KNOW YOUR POWER VALVES - SIX FEATURED

DESIGN YOUR OWN LOUDSPEAKER - TWO CAD PACKAGES REVIEWED

FREE D.I.Y. SUPPLEMENT No. 7
Audio valves with famous Brand Names of yesteryear such as MULLARD, MOV, GEC, RCA etc., are in very limited supply and their scarcity also makes them very expensive.

We at Chelmer Valve Company however provide high quality alternatives to these old makes. We have over 30 years experience in the supply of electronic valves of all types and during this time have established close ties with factories and sources worldwide.

For high fidelity use we further process valves from these sources using our specially developed facilities. After rigorous testing - including noise, hum, microphony, post burn-in selection and matching as needed - we offer this product as CVC PREMIUM valves.

A selection of the more popular types is listed here.

### Price list & Order Form for CVC PREMIUM Audio Valves

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<th>Valves</th>
<th>Unit Price</th>
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<td>4PIN (FOR211)</td>
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### MATCHING CHARGES *

Make CHEQUES payable to: 'CHELMER VALVE COMPANY or pay by ACCESS/MASTERCARD/VISA, give details:

* MATCHING, if required; state valve types & if PAIRS, QUADS or OCTETS - Allow £1.00 per valve for this service.

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**NEWS**
What's new and what's on its way for the DIYer

---

**IPL S3 TRANSMISSION LINE LOUDSPEAKER**
We build a floorstanding loudspeaker kit from IPL acoustics. This £290 Transmission Line loaded loudspeaker offers excellent bass and dynamics.

---

**RIAA PHONO HEAD AMPLIFIER**
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---

**KNOW YOUR POWER VALVES**
We find six rare and special power valves for you to drool over.

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**LOUDSPEAKER CAD PACKAGE**
Two very affordable loudspeaker design packages tested. Boxcalc offers fuss free box design and Netch can make crossover networks fun.

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**KIT SUPPLIERS**
Want to know where to get those bits for your DIY project? Our list of the best suppliers shows you the way.

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VINTAGE VALVE

FISHER SA-100

This very attractive stereo amp provides 17 1/2 watts per channel, a centre channel output for connection to a new amp, input level adjustments, easy to use bias adjustments, as well as AC and DC adjustments. This is all under a lovely brass cage on a solid copper chassis. With an efficient speaker this is a marvelous amplifier.

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CANADA V6C 2M3

World Radio History
HOT ON THE HEELS OF HD-A
Following the development of their High Definition Aerogel drive units, soon to be used by Mission Cyrus in their forthcoming 752 loudspeaker, Audax have announced an even newer material, HD-I. High Definition Inertial is currently only available as a 15inch, 4Ω, 101dB sensitive (i) drive unit intended for car subwoofer operation, but expect to see a range of hi-fi drive units in the near future.

HD-I uses a three dimensional array of long carbon fibres coupled with a polymer laminate to give an ultra-light, ultra-stiff cone material. HD-I is around half the weight of a similarly sized paper unit.

£60/m. The screened silver interconnect uses 5/0.28mm strands and is available for £1.16/m. Maplin now also offer silver solder, a 50cm length costs £3.95.

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

GT UPGRADE KITS
GT Audio now offer a wide range of audiophile upgrade kits for vintage amplifiers and tuners. The kits are available for all Leak amplifiers and tuners, Quad amplifiers and tuners, Radford amplifiers, PYE PF91, HF12 Mozarts, PYE tuners, RCA and many more. Typical prices for the upgrade kits are £160 for a Leak TL12+ kit and £120 for a Quad II kit (not including power supply capacitors). The kits include all components necessary to bring your vintage delight back to glory, including high quality polypropylene capacitors and Military Spec Resistors.

GT Audio, 5 Upper Road, Higher Denham, Bucks, UB9 5EJ.
Tel: 0895 833099

DIY ON THE UP
The 1994 Mintel Marketing Intelligence report on British Lifestyles shows encouraging news for both hi-fi and the DIY-er. More people than ever are confident about taking on DIY tasks themselves and, combined with the news that "When it comes to leisure, home based activities will continue to predominate, boosting the sales of brown goods such as televisions, hi-fi equipment and recorded music" it looks as if DIY hi-fi is likely to grow in popularity.

