

Hi-Fi WORLD SUPPLEMENT

No. 12 DECEMBER 1994

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SUPERB SORCERER
CD CONVERTOR**



**MAPLIN'S 1995 ELECTRONICS
CATALOGUE REVIEWED**



LETTERS AND Q&A

**RESTORING THE
ROGERS CADET III
VALVE AMPLIFIER**

**TWO NEW AUDAX HIGH
DEFINITION AEROGEL
DRIVERS TESTED**

FREE D.I.Y. SUPPLEMENT No. 12



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2 Penylan Mill, Oswestry, Shropshire, England SY 10 9AF
phone Oswestry (0691) 652894

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 incomparable design expertise in the needs of the home constructor. The current range of Hart kits is designed to give you the important core components of a system as a matching ensemble of audio excellence

1100 Series. LH80W "Audio Design" Mosfet Power Amplifier.

Another masterpiece from the drawing board of John Linsley Hood and another opportunity to give a system mega sound performance for only a few hundred pounds cost. A host of advanced features, in the hands of the skilled designer, give this amplifier a performance that really is only equalled, not exceeded, by the 4 or 5 figure price tagged exotica

As always with a HART kit you have the pleasure of building selected, state of the art equipment, allied to the knowledge that your money has all been spent on quality components, you save all the costs of building and testing, plus the dealers margin on top of these by doing it yourself.

To give an idea of the measures taken to achieve ultimate quality and linearity in this amplifier each of the four output devices is only called upon to work at one NINETY-SIXTH part of its ultimate power rating.

We are proud to offer this latest John Linsley Hood masterpiece, the flagship of our range, which we believe is truly the ultimate design for the perfectionist, combining as it does the best circuit design, the best engineering and the best components, surely the only recipe for REAL sound fidelity. The HART KIT concept also makes it possible to build an amplifier with the facilities YOU want and we offer no less than three variations with options on the basic theme to suit your needs. One of these versions will, we feel sure, cater for your requirements. Should your requirements change at a later date then upgrades or alteration to a different version are no problem, try doing that to your High Si store amplifier!

The Standard version has a passive input selector circuit with Alps Precision Low-noise volume and balance controls, switchable CD, Tuner and Pre-amp inputs and an optional stereo bargraph output level display. The 'Slave' version has stereo power amplifiers and standard power supply. The 'Monobloc' version again has the standard power supply but since it is only driving one power amplifier higher than normal output power is achieved with total channel separation. The slave and monobloc versions enable very sophisticated bi-amping and active crossover systems to be constructed.

K1100 Complete STANDARD Amplifier Kit, two power amplifier channels and one power supply module, direct input passive signal selector stage, Construction Manual and RLH11 Reprint.
SPECIAL DISCOUNT PRICE FOR COMPLETE KIT IS ONLY £395.21
A1100 Factory Assembled £499.21

K1100S Complete SLAVE Amplifier Kit, as above but without passive input stage.
SPECIAL DISCOUNT PRICE FOR COMPLETE KIT IS ONLY £333.62
A1100SC Factory Assembled £422.62

K1100M Complete MONOBLOC Amplifier Kit, consists of all parts for one power amplifier channel and one power supply module and all chassis parts.
SPECIAL DISCOUNT PRICE FOR COMPLETE KIT IS ONLY £261.20
A1100M Factory Assembled £329.20

All HART kits are designed for easy home construction to the very highest standards, and can be built by anyone of average manual ability. If you are still not convinced how easy it is to build it yourself with a HART kit you can order the Instruction Manual to read for yourself and we will refund the cost when you buy your kit!

PROBABLY THE LAST VINYL PREAMP YOU EVER BUY.

For those who love the vinyl medium the listening pleasure can only be enhanced by using the very best phono preamplifier available. The Hart range of phono preamps feature a special shunt feedback circuit topology and are designed by John Linsley Hood. This circuit format gives audibly superior sound to the standard series feedback system normally used and gives a performance that will exceed or equal that given by the best of the mega priced offerings. Our range includes units to suit everyone from the occasional user to the serious audiophile. All can be changed to suit moving coil or moving magnet cartridges at the flick of a switch.



K1500 Series. This is an integrated circuit version of the shunt feedback concept, using so little power that it may be run from



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A1500 Factory Assembled £118.76

K1450 Features a totally discrete component implementation of the Shunt Feedback concept. Audiophile grade components fitting to an advanced double sided printed circuit board make this a product at the leading edge of technology that you will be proud to own. Nevertheless with our step by step instructions it is very easy and satisfying to assemble. Due to the higher current consumption this unit is powered by our mains driven K1565 Audio Power Supply, itself an advanced piece of technology in a matching case. This supplies the superbly smoothed and stabilised supply lines needed by the preamplifier and features a fully potted Hi-grade toroidal transformer along with a special limited shift earth for hum free operation. Suitable for all moving coil and moving magnet transducers this unit is especially recommended for, and will extract the very best from the modern generation of low output high quality transducers.

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TECHNICAL BOOKSHELF

Modern Books. Selected to represent the state of the art today.

"THE ART OF LINEAR ELECTRONICS."

J.L.Linsley Hood.
Just Out Hot Off the Press, the definitive electronics and audio book by the renowned John Linsley Hood. This 300+ page book will give you an unparalleled insight into the workings of all types of valve and solid state audio circuits. Learn how to read circuit diagrams and understand amplifiers and how they are designed to give the best sound. The virtues and vices of passive and active components are examined and there are separate sections covering power supplies and the sources of noise and hum. As one would expect from this writer the history and derivation of audio amplifier circuitry have an entire chapter, as does test and measurement equipment. Copiously illustrated this book is incredible value for the amount of information it contains on the much neglected field of linear, as opposed to digital, electronics. Indeed it must be destined to become the standard reference for all who work, or are interested in, this field.

SPECIAL OFFER. With each book purchased you may request a FREE extended index, written by the Author, exclusively from HART. 0-7806-0868-4 **£16.95**

Don't forget most of our kits have reprints of articles by John Linsley Hood that you can purchase separately.

"DIGITAL AUDIO AND COMPACT DISC TECHNOLOGY"

2nd Edition. Baert, Theunissen and Vergult. (SONY Europe)
A thoroughly well written book covering the field of recording media starting with the Phonograph right through to modern professional PCM digital recording systems with particular and extensive coverage on the compact disc. All aspects of the recording and reproduction processes are explained with separate chapters on such things as compact disc encoding and the use of cross interleaved Reed-Solomon error correction code (CIRC). This book is of course essential reading for engineers and students involved in the field but its very low prices makes it ideal for the enthusiast of recorded music who wants to know more about the hidden processes going on in his CD player.
1992/94 248 Pages. 247 x 190.
0-7506-0614-2 **£17.95**

"THE LOUSPEAKER DESIGN COOKBOOK" Vance Dickason. (4th Edn.)

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

1991. 152 Pages.
0-9624-191-7-6 **£22.95**

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0-85935-324-3 **£3.95**

Postage on Single Books is £1.50 except for The Art Linear Electronics, Digital Audio and Compact Disc Technology and The Loudspeaker Design Cookbook which are £3.50. Two, or more books are only £4.50, any size, any quantity.

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1947, Reprinted 1990. 40 Pages.
0-9624-1918-4 **£6.95**

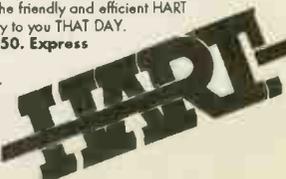
LOUDSPEAKERS; THE WHY AND HOW OF GOOD REPRODUCTION. G.A. Briggs This easy-to-read classic, last revised in 1949, introduces the reader to concepts such as impedance, phons and decibels, frequency response, response curves, volume and watts, resonance and vibration, cabinets and baffles, horns, room acoustics, transients, crossovers, negative feedback, Doppler and phase effects, and much more. A provocative survey of the right questions about sound reproduction.
1949 Reprinted 1990. 88 Pages.
0-9624-1913-3 **£8.95**

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D.I.Y. Supplement

Contents

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All of the projects in this supplement have gone through rigorous listening and test procedures. The performance and specification of these projects can only be guaranteed on kits bought directly from World Audio Design Ltd.

KIT NEWS

New valves, kits, drive units and other goodies in the world of DIY hi-fi.

5

HIGH DEFINITION AEROGEL DRIVERS

Noel Keywood tests two of the latest Audax HDA drive units, dedicated to super-midrange quality.

8

AUDIO TECHNOLOGY SORCERER

Nick Lucas builds a do-it-yourself CD convertor, using the high quality Burr-Brown PCM63P DAC chipset.

15

ROGERS CADET III

Continued from the main issue, Andy Grove describes in detail the circuit of this classic valve amplifier and gives useful restoration hints.

19

BOOK REVIEW

This month's book review covers the latest Maplin catalogue, now in full-colour to give customers a better picture of what they're getting.

THE MAPLIN CATALOGUE '95

25

DIY LETTERS

Last, but certainly not least, the DIY Letters corner. Working on a design or looking for a kit to build? Ask our panel of experts. We'll help you make the right choice.

27

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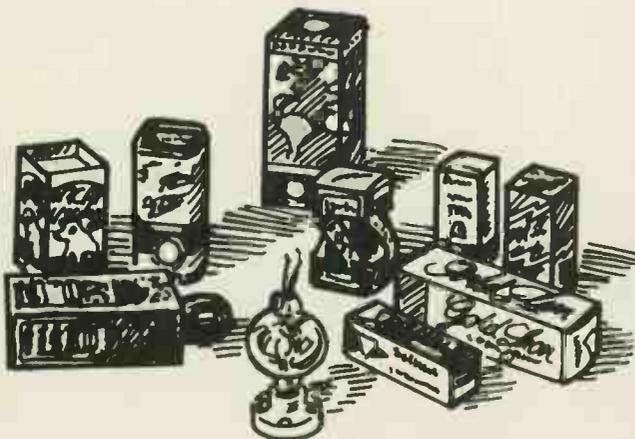
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KIT NEWS

ANTIQUE ELECTRONIC SUPPLY

1995 Catalog

- TUBES
- PARTS
- BOOKS
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A CATALOGUE OF VALVES

Antique Electronic Supply are now distributing their 1995 catalogue covering valves, parts and supplies for collectors and hobbyists. The catalogue has 36 pages covering over 3000 types of receiving, audio, transmitting and industrial valves, as well as an extensive range of capacitors, books and other items needed for the restoration and construction of valve equipment.

For further information, contact:

Mureen Cravener
Antique Electronic Supply,
221 South Maple Avenue,
Tempe,
Arizona.
85283
Tel: (602) 820 5411
Fax: (800) 706 6789

FREE SERVICE FOR REVOX OWNERS

On November 17/18th, Herts Hi-Fi, the appointed service agents for Revox hi-fi products, are holding a free Revox clinic where owners can bring their tape machines. Herts Hi-Fi can provide a full service on all Revox products from the early G36 valve tape machines of the '50s up to the latest models. The clinic will work on an appointment system, so book early, and all machines will be checked over and given a report on their condition. Herts Hi-Fi also stock a selection of second-hand, reconditioned Revox machines.

Herts Hi-Fi
Suite 110,
Smug Oak Business Centre, Lye Lane,
Bricket Wood, Herts. AL2 3UG
Tel: 0923 893711

CZECH 300B VALVE OFFERS POWER

A new, high power 300B equivalent will shortly become available from Czech valve manufacturer Vaic (see page.7). Its development was financed by Italian suppliers and production is limited to around 300/month. Although useable as a direct replacement for the 300B, the new valve is claimed to have significantly uprated anode dissipation, going up from 40watts of the standard design to 65watts. Maximum ratings are 500volts across the valve and 130mA through it, with an expected life of 10,000 hours. De-rated, it will give 20,000 hours or so. Price has been set at £300, and a guarantee of 2000hours/1 year (whichever comes first) is offered by Audionote (UK), its suppliers.

Audionote Ltd.,
Unit 1,
Block C,
Hove Business Centre,
Fonthill Road, Hove,
East Sussex BN3 6HA
Tel: 0273-220511

NEW VALVES FROM P.M. COMPONENTS

No fewer than three new valves will soon become available from P.M. Components. German Telefunken's EL156 has been revived, but in modified form to make it more applicable. It is a high power - 50watt anode dissipation - beam tetrode for audio output stages, but P.M. have had an International Octal (IO) base fitted, instead of the original German base. Standing no less than 130mm high overall, and 50mm in diameter, this new valve has a tubular bulb made from thick glass, giving it a heavy, chunky feel. Its power handling ability will endear this valve to anyone wanting to produce high outputs without going to the expense and space consumption of running paralleled output pairs.

