make sure the baffles are strong.



The low pass filter and equalisation for the dipole subwoofer.



A suitable power supply and the active high pass section for the Quads. See Supplement No.19 December '95 for further details.

SOUND QUALITY

Immediately apparent with a dipole system is the complete lack of boxy colourations. Bass can sound a little light in colour (definitely not power) until you get used to it, with no thickening of tone normally caused by a cabinet. Bass certainly couldn't be termed 'dry' though. In fact it was surprisingly full and warm with the double bass introduction to Lou Reed's 'Walk on the Wild Side', clearly revealing the rich harmonic structure and resonances of the instrument's wooden body.

The other great difference between a dipole bass system like this, and just about every other box loudspeaker, although Castle's Howards get close, is its ability to follow a bass line, clearly enunciating each note. As a bass guitar moves up and down its own musical scale these subwoofers capture every change in pitch cleanly, playing all notes with equal force.

A criticism often levelled at box systems is their tendency to 'one note' bass lines. This occurs when driver and box are tuned to a particular frequency. With a dipole the driver can span its range free from interaction with a box. Eddie Reader's album benefited most here. Where the bass normally sounds overblown and forced, the cones working so hard to capture low subsonics that all above is lost, the dipole system gave a radically better performance. Bass was cleaner, faster and tighter, but best of all upper bass took on a new lease of life; it was able to describe the tune being played. I'd never realised that there were so many notes there to be uncovered. Normally there's a wash of bass with little definition around individual notes.

Compared to Celestion's SL6000 system, which used two drivers for each side, our system did lack ultimate extension. It went as deep as any large 3-way floorstander, deeper than the Spendor SP9/1s reviewed in the main issue this month, but the SL6000 just doesn't seem to stop going. Remember though that the SL6000 cost around £1800 just before it went out of production and whilst its heavy twin-cones possessed downward extension, they did not display high sensitivity.

AUDIO NOTE

AUDIO NOTE AUDIO COMPONENTS PARTS & PRICE LIST.

[illegible]

VACUUM TUBE VALLEY

[illegible]

POSITIVE FEEDBACK.

[illegible]

COMPLETE KITS.

[illegible]

AUDIO NOTE OUTPUT TRANSFORMERS.

[illegible]

[illegible]

AUDIO NOTE AUDIO QUALITY OUTPUT TRANSFORMERS.

Group A

Recommended Valve | Max O/P Power | Prim-Sec Imp | Size Weight | Max Current | Price Ex UK VAT

[illegible]

Group B

[illegible]

KEW SE Product

[illegible]

Group B
Push-Pull Circuits

[illegible]

Group C.
Single-ended only

[illegible]

Group D.
Pure Silver Wired Outputs

[illegible]

[illegible]

AUDIO NOTE CHOKES & INDUCTORS.

Value | Size | Price Ex UK Vat

[illegible]

AUDIO NOTE MAINS TRANSFORMERS.

[illegible]

Primary Voltages | Secondary HT Windings | Secondary Heater Windings | Price Ex UK Vat

[illegible]

[illegible]

AUDIO NOTE PAPER IN OIL SIGNAL CAPACITORS

[illegible]

Value | DC Voltage | Size | Price ex UK Vat

[illegible]

[illegible]

AUDIO NOTE PAPER IN OIL COPPER & SILVER FOIL SIGNAL CAPACITORS

[illegible]

AUDIO NOTE COPPER FOIL PAPER IN OIL CAPACITORS.

Value | DC Voltage | Size | Price ex UK Vat

[illegible]

AUDIO NOTE SILVER FOIL PAPER IN OIL CAPACITORS.

[illegible]

AUDIO NOTE SILVER FOIL SIGNAL CAPACITORS.

[illegible]

Value | DC Voltage | Price ex UK Vat

[illegible]

AUDIO NOTE PAPER IN OIL RESERVOIR CAPACITORS.

Value | DC Voltage | Size | Price Ex UK Vat

[illegible]

AUDIO NOTE ACID & CLORIDE FREE SILVER SOLDER.

[illegible]

AUDIO NOTE CABLES & WIRES.

[illegible]

Gauge | Insulation Material | Price per Meter Ex UK Vat

[illegible]

AUDIO NOTE 15 Strand 0.09mm 99.99% Silver Wiring Wire.

[illegible]

AUDIO NOTE COEX INTERCONNECT CABLES.

Type/Colour code | Construction | Price per Stereo Meter Ex UK Vat

[illegible]

AUDIO NOTE SPEAKER & WIRING CABLES.

Type/Colour code | Construction | Price per Mono Meter Ex UK Vat

[illegible]

PTFE Insulated Silver Plated Copper Wires

[illegible]

AUDIO NOTE HIGH QUALITY STEPPED ATTENUATORS & SWITCHES

[illegible]

Type | Value | Price Ex UK Vat

[illegible]

AUDIO NOTE HIGH QUALITY CERAMIC VALVE BASES.

[illegible]

Type | Mounting | Plating | Price Ex UK Vat

[illegible]

TOPCAPS

[illegible]

Industrial Grade Valve Bases

Type | Mounting | Price Ex UK Vat

[illegible]

AUDIO NOTE CERAMIC STAND-OFFS.

[illegible]

Type No. | Number of Tags | Length | Solder Connection | Chassis Fixing | Price Ex UK Vat

[illegible]

AUDIO NOTE SELECTED AUDIO VALVES.

Our valves are selected from the best available sources and are tested to the same stringent standards that we apply in the production of our own amplifiers. They fall into two categories: standard production items and rare, mostly NOS [illegible] valves which are no longer in production. We have compiled a special list of the NOS items, which is available against a stamped self addressed envelope, if you live outside the UK send US$ 2.00. [illegible]

Standard Stock Items.

Type No	Type	Price Ex. UK Vat
[illegible]	[illegible]	2.95
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	5.45
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	2.75
[illegible]	[illegible]	5.95
[illegible]	[illegible]	3.25
[illegible]	[illegible]	6.75
[illegible]	[illegible]	8.75
[illegible]	[illegible]	14.75
[illegible]	[illegible]	1.55
[illegible]	[illegible]	4.51
[illegible]	[illegible]	2.45

[illegible]

AUDIO NOTE 1/2 WATT TANTALUM RESISTORS.

[illegible]

AUDIO NOTE 1 WATT TANTALUM RESISTORS.

[illegible]

AUDIO NOTE PRECISION CARBON FILM RESISTORS

[illegible]

HIGH WATTAGE WIRE WOUND RESISTORS.

[illegible]

BLACK GATE ELECTROLYTIC TRANSFER, High Performance, Graphite [illegible] capacitors.

[illegible]

IMPORTANT NOTICE!

PLEASE NOTE, THE PRICE LIST FOR BLACK GATE CAPACITORS IS A GUIDELINE ONLY. DUE TO THE CONTINUOUS STRENGTHENING OF THE JAPANESE YEN, IT IS IMPOSSIBLE TO PRINT UP-TO-DATE PRICES MONTHLY, SO ASK FOR PRICE WHEN YOU ORDER.

Value	Voltage	BG-Type	Suggested Use	Price Ex. UK Vat
[illegible]	[illegible]	[illegible]	[illegible]	1.65
[illegible]	[illegible]	PK	[illegible]	1.75
[illegible]	50volt	PK	[illegible]	1.05
[illegible]	50volt	[illegible]	[illegible]	1.12
[illegible]	[illegible]	[illegible]	[illegible]	1.23
[illegible]	[illegible]	[illegible]	[illegible]	1.36
[illegible]	[illegible]	PK	[illegible]	1.68

[illegible]

POTENTIOMETERS.

[illegible]

STANDARD TYPE SWITCHES

[illegible]

STANDARD ELECTROLYTIC CAPACITORS

[illegible]

RCA, BNC, BANANA PLUGS, RCA SOCKETS, SPEAKER & GROUND TERMINALS & LOUDSPEAKER SPADES

RCA PLUGS.

[illegible]

RCA SOCKETS.

[illegible]

BNC PLUGS & SOCKET.

[illegible]

FERRITE RINGS.

[illegible]

AUDIO NOTE Moving Coil, CD Line & Input Matching Transformers.

[illegible]

AUDIO NOTE CHASSIS SETS.

[illegible]

AUDIO NOTE COMPLETE KITS.