Mintel also predicts "a healthy growth in book, magazine, newspaper and stationary sales" which gives us heart as well.

So what are you waiting for - now's the time to go out and get those kit loudspeakers you've been thinking about, or that valve amplifier. You know we'll be hard at it, producing more DIY Supplements to feed your growing interests.

Mintel, '94 Lifestyles £895.
Sales Tel: 071 606 6000

PADDED MAGNETS
Following the success of their Deflex loudspeaker cabinet damping pads, Spectra Dynamics have added three new pads, designed to be fixed to the back of the magnets of drive units. By covering the hard reflective surface of a drive unit's magnet with the new 3, 5 or 7inch Deflex pads, the performance of a loudspeaker is said to be greatly improved.

The Speaker Co., Unit 9, Waterside Mill, Waterside, Macclesfield, Cheshire, SK11 7HG.
Tel: 0625 500507

STRIKING SILVER
Another new addition to Maplin's range are two pure silver cables. The pure silver loudspeaker cable is made up of 7/0.28mm twisted strands and sells for £60/m. The screened silver interconnect uses 5/0.28mm strands and is available for £1.16/m. Maplin now also offer silver solder, a 50cm length costs £3.95.

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Essex,
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Tel: 0702 554161
Reference Grade Crystal locked Digital to Analogue Converter

Audio Synthesis
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Telephone 061 434 0126 Fax 0602 258431
Building the S3s turned out to be a lot easier than I initially thought. Although none of the panels were rebated, which helps their location, I found construction straightforward.

First of all, as with any loudspeaker kit, I would suggest that you attempt a dry run, since this gives you an idea of how the cabinet goes together and what problems are likely to occur when gluing. For example, I realised during my dry run that if I didn’t hammer in the threads for the drive unit bolts first, then it would be nigh on impossible to do so after the glue had been applied.

The trick to gluing up a cabinet like this is to use just enough glue. If you do, not only does the glue pour out of the joints and fix the cabinet to the newspaper beneath, but the panels slide around, making it extremely difficult to hold them square. A thin smear should be used and the panels worked into place by sliding them slowly against each other. This builds up stiction and the panels stay firmly in place even without clamps. IPL recommend using a hot melt glue gun and small, square, wood blocks to hold each panel in place, but in practice I found these unnecessary.

The cabinet is built up on one side panel so that the crossover and internal damping can be located before the cabinet is closed. It is very important to solder up the crossover correctly first time, because once the other side panel is glued in place it is virtually impossible to correct it. However, the instructions

Continued on page 9...
SPEAKER KITS FROM IPL ACOUSTICS

Over a 5 year period I.P.L. Acoustics have developed a range of high quality speaker kits, using the best units from SEAS, MOREL, AUDAX, VISATON and I.P.L and have produced a comprehensive range of speakers which will compete with the most expensive of commercial designs. All speakers have BIWRED crossover kits containing high quality components and terminals.

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M3TL
A2 RIBBON KIT
M2 MINI-MONITOR

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PLUS KITS...£167.00
PLUS KIT....£222.00
TOTAL KIT...£226.00
TOTAL KIT...£291.00
PRE-VEENEERED CABINET NOW AVAILABLE. Carriage charge extra on all kits.

If you would like further details please send £1.50 for 36 PAGE SPEAKER BUILDING CATALOGUE, comprising VALUABLE ADVICE on DESIGNING, BUILDING and TESTING speakers and full technical specifications including response curves of eight kits, drive units, and details of SPECIALIST CABLES and ACCESSORIES.

I.P.L. Acoustics, 2 Laverton Road, Westbury, Wiltshire, BA13 3RS. Tel: 0373 823333

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VINTAGE VALVE

DYNACO STEREO-70

This is one of the most famous American tube amps ever made. Rated at 35 watts per channel, it uses 4-E134’s, 1-GZ34 and two 7199’s. This very reliable amp is great for those who wish to modify parts or use it just as it is. Bias is easy to adjust, and the unit can switch between mono and stereo. The output tubes can operate at 65% of their capacity, and the filter caps at less than 85% of their rated voltage. A true classic.