P.M. have also re-arranged the electrode structure of the EL156 to both KT88 and KT66 patterns, resulting in high grade equivalents. This seems appropriate, since GEC's book 'An Approach to Audio Amplifier Design' from 1957, is being re-printed and will undoubtedly generate a demand for these once-popular GEC audio power output valves.

A new EL34 is promised too, based precisely upon Mullard's original design. Apparently, there has been much

AUDIOCAB

" YOU CAN'T JUDGE AN LP BY ITS SLEEVE "

So does it matter what those MDF boxes in your listening room look like as long as they sound grrrrreat? We think it does, and we think you do too.

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Still not sure about producing the finish you want? O.K. We'll assemble and finish the kit for you to your specification.

Incidentally, a pair of KLS3's will soon be on demonstration by appointment, so if you live within striking distance give me a call.

Now how about a cabinet to hold all your C.D.'s, in the same style as your speakers, maybe hand dragged or sponged to match your decor.

We specialise in the production of cabinetry and do not therefore at present supply drive units or the other components you will need to complete your loudspeakers.

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3A Amp1A Tungram	£32.40	85A2 Mullard	£5.93	ER20C-01 Thermionic Gold	£8.50	EL34 Chinese	£7.00	813 Socket	£15.00
5c 450A STC UK	£259.35	300B Thermionic Gold	£69.00	ER30C 01 Thermionic Gold	£8.50	EL34 Thermionic Gold	£9.95	Octal McMurdo UK	£1.20
5R4GY RCA	£5.93	805 USA	£54.00	E88CC Siemens East	£11.55	EL34G Sovtek	£7.00	Octal PCB nylon	£2.70
5U4G Sovtek	£4.80	300B Silvertone Chinese	£69.00	E88CC Thermionic Gold	£6.90	EL84 Sovtek	£1.82	Octal PCB foreign	£1.20
5Y3GT RCA	£3.90	807 Valvo Holland	£10.50	ECC81 Mullard UK (CV4024)	£7.50	EL84 Thermionic Gold	£4.00		
6AS7G Russian	£4.00	811A Thermionic Gold	£12.00	ECC81 Thermionic Gold	£5.25	GZ32 Miniwatt France	£8.00	B9A Sockets for ECC83, EL84, EF86	
6B4G Russian	£19.50	845 Thermionic Gold	£33.00	ECC82 Mullard UK	£9.00	GZ34 Sovtek	£7.95	etc suitable for preamps	
6BH6 RCA	£2.48	5687WA Sylvania	£6.45	ECC82 Thermionic Gold	£4.50	GZ34/5Y3GT Sovtek	£4.20	B9A Ceramic skirted chassis with	
6CG7 Penta USA	£6.75	5751 RCA	£7.32	ECC83/12AX7WB Sovtek	£3.50	GZ37 Mullard UK	£4.95	screening can. made in China	
6L6GC GE	£22.50	5881/6L6WGC Sovtek	£8.00	ECC83/ECC8035 TESLA	£13.13	KT66 Thermionic Gold	£9.50	£1.20	
6L6GC Thermionic Gold	£6.50	6189W GE/RCA	£5.99	ECC83 Thermionic	£5.25	KT88 Thermionic Gold	£18.50		
6L6WGC Sovtek Russian	£6.00	6336A Penta USA	£58.50	ECC85 Mullard	£5.70	PL519 ECG/Philips	£6.23	B9A Ceramic skirted chassis with	
6SL7GT STC UK	£6.00	6550A GE USA	£33.00	ECC85/6AQ8 Thermionic		Jumbo 4 pin for 211	£11.50	screening can. made in Russia	
6SN7GT STC UK	£7.50	6550A Thermionic Gold	£11.50	Gold	£3.90	Jumbo 4 pin gold plated		£0.90	
6V6GT STC UK	£4.20	6550WA Sovtek Russian	£19.95	ECC88 Chinese	£3.90	for 211	£24.00	B9A PCB Gold pins	£2.40
6X4W Raytheon USA	£2.50	CV4003 Mullard UK	£9.00	ECC88 Thermionic Gold	£6.90	UX4 used for 2A3/300b	£2.25		
12AX7 Thermionic Gold	£5.25	CV4004 Brimar UK	£7.85	ECC88/6922 ECG Philips	£5.18	UX4 large locking type	£6.00	BD9 magnoval chassis mounted	
12AX7W A Sovtek	£3.50	CV4024 Mullard UK	£7.50	ECL82 Russian	£1.58	B5 UK	£3.60	for PL519	£2.25
12AX7WB Sovtek	£3.50	DG732 Tungram Hungary	£32.48	ECL86 East European	£3.23	UX5 McMurdo UK	£2.10	Topcap used for 807	£1.20
12BH7A GE Brands	£13.50	ER1CC Thermionic Gold	£5.25	EF86 GEC UK CV4085	£19.50	B7A used for 6C33CB	£3.23	Topcap 12 E1 5B 254M	
12E1 STC/ITT UK	£15.00	ER1CC-01 Thermionic Gold	£9.50	EF86 Sovtek	£4.50	B7B McMurdo UK Chassis mount	PL519	£3.00	

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We can supply sockets for any valve listed in this advertisement. For matched testing please add £2.00 per valve (eg. £8.00 per quartet)

KIT NEWS

demand for a quality copy of the original. Only a few originals are left in the world and, in the Far East, hundreds of pounds would be paid for one.

Finally, and perhaps most interestingly, for the rapidly increasing number of 300B amplifiers appearing, a

new, up-rated super-300B is to become available. It will have a titanium anode, a stronger and better supported electrode structure and a special thoriated tungsten bright-emitter heater, made in Japan by a new production process. Bright emitters actually possess better emissive properties than indirectly heated and dull emitter types, but they consume power and can become fragile. These days, however, when performance takes precedence over

all else, better bright-emitters are a strong plus point. They also make for a very attractive appearance, glowing brightly within the bulb. Price will be £125, about double that of standard 300Bs.

All the new valves will be made in Chinese valve plants.

**P.M. Components,
Unit B3,
Springhead Enterprise Park,
Gravesend,
Kent DA11 8HD.
Tel: 0474-560521**



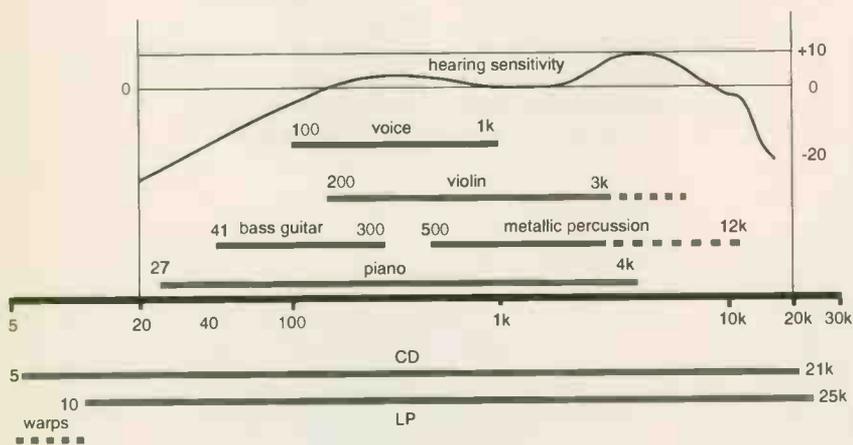
◀ Czech manufacturer Viac has recently introduced this new valve based on the 300B, but with an increased anode dissipation of 65watts.



◀ P.M. Components are shortly to offer this Chinese made EL156 high power beam tetrode, based on the original Telefunken EL156, but with an octal base.

A NEW TECHNOLOGY

Noel Keyword tests Audax's high technology high definition Aerogel drive units.



Concrete cabinets and tweeters that fire everywhere are just two recurrent ideas in loudspeakers. Superficially they seem sensible, in practice they are either impractical or inconsequential in their affect upon sound quality, yet there's a cyclic reappearance of these things in hi-fi. In my time there's been Stig Carlson of Sonab, the man with a tweeter fetish, and, more recently on another up cycle, Canon with a budget variant. Concrete loudspeakers and concrete ships, it seems to me, appear and sink with equal speed.

The box with two drivers in it seems boring and earth bound; it's an arrangement that rarely seems to sparkle, but it's got some difficult to beat advantages. Here's an overview of the loudspeaker, why concrete ones sink as fast as they are launched, why multiple tweeters are most enduringly found on telephone wires and why the twin-driver box reigns supreme, even though it's not the best thing going.

Loudspeakers have to cover a very wide frequency range. Down at low frequencies a large volume of air must be moved to produce powerful deep bass and to do this a big cone moving over a comparatively large distance is needed. At high frequencies the crash of a cymbal can only be reproduced accurately if the drive unit moves very quickly. Since it's difficult to make big objects move quickly or control them once moving, this requires a

small, light cone - in fact, a dome these days. So big cones move air for good bass reproduction, whilst small, light domes are needed for treble reproduction.

It is possible to make one drive unit cover the entire audio band, but it will often do so by radiating sound over its entire area to produce bass, and from just part of its area for treble. Speakers with big paper bass cones and a shiny aluminium 'parasitic' tweeter cone at their centre are a good example. With these, the crossover region between the two is relatively uncontrolled, giving a ragged frequency response, making them medium-fi.

To get an approach on loudspeaker design it's a good idea to look at some fundamentals, namely what we are trying to reproduce and what we can hear. The diagram shows frequency range of some common musical instruments, human speech/vocal range and, very importantly, hearing sensitivity. Bear in mind that these things are necessarily approximate, by their nature. Hearing range varies between individuals and with sound level, my curve being for fairly high levels. Whilst the violin reaches 3kHz in fundamental frequencies, it has very strong overtones (i.e. 2nd and 3rd harmonics) which put much energy up at 6kHz and higher. A close miked crash of cymbals, sibilance, a struck chord on a steel string guitar - all these things will generate strong high frequency transient energy that reaches 10kHz and higher. So

we can't be precise about frequencies and levels, but it is important to consider them all the same.

We can clearly perceive notes aurally (as opposed to physically) from 40Hz up to around 4kHz. That's why musical instruments don't commonly go higher or lower - it doesn't sound especially nice. Bass guitar goes down to 41Hz, but bassoon and plucked bass can go a little lower. Below this, especially, comes the organ, which reaches down to 16Hz for seismic effect. Below 40Hz notes start to possess physical power and can shake windows. The body can perceive right down to 5Hz or so and, I can assure you, subwoofers that reach that low do come across as awesome (REL reaches 8Hz; Celestion SL6000 reaches 5Hz - I've measured and used both). CD has clean bass signals down to 5Hz. LP really doesn't extend cleanly below 20Hz because arm/cartridge resonance and warps become a problem.

You may be surprised that speech doesn't go very high. Male speech, I found from measurement, is strong in fundamentals from 80Hz up to 630Hz, but there's plenty of energy lower down than this, and also higher up in overtones. Sibilance puts out strong energy up to 10kHz. Female speech is pitched higher, up to twice that of male speech. Curiously, intelligibility of speech depends upon detecting the overtones - perhaps leading edges, their timing and order would be a more appropriate way of seeing it - needing a bandwidth ranging from about 500Hz-3kHz for a good understanding of what is being said.

Now look at the peculiar sensitivity characteristic of the human ear. The ear is nominally flat (within 5dB or so) from 100Hz up to 8kHz. A big problem characteristic that increasingly obsesses me, however, is that it displays a +10dB sensitivity peak around 4kHz - and this is exactly where most speakers cross over from bass/midrange to tweeter. Because of this, their frequency response and phase error problems are in the ear's most sensitive region.

In my experience a good three-way loudspeaker, with midrange unit that works smoothly right through this critical midband region is preferable to a two-way design that crosses over here. Crossing over lower down, around 1kHz where the ear is less sensitive, is one solution, but this is in the range of musical instruments. A preferable alternative is to cross over higher up, 7-8kHz or higher ideally.

So, ideally, we need one drive unit that can work smoothly from 100Hz up to 7kHz or so. We barely possess such a thing at present. In spite of all its practical drawbacks, the electrostatic loudspeaker can manage such a performance. The conventional dynamic driver is more limited however, meaning that conventional loudspeakers are still barely

adequate at present, even though we tend to assume they can do their job satisfactorily. I'm looking for a good midrange unit that can manage this performance and you'll see that the Audax HM100Z0, tested further on, gets close.

And now on to cabinets - a fetish indeed! Yonks ago, someone realised that when a cone moves in one direction, say forward, it creates a positive pressure up front and a negative one (rarefaction) behind. Now, high pressure is going to neutralise or 'fill up' low pressure if it can, so if they meet, the two will mutually cancel. This occurs around the edges of the drive unit, but can be prevented by enclosing the rear of the driver in a box, so the rear wave cannot get out. This produces other problems, the main one being that to get even bass reproduction, the box and drive unit must be matched to each other and (preferably) the box subjectively tuned by port adjustment, etc, to sound just right.