[illegible]

KIT ONE

[illegible]

KIT TWO

[illegible]

KIT THREE

[illegible]

KIT FOUR

[illegible]

PRE-AMPLIFIER KIT.

[illegible]

Circuits, Valvedata & Basic Technical Information

[illegible]

SOUND PRACTICES

[illegible]

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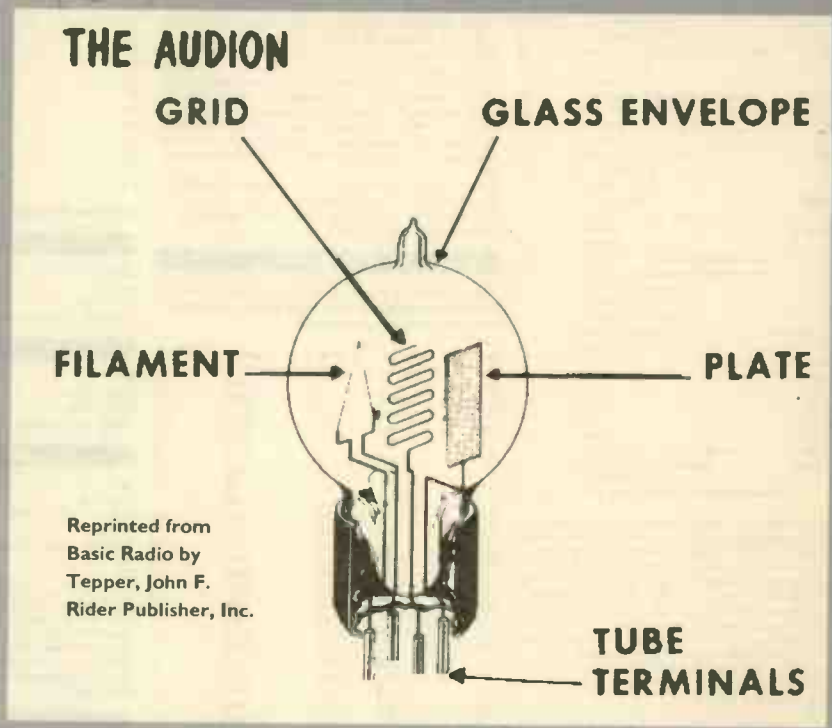
AUDIO NOTE

KNOW YOUR PO

Andy Grove is your guide to five of the most common triode power output valves.



DeForest's Three-Electrode Tube

A discovery of Thomas Edison's over a hundred years ago led to what is now regarded by many as being the best possible device for audio amplification. It is the directly heated triode.

Experimenting with carbon-filament electric lamps in the 1880's, Edison discovered the then inexplicable 'space current', an electric current which could be made to flow in a vacuum. Placing another electrode inside the evacuated bulb, he observed that a current would flow across the vacuum between filament and electrode, but only if the electrode was at a more positive electrical potential than the filament. He filed a patent in 1884, but left it at that, doing no more research on the subject.

It took John Ambrose Fleming to recognise a potential use for this strange 'space current' effect, and J J Thompson's discovery of the electron in 1897 to explain it. Fleming was searching for a new type of detector for use in the radio receivers of the time. Edison's 'space current' was unidirectional and hence capable of rectifying or detecting an AC signal. Fleming built upon this principle and developed his 'Oscillation Valve'

Today, this would be known as a diode. The original Oscillation Valves were no more efficient than the other forms of detectors, crystal rectifiers for example, of the time. By the turn of the century, Lee De Forest had begun to experiment with two-electrode valves in an attempt to improve their performance as detectors and hit upon the idea of placing a third electrode inside the bulb. Originally, the third electrode was just another metal plate, then a perforated metal sheet and finally a wire mesh or 'grid', the name that stuck.

By varying the electric potential applied to this grid, the 'space current' can be controlled. The Audion, as this valve was known when de Forrest patented it in 1907, was the very first active electronic device, since a signal applied to the grid could be amplified. It was developed into what we now know as the triode, a three-electrode valve.

The 'space current' on which valves rely was discovered to be a stream of charged particles, electrons, emitted by the hot metal filament. Usually they go through a cycle of being emitted, hanging around for a while, and then returning to the filament, releasing their potential energy as a photon of light. These particles, however, are negatively charged and will be attracted to a positively-charged electrode, causing a current to flow. If another electrode is placed between the filament and anode (positively-charged electrode) it can be used to influence the electrons as they pass by.

Making the grid negatively-charged creates a negative electric field repelling the electrons and reducing the 'space current'. Making the grid positive has the opposite effect, increasing the 'space current'. So, by varying the grid voltage, we can control the current flow: this makes the valve a 'transconductance' device capable of amplifying an electric signal.

Note that the electron, the carrier of electric signals and charge, was discovered after positive and negative charge and current flow were defined. Unfortunately, they were chosen to be the wrong way round! This means that although the electrons flow from filament to anode we talk of current flowing from anode to cathode.

The directly-heated triode output valve is extremely linear and, below its maximum power output levels, the distortion is very low, even without feedback or push-pull cancellation. Compared to a pentode, triodes have a much lower impedance, which translates to better 'speaker damping. Again, feedback is not necessary for a reasonable damping factor. So it is possible to get excellent results from a very simple single-ended amplifier with only two or three stages. This is the beauty of the triode

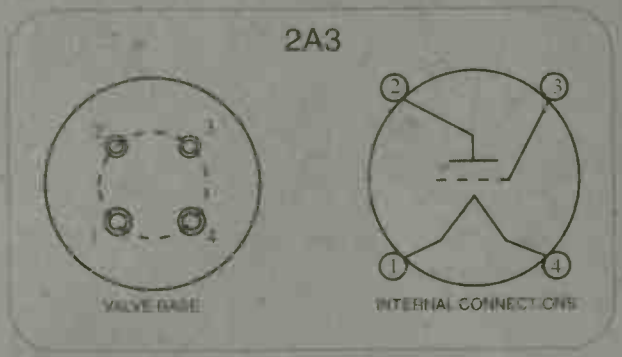
OWER TRIODES

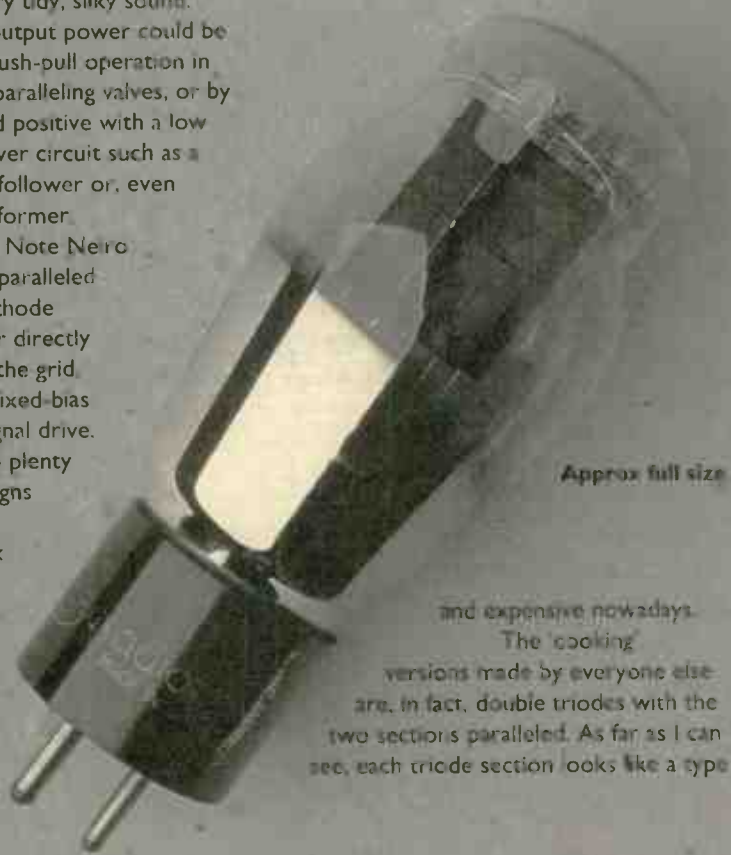
The 2A3

The 2A3 is a 15W-dissipation directly-heated triode with a UX4 base and 2.5V dull emitter filament from the good ol' U S of A. In basic single-ended mode, power output is around the 3-3.5W mark. This may seem diminutive, but the 2A3's sound is incredibly open and dynamic. Correctly designed and set up, the 2A3 amplifier is always poised ready to react to the music signal and produces a very tidy, silky sound.