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TRANSMISSION LINE LOUDSPEAKER

MEASURED PERFORMANCE

IPL's S3s are a transmission line loudspeaker venting low bass from a mouth at the bottom of the cabinet. This makes measurement difficult, since to get output from this port to integrate with the midband and treble you need to be well back from the front of the cabinet, but here you tend to suffer room reflections badly.

The response was taken far enough back to get the effect of low bass, albeit not integrated as well as it would be in the listening position, but not too far back that unwanted reflections appear. Through the midband and treble the IPLs are very smooth, the small lift in the upper midband should help to push vocals out of the box and, apart from this, the response is flat right up to the 16kHz band.

The S3s are quite sensitive too, producing an above-average 87.5dB for a nominal watt measured at 1m. This means that they will go loud with relatively little power, suggesting that amplifiers in the region of 20-40 watts should be ideal. Their high overall impedance of 1112 ohm confirms this, showing that the S3s will not demand much current to drive them either. Neither are they reactive, since from 200kHz upwards their impedance characteristic is almost flat, suggesting that good results could be obtained from feedbackless amplifiers which are affected by the load they drive.

The IPL S3s are well engineered to give a flat, well extended frequency response and provide an easy load for almost any amplifier. This, along with their price, makes them appealing to a wide audience (DIY skills excepted) - and they sound pretty good too.

SOUND QUALITY

IPL’s S3s are a lively loudspeaker, they resolve a wealth of detail and play it with energy and enthusiasm. They are involving - when I was writing this article I had them playing in the background and constantly found myself turning around to listen to what they were doing - a zing from a metal guitar string or vocals sounding more open and transparent than I remembered, catching my attention. They aren’t intense, but they do involve.

Grant Lee Buffalo once again sounded superb. This is a fine recording, real atmosphere and good acoustics to be found on most tracks. The sharply focused guitars, underlying kick drum and slightly coarse vocals of Grant Lee Phillips all combined perfectly to give an engaging and musical presentation.

The S3s had a good amount of slam too, with The Blue Aeroplanes 'Broken and Mended'. They filled the room with powerful drumming, squealing electric guitars, and the half spoken, half sung vocals of Gerard Langley.

Ultimately, these speakers don’t have the holographic projection of the better quality British loudspeakers, or the precise imaging, but those qualities tend to cost three or four times the asking price of the S3s. If you can do a little neat soldering, and some simple woodworking, you’d be daft not to consider the S3s. They’re fun to build, are well designed and sound superb.

IPL Acoustics, 2 Laverton Road, Westbury, Wilts BA13 3RS.
Tel: 0373 823333

Frequency Response

Impedance

include a circuit diagram, schematic and a photograph to ensure that disasters don’t happen.

Once all of the internal guides for the transmission line and the cabinet baffles have been glued into place the crossover needs to be mounted. I fed the wires from the crossover to the drive units through the internal damping pads and then out through the cut-outs in the front baffle.

Finally, if you’re sure that everything is installed correctly, the other baffle can be glued into place. A heavy weight should be used to hold this firmly in place and the cabinet left to dry.

Meanwhile, the stand can be glued together. This came undrilled, as did the grilles, presumably because not everyone will want to fit spikes to the stand or grilles to the speakers. The stands should be filled with sand once they are glued up and thick carpet tape used to seal the hole to prevent it escaping.

The rest of the construction was all quite straightforward. The front and rear of the cabinets can be lightly sprayed black and the sides and top, which are pre-veneered, polished to a high shine. Thin strips of adhesive veneer are supplied to cover the bare MDF ends that show on the top. The result is a very professional looking loudspeaker. Now let’s hear what it sounds like.
Audio Note Amplifiers to the discerning do-it-yourselfer, paper in oil signal capacitors, copper constructing new valve amplifiers. Many other useful bits after the addition of postage and parking costs.

Credit card transactions of £20.00 please note that there is a minimum charge on the best pre-amplifier circuit we have come across. We generally overspecify our transformers by 100%, which means that they will instantaneously allow peaks of double the given maximum power through undistorted.