There isn't much need for concrete in any of this. Concrete is a rigid aggregate (there are others) that is non-resonant, so it does make a resonance free cabinet.

However, it isn't difficult to brace a wooden cabinet or use thicker MDF to effectively suppress panel colouration. Concrete needs as much or more internal damping, it is difficult and slow to mould and needs a lot of finishing work. Perhaps worst of all, it is almost too heavy to lift and, because of its weight, costs a fortune to transport. If the extra costs of using concrete means commensurately cheaper drive units must be used to meet a price, then the speaker will sound worse, not better. Exit concrete.

The smooth, predictable frequency response of a modern drive unit can only be appreciated if it fires straight at a listener's ears. Fire a drive unit at a wall, window or ceiling however, and the sound that bounces off will be far from flat in its response - it will be very ragged in fact, suffering deep troughs and narrow peaks, according to what it is reflected off.

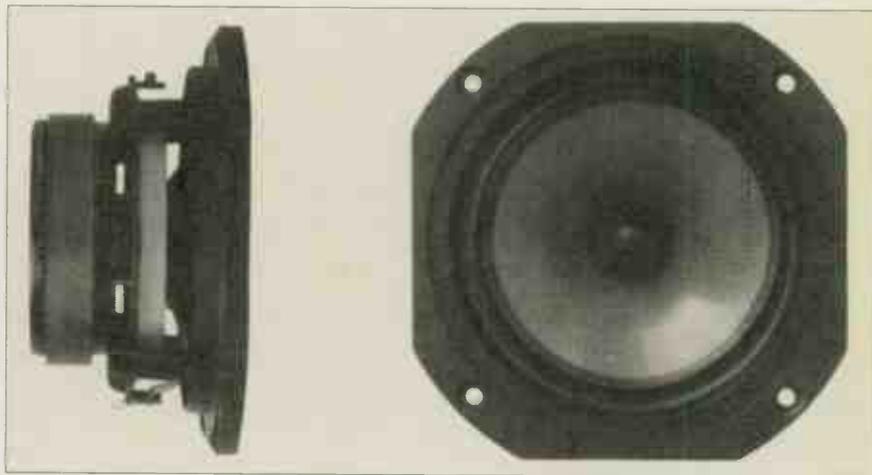
When sitting in front of speakers, much energy reaches your ears direct and that's the quality stuff. That's what all the engineering effort went into; that's the sound of your speaker. However, quite a

lot of sound energy gets reflected off the ceiling and side walls or windows to your ears. That's the ragged stuff over which no one has much control, unless you acoustically treat your room. To hear the balance between quality direct sound and ragged reflected sound, sit on a chair first close to your speakers - say a few feet away, then move back a few feet at a time. As you do so, a greater proportion of reflected sound will reach your ears. Notice how, especially if you have low ceilings and can get 15ft or more away, that the sound stage will get messy and the sound generally untidy. That's due to the proportion of reflected sound becoming great.

Any loudspeaker system that throws sound around the room, especially treble, will give a rather arbitrary result because of this. The idea is to provide a sense of spaciousness, but it is a simple and fairly crude effect, well known about in audio, that also generates treble muddle and a poorly defined on-axis listening experience. Multiple tweeters sing more sweetly lined up on telephone wires, I can assure you; that's the best place for them.

AUDAX HM130Z0 MIDRANGE UNIT

Although a dedicated midrange driver, like the smaller HM100Z0, the new HDA cone HM130Z0 unit from Audax is a different animal. Fitted with a larger (nominally 5.25in) cone and a more compliant surround, its basic cone resonance lies at 68Hz, a lot lower than that of the 100Z0. Its response extends



Frequency Response

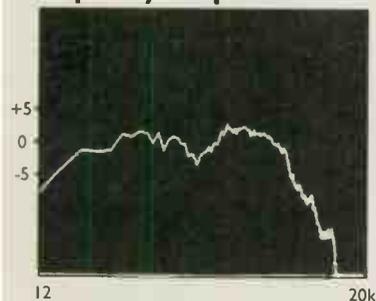


Fig 1 - Useable output extends from 100Hz up 5kHz, with a dip visible at 1kHz. The slight extra lift in output from 1.5kHz up to 4kHz can be usefully levelled to match output lower down by use of a 0.3mH series low pass inductor. Low bass input is best limited with a 100µF Alcap capacitor in series.

down much further as a result.

Although able to handle upper bass, response starts to roll down below 200Hz, our analysis shows and 150Hz would be a normal lower limit. Audax make a variant, the HM130Z4 bass/midrange unit, that's better able to handle lower bass frequencies, although it doesn't reach up so high.

This unit has a strong cast chassis and an HDA cone of Kevlar and carbon fibres in a controlled mix, bonded by an acrylic polymer gel. Its inverted rubber roll surround is compliant and has a long throw and a soft rubber phase plug has been used to smooth out the high frequency response.

Unfortunately, whilst this driver has a beautifully smooth high frequency response that extends smoothly up to

5kHz before rolling away, it also has a strong midrange dip centred at 1kHz that appears to be related to the cone/chassis diameter. It was little improved by our usual sticky tape/Blu-tak

Impedance

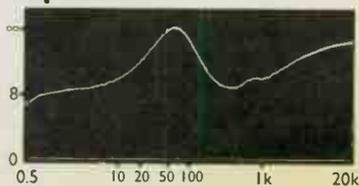


Fig 2 - Resonance occurs at 64Hz. Below this impedance falls to the DCR value of 6.4Ω. Above it reaches a minimum of 8Ω at 400Hz before rising up to 35Ω or so at 20kHz.

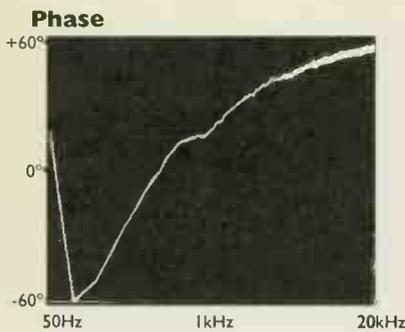


Fig 3 - The electrical phase characteristic shows this unit is inductive above 500kHz.

mods to smooth out contours, although a finger placed over the roll surround got rid of it completely, suggesting the problem is amenable to solution by simple re-design, if not by user modification. The dip is deep and wide enough to make itself known subjectively, detracting somewhat from overall fidelity.

Audax quote sensitivity as a high 92dB and nominal power handling at 50watts.

LOAD CHARACTERISTICS

The d.c. resistance measured 6.4Ω but low frequency response peaks up the impedance curve to over 60Ω at 64Hz - a very high value. This keeps overall impedance in the audio band up to 8Ω minimum, but rising inductive reactance above 500Hz takes impedance up to 35Ω at 20kHz, as our impedance plot shows.

The response analysis suggests 5kHz might be a good crossover point. Here, impedance measures around 30Ω, the value seen by the crossover. Most of this is inductive reactance (29Ω), inductance calculating out at 1mH.

CROSSOVER

This driver rolls off so smoothly at high frequencies that it hardly needs a low pass section. However, since it has to phase match a tweeter, in practice a simple first order section might be needed and I found a 0.3-0.5mH series inductor gives about the right roll off. Experimenters should bear in mind that most dome tweeters project around 2.3cms or so in front of the base of this unit's cone and that one wavelength at 5kHz is just 7cms, meaning a dome tweeter is likely to be around 90 degrees out of phase simply by nature of its

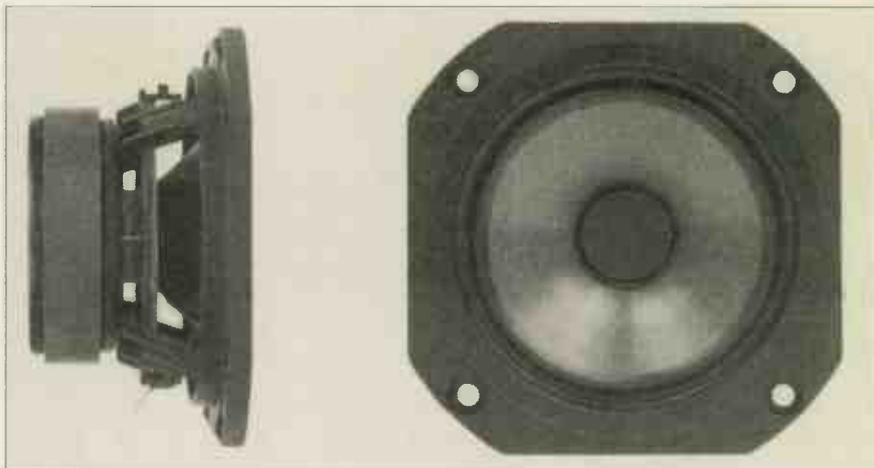
construction and positioning on the baffle. My experiments have suggested that the ear is sensitive to significant phase error around 3kHz - a region where it has greatest amplitude sensitivity and perhaps phase sensitivity too. It may well be that best phase matching can be obtained by not using a low pass with this driver but by feeding a tweeter from a simple first order high pass. If this is so, then a suitable crossover for HMI30Z0 becomes just a single 100μF reversible electrolytic to limit bass input by acting as a first order high pass at 150Hz.

CONCLUSION

Everything about the new HMI30Z0 looks good, except its suckout at 1kHz which, unfortunately, was not easily curable. This won't affect sound quality as much as might be expected, possibly detracting a little from vocal body, apparent conciseness of phrasing or even drawing attention to sibilance by disembodiment of highs from lows. The pity is that this mars an otherwise fine drive unit, one that covers a wide range and needs few crossover components. It is likely that in spite of this, the HMI30Z0 will still provide good, clear sound though, because of its HDA cone material.

AUDAX HM100Z0 MIDRANGE UNIT

The new HM100Z0 4in midrange unit from Audax is, in my view, potentially more important than most other hi-fi components or products launched recently. Conventional loudspeakers are very flawed in what they do; advances are desperately needed. This unit, based on a new super lightweight cone material - High Definition Aerogel (HDA) - could well offer home constructors and manufacturers a way forward. Here's our assessment of it.



Frequency Response

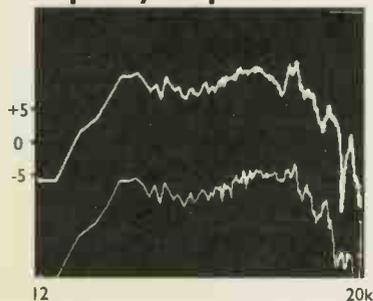


Fig 1 Above - frequency response as standard. Below - with phase plug.

Being a dedicated midrange driver, not a bass/midrange, the HM100Z0 has a

fairly stiff surround. It isn't meant to move volumes of air at low frequencies. Audax have other designs for that purpose. They also have a slightly larger (5.25in) HDA dedicated midrange driver with a much more compliant surround, the HMI30Z0, for those who want to go lower down in frequency.

To quote Audax, HDA is ultra light, extremely rigid and of maximised internal damping. It's a controlled matrix of carbon and Kevlar fibres in a acrylic polymer gel, whose thickness can be varied over the cone profile. To you and I, it's slate grey in appearance and curiously sticky to the touch, collecting specks of dust and debris which are a little difficult to coax off.

The lightweight cone is attached to an unusually stiff, inverted rubber roll surround, which is attached to a heavy

and very stiff cast frame in the constructors version. A less expensive and rigid pressed chassis version is available for production, but these need to more care in fixing. The rear carries a relatively

Impedance

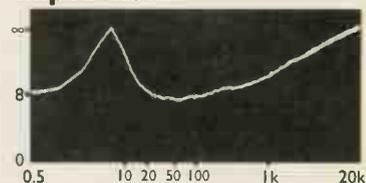


Fig 2 - Impedance starts at 6.5Ω and rises above 1kHz to 30Ω at 20kHz. The peak is the cone's low frequency resonance, which sets the lower frequency limit of 230Hz.

large magnet which, together with a light cone, makes for very high sensitivity, quoted at 92dB.

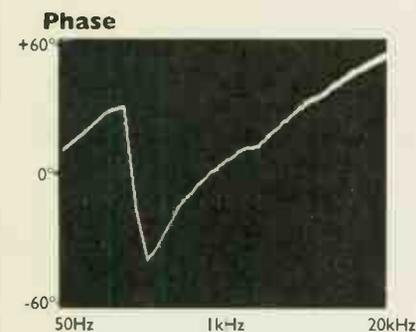


Fig 3 - Electrical V/I phase swings through resistance to capacitance above resonance, but becomes inductive again above 1kHz.