Electrical output power could be increased by push-pull operation in Class A or B, paralleling valves, or by driving the grid positive with a low impedance driver circuit such as a 5687 cathode follower or, even better, a transformer.

The Audio Note Nerro amplifier uses paralleled 2A3s and a cathode follower driver directly connected to the grid, supplying the fixed-bias voltage and signal drive. There are also plenty of vintage designs that used the 2A3; by Brook in the States, for example. There are several versions of the 2A3, but what is important is the anode type. Tung-Sol made what is regarded as the best example, which had a single anode and single filament. These, however, are very rare and expensive nowadays. The 'cooking' versions made by everyone else are, in fact, double triodes with the two sections paralleled. As far as I can see, each triode section looks like a type 45, a smaller, earlier valve.





Approx full size

At present, original 2A3s from Sylvania and the like are still available but are quite expensive. There are also the Russian and Chinese Golden Dragon types in current production. I would suggest running the valve at 250V, but with around 50mA current to keep the dissipation down to 12.5W. Load impedance should be approximately 2.5k for standard operation, power around 3W.

Equivalents:
The 2A3 has a few cousins: the 6A3, the 6B4G and the 6A5. The 6A3 is a 2A3 with a 6.3V filament, the 6B4G is a 2A3 with an octal base and 6.3V filament and the 6A5 is 6.3V but has an indirectly-heated cathode and an octal base.

Characteristics:
ra=800Ω at Va=250V, Ia=60mA.

The 300A and 300B

The 300B, developed in Bell Labs for Western Electric's cinema amplifiers, is a 40W dissipation triode with a 5V dull emitter filament and a UX4 base. The only difference between the 300A and the 300B is the locating-pin position. This valve has achieved cult status the world over. Its perfectly-balanced sound quality and ease of use have made it essential for the single-ended enthusiast and experimenter.

In SE mode, power output is usually around 8-12W. More is possible, but usually at the expense of distortion or valve life. Again, push-pull, paralleling and positive grid drive will yield more power.

Just like the 2A3, the 300B has a metallic nickel anode and I believe this contributes in some degree to its particular sound. In a properly-sorted amplifier the 300B excels at portraying natural timbre and can have real impact in the bass if the output transformers are up to it. Poise and dynamics are also superb. The 300B amplifier has become the fashion accessory of the '90s. There is a myriad of modern designs with various price tags ranging from circa £1000 to over £80,000. (Guess who makes the expensive one!).

Western Electric used the 300B in several vintage amplifiers. The best-known is the WE91, which used a 310A pentode to drive the 300B. There is only one stage of amplification before

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Helius Orion II tonearm	£175	(£495).
Audio Innovations S200 pre-amp	£250	(£350).
Audio Innovations S200 power-amp	£225	(£500).
Audio Innovations 1st Audio 7.5 watt triode	£700	(£1750).
Audio Innovations 2nd Audio 15 watt triode monoblock. Excellent condition	£1500	(£3250).
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The **Riverside 4040** is our integrated amplifier. It features dual mono construction and has five line level inputs and both 4 and 8Ω outputs. The output stage is configured in the classic McIntosh connection, which gives stable, wide-band operation even with difficult loud speaker loads. The stainless steel chassis and transformer cover are hand polished to a mirror finish, and come with semi matt black valve cover. 4xEL34, 4xECC83, 2xECC82. A full description, including circuit diagram, is given in our manual, £6.50. Kit £780, fully assembled £995.

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.

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 McIntosh connection and have excellent low frequency reponse, and have 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, 2x70V@5A. Price £60. Other primary voltages can be supplied to special order. Reference book giving connection diagrams, specifications, as well as circuits for using these transformers, £5.

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 manual, £6.50.

Connector kit: 12x 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, and a regulated high voltage supply per channel. 3xECC83, 1xECC81, 2xECF80. Full details and circuit diagram are in the reference manual, £6.50. Kit £225, fully assembled £275.

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

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 - details in P2 manual, £6.50.

The chassis (main chassis and transformer cover) is made from mild steel. Each kit comes complete with mesh valve cover and base plate, finished in black. Price £110. For those who wish to use 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 13A plug, £15.

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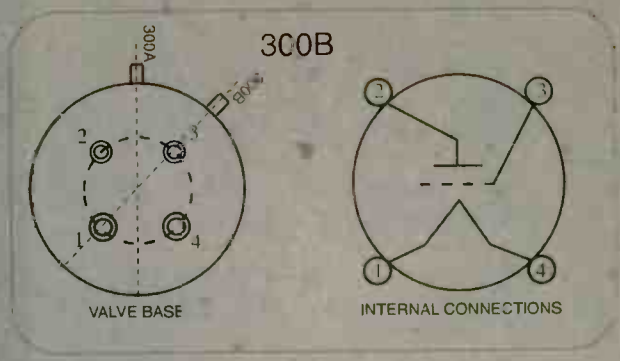
the output valve and, for such a simple circuit, it gives fantastic sound quality. It is very easy to make similar amplifiers using, say, an EF86 or a 6J7 (either is a better choice than the 6SJ7 often used in replicas) instead of the rare 300A.

As far as I know, the 300B was only made by two companies: Western Electric in the US and STC in the UK. The STC version has a '4' in front of the type number, making it the 4300B. In fact, STC was originally a subsidiary of Western Electric and went by the same name. ITT acquired Western Electric International in the '20s when the name became STC in the UK.

Western Electric showed samples of a new 300B at this year's Consumer Electronics Show in Las Vegas, although they are rarer than the vintage ones at the moment, with a price to suit! There are also Russian types on the way, though at present they are not generally available. However, our thirst for 300Bs can be slaked by the Chinese Golden Dragons which are excellent and reasonably priced. For single-ended operation, try the 300B at, say, 375V and 85mA current with a 2.7k-3k load; power approximately 9W.

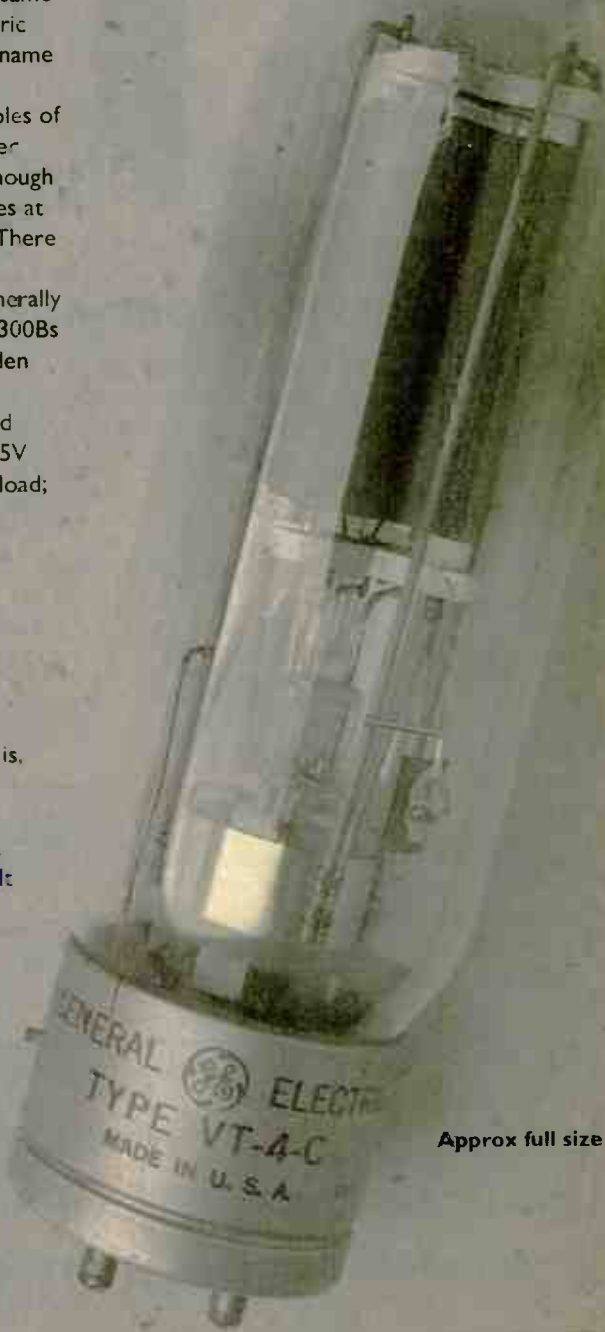


Equivalents:
STC's 4300B; there is also a titanium-anode version made by Golden Dragon, the 300B LX.