We can also supply a set of data sheets for the most commonly used valves, EICO 5U4G, GZ34/5AR4. EL84/6805, 6V6GT, 6917, 300B, 211VT4C. 845 EL34/6CA7. 263, 6922, 12AY7/6072A 1025/12AX7/ECC83, 604. 5U4G, GZ34/5AR4, EL84/6805, 6V6GT. We generally overspecify our transformers by 100%, which means that they will instantaneously allow peaks of double the given maximum power through undistorted.

We do not give any further technical information on our output transformers, as we do not wish to take part in technical competitions, our products are designed to deliver performance which are far beyond those which can be understood once they are listened to.

In addition to the output transformers offered below, we defer a design service, when we can supply almost any requirement for wideband high quality Audio Note paper in oil capacitors, moving coil transformers, line inputs, radio, phono amplifier, interstage, drivers, power or output power, we design and manufacture products in house, the cost for the paper design in £220.00, prototype cost is calculated on a per case basis. We can also produce production quantities.

Sizes are given as Width/Height/Depth, where depth is the depth of the coil and not the depth of the core.

If you would like suggestions to base a future project around, then we shall be happy to extracts from old books which give some...
We offer three quality levels of resistor quality, all 1% tolerancing with the发烧友 resistors, which are simply magnetic cores (to the vast majority of other metal film resistors), but nonetheless very good sounding, as used in our uptown matted amplifiers, up to quality level 3 (the MESHEX32) for high-end audio applications.

We can also supply a range of more modestly priced components, still good quality, but more industrial grade, if you like. 220mF 100volt BG-N Type Lastly, we can supply a range of more modestly prices components, still good quality, but more industrial grade, if you like.

34x42 220mF 100mF
34x81 47mF 47mF
35x107 22mF 10mF
35x224 10.000mF 100mF
35x257 566011 100volt N- Series
35x321 and is called Improving your CD-Player and can be obtained by sending a stamped addressed envelope to e requesting this leaflet.

Actually, da Exchanging any electrolytic capacitor anywhere in the circuit of an amplifier or in ho crossover of a speaker will greatly improve sound quality. We consider this to be a major breakthrough, since most amplifier manufacturers have been using the same range of electrolytic capacitors for a very long time.

This is definitely the best sounding resistor stock we have ever had. Up to now the tantalum film resistors have been for the best results. With these new resistors we have had a major breakthrough, since with a resistance ratio of values of 1/2 watt and reintroduce the 1 watt range, I consider this to be a major breakthrough, since no- frills power supplies and components.

...with 7566 current giving 9/10 watts out. This is definitely the best sounding resistor stock we have ever had. Up to now the tantalum film resistors have been for the best results. With these new resistors we have had a major breakthrough, since with a resistance ratio of values of 1/2 watt and reintroduce the 1 watt range, I consider this to be a major breakthrough, since no- frills power supplies and components.
Andy Grove - our in-house designer - builds a phono head amplifier for the enthusiast, while Robert Wilson listens.

The first, introductory part of this project, published in Supplement No6 accompanying the December issue, was structured around a basic prototype phono stage. In this second part we decided that the final design deserved to be a little more complex, since the increase in price was likely to be acceptable to most readers. As a result two Integrated Circuits (silicon chips) are used in this final version to give better network isolation and improved interfacing.

To make the project more suitable to experimenters, we also decided to use chip sockets, which are frowned upon, rather than surface mount devices. However, having chosen the most suitable IC for your own purpose - MM or MC - it is advisable, ultimately, to use a surface mount package for best sound quality.

The original purpose of this project was to provide a very low noise preamp for moving coil cartridges, since most MC stages hiss audibly. However, by using sockets, an IC suitable for MM cartridges can be plugged in as an alternative. This broadens the project's appeal and gives a lot of scope for experimentation.

CIRCUIT DESCRIPTION

The phono stage uses two Op-Amps as gain blocks, with a passive R.I.A.A. equalization network placed between them. This configuration isolates the sensitive network from the outside world, avoiding any interference.

IC1 is configured to have a gain of 561; IC2 has a gain of 23, but there is a loss of about -20dB (the signal is reduced by ten times) through the equalization network, so the overall gain is approximately 1300.