I'd hope a unit like this could reach up past the sensitivity peak of the human ear, located around 3kHz. There's some small disappointment here. Our analysis shows that there's a dip at 1kHz in the response of the unit, and either side output rises up by 3dB. The top trace of the unit, in unmodified form, shows that at 4.5kHz there's a suckout followed by a sharp peak at 5.5kHz. Most peaks at high frequencies are due to phase additions/cancellations caused by reflected waves from mechanical discontinuities. This peak was cured by making up a phase plug of Blu-tak and attaching it to the open pole piece (see diagram). The large 5.25in unit has one; the smaller 4in unit obviously needs one.

A tweeter could easily be integrated, crossover occurring around the 7kHz region. It strikes me that a Tonigen ribbon tweeter, which goes no lower than 6kHz, would probably match in, but the HM100Z0 would then have to be attenuated down to reduce its sensitivity, which is a bit of a waste. Audax make high sensitivity tweeters able to match the HM100Z0.

LOAD CHARACTERISTICS

To get any crossover section feeding a driver to work properly, or at least roughly as predicted, the nature of the driver as load must be known. Our impedance (Fig 2) and phase plots (Fig 3) show many interesting, if common features.

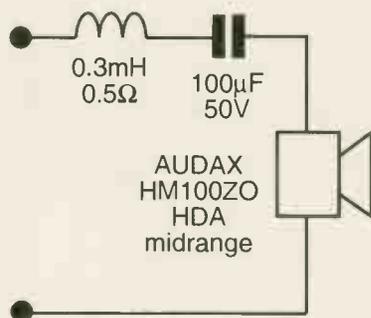


Fig 5 - A simple crossover that gives the HM100Z0 smooth response from 200Hz up to 7kHz, plus good acoustic phase characteristics

Minimum impedance is the d.c. resistance value, as it has to be, which measured 6.5Ω . This is held up to 1kHz, apart from the peak due to cone resonance against the incompressible surround, which occurred at a high 230Hz. The phase plot shows how the load swings from inductive to capacitive here (-45 degrees). Maximum impedance is 30Ω , being hit at resonance and 20kHz.

Voice coil inductance becomes consequential above 1kHz, causing impedance and electrical phase angle to rise steadily. At around 6kHz, which might be taken as a crossover frequency, impedance measures around 12Ω (which gives us an inductive reactance of 10Ω and an inductance of 0.3mH). So the crossover isn't feeding 8Ω , nor a resistance, and account must be taken of this. DIYers should note that this is one reason why general purpose crossovers don't work and why a crossover is designed to match a specific drive unit, meaning other drivers cannot be substituted.

CROSSOVER

From this information I guessed that a 0.3mH crossover inductor in front of the unit (with phase plug) would be a good

starting point for a first order low pass section and, sure enough, it gives the attractive result shown in Fig 4, much of the treble peaking between 2kHz and 5kHz being attenuated, output rolling off smoothly above 7kHz, the -3dB point.

Now the HM100Z0 is beginning to look very attractive, since just one small 0.3mH (0.5Ω DCR) coil is needed to achieve a smooth and extended midband, free from breakup modes and with a gentle roll over at 7kHz into which a tweeter will match easily. Better is to come.

The bass hump similarly can be smoothed over with a simple first order high pass section comprising just one $100\mu\text{F}$ ($150\mu\text{F}$ shown since that's all we had in our bits box at the time!) reversible electrolytic (Alcap) capacitor, giving a bass response shown in Fig 4.

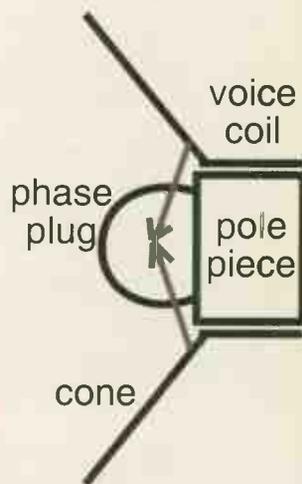


Fig 6 - The flat pole piece face benefits from the addition of a phase plug to prevent phase cancellation from the cone (see arrows) causing a peak and suckout at 5kHz. We used Blu-tak, but soft rubber is the usual material.

Frequency Response

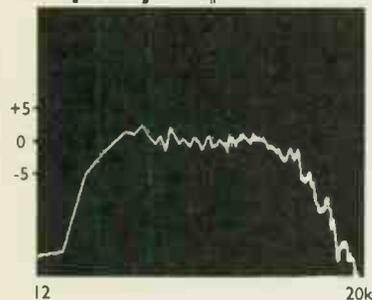


Fig 4 - Frequency response with series capacitor and inductor acting as high and low pass first order crossover filters.

Fitted with a phase plug, the HM100Z0 reaches up to 6kHz fairly smoothly, albeit still with steadily rising treble output, as the lower trace shows. Interestingly, above 6kHz output falls away smoothly, suggesting a simple first order low pass filter comprising a series inductor could be used for good acoustic phase behaviour, its slow roll-off rate pulling down the 5kHz plateau by a useful amount to give an approximately flat response.

CONCLUSION

We now have a super high tech HDA midrange unit giving a wonderfully smooth response from 200Hz up to 7kHz when fed from just two crossover components. Since this covers the most critical part of the audio band, putting the crossover point one octave higher up, into a region where the ear is less sensitive, than that of most loudspeakers, the HM100Z0 midrange unit is obviously able to deliver the goods in a cost effective way. It is easy to apply and can be used to form the basis of a very coherent and revealing loudspeaker in which just one drive unit covers the most critical part of the audio band. It's a very well engineered, modern driver. We hope to rev up our soldering irons soon ●

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CD WIZARD



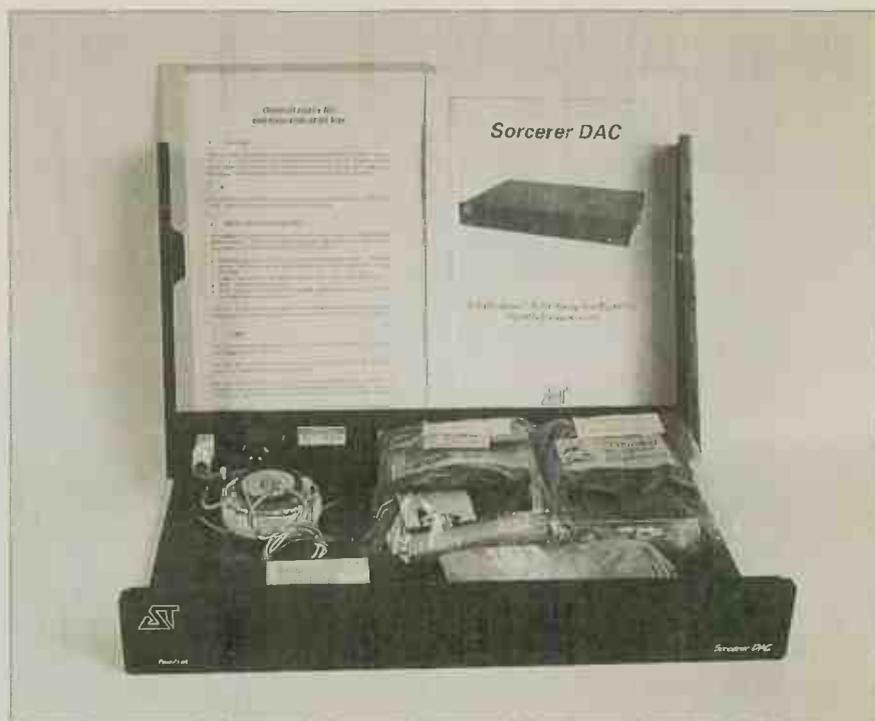
Nick Lucas conjures up his soldering iron and sets to work building the Audio Technology Sorcerer CD convertor.

Recently, when I travelled from Hi-Fi World's workshop and store in London's Notting Hill area, where I work, to the offices, I was greeted by Noel and Dominic grinning: "Good, Nick is here - do you want to build a DAC?" A DAC! I thought. What, no valves? This could be different. So I picked up the kit and commandeered Andy's design room.

The kit was the new Sorcerer digital to analogue converter for CD, supplied by Audio Technology. Connection to the transport can be made electrically via the usual phono socket input, or optically through either the common Toslink cable and connectors or through an upgraded AT&T option, the latter costing £81 more. The AT&T option runs at 50M bits (Megabits) compared to 20Mbits for Toslink, giving a better sound. To take advantage of this performance gain you need a transport with an AT&T optical output, which isn't so common, but Arcam transports fit the bill.

Another benefit of using an Arcam transport with the Sorcerer is that it can be Sync-Locked, which helps reduce jitter and produce a cleaner, more focussed sound.

The kit contains a minimalist styled black powder-coated steel chassis with



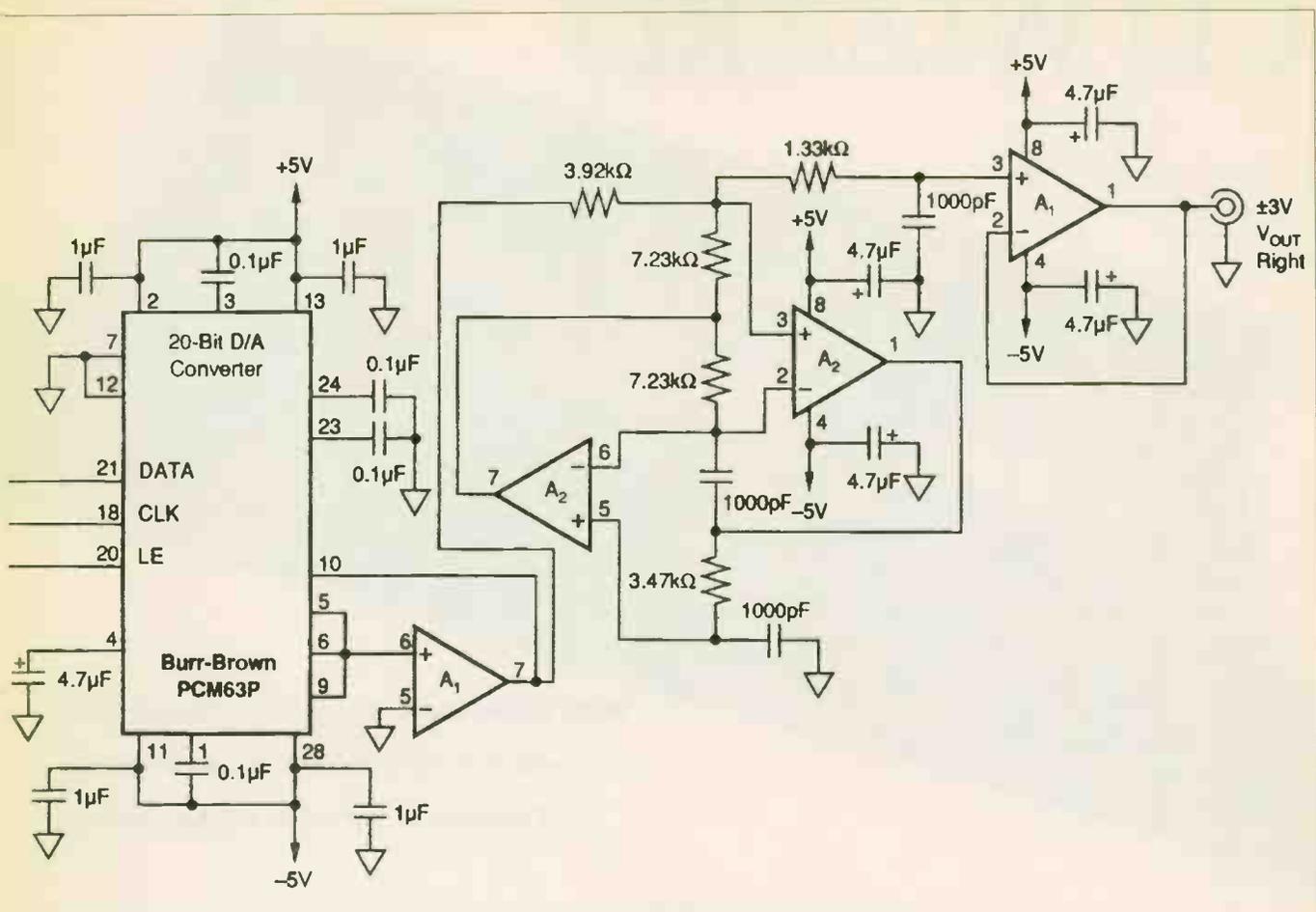
The kit is well presented, with high quality components and clear instructions.

an anodised alloy black front panel. An LED indicator on the front panel changes from red to green as the convertor senses power first and then locks onto the incoming signal. On the back is an on/off power switch, IEC socket, co-axial digital input, two optical connectors, one being the Sync Lock,

and two phono output sockets. The dimensions of the chassis are 430mm (width) x 270mm (depth) x 62mm (height). The primary of the mains transformer is pre-connected to avoid the constructor coming into contact with mains voltages.