The 211

The 211 is a bright-emitter directly-heated triode with a carbon anode. The late versions have a 100-125W anode dissipation, and 10V filaments. The 211 was originally a 50W valve and in Class A 75W to 85W should be considered the maximum rating for long life. Depending on operating conditions, SE power output is typically 15-20W, although, again, more power can be achieved. I have built 211 amplifiers which put out 30W unclipped from one 211 without over-stressing it. This is because the 211 was designed as a transmitter valve and is therefore very rugged.

In Class B2 modulator service nearly 300W can be obtained from a push-pull pair. The sound quality of the 211 is, in my opinion, among the best. If the operating conditions are very carefully optimised the 211 gives a jaw-dropping musical experience. It is capable of being incredibly delicate and refined while at the same time playing a truly seismic bassline. I also find that the presentation of tonal colour by the 211, although not as instantly alluring as that of the 300B, has a more natural character. This could be due to its exceptional linearity, which is better than the 300B's, and the non-metallic carbon anode.



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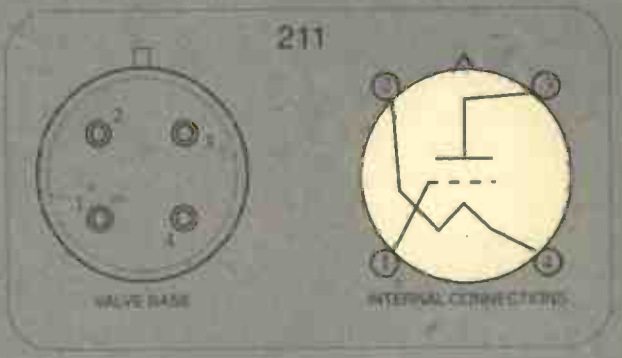
The main problems with the 211 are the voltage, circa 1000V, needed to get it going and the searing temperature the bulb reaches, so safety is a major concern. The output transformer also needs to be very well designed to get the most from this valve because it needs a very high impedance load, 15k, to make it sing. The most commonly-available original types are the RCA and General Electric, the GE being regarded as the best of the two. The Golden Dragon version is also good; the 211 is a very old design and is apparently easy to make.

The Audio Note Ongaku is probably the best-known example of a modern 211 amplifier. Western Electric built amplifiers using their version of the 211, the 242D, as output valves and diode connected as rectifiers!

Equivalents:
242D and VT4C

Characteristics:
15k SE output transformers are hard to come by, so use this operating condition for standard SE:
Va=1100V, Ia=70mA, Vg=-60V, Rload=10k, power around 18W.



The 845

Although very similar to the 211, the 845 came later. It was designed specifically as a high-power audio valve for sound reproduction and AF modulator for AM transmitters. The carbon anode and filament are shared with the 211, but the grid pitch and spacings have been changed to make it a lower impedance device. This allows a greater power output before positive grid drive becomes necessary, up to 30W at maximum ratings.

However, the 845 needs a very large drive signal of up to 400V peak to peak, making transformer-coupling from driver to 845 mandatory in a highly-tuned amp. The large swing required is beyond most small signal valves, so some sort of small power valve is needed. Tim de Paravacini uses a 6BL7 TV horizontal deflection triode in the valve Yoshino; ideally, the 6BL7's higher transconductance, more linear, brother the 6BX7 would be a better choice. However, these are rare and expensive and perhaps the best solution would be to use a 2A3 or similar.

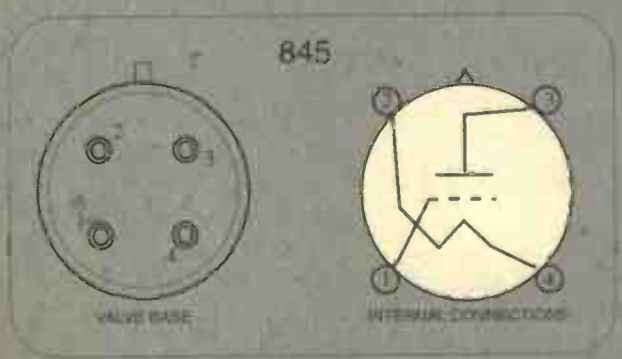
Sound quality is similar to the 211, with that effortless big triode sound. Not only are there dynamics, but also a sense of dynamic scale. Compared to the 211, the accent seems to be on the lower end of the frequency range, with tremendous bass control and impact. In most applications, however, the driver stage will have a large effect on the overall sound, so using the fleet-of-foot 2A3, transformer-coupled, as a driver really would make a great combination.

Danger levels are on a par with the 211, but as the 845 is quite often run at its maximum 100W anode rating the bulb will get obscenely hot. Unfortunately original 845s are more or less extinct. Expect to pay over £200 for a United or RCA NOS example when available. Like the 211, the Chinese 845 has a very good reputation so all is not lost, and you get a lot of valve for the money.

There are a few modern amplifiers using the 845. Apart from Tim de Paravacini's Yoshino, there is also the Smart 845 from Unison.

Equivalents:
None.

Characteristics:
A good operating condition for maximum power from an 845 with reduced drive voltage and power supply requirements:
Va=1100V, Vg=-160v, Ia=90mA, Rload=6.5k.
Power should be over 25W if the output transformer is good, though then the valve is run quite hard.



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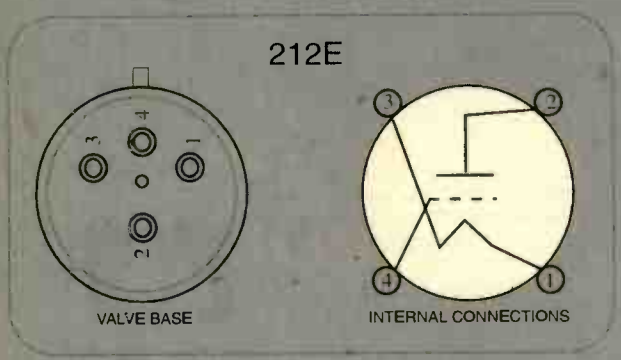
The 212E

If there is an omnipotent god of audio valves it must be the 212E. It looks like a mutant hybrid of the 211 and 300B, with its 275W-dissipation tantalum anode and giant hard glass envelope. Single-ended power could be up to 100W at maximum ratings, but to extend life with reduced ratings power would be around 50 to 60W. For those looking for nuclear power levels, output in Class B or AB2 could be up to 1.7 horsepower (1300W!).

For such a beast the 212E is quite sensitive. Lessening the voltage swing places demands on the driver stage; as the anode runs at a red heat the grid will get very hot so transformer coupling would be necessary to sink the resultant grid current. The anode is made of tantalum so it doesn't melt!

Transformer-coupled, any good triode such as the 6SN7 would drive the 212E but a small power valve like a 2A3 would be better. The power supply would have to be serious: an SE amp would need 1500V at around 150mA; maybe mercury vapour or xenon rectifiers could be used.