R1 is the cartridge loading resistor, here it is set at 100Ω, but some moving
coil cartridges prefer lower impedances, sometimes as low as 3Ω, check your data sheet and experiment for best results.

The circuit shown is for moving coil (M.C.) cartridges. If you have a moving magnet (M.M.) cartridge, reduce the gain of IC1 by changing R3 to 5.6k. You will also need to change the loading resistor to 47k and put a capacitor of around 100pF across the input. Again, a little experimentation will allow you to optimize the circuit for your cartridge.

C1 gives a lot of D.C. feedback to eliminate any D.C. offset at the output of IC1, which would be amplified by IC2, possibly causing it to latch up. C1 also determines the low frequency rolloff. A larger value of up to around 470µF will extend the bass, but it will also allow turntable rumble and record warps through in all their glory, causing severe cone flap with reflex loudspeakers. Reducing the capacitor to 100µF or even 47µF will eliminate warps and give a lighter, faster bass quality. Try different values and assess the trade-off of bass depth against cone flap, bearing in mind that cone flap won’t be a problem with sealed-box (infinite baffle) loudspeakers, nor will it occur with power amps that roll off at low frequencies.

C1 needs to be a high quality component because it is in IC1’s feedback loop. Even super-quality electrolytics like Black Gates only cost a few pounds for a small component such as this, so it is worth the extra expense if you have a decent cartridge.

Next is the equalization network itself. The components used here must all be high precision components or the accuracy of the R.I.A.A. curve will be compromised. The values given here have been carefully calculated and if high precision resistors and capacitors are used (1% or better) the R.I.A.A. equalization should be accurate to within +/-0.1 dB! You will notice that there are resistors and capacitors paralleled up all over the place in the network. This is to get specific, non standard values by using more or less standard components.

IC2 is simply an output buffer with a gain of 23. There is a 220Ω resistor on its output (R9). This helps the op-amp remain stable when driving capacitive loads, such as cables. C9 stops any D.C. from reaching your power amplifier, even under a fault condition. R10 ensures that the output is always held at 0V D.C.
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We checked several op-amp types for their sound quality and noise. For M.C. the best combination was IC 1 as AD797 and IC 2 as AD743. This combination gave a very crisp and detailed sound, and low noise, but these ICs are quite expensive. Also, the AD 797 would not be suitable as a front end for M.M., as I shall explain.

Although these chips are relatively expensive, you can literally plug in any good op-amp which has a 741 type pinout. I tried TL071 and 55M2131, but neither had the focus of the AD797/AD743 combination. Others to try are OP37, NE55340 and OPA604, although with these ICs you may suffer from noise on M.C.

The power supply is very straightforward. There is a centre tapped transformer and a full wave bridge rectifier to give a raw supply of +/- 20V, with a 0V earth rail. This is fed to two regulator ICs to supply the chips with a stabilised +/-15V supply.

There is plenty of decoupling around the ICs themselves to eliminate any parasitic instability. It comprises a 33µF electrolytic and a 0.1µF polyester capacitor soldered very close to the IC itself.

### Voltage Noise or Current Noise?

I stated earlier that the AD797 would not be suitable for M.M. use. Why? Because it would be too noisy. This may seem strange because I have recommended it for M.C. which is even more sensitive to noise. The reason for this is that the AD797 is a bipolar input type, designed for use with low impedance signal sources around the 100Ω mark. It has a very low voltage noise of 0.9nV/√Hz, but a current noise of 2pA/√Hz. At low impedances the voltage noise will predominate. Moving coil cartridges are very low impedance devices, having a source impedance of just a few ohms, and a load impedance of up to 100Ω (Ω = ohms).

As impedance rises the current noise of a device will start to dominate. Moving magnet cartridges require a load impedance of 47k - around 500 times greater than that required for M.C. Here, we need an op-amp with low current noise and the AD743 fits the bill nicely, possessing a current noise of 6.9nA/√Hz, which is about 500 times lower than the AD797. It has a rather poorer voltage noise of 3.2nV/√Hz which is 3 times higher. This is because the AD743 is a FET input op-amp, designed to work with high impedance circuits.