The accompanying instruction book

SORCERER DAC



Burr Brown PCM63 DAC and associated filter circuitry.

details general information about the DAC, safety, soldering tips, how to handle the static sensitive ICs, instructions - dealing with the two circuit boards separately, two layout diagrams for input and output connectors and transformer connections, as well as setting up and using the DAC. Also, printed circuit board diagrams and a circuit diagram are provided.

All components are packaged well, two bags for each PCB and composite parts, another bag for connectors and a 'static free' box for all static sensitive ICs. It is quite hard to cause immediate damage to these ICs, but mis-handling can shorten IC life, so to be on the safe side it is essential you follow the guidelines provided.

Now onto PCB assembly, starting with the digital interface receiver (DIR) board. The numerous component bags are clearly labelled with component type, quantity and PCB diagrammatic representation, making it difficult to insert a component in the wrong place or the wrong way around.

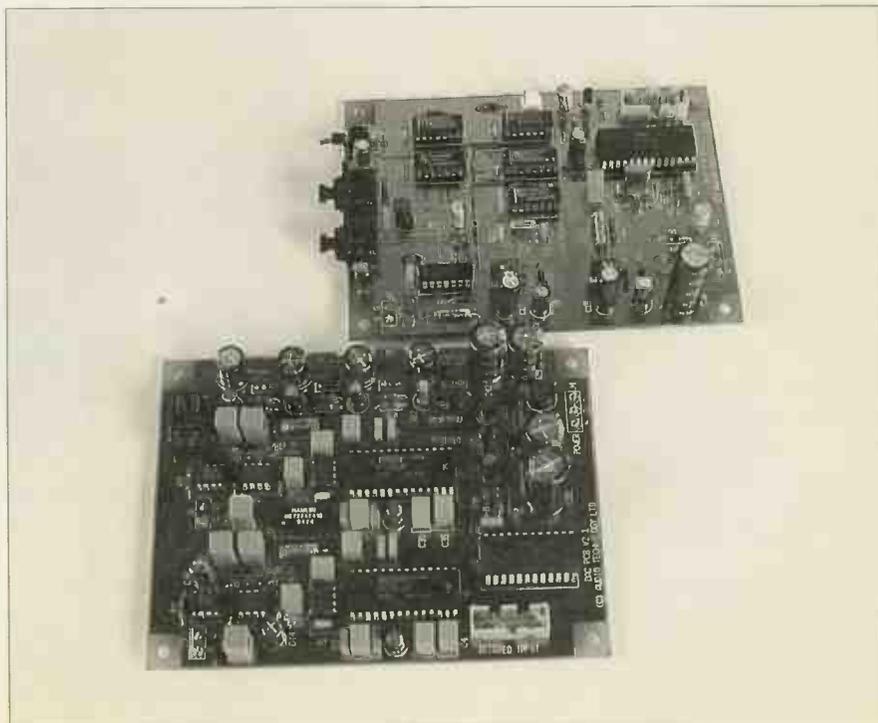
I followed the instructions carefully, especially concerning the order of component placement. This is important when soldering the IC sockets, as they should lie flat; obstruction by taller components can

make this manoeuvre tricky. I soldered all components as close to the circuit board's surface as possible.

The main DAC circuit board has a higher component density, but is no

more complicated to assemble. Again, I made sure I had the PCB sockets the correct way round.

With approximately 650 solder-points in total, this kit is an excellent



It took around 4-5 hours to assemble the two main circuit boards.

SOUND QUALITY

way of tuning up your soldering technique. To make the job as neat and accurate as possible, a fine tip soldering iron should be used.

Fitting the hardware to the chassis was relatively straight forward. When connecting the LED leads to their specified coloured wires I made sure which was the shorter in order to get polarity correct (well, I did after I'd got it wrong first time). It was necessary to unscrew the front panel a little to position the LED.

Connecting up the transformer secondary leads and input/output socket was simple. All that remained then was fixing the ribbon cable and then I found I had built a serious piece of digital kit. I normally build Hi-Fi World valve amplifiers and correct people's DIY mistakes, so this kit was an interesting diversion. It took me about six hours in all to build the Sorcerer and happily it worked first time. That wiped the smile off Noel and Dominic's faces!

If you have any difficulties, Audio Technology will give you any help necessary. Well done Audio Technology, I enjoyed this mission, even though there weren't any valves.

Next to the reference Pink Triangle Da Capo convertor, the Audio Technology Sorcerer lost surprisingly little. It has a similarly sweet and open treble quality, good body and focus through the mid range and a taut, dry bass. Ultimately it didn't reveal quite the same level of

“Happily it worked first time. That wiped the smile off Noel and Dominic's faces!”

detail, losing a little of the dusky atmosphere on John Lee Hooker's Boom Boom, and not producing quite the same holographic, three dimensional imagery and projection of the violin on fone's violin and piano piece.

Steve Earl's Copperhead Road was energetic and lively, with the fast, steely

treble steering clear of becoming sharp or grainy. In fact, the treble remained clear and pleasantly sweet throughout the listening tests, independent of type, style and loudness of the music being played.

Pale Saint's Song of Solomon was captivating with its gentle guitar intro, backed by military style drum beat full and real enough to scare. Vocals add a simple melody to the track, and it was here that I noticed how well the Sorcerer held individual instruments in their own space, making it easy to follow each separate part, or just sit back and enjoy the overall result.

In summary, Audio Technology's Sorcerer has a rich, smooth and full bodied sound with sweet clear treble. For anyone with the ability to construct this convertor, it's a chance to get a top quality sound, for an affordable price.

DB

Sorcerer Kit
Built
Audio Technology
P O Box 147,
Bedford. MK41 8PR
Tel: 0585 225693

£699
£1051

MEASURED PERFORMANCE

The frequency response of the Audio Technology Sorcerer CD convertor benefits from good filter engineering: it's very flat, tapering off just slightly at high frequencies with no ripples, peaks or ringing. This should give a clean and clear sound with a subjectively neutral balance. Towards the bottom end of the response, bass level falls just slightly, enough to give a lean and dry bass, but not enough to take away power or low end grunt.

The distortion plot below is from the right hand channel, which shows quite strong 3rd harmonic that may give the Sorcerer a slight sharpness to its sound. However, the left channel measured considerably better, with only lowish amounts of higher order distortion present, namely 5th and 8th.

Overall though, the Sorcerer shows low distortion levels, yielding a good dynamic range of 107dB. Noise, as with all CD players these days, was low enough to be inaudible at -97dB, and channel separation wide. Output was high at 3.1V, but this isn't a bad thing for those who use a passive preamp where the extra headroom is useful. Be careful in an A-B demonstration though: the

Sorcerer will sound subtly louder and more dynamic for the same volume control position. **DB**

TEST RESULTS

Frequency response 4Hz-21.5kHz

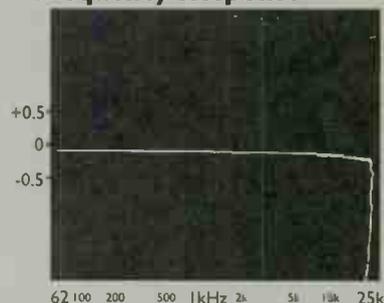
Distortion (%)		
-6dB	0.005	0.006
-30dB	0.029	0.019
-60dB	0.44	0.58
-90dB	29	28
-90dB dithered	10	11

Separation (dB)	left	right
1kHz	105	120
20kHz	80	91

Noise -97dB
with emphasis -99dB

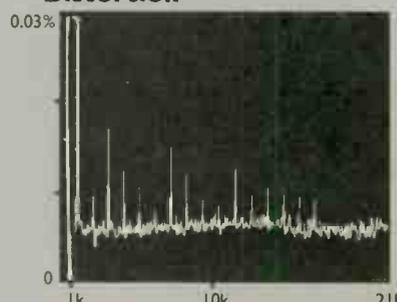
Dynamic range 107dB
Output 3.1V

Frequency Response



Very flat response shows good filter engineering.

Distortion



Slightly high distortion may add a touch of brightness to the sound.

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.... Continued from page 35 main issue

I bought a second-hand Cadet set-up with mono tuner about 12 years ago. It cost me £15 and I carried it home on the bus in a carrier bag. I sold the amps a few years later when I got my Leak TL12s and later TL50s, but I still have the tuner. The sound quality was classically valve, warm and sweet with a liquid midrange, but the preamp left quite a lot to be desired. Like many older preamps the RIAA EQ wasn't quite right so I eventually used the tape replay input with a separate home-brew phono stage.

The Cadet's RIAA EQ network is contained in a little round plug-in box which fits on the side of the preamp. This used to drive me round the bend when I used the internal phono stage because I always had a nagging urge to clean the pins on the plug-in unit. The preamp connects to the power amp via an umbilical cord and an absolutely terrible moulded plug with very fragile and bendy pins. No matter how I arranged the positions of the two units the umbilical cord always looked like it was going to pull out of the power amp, and as the preamp is so light the springiness of the thick cord would cause it to slide into an annoyingly untidy position.

Other idiosyncrasies include the tone controls, one you had to turn clockwise to increase while the other required anti-clockwise rotation, and the screw down speaker terminals which have trouble gripping bell wire, let alone 79 strand. These niggles made owning my Cadet more fun than a boring nice-burner black box and offered a sound quality which is hard to beat.

The preamp section of the Cadet is a rather complicated affair, incorporating tone controls, filters and a feedback network around $V1a/V1b$ for the RIAA correction. Switches select whether the feedback signal, taken from the junction of $R7/C3$, goes via $R5$ for a flat response or via the plug-in EQ unit for phono response. $V1b$, the second stage, uses what is known as "Grid Leak Biasing", where the bias voltage is developed across a very high value resistor (in this case $R6$ is 8.2M) by the leakage current from the valve's grid, this is done in this case to give the second stage a very high input impedance to maximize gain and make the feedback as effective as possible.

The balance control works by varying the feedback around each channel. The third stage also has a feedback loop around it for the tone controls and filters with a simple potentiometer volume control on the output.

The power amp used firstly ECL83 and then ECL86 valves. Mine had ECL86s, which, like the ECL83s, are dual valves with a high μ triode and an output pentode in



CADET FORCECONTINUED

Andy Grove gives some useful advice to anyone attempting to restore the ROGERS CADET III.

"I bought a second hand Cadet set-up with mono tuner about 12 years ago. It cost me £15 and I carried it home on the bus in a carrier bag."

one envelope. The triode section is identical to one section of an ECC83 and the pentode section has an anode dissipation of 9W, slightly less than an EL84's 12W.

The ECL83s give around 7W and the

cause a signal to appear on the anode and cathode, but one is 180 deg. out of phase with the other.

The split load inverter suffers from differing output impedances for the two phases which can cause problems at high frequencies. However the ECL83 and ECL86 pentode sections are easy to drive so there is no problem in this particular circuit

if attempting to rejuvenate one of these set-ups I would replace all of the electrolytics with new items; the originals are probably dried out inside and electrically leaky by

now. Low voltage types could be Rubycon PS2 or Elna RSH; Black Gates are probably over the top but may be used to effect if you have a deep wallet. For high voltage types I try to use Nippon Chemicon or Siemens, as these are very high quality and sound great, but they are somewhat expensive and difficult to locate.

The coupling capacitors may also be suffering from leakage which will affect $V1b$ in the preamp very badly due to its grid leak bias, but good replacements are available. Phillips make a good polyester capacitor

ECL86s should be good for 8-10W output, but the dinky output transformers will limit bass power.

The circuit used in the Cadet power amp is reminiscent of the GEC 912, with a single gain stage and a split-load phase inverter driving the output valves directly. The split-load inverter is probably the most widely used of all phase splitters due to its simplicity. The signal is taken from both the anode and the cathode of the valve with identical values of resistors in each circuit. Any current which flows in the valve will

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* Note that the chassis wire is excellent for loudspeakers internal wiring or to replace the jumper connectors used when Bi-wire speakers are used in single wire mode. When using the wire to carry signals of less than 100hz a double run should be used. High quality preamps should be wired with 16T.

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type	primary Z	max dc	max power	suggested valve type	price (inc)
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se102	3K0	75mA	25W	300B, 2A3	£67.57
se103	3K5	75mA	25W	300B, 2A3	£69.12
se104	3K5/43% UL	80mA	25W	EL34, 300B(omit UL taps)	£67.36
se105	2K6/43% UL	110mA	25W	parallel EL34, 300B	£68.14
se106	10K0	75mA	50W	211	£166.85
se201	1K25	150mA	30W	parallel 2A3/300B	£82.24
se202	1K5	170mA	30W	parallel 2A3/300B	£84.63
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Also available se OTX for 6080.