I'm afraid I can't really comment on the 212E's sound. It was

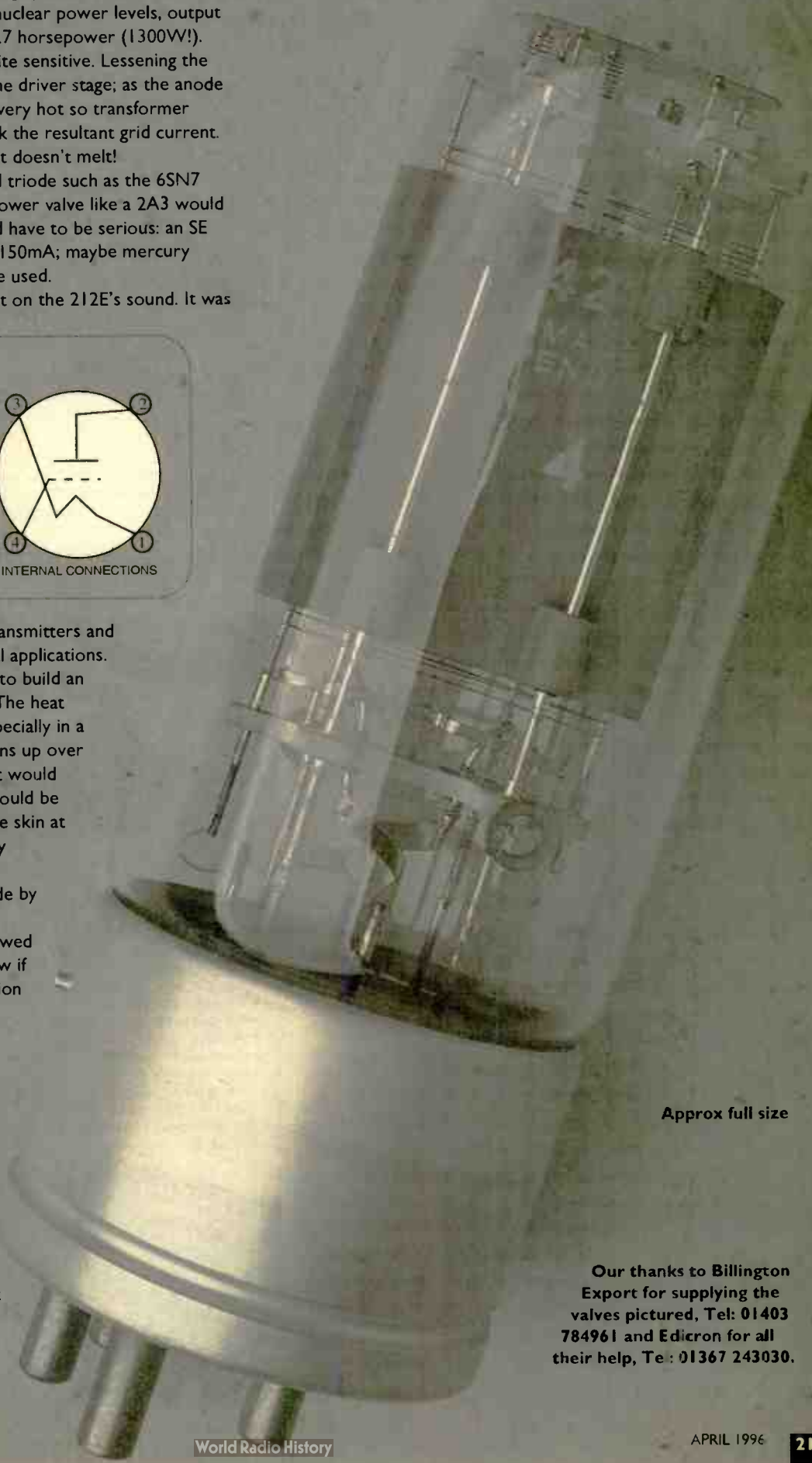


meant for modulation service in transmitters and other very high-power professional applications. You would have to be totally mad to build an amplifier using one for the home. The heat emitted would be tremendous, especially in a small room: the filament alone burns up over 90 watts, so two 212Es in full flight would put out 730W of heat. The bulb would be a positive health hazard, searing the skin at a touch. However, the 212E is very popular in Japan.

The 212E and 4212E were made by Western Electric and STC respectively. Western Electric showed a 212E at the CES, but I don't know if it's going to be in current production and available in the UK.

Equivalents:
The STC 4212 is the most usual type but these are becoming rare and expensive. There are equivalents to the 212E: the MY3-275 by Mullard and the V1505 by Ediswan.

Characteristics:
Try these operating conditions: a=3000V, Ia=120mA to 560mA at full output, Grid to Grid drive voltage=396V, Rla-a=13.8k, power approximately 1300W (push-pull pair).



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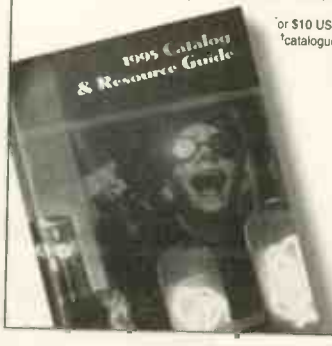

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KILLER CAR STEREO ON A BUDGET

An easy cure for ho-hum auto sound, by Daniel L. Ferguson, reviewed by Dominic Baker.

Discovering the high cost of separate subwoofers, midrange drivers and tweeters, along with all of the associated amplifiers and active filters needed for in-car audio, Daniel Ferguson set about developing a system for his own car that was not only more affordable, but better too. This book is the result

How to achieve high-quality in-car sound for a reasonable price? His answer is to keep the existing head unit (CD or cassette/radio) and the front and rear loudspeakers, turn down the bass and raise the treble to get midrange and treble clear and neutral, then add his subwoofer.

Most of these systems use small 3-6in drivers, normally full range or co-axial, with some bass-boost built in to balance the sound. Reducing the amount of bass small drivers have to deal with reduces cone excursion so that they will go louder without distorting, giving a clearer and more detailed midrange and treble. The lower power these drivers need as a result means that an existing head unit should be more than powerful enough to drive them cleanly to good levels.

By reducing the range the existing system has to cover you are effectively getting better quality without the expense of an extra power amplifier or pricier midrange/treble drivers. To turn this into a 'Killer Car Stereo' all you need to do is to add a good subwoofer, one capable of handling powerful bass without distortion, to match the midrange and treble.

The greater part of the book is devoted to building this subwoofer system and the way it and your existing stereo can be integrated in a number of different vehicles. Various cabinet designs and types are shown, enough to cover just about every situation likely to be met.

Because of the high cost of commercial active crossovers for in-car use, the author has developed his own version. This is a simple enough affair, and should cost the keen DIYer less than £50 or so to construct. It comprises three 741 op-amps and a handful of passive components, all readily available at any Maplin store.

This crossover serves three purposes. The first circuit block sums the two channels together to give a mono signal for the subwoofer. This obviously has to be done in a way that doesn't affect the output of each channel of the main head unit. Around this first section there is also provision for gain control and variable low frequency damping to match a wide range of drivers.

The next block of the circuit, a high pass filter, acts as a rumble filter, removing very low bass which would otherwise cause cone flap. Again, this serves to reduce the load on the driver, giving a tight and clean bass quality. The final stage is a low pass filter, rolling off midrange and treble to leave just the bass signal for the subwoofer.

A full circuit and component listing is given for the active crossover, along with suitable drivers and how best to use them. For those who want a more professional look, Old Colony Sound Lab do a kit comprising printed circuit board and component pack for $50; for $75 there is a built and tested module available.

The book takes a very down-to-earth and practical approach. It's really saw-in-hand stuff, with component listings and recommended suppliers mentioned wherever possible. After reading *Killer Car Stereo on a budget* I would certainly be tempted to follow Ferguson's advice and build his crossover for any car system I had to install. Come to think of it, my sister's looking for a little more of that techno/house-style bass in her Metro, so I know what she'll be getting for her next birthday ●

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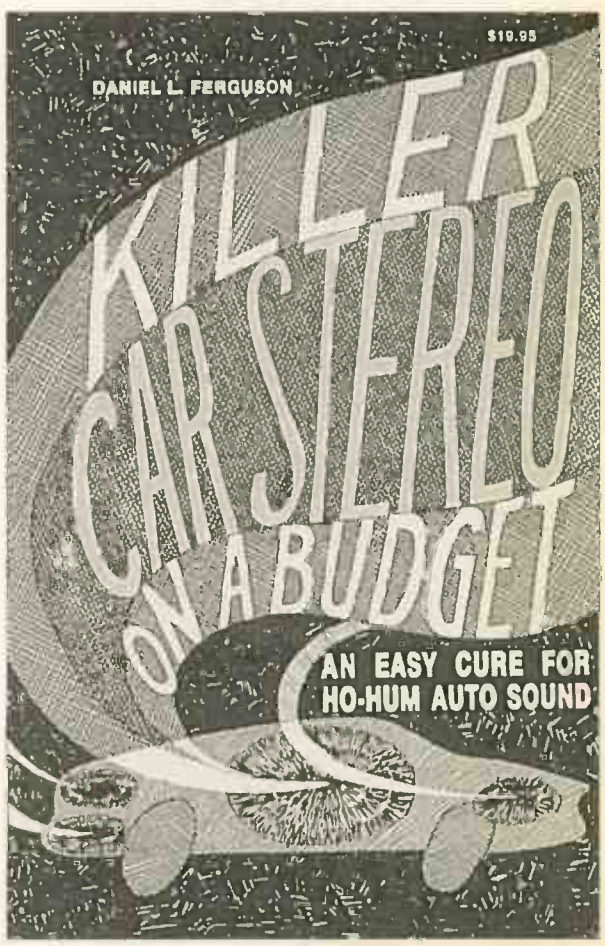

ULTIMATE AUTO SOUND

Your guide to heaven on wheels, by Daniel L Ferguson, reviewed by Haider Bahrani.