### Measured Performance

The bandwidth of this stage has been set to roll off just above 20kHz, such that droop at 20kHz is no more than -0.5dB maximum. In practice it is a little less than this, putting the -1dB point out at 37kHz. The idea is to make sure as little unwanted information as possible above 20kHz gets through to subsequent stages, to remove any likelihood of transient distortions. Ticks and pops typically produce the sort of high level supersonic information that may cause problems, especially from the peak-up treble response of many moving coil cartridges.

Down at the other end of the spectrum lies another consideration. Extend gain downward to 5Hz or so, and many Japanese designers do, and there’s no doubt that really deep bass will often be audible. However, warp signals, which can be very large, will also be amplified, causing cone flap in reflex loudspeakers, in particular. Also, drop the arm onto a record clumsily downward to 5Hz or so, as many Japanese loudspeakers, when a low output moving coil cartridge is used.

A circuit board and kit of parts will be available shortly - ring 071-266 0416 for further details.

### Sound Quality

While I was listening to the Cyrus amp our engineer, Andy Groves, came in to the listening room and asked for my opinion of his phono stage. The front-end used was the resident Garrard 401/SME 312, but in this case fitted with a Goldring Elite moving coil cartridge. The first album on the player was the B-52’s original L.P. It came over as incredibly fresh sounding. The phonostage has a very incisive quality that helps to cut through a lot of the grunge inherent in vinyl replay, the top end is especially sharp and crystal clear which leads to a very coherent overall picture with a large, solid and well defined soundstage. Bass reproduction was vivid, the lack of euphonic colouration and reduction of obvious vinyl overhang leads to a vibrant, tight and highly enjoyable sound, full of life and dynamics. Robert Wilson
“It is a rare experience to play a track that you have known for the better part of, say, twenty years and suddenly, to hear new details and information.”

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It's much more ecstatic and solvency than train spotting and they've got the disease worse in Japan, Hong Kong and Singapore - not to mention the USA where valves of the sort pictured here are pursued with great dedication, as well as fat wallets.

For example take the Peps 4212 pictured here. Obsolete, rare, extremely expensive and potentially dangerous, it hasn't yet appeared in any Hi-fi magazine. So who buys them and why? Simple. Billington's and Collmoure UK valve warehouses have both told us that they despise into Japan where many the homes of the rich (disreputably rich) and not at all.

Big News in the valve world typically comprises a crate of 21 valves discovered in a French Scrapyard for, in some versions of this story, a Greek vineyard left over from World War 2, complete with Stars and Stripes on the crate and US Army Signal Corps imprinted on the sides. More probable is the old boy who pops his clogs, leaving behind a hoard of valves in the potting shed. A horrible twist to this one is the widow who decides they are worthless and smashes the lot to get rid of them.

So this is a universal human disease, one suffered more acutely in countries.
KNOW YOUR POWER VALVES

other than the UK. Not yet recognised by the WHO. I must add, to date, there's no known cure other than the in-built one of an electric shock bigger than any administered at Alcatraz. Real enthusiasts claim to be able to survive and enjoy even this, however, which must cause concern to The Great Reaper.

You will find valves in the bedrooms, bathrooms, cars and backpack pockets of enthusiasts, let alone in the 3.5 watt PX4 amp gracing the front room.

The lure of the thermionic device has traditionally been a male preoccupation, much like choo-choos, but even this is beginning to change. Flying back from a Christmas break in Tenneriffe, a colleague struck up a conversation with a woman sitting beside him. They found they had a love of music and hi-fi in common. Then she whispered conspiratorially "but really I'm into valves". For the rest of the flight the subject didn't change. This is a true tale - Hi-fi World has her number. So the problem is spreading and will get listed soon as communicable and dangerous by the WHO.

I hope this visual review will fire your imagination. It's a look at an almost illicit trade, one that few people want to really talk about too much, because then the prices go up and availability becomes even more of a problem. There's much talk about re-starting valve manufacture to satisfy demand, but capital costs are frightening. The reality is that factories in the West, like MFD in Kentucky, are closing down. Only the Germans and the Russians currently manufacture valves and Soviets, in particular, are highly regarded. So the chase goes uncured. Remember this if you are tempted into sampling the forbidden fruit of discrete valve triodes, for example. In the end they'll come and take you away - either in a straight jacket, or a straight shaft.