Push Pull Output Transformers

type	a to a Z	max dc	max P	suggested valve type	price (inc)
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pp102	9K0	50mA	15W	EL84	£54.06
pp103	5K0	65mA	30W	2A3	£58.75
pp104	5K6	100mA	25W	EL34	£60.51
pp105	7K0	100mA	30W	EL34	£62.28
pp106	4K0	100mA	30W	EL84	£62.39
pp107	6K0	100mA	50W	845	£72.85
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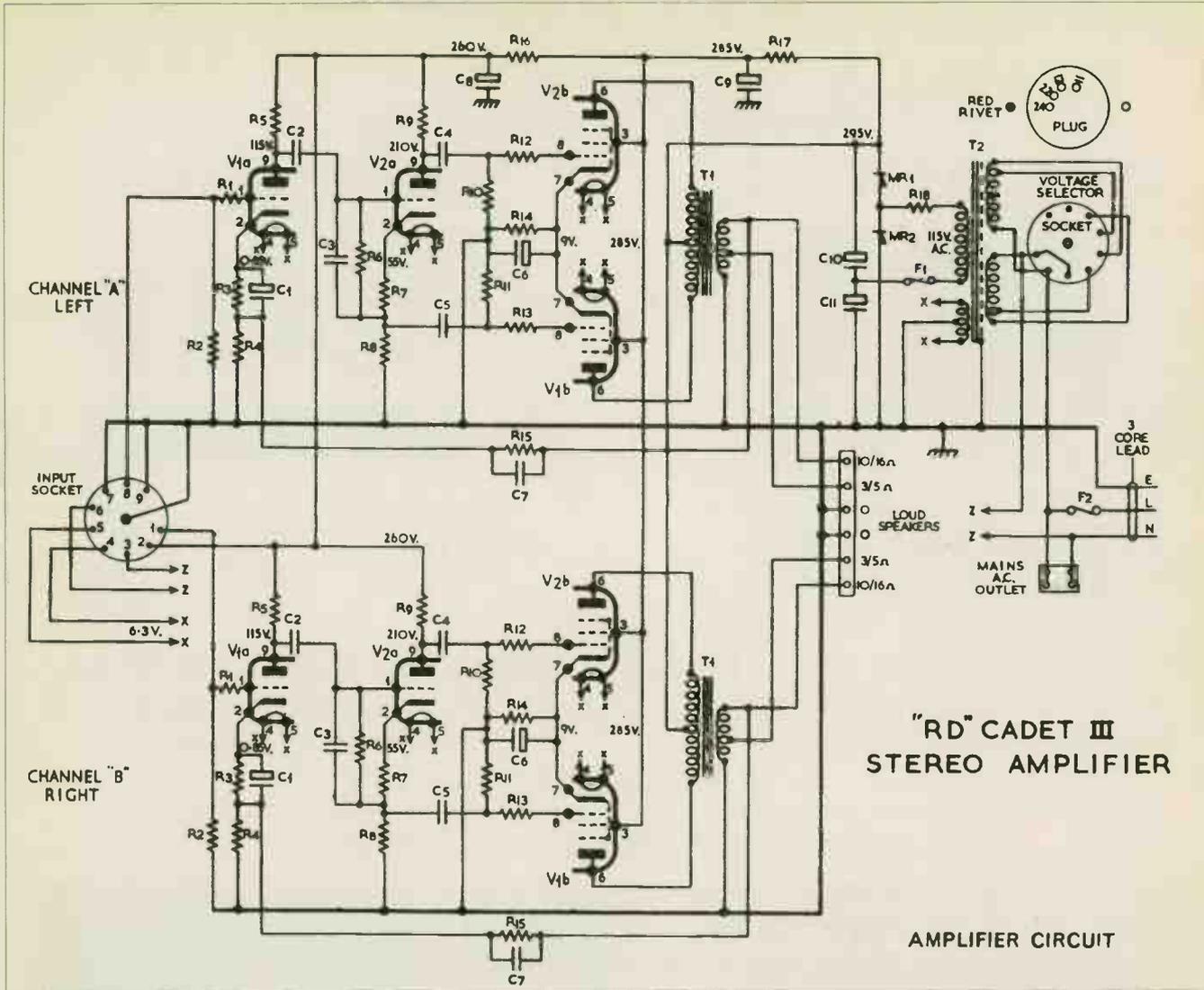
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AMPLIFIER CIRCUIT

Power Amp

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R2	1M	1/4W	Carbon
R3	1.2k	1/4W	Carbon
R4	220R	1/8W	Hi Stab
R5	220k	1/4W	Carbon
R6	1M	1/4W	Carbon
R7	1k	1/4W	Carbon
R8	47k	1/4W	Carbon
R9	47k	1/4W	Carbon
R10	470k	1/4W	Carbon
R11	470k	1/4W	Carbon
R12	22k	1/4W	Carbon
R13	22k	1/4W	Carbon
R14	130R	1W	Carbon

R15	6.8k	1/8W	Hi Stab
R16	5.6k	1W	Carbon
R17	470R	1W	Carbon
R18	2.2R	4W	W. Wound

Capacitors:

C1	40uF	16V	Electro
C2	22nF	400V	Polyst
C3	400pF	350V	Polysty
C4	0.1uF	400V	Polyst
C5	0.1uF	400V	Polyst
C6	40uF	16V	Electro
C7	680pF	350V	Polysty
C8	16uF	350V	Electro

C9	16uF	350V	Electro
C10	100uF	275V	Electro
C11	100uF	275V	Electro

Valves:

V1a/b	ECL86
V2a/b	ECL86

Silicon Rectifiers:

MR1/MR2	BY114
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(type 368 with bright orange case) which would be an excellent replacement retaining much of the character of the old polyesters with their soft if slightly grainy treble.

Paper-in-oil capacitors may be worth investigating, for example Sprague Vitamin Q available from Sonic Frontiers or the Danish Jensen types imported by Audio Note, but avoid the cheap epoxy impregnated type paper capacitors in the

catalogues, - they aren't really suitable for audio in my view. Polypropylene capacitors like Solens or Ansars may be used, but again avoid anything which isn't designed for audio unless you have tried it. Many capacitors on sale in the specialist tweaking catalogues today as audio grade components are actually bought from RS etc. and sound abysmal, as they are not intended for audio. Solens or Ansars are not

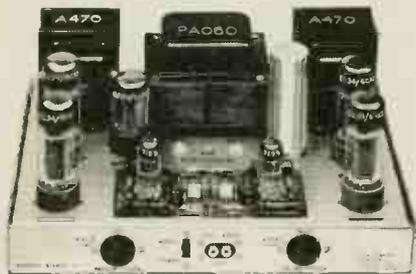
expensive and offer excellent sound quality, but will alter the sound of the amplifier, steering more towards today's valve sound.

Some of the resistors and potentiometers may also be suspect, producing noise, or they may have drifted away from their original values. I would recommend high quality carbon resistors for an authentic warm sound; metal films will always impart a bright, tinkly sound to the



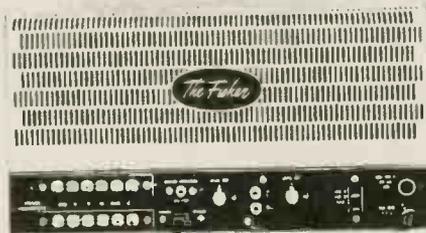
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220pF	400V	.50	10nF	63V	.75
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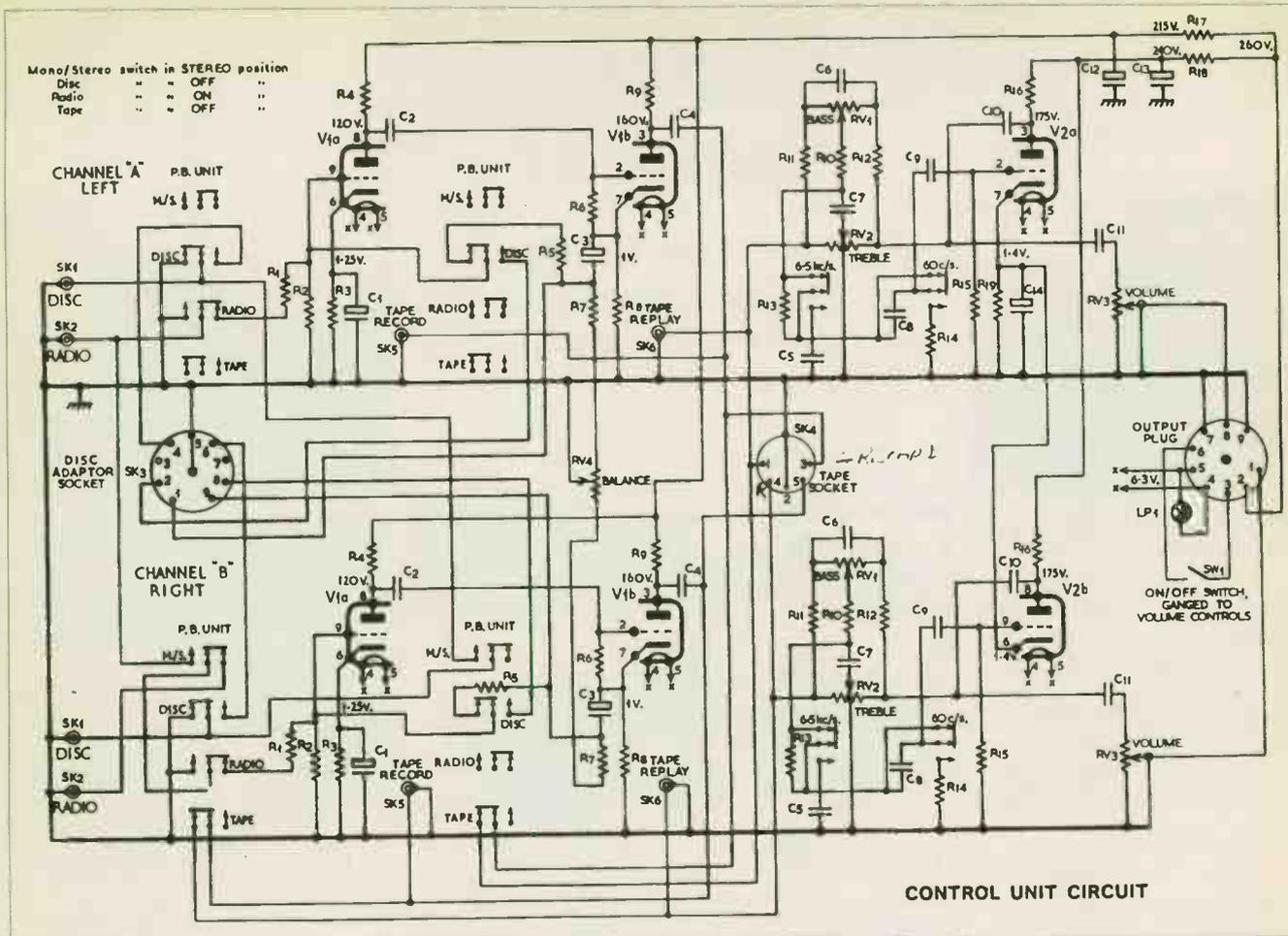
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Preamp

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R2	820k	1/8W	Hi Stab
R3	2.2k	1/8W	Hi Stab
R4	220k	1/3W	Hi Stab
R5	33k	1/8W	Hi Stab
R6	8.2M	1/4W	Carbon
R7	270R	1/8W	Hi Stab
R8	2.2k	1/3W	Hi Stab
R9	100k	1/4W	Carbon
R10	470k	1/4W	Carbon
R11	100k	1/4W	Carbon
R12	100k	1/4W	Carbon
R13	330k	1/4W	Carbon
R14	270k	1/4W	Carbon
R15	270k	1/4W	Carbon
R16	100k	1/4W	Carbon
R17	22k	1/4W	Carbon

Capacitors:

C1	40uF	16V	Electro
C2	22nF	400V	Polyest
C3	40uF	16V	Electro
C4	0.1uF	400V	Polyest
C5	400pF	400V	Polysty
C6	4.7nF	400V	Polyest
C7	100pF	400V	Polysty
C8	1.2nF	125V	Polysty
C9	1.5nF	125V	Polysty
C10	0.1uF	400V	Polyest
C11	47nF	160V	Polyest
C12	16uF	350V	Electro
C13	16uF	350V	Electro

Potentiometers:

RV1	Dual 1M	Lin
RV2	Dual 500k	Lin Centre Tapped
RV3	Dual 250k	LOG+Switch
RV4	Dual 1k	Lin

Valves:

V1a/b	ECC807
V2a/b	ECC807

Hi Stab= High Stability
 W.Wound= Wire Wound
 Electro= Electrolytic
 Polyest= Polyester
 Polysty= Polystyrene

treble common to many modern valve amps. Beyshlag or Philips MRS25 are OK, Holco and Shinkoh are somewhat better but still suffer from the metal film tinkle, and to restore using Vishay's incredible VSR series would cost several hundred pounds.