Ultimate Auto Sound was written five years after Killer Car Stereo, by the same author, and builds on the ideas of the original. As the title suggests, this book is more biased to getting the best sound possible, rather than just a better sound for less money. So, for example, where his original system used cheap and readily available components and drivers, here higher grade audio components are used in a system which is essentially very similar.

The basic premise of 'Killer' was to keep most of the original equipment in the car, including tape deck, amplifier and speakers, then add a subwoofer. The construction of this and the associated electronics was what most of the book was devoted to. In the case of Ultimate Auto Sound Mr Ferguson takes us a step further, by encouraging us to dispense with most of the factory supplied equipment and tailoring a budget system with fewer compromises, while still getting change out of $1000.

Ultimate Auto Sound is really a very easy to read 'a la carte' menu for the auto sound system constructor with a range of systems covered. These are all modular in approach, the final system being determined according to budget and priorities set by the author. Following the book is very systematic and it is ideal as both a constructor's guide and a reference.

Chapter two is really where the fun starts. Five systems are presented for the reader to pick as a starting point with budgets ranging from $270 to $1000. The systems shown can be split into two categories: ones that use high level output (speaker output) to drive the new system or low level ones (line/preamplifier output). Usually the standard issue decks have high level only, so naturally more budget systems are based around these. A fair amount of discussion is to be found here on the initial steps to be taken. Since Killer Car Stereo the scope has widened; more decisions need to be made concerning the number of speakers to be changed, the head unit and whether four channels are needed.

Most of this follows on neatly from the original concept of starting with the addition of a subwoofer system. The basic system introduced is really just that with the option of graduating on to replacing the main speakers as and when budget allows, starting with the dashboard pair.

The following couple of chapters are devoted entirely to choosing new equipment and replacing the factory supplied front and rear speakers. The majority of the text focuses on the minimum work and cost for the best possible results. An example of this is the fixing of the new speakers in the location provided by the car manufacturer. Rear car system arrangements are detailed for a range of cars from a sedan (saloon for those of who read non-American English) to the all favourite American pickup truck. Although some of these vehicles may seem foreign to us, many of the principles employed will be useful to owners of MPVs and the like.

Construction and installation are neatly detailed in the penultimate three chapters. Basic rules are listed in a reference like manner for such things as cabinet construction and crossover assembly, providing a painless guide for all levels of ability.

Ultimate Auto Sound also carries a chapter on Competition Level Systems which concludes the book. The emphasis in this chapter is more on competition level sound quality than fancy gadgetry. Actually Mr Ferguson veers away from the chrome plated glamour (or tack!) by naming the chapter 'Dream Systems' which are practical and aesthetically pleasing. So if the machine just ate your gold card or, like me, you never had one to start with, this is the car hi-fi constructors' book for you.

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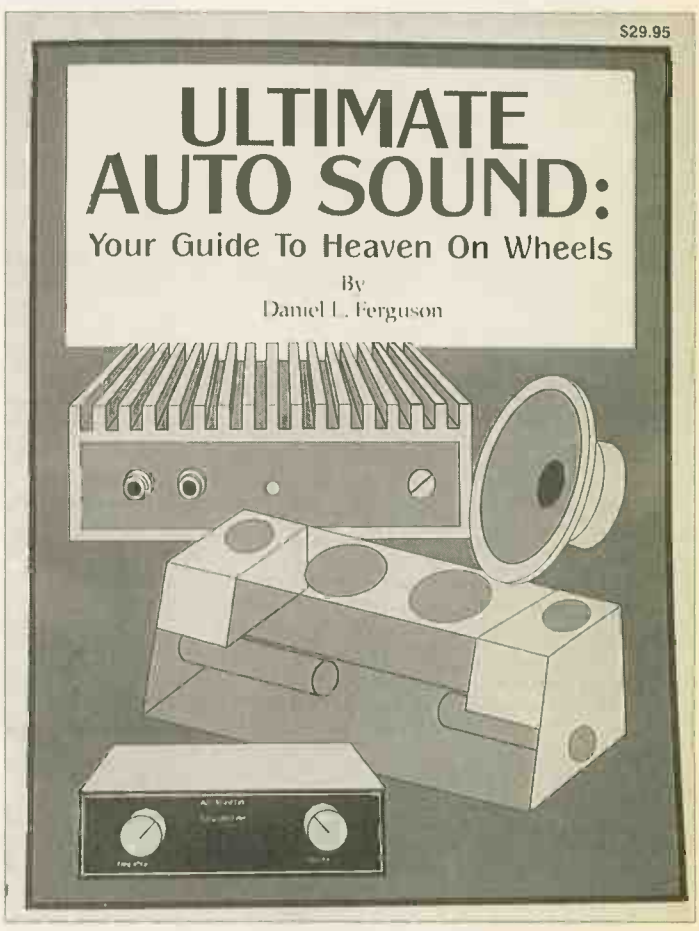

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D.I.Y. Letters

ONLY OBEYING ORDERS. . .

I have been "ordered" to build a hi-fi by "she who must be obeyed". After hearing a K5881 built by Ben Johnson, I have come to the conclusion that you folks are pretty switched on and have good ears.

I congratulate you on a fine amp, which did surprisingly well when pushing my series one B&W 802s (I hate metal domes). It couldn't go loud, though it did much more than I expected in a 32ftx17ft room! Well done indeed!

Ben has recently modified his amp with high-speed soft-recovery diodes, Holcos, Multicaps and Gold Dragon input tubes. It just sounds better all the time. Driven by a CAL Icon 2 via a passive, he reckons it eats his Naim gear!

On the basis of this I intend to build KLS3 for the love of my life, with air-cored copper foil inductors, all-film caps and bi-wired with Kimber TC4/TC8.

As for my system, it's VTL Compact 100 monoblocks (Vishay/Holco/Solen Multicap/Pearl iso socket/Kimber mods so far) a local Lewit pre-amp modified beyond recognition (new power supply plus Vishay/Holco/Solen Multicap/Alps/Kimber), Nakamichi LX5 (mods about to start), Arcam Delta 270 (with low ESR power supply mods and Holco analogue stage), Linn LP12/Basic/K18/ Audio-Technica vacuum hold-down platter, plus a much modified JBL 15in pro-subwoofer.

All cables are Kimber PBJ+TC8. The 802s have had all the bi-polars replaced with film caps; the next step is an external crossover box, all air-core inductors and tri-wiring. I have a 401, and I am thinking of restoring it and flicking the Linn. I was interested to read the test '401 vs TD124'. What would interest me is a plinth test between Slate and Loricraft, any comments?

Is the K18 worth keeping? I gave up on coils as exciting but too 'un-even-handed' a few years back. Has this changed? Would the Goldring 1042 be better?

I've been trying to contact Audio Note by fax, partly to find out about Black Gates. They won't respond, so do you know of anyone else who sells them, or an equivalent? I also have in mind building single-ended amps to drive the heads of the 802s, parallel 211s at 1KV perhaps. Can you point me in the right direction for designs and components, especially the transformers.

I must say you guys put out a delightful magazine. The supplement is of particular interest to me: the more there is in these the better I'll like it! About the only criticism I have is that it would be useful if you *always* mentioned all the other components used when you test things. You usually do, so I find precious little wrong with your mag!

The only suggestion I have is that you do some articles on how to improve current components - my Arcam Delta 270 is a classic case of a component that is offensively unexciting in standard form yet has vast potential. The low ESR power supply caps (especially replacing the standard 10µF with a good 100µF) put some weight, speed and definition in the bass and cleaned everything up. The Holcos gave it more speed plus detail and depth of image.

I suspect that many of your readers would appreciate being shown how to achieve the sound they want within the budget they have: certainly it's why I choose to mod things. Further, the only 'extra' equipment I needed to get to work on the CD was a field static safe kit, making such a project good value.

Roy Tipper
Wellington,
New Zealand.

Black Gate capacitors are, as far as I know, unique. Their performance, both sonically and electrically, is without equal. The new BG-NX types seem to have no resonance at all and behave themselves all the way up to high radio frequencies, better than most film capacitors. Do you have the correct number for Audio Note? I can assure you they are still in the business of supplying components. (Fax 01273 731498)

Audio Note also have transformers for 211-based projects, although they have no driver transformers at present. However, before spending a large sum of money on the transformers and components be sure you ▶▶

understand the dangers of 1000V-plus. Apart from the obvious shock hazards, seemingly small capacitor values can store lethal amounts of energy. For example, 100µF at 1000V stores 50 joules of energy, the same as a 111,000µF capacitor at 30V. AG

GRADUATING TO TRANSISTORS

First, many thanks for publishing my letter, 'Novel Hybrid'. Having now graduated, I am re-building the amplifier to an all-solid-state design but I have taken on board your idea about a choke-regulated power supply.

I think you may be correct in saying a valve-driving-transistor configuration is not one of the best. I was sent a copy of such a design from a man in Belgium as a result of the letter! The design does apparently sound quite good though.

Secondly, loudspeakers. In Supplement No. 8 you reviewed 13 bass units. The only one you have used is the Morel MW1075 in your first loudspeaker design. I have built this for a friend and it sounds great, although the tweeters take lots of running in. My question: When can we have a design for a big sensitive loudspeaker which will go loud on 15 watts (say 93dB 1W/1m)? How about using a 12in Beyma 12B-100/R in a 150l reflex enclosure?

According to my calculations, the transient response is a bit poor with this driver if you want low bass. Will this be a serious problem at frequencies below 200Hz where the driver would be used? If there are others such as the 15in AC15 driver from AC Components in the USA (advertised in the back of The Loudspeaker Design Cookbook),.do they have a UK distributor?

I know this makes for a very big loudspeaker, but the bass from large drivers in big cabs always sounds better to me than that from smaller 6" to 8" units in slim-line boxes which lack a sense of scale, even if their imaging is better.

Some of us aspire to Tannoy GRFs. NK liked them in July '92! Do you know of any good books or computer programs on horn loading?

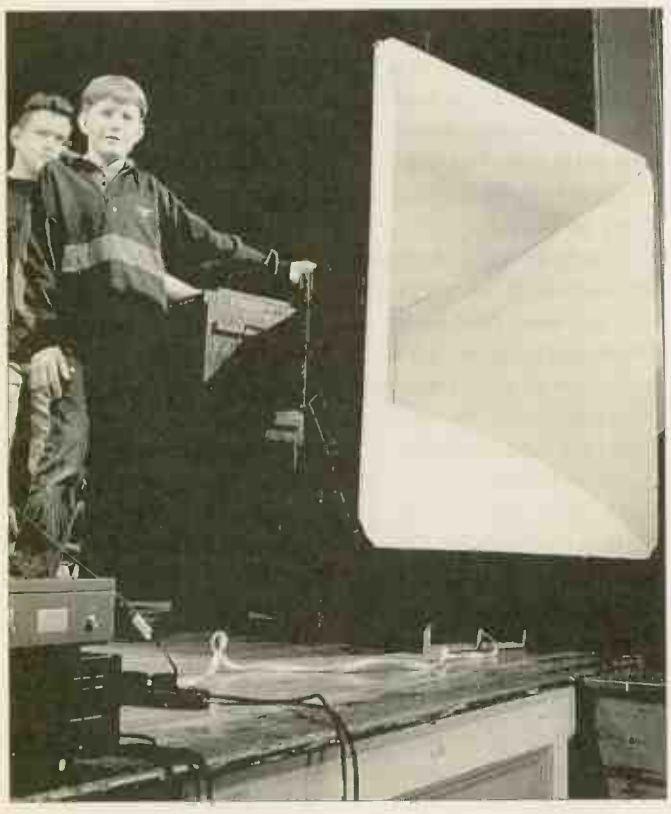
Stephen Goodwin
Bracknell,
Berkshire.

We would love to do a project on a large three-way floorstander with good sensitivity, but it would only have a limited appeal in the UK where listening rooms are small. I have a three-way design running at home using a 13" professional Audax bass unit that in its present form is producing around 97dB SPL 1W@1m. The midrange driver is mounted on an open baffle. The idea is to combine horn-like efficiency and electrostatic clarity with the bass depth and power a good reflex design is capable of. They are big though, measuring 350mm wide, 1200mm high and 600mm deep - not ideal for most UK rooms.

The reason bass from large drivers sounds so much better is that they don't have to move so far to shift the same volume of air. This means they are working in a much more linear fashion, producing lower distortion than a small cone at its limit. Larger units also tend to have more substantial magnets, better able to control the cone.

Finding any in-depth information on horn loudspeaker design isn't easy, and there are few computer packages for modeling such a design. The book Loudspeakers by Briggs, available through our World Library, carries a few pages of useful information, and Speaker Builder, an American publication available from Audio Amateur (Tel: 001 603 924 9464) carries the odd article by Bruce Edgar on horns.

You could also try Old Colony's Audio Amateur Loudspeaker Projects, code BKAA1, which includes three good articles on horns. They can also offer a horn design program for $19.95 based on an article published in Speaker Builder May '95, as well as AudioCad Pro ($119) which also has a section on horn design. Contact Old Colony on Tel: 001 603 924 6371. We hope to be reviewing some of these books and software for horn loudspeaker design in the near future, so keep your eyes peeled. DB



A Tractrix horn: information on horn loudspeaker design is scarce, however.

PUTTING FLESH ON THE BONES

Dear Hi-Fi Masters, I have to come forward and tell you that a couple of months ago if I heard the words 'valve' or 'tube' I thought of my grandmother's Schneider radio that was on its way to be thrown away 10 years ago.

It was by accident that I found myself looking at a strange magazine called Hi-Fi World dated August '94 which had a picture of a valve amp. Me being a student of computer science with a past as a TV repairman and a kit-builder, I have found myself since then looking for something with more flesh; when I say flesh I mean a kit that is something else, not a cheap monster that never did what it was meant to do.

Well, this month I read about the K6L6 amplifier which looks so good and nice that I want to build it. I have the ability to have it specially constructed for me. It would be too expensive for me to have it bought from a dealer in Europe because of the taxes that are so high here and the exchange rate that makes it about six times more expensive.

There is some information missing concerning the mains and output toroidal transformers. Other things I wanted to ask: 1) Do I miss some

information if I build the amp from the article alone or are there some aspects in mind that are not expressed there;
2) A valve number is usually followed by some letters like 6L6GC or 6L6WGC. Is there any difference between the two, and in other cases do I lose performance when using substitutions;
3) Safety measures and ways to accurately test kits;
4) I think it would be very convenient for the constructor to know all the information about the kit, like SN ratio.
5) Some history about the amp.
6) What do I do If I want to add a pre-amp: where do I connect it and how?
7) Where do I find good software on loudspeaker design?

Dror Sofer
Herzlwa,
Israel

The output transformers of a valve amplifier are the most critical part of its operation, especially where a large amount of feedback is involved. Any deviation from the specified winding instructions and the transformer will have different phase shifts at frequency extremes and the amplifier may become unstable or the frequency response will not be flat.

The feedback compensation networks will need to be adjusted to regain satisfactory operation. This means you will need access to a scope and signal generator.

World Audio Design output transformers are proprietory and details of their internal construction cannot be divulged. To successfully build the K6L6 you must have a good understanding of electronic principles and high-voltage safety. The very high open loop gain of the circuit makes layout critical, so you should have some experience of constructing sensitive electronic circuits.

The prototype K6L6 amps used Russian 6L6GT and Chinese 6L6GC valves, the Golden Dragon Chinese type having a higher dissipation rating and delivering more output power. Russian 5881s could also be used: this valve is very rugged and long-lasting.

Alternatively, original USA 6L6GCs could be used or even GEC KT66s or Western Electric 350Bs if you can find them. The last three types are the most developed form of the 6L6 breed and the KT66 is regarded as the best.

There is also the less well-known 7581, which was developed specifically as an audio valve and is similar to the KT66. All should give excellent performance in K6L6.