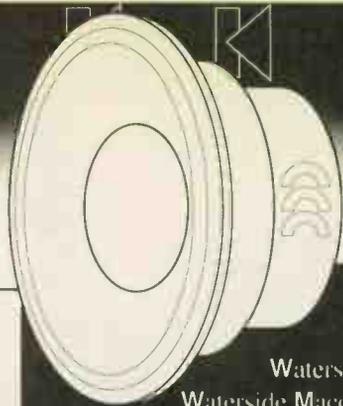
For replacing the potentiometers Alps are the best value for money but are only available in a limited range of values. To keep everything authentic use carbon film types, although RV2 with its centre tap will probably be impossible to find.

The two diodes used in the power supply should also be replaced, as I remember one died in mine. I recommend using the soft recovery avalanche diodes type BYV96E. Also, the two can capacitors in mine had spewed their guts into the amp, probably because of the diode's demise, so they needed replacing as well. Use a good make such as BHC or Nippon Chemicon for these, but don't let yourself be persuaded to put in giant sized multi thousand microfarad megacaps - they will slow the amplifier

right down and strain the mains transformer - small is beautiful.

The ECC807 valve used in the preamp is now unavailable anywhere; the most suitable replacement for it is the ECC83. The ECC83, however, has a completely different pin-out, so soldering iron work is necessary and where as the ECC83 has a μ of 100 the ECC807 has a μ of 150 meaning that returning the unit to original spec is impossible, but as I said the preamp is not the strong point of the Cadet. Have fun!

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Deluxe Kit £315pr

As above but includes cabinet kits machined from 25mm MDF fully rebated for ease of construction.

Tornado Standard Kit £275pr

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Deluxe Kit £385pr

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RPD 10 £615pr

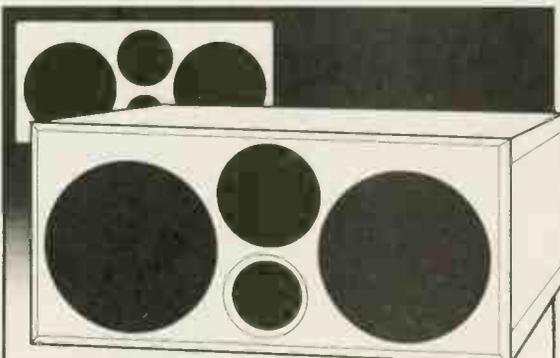
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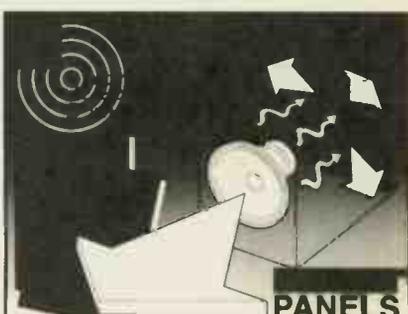
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THE MAPLIN CATALOGUE 1995

Reviewed by Dominic Baker.

If the rate at which the Maplin catalogue thickens each year is any indication of how the DIY electronics industry in the UK is growing, then everybody's doing well. Not only are there more pages in this bumper catalogue but it's now all-colour, the intention being to give Maplin customers a better idea of what they're getting, a great improvement.

Interestingly, most of its 864 pages are devoted to audio products, starting with headphones, followed by car hi-fi products.

Many people with good home systems want a similar quality of sound in their car. For this purpose there are active crossovers and power amplifiers capable of up to 140W and a host of accessories to help install them. As yet Maplin don't have a range of in-car drivers, but I suspect they will soon.

On to more serious hi-fi things, Maplin stock a range of hi-fi drive units. Included are soft-dome and titanium composite tweeters as well as fibreglass and Kevlar bass/mid drive units for under £30. This section could benefit from the insertion of

a simple crossover chart to, as Maplin do elsewhere. For example, the aereals section is preceded by useful table of all TV and FM radio stations across the country, complete with broadcasting frequency and transmitting power. Loudspeaker crossover components are another inexplicable omission; few people stock them in Britain, yet 'speaker construction is incredibly popular.

Regular readers will already know about Maplin's new valve amplifier kit, the Millennium 4-20. This 20watt valve design costs just £199.50. We reviewed in November; it is good value, but not recommended for amateurs. As with our designs, we don't encourage people to build this sort of kit without being thoroughly conversant with electronics and mechanical construction techniques first.

Maplin help here too, stocking a large range of books which, combined with practical experience makes building simple projects, quick and fun.

There are plenty of projects for beginners: simple radios, peak detectors, headphone amplifiers etc. New in the audio section of Books, is Killer Car Stereo on a Budget - which sounds intriguing. There's also Bullock on Boxes, one of the writers from American magazine Speaker Builder describing the in and outs of loudspeaker cabinet design, and the highly regarded Loudspeaker Design Cookbook by Vance Dickason.

An important area of electronic design and construction, too often skimmed over because of cost, is test equipment. This is especially applicable to audio, where it's not whether it works, but how well it works that counts. Maplin devote a large section to test equipment, where you can pick up just about everything: oscilloscopes, signal generators, level meters and multimeters, including ones that measure capacitance, inductance and frequency - especially useful for loudspeaker work.

There are still all the tools, cables - including silver interconnect and 'speaker cable and connectors, you could ask for. One area we have had correspondence over, is cases for projects. Sadly, I couldn't spot a single new case or control knob, which is a shame because as we know from readers' letters there is a demand.

The only new capacitors of interest to hi-fi enthusiasts are the miniature polypropylene film and foil caps, but Maplin still stock a good range of larger polypropylenes and high precision polystyrenes. The resistor's section carries a resistance band guide, for those of us who still aren't sure which colour relates to which value.

There are numerous other products, but I hope that what I have mentioned is enough to convince you that for £3.45 from Maplin stores and W.H. Smith, the new catalogue is value for any home constructor ●

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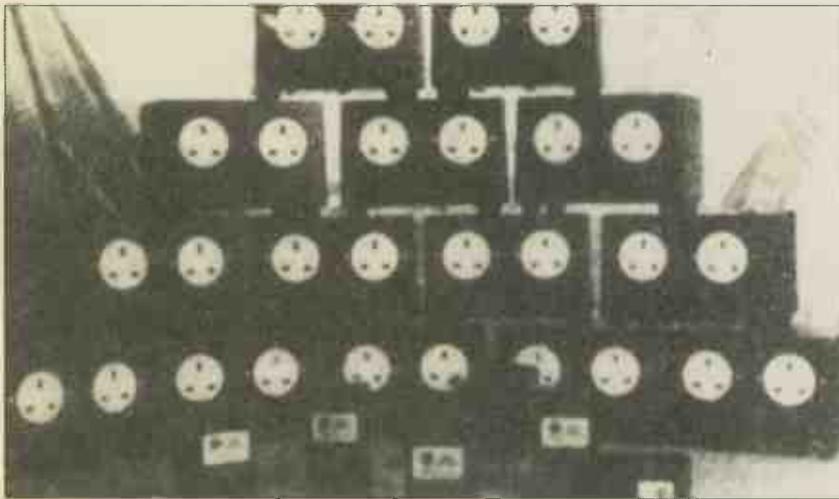
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VALVE RECTIFIERS

I was intrigued with the problems you had with the GZ34 remembering the figures quoted, but thinking they did not go together. A Mullard manual reveals that although the GZ34 has a maximum AC input of 550V, the maximum output at this level is 160mA with a capacitor input filter. Using a choke input filter, the maximum output current is 225mA. In each case, the maximum allowable input capacitor is 60 μ F and for the choke input filter 10H is the quoted inductance figure. All common rectifier data studied hinges around these figures - for instance the 5U4/U52, the U18/20, the GZ33/GZ37/U54 etc. There is a little variation, but in general 500V AC is the maximum input voltage and up to 250mA the maximum output current.

Directly heated rectifiers have a problem in that the output DC is up and running quite quickly after switch on, in the manner of silicon rectifiers. Obviously the modern GZ34 is the valve to pick for new designs; the others can only be used in one-off projects and home construction. They are common enough still, but not plentiful.

Another idea would be to run two GZ34s in parallel, a common enough practice in the larger amplifiers years ago. To gain the maximum output from one valve, choke input smoothing is another idea, but this reduces available output voltage - to 465V DC from 550V AC input in the case of the GZ34. There is one valve which beats the lot - the Telefunken EZ150. This has ratings of 600V AC in and 380mA out with capacitor input filter, and 600V AC in and 560mA DC out with a choke input filter. There is one huge snag though - it was expensive and hard to find, being an industrial type.

One more point about valve rectifiers - the output current ratings are dependant ►►

D.I.Y. Letters

WELCOME BACK!

I hadn't bought your magazine for over a year: is it me or is it you? It's a much better read than I remembered. sensible suggestions, DIY projects, articles, music lovers even! I feel I've sadly missed out, god help you now! I'm very prone to writing articles and very long letters to anyone who might read or even publish. I'm an inveterate fiddler who can't leave any self respecting product alone for more than five minutes.

My system comprises Systemdek 11x with a 16lb chassis, a 1inch thick platter, 2 Swiss precision motors with outboard power supply a very modified Linn Ittok and AT OC9 Stilton, mounted on a thrice isolated double-glazed platform. This is directly wired to an early Kinshaw Perception phono stage through a brand new, and as yet unmodified, Orelle pre-

amp. This is in turn connected to four monoblocks (of my own loins) powered by two 1000VA ceramic cored frame trannies with accompanying powerblocks. These drive two extremely power hungry IPL M3 transmission line speakers, that Ivan Leslie himself wouldn't recognise. Other equipment is Nakamichi ZX-9, and Arcam Alpha-plus. All cables are home produced and dazzle the opposition regardless of pedigree or cost.

The point of my letter (at last!) is that in this day of Mega-bucks and industry hype there are a growing number of people - enthusiasts - who tend to value the enjoyment of music and the sharing of this pleasure above and beyond the need to support profit margins. They produce competent and affordable equipment, and aren't too proud to offer advice and help to those who ask. The fact

that I have now discovered a very professional magazine that also falls into this category only reinforces my (previously flagging) faith in human nature. Full marks to you and all who sail in her: I am now a convert.

**Tony Sharman
Reading,
Berks.**

I agree whole heartedly with your last point. There are manufacturers around that do put more effort into producing high quality sound, and less effort into making vast profit. Unfortunately, this can be the death of some small companies, but Pink Triangle and DPA Digital have shown that by innovation with their discrete CD convertors, which lead the world, success can be found from engineering better sounding equipment.
DB

on another factor. Anode series resistance figures are usually quoted in data manuals for various operating conditions mentioned, for capacitor input filters. This resistance is usually provided by the transformer winding feeding the anodes, but where this is not enough, extra resistance must be provided between the valve anodes. Taking one example for the GZ34, the anode series resistance with 550V AC in and 160mA out should be 200 ohms. This resistance limits the peak current flowing through the rectifier when it is charging up the reservoir capacitor as well as supplying the load current. The resistance figure quoted assumes the maximum 60µF reservoir capacity. Many valve rectifiers specify lower values for this capacitor - this is important when servicing old hi-fi, reservoir capacitors should be kept at the original value or pretty close if rectifiers are not to suffer overload.

I hope you find this of interest. Home constructed hi-fi and the reintroduction of kits can only be a good thing. What we need now is a company making aluminium chassis blanks in various sizes, just as H.L. Smith on the Edgware Road supplied until a few years ago.

**Philip Taylor
Billinghurst,
W. Sussex.**

There seems to be some misunderstanding regarding the problems we had with the Russian GZ34 in our amplifier. The valves were running within the Mullard specified ratings with regard to both DC current, peak current and reverse voltage, and we were using two for one amp to increase capacity.

The problem lies in the fact that the current Russian or Chinese GZ34 is not capable of running at the same voltage as the original due to far less precise electrode spacing tolerances with rough surface and bad

adhesion of the cathode coating to the cathode tube. This caused severe cathode stripping with associated flashover and breakdown of the valve.

When designing a valve rectification system for a power supply the calculations become very complicated, which is why the manufacturers often published examples and charts to give an "at a glance" starting figure which allows a designer to decide on valve type, transformer rating etc, before ploughing into reams

of calculator smoking number crunching.