The manual supplied with a kit gives information on building and testing as well as safety precautions, fault-finding tips and so on. This is the advantage of buying a complete kit, as all the components are of the correct type and specification and there is backup from the company which manufactures it.

Letter of the Month

BATTERY-POWERED DIGIT

Here's a little DIY-project from Germany that will wipe away your reference D/A convertor. Basis is a QED Digit (not because of the cost, we've tried to tune much more expensive convertors/demo boards) and a 12V car battery. Now:
1) The car battery should be buffered with at least 200µF electrolytic caps
2) Replace the original OPA with a Burr-Brown OPA 2604 or 2107
3) Replace C43 (electrolytic cap near the OPA) and C40 (electrolytic cap near the convertor chip) with higher values like 2200µF
4) On the bottom side, solder film caps (MKT or MKS; MKP will be too large) parallel to each electrolytic cap and each tantalum cap (values: 100nF-1µF)
5) Split the supply path for 5V (after the 7805) and insert an inductor around 80mH/500mA
6) If only supplied by battery: take out the 12V Zener diode, replace the resistor (330R) with a wire
7) The coupling el. caps should be bridged with MKPs or - better -: replaced by an similar value MKP
8) Now: fix all el. caps with hot glue to avoid bad vibrations and store the battery and the large el. cap pack in a box filled with sand

We've compared this little underdog to many well-known products like Pink Triangle (also with accu supply), DPA, Parasound, Forsell and Proceed and it always won. Even with a little charging station for the battery and a nice case this convertor will cost you much less and will give you plenty of fun building and listening.

Of course, most of these changes can easily be done (with more or less success) to integrated CD players/tuners/amps, but — before tinkering—do some calculations about max. load of voltage stabilisers, decoupling an IC or amp stage, unity gain use of OPAs and so on.
Greetings and much fun,

Tilo Gockel
Saarbrücken,
Germany.

Please remember that if you are thinking about making any modifications to your CD player or convertor, that you will need to have a good knowledge of electronics. Your guarantee will certainly be invalidated, at the very least. DB

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. Write in to: Hi-Fi World DIY letters, 64 Castellain Rd, Maida Vale, London W9 1EX.

There is nothing worse than spending all of your money on bits for an amp only to watch it all disappear in smoke during an unsuccessful test run. Full information on the World Audio Design kits appears in the original articles. The K6L6 is a line integrated amp and needs no pre-amplifier except for phono input. AG

The loudspeaker design package I use and have high regard for is Robert Bullock's BoxModel. This is a simple package which uses Thiele-Small parameters to model a predicted response of a driver in a sealed or reflex enclosure. This is available from Marton Music, Tel: 01282 773198.

Optimising the crossover to get a smooth frequency response and impedance will require some test equipment though, Liberty's IMP being one of the most affordable systems. IMP generates its own test signal, fed via a microphone and preamp into your PC, which displays the results. This enables you to very accurately design and optimise your own loudspeaker. IMP is also available from Marton Music. DB

HOW TO BLOW UP YOUR NEIGHBOUR'S SCHNAUZER AND OTHER CONUNDRUMS

In the DIY supplement No 6 , December 1993, you contributed an RIAA head-amp design based on an AD797 op-amp. I am currently working on a four-valve pre-amp of my own origin, but decided that I wanted to build an IC-RIAA for reference, and for fun, too, when I saw this article in Hi-Fi World.

My only problem with getting started now is that I lack Part II of the article which was supposed to include the circuit diagram of the whole construction. I couldn't get hold of that issue at the time and now it is impossible to get it in Sweden.

No one sells old Hi-Fi World mags in Gothenburg. 'Fishermans Monthly Friend', 'More Ways to Deliberately Blow Your Neighbour's Speckled Schnauzerpoodle Up', 'Feet, Fists and Funderbolts', and, you name it, they have it. Not Hi-Fi World though.

Actually the circuit for my preamp is more of a merger of two fine valve amp circuits from a much more able designer, Swedish Jan Lodstrom, where one is a five-valve and the other a three-valve alternative. I wanted a cathode follower output to improve 'drive' capability but not the tape buffer stage in the five-valve alternative so I ended up with four valves (2xECC 83, 82, 81 where the 81 could be 82 or 83 as well).

If you would like to help me with your circuit diagram I have some further questions about this for you: In the data sheets for AD797 I read that when rs (source resistance) is higher than 1k, noise level increases. Is this a problem in this circuit, with approximately 1k of moving magnet pickup resistance? Or perhaps the low-noise construction of this IC gives the noise level lots of 'room' to increase in this way before it becomes a problem?

I have thought about using a passive RIAA-network after the 797-stage or after the second gain/buffer stage instead of including it in the feedback loop of the IC. Could the 797 provide all the necessary gain (about 40dB, right?) so there's only one gain stage needed and the second stage could be a buffer, for example an LT 1010? (In that case it would be possible to put the passive RIAA-network after the buffer and scale its impedance down (and capacitance up) to obtain less noise, wouldn't it?

I'm sending you my valve preamp circuit and hope that you can get something out of it. The simplicity of the circuit is what appeals to me the most.

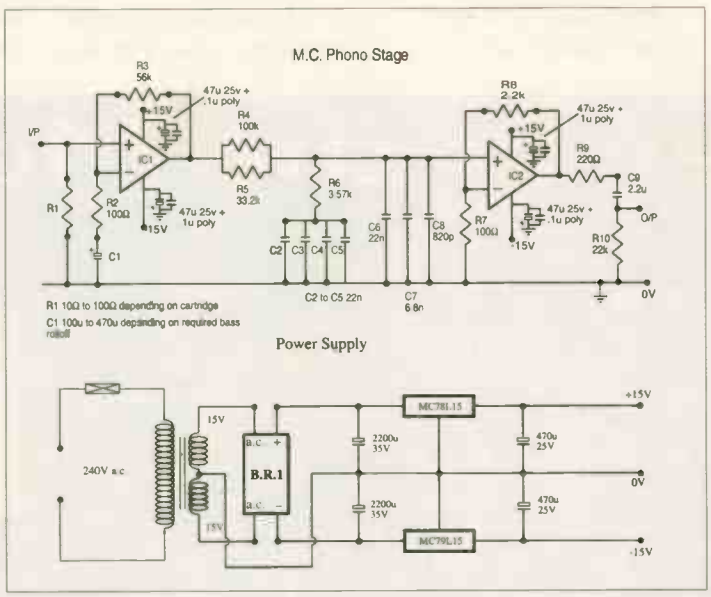
The chassis is rather small, only 4"x6" so there isn't much room in the box and the signal leads are not very long. The 'earth bus' (ground connection) is a 6mm thick square brass rod with five threaded M3 holes with screws. The common connections for each stage are tightened to the brass rod via these screws and the ground wiring layout can thus be changed easily if there is a need for that. The components are easy to change, too. The RIAA is in a silicone-filled little plastic box which is also easy to change, so I can experiment with other filter components.

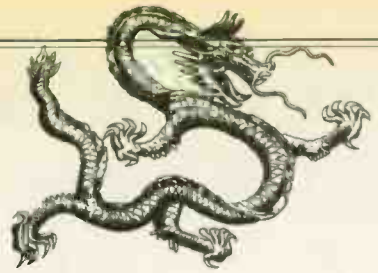
Mats Leido,
Gothenburg,.
Sweden.

You not only need the second part of the article but, as there was an error on the original circuit diagram, you will need the correct circuit as well. Construction is easy enough and World Audio Design offers a very high quality PCB for the purpose, with a low-noise, low-hum layout, instructions and the correct circuit included.

The AD797 has a bipolar transistor input stage and is intended to be used with low source resistances. The random noise current flowing at the inputs would make the device very noisy with high source resistances. In the final article the AD743 is specified as the input device for MM. This has FET inputs and no current noise to speak of and is much better matched to MM type impedances. The AD797 remains lower noise at MC impedances.

With regard to noise, the general rule of thumb is that if the gain of the input stage is greater then 10, then all of the noise generated after becomes more or less irrelevant. So, the input stage defines the overall noise of the amplifier. Scaling the resistances of the RIAA network down will not quieten the circuit to any great extent, but will make the op-amp's output circuitry work harder. In the final circuit of the Solid State Head Amp, the EQ circuit was fully passive, similar to what you describe with input and output buffer/gain blocks. AG





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