The ratings for minimum series resistance and maximum reservoir capacitor size are important in limiting the peak current through the rectifier, as it pumps charge into the reservoir every AC cycle. The GZ34 has a maximum of 750mA per anode peak and it is quite easy to reach this value when aiming for low ripple with large capacitors. The reservoir capacitor and series limiting resistors can be any value as long as the peak

current value is not exceeded, but accurately calculating the peak current is a complex and laborious procedure which is why it may be best for experimenters to use manufacturers charts.

Choke input filters give good regulation, but suffer from low output voltage when compared to capacitor input types. Regarding the EZ150 it sounds pretty hunky, but we are using one hell of a beast in our prototype twin single-ended 211 amplifier, capable of

Letter of

SYSTEM TROUBLES

I would be very grateful if you would be able to help me sort out a problem with my system.

Current equipment: Audiolab 8000A amplifier, Leak 2001 turntable, Rotel 965BX CD player, home built bi-wired transmission line speakers, Audioquest Quartz interconnects, QED 79 strand speaker cable.

Room: reasonably large rectangular lounge, normal soft furnishings. Music: mainstream rock to classical and opera, mostly from CDs.

I built the speakers myself from a Wilmslow Audio kit. This was based on a 1991 article by Richard MacDonald and I have enclosed a (rather poor) photocopy in case you are unfamiliar with the design. They are large, two-way, transmission lines with 8" Volt bass/mid-range units and 1" Elac metal-dome tweeters, crossing over at 3kHz.

I like a strong bass (and these speakers certainly deliver that!), but the midrange lacks detail - voices

often seem recessed - and the treble is not that convincing either. Part of the problem may well be positioning and I will try moving the speakers further away from the wall, but I suspect that the bass is simply overpowering the midrange and upper frequencies. I would like to get a more balanced sound without having to use the amplifier's tone controls, which to my mind ameliorate rather than cure the problem. What can I do? Is it a speaker problem, the cables or does the problem lie elsewhere?

Thinking about my speakers, I am an avid reader of your DIY articles (which are, in my opinion, Hi-Fi World's real differentiator in the market place) and I notice that almost all of your loudspeaker designs use long-haired wool to fill the void space and carpet felt to line the enclosure walls. I have already partially filled my lines with long haired wool, although I am not sure how

much of a difference it made. Is there anything else I could do to improve detail in the midrange and high-frequencies? For example: (1) Should I line the transmission line walls with felt? (2) How densely should I have filled the enclosures with wool? Should the entire line be filled? (3) Should I adjust the crossover design by reducing R1 (and if so, what would you recommend)? (4) Perhaps my speaker cables aren't good enough. Should I up-grade them and, if so, what would you suggest?

And finally, would my speakers be suitable for one of your valve amplifier kits (and is there anywhere I could demo the 300B design for example)?

Many thanks for your help and for producing a hi-fi magazine that I actually look forward to buying!

**Neil Rummens
Fulham,
London.**

500mA DC out at 2500V AC input! **AG**

The GZ34 was run within its current and voltage limits, and with necessary surge series resistors. In fact, all these variables were the subject of lengthy experiment. What we found in the end was that nothing, but nothing, would stop modern Russian and Chinese GZ34s flashing over after a few days operation close to the limit when, previously, there had been no trouble at all from months of test

running with original Mullard valves. This introduced a serious delay into the development of our 300B amplifier.

We've since been told a strange tale whose truth we cannot validate. A U.S. company is said to have ordered modern GZ34 equivalents, providing build plans for a valve having poorer tolerances and spacing than was used by Mullard. This has resulted in a pseudo-GZ34 reaching the West which looks like the real Macoy, but is in truth a

poor imposter. The original was a very carefully made, high technology valve that today's factories cannot match, it seems, perhaps for the reason above, or perhaps because their annealing and vacuum techniques are not good enough.

We now use a GZ37 instead. The wonder of it is that thousands still exist so it is gloriously cheap - and they are all top quality military spec originals. They work beautifully - just as Andy always promised me when I was throwing a GZ34 fit! **NK**

CHASSIS FOR KITS

I feel that one area of manufacturing in DIY has been overlooked. There are many companies to choose capacitors and the like from, but I have found it very difficult to find cases for my hi-fi.

Maplin Electronics are the best I have found to date in supplying off the shelf cases, but I can't help feeling there are better suppliers somewhere. I realise that the main manufacturers produce their own cases, but surely not all of them do. I

The Month

Transmission line loudspeakers can suffer from colouration in the midrange caused by reflections and resonances in the line. Make sure that the cabinet wall directly behind the Volt bass unit is thickly lined with carpet felt, perhaps even a double layer on the rear of the cabinet to prevent reflected waves coming back through the drive unit. The whole transmission line is best lined with carpet felt also and then stuffed with long haired wool. Typically, long haired wool is distributed along the line at a density of 7kg/m³, gradually decreasing so that the last 200mm or so of the line is empty. The wool will also need to be held in place by some means so that it doesn't all work its way downwards over time - use some garden netting or something similar to hold it in place.

These modifications will give you the bass that the original designer intended, and you may find that no

further alterations are unnecessary. However, if you still feel that the bass is too strong, and want more detail from the midrange, the following tweaks will do just that.

1. The bass level can be reduced by simply adding a series resistor to the bass crossover network. This will have the effect of raising impedance in the bass, which is already quite high on this loudspeaker, but try 2-4Ω resistors to see if it gives you the subject result you want.

2. If you are not already using high quality polypropylene capacitors, replace them with Solens. We find these give a clear, but smooth sound and will improve midrange detailing.

3. The midrange level can be increased by decreasing the 2mH inductor on the bass unit. I'd suggest you reduce it to 1.8mH to start with, which may sound like only a

small difference, but as the midrange level increases, it will also add output to the tweeter, and the subjective effect may be quite strong.

The tweeter level could be increased by reducing the 1.5Ω resistor, but I would advise against this. The impedance in the treble is already very low, reducing this resistor may place too demanding a load on your amplifier.

To answer your last question, our 300B amplifier could be used with your loudspeakers, but best results will probably be obtained with the feedback switched in. This will help to reduce the effect the varying impedance of your speakers would have on the amplifier. Demonstrations are available at Hi-Fi Confidential on Buckingham Palace road, close to Victoria Station. Give Luigi a call on: 071 233 0774.

Good luck with the tweaks. **DB**



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wondered if you would be able to research other suppliers as you have done with your component and kit suppliers listings.

One other point I would like to make is about the advertising of hi-fi shows. I have been to only one hi-fi show, the Bristol show, but if I had seen others advertised before they were over I would go to many more. I see magazines such as your own produce reviews on these events, but always after it has finished. Is there any particular place that these events are advertised or do we have to rely on the normal hi-fi magazines?

Mr. T.W. Long
Reading,
Berks.

As you have found, Maplin offer quite a reasonable range of project boxes and rack mount style enclosures. Many metalworkers will produce one-off chassis for customers to their own specification and design, but there are two problems. Firstly they cost: for example, a prototype of our 300B chassis, unfinished in bare metal, costs around £400. Secondly, metalworkers require a full set of engineering drawings, which

without a computer or some formal training in engineering drawing are very difficult to produce.

Your best bet is to get standard cases through component suppliers such as Maplin. Other good suppliers of such chassis are Electromail Tel: 0536 204555 and Farnell Electronic Components Tel: 0532 636311. They both offer a range of cases like Maplin, but each stock different styles and finishes, so you should be able to find something suitable from one of them. **DB**

FAULT FINDING

I read with interest your article in the July 1994 issue on valve availability and reliability (New Wine From Old Bottles). In particular, I was interested in your description of the premature failure of a GZ34 and your comment that "we, like others, have found that some of today's valves are hampered by reliability problems".

My own experience with a valve amplifier has not been completely happy. I built a power amplifier from a Velleman kit (no slight on your own kits; I bought it before you started producing them) and was initially delighted with the

results, but after a few weeks one of the output EL34s failed, taking with it the cathode resistors and the H.T. fuse. I checked for possible causes, found none and replaced the failed components. All was well for a few months until, shortly after moving to France, another valve failed with the same consequences.

After carrying out repairs, I replaced all the original (unbranded) valves

with Chelmer Valve Company devices and, nine months later, all is still fine with no further failures. The French magazine "Le Haute-Parleur", in a review of the Velleman amplifier (October 1993), mentions that the latest kits include a relay to delay switching on the H.T. supplies until the valves have warmed up and hence improve valve life. To some degree, a slow turn on of H.T. voltage is inherent in amplifiers using a valve rectifier, but as your own experiences have shown, they can have their own problems.

What conclusions do I draw from my experience? Was I unlucky with the two valves that failed, or am I now fortunate in finding a valve supplier that supplies a reliable product? Should I modify my amplifier to delay the H.T. switch on? In isolation I have no means of knowing the answer, but your article at least indicates that modern valves need to be treated with a degree of suspicion. We are all concerned that our new purchases should be reliable and give long, trouble free service and, those of us old enough to remember the changeover from valves to semiconductors in domestic equipment can confirm that one of the claimed benefits was improved reliability of the transistorized equipment.

In case this sounds too gloomy, I should add that the sound of my valve amplifier, playing through a pair of Magneplanar loudspeakers, is superb. The kit (and I suspect this applies to all valve amplifier kits) should only be tackled by people who have a fair idea of what they are doing, and they should be capable of handling the problems I experienced.

John Walker
France.

If you are sure you could find no fault in the amplifier circuitry, e.g. faulty wiring or cathode bypass capacitors, leaky coupling capacitors etc. then the problem was more than likely the EL34s. I have

experienced problems with original Mullard EL34s in amplifiers of various types, with symptoms very similar to what you describe. I found that the EL34s had actually gone short circuit inside and I have never been able to figure out why this happens. On visual inspection the valve looks fine with no crossed wires inside, but a quick check with an Ohmmeter shows a short, and of course the amplifier croaks.

Peter Watson of P.M. components threw some light on the subject. There are two problems with the structure of the EL34. Firstly, the valve has a very high dissipation for its size, which means there is very intense heat inside and, of course, the electrodes are close together because of the small size, so they may come into contact through expansion.

Also the EL34 has a special base which eliminates the "glass pinch" common to most other valves. Mullard made a big thing about this at the time because it allowed an anode voltage of 800V. This means that over the course of time, or if the valve is knocked when hot and the elements move slightly, a short is possible.

This problem has been worked on since the original launch of the EL34, due to complaints from manufacturers of high powered guitar amplifiers. P.M. Components latest incarnation of the EL34 will have a glass pinch similar to the 6L6 which will hopefully eliminate this problem. **AG**

The amplifier should be fused tightly enough to prevent burn out, which requires heavy current to be drawn. We measure mains current draw and use a slow blow fuse to withstand switch on surge, finding this can cope with internal failure, as long as the fuse rating is close to the running current, e.g. a 1A fuse for a 0.8A current draw. **NK**



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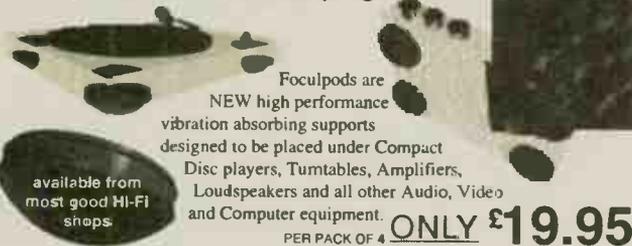
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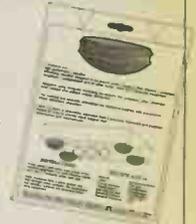
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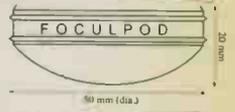


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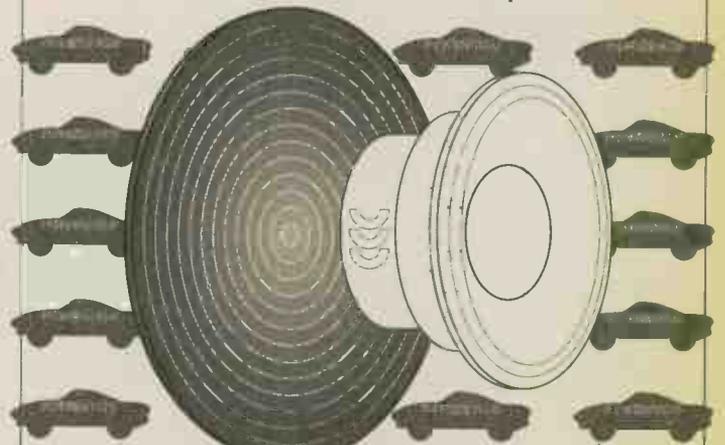


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