ACT

by Andy Grove, self-confessed single-endophile,

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Type 4212 Triode, STC U.K.
What a monster! Look at the comparatively tiny 211/VT4C next to it in the main picture. This beast can run at a hair raising 3000V and output 70 watts or more of single-ended power, or if you are into earthquake simulation (or VERY insensitive speakers!) a push-pull pair will deliver 1.4 kW! With its maximum anode dissipation of 275 watts and a filament which burns up nigh on 90 watts just to fire it up, the 4212 will keep you AND your neighbours warm during those cold winter evenings!

Type 211/VT4C Triode, G.E. U.S.A.
This is one of my favourite power valves. With a recommended maximum anode dissipation of 75 watts at a not so much hair raising but definately spine tingling 1250V, this is still a serious valve, capable of 20 to 27 watts single-ended or up to 250 watts push-pull. The VT4C is the US military version of the commercial 211. Used in the AudioNote Ongaku and other Oriental dream machines the 211 gives one of the most open and dynamic sounds I know. When using the 211 I prefer to run at slightly lower than maximum voltage to get a sweeter sound, 1150V seems about optimum. With its brightly glowing filament lighting up your room and sublime sounds caressing your ears you know you’ve reached Nirvana.

Type DA100 Triode, G.E.C. U.K.
True British muscle, this is the Aston Martin of audio valves. Shown here is the stiff upper lip military selected version CV1219. As the type number suggests, this is a 100 watt dissipation valve, and its maximum rated voltage is 1000V, slightly lower than the previous Volt-hungry valves. With 35 watts of single-ended power and up to 300 watts in Class AB2 push-pull, the DA100 is a juicy valve, but being a low impedance type it needs a large driving voltage to make it sing.
Similar in many ways to the American 845, another 100 watt, but with a walnut interior the DA100 is a very rare valve and even used examples fetch high prices on the underground market.

Type D060 Triode, Mullard U.K.
There are two types shown in the main picture, the gorgeous bulb shape of the earlier and more valuable D060, and the restrained military numbered CV1206. Both have the odd square base like the DA100, and in fact the Mullard D060 and the G.E.C. DA60 are interchangeable. This is a 60 watt dissipation valve with a much more down to earth 500V maximum anode voltage. A respectable 10 to 11 watts of single-ended power should be available, running the valve somewhat below its maximum ratings.

Type 300B triode, W.E. U.S.A.
This example is not an original. It is most likely Chinese in origin, as original Western Electric valves have legendary status in Japan and therefore prices soar and availability is limited.
300B is a 40 watt dissipation valve which can be used at (comparatively) low voltages in the order of 350 to 450 volts, and in fact Western Electric developed the 300B to work at these lower voltages for use in horn loaded cinema sound systems. Single-ended, anything between 8 and 15 watts can be extracted, depending on how much you want to cane the valve. I would say that for best sound quality about 375 to 450 volts across the valve, running the anodes at around 36-38 watts dissipation is optimum giving around 9 to 10 watts output. 300B is renowned for its warm, textured and smooth sound and, if driven properly, excellent bass and dynamics.
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Dominic Baker takes a look at two computer packages that, between them, can completely design a loudspeaker.

My experiments with a large number of loudspeaker design packages show they are all much the same. The majority are bass-alignment packages: that is, they suggest the dimensions of an infinite baffle or reflex enclosure for a particular bass driver. They all rely upon the same set of Thiele-Small parameters and the same mathematical equations to predict enclosure dimensions. So, they all come up with the same answer, whatever they cost.

The more complex and expensive packages allow you to design isobank enclosures, can calculate missing Thiele-Small parameters for you from the ones you do have and some can even suggest a simple crossover. But for the majority of DIYers, all that is needed is a basic package that gives a good starting point from which to experiment.

Boxcalc does just that. It is simple to use and easy to understand. It is a no-frills design package that is as accurate as any other. It needs just a few simple parameters to work. Vas, Qts, R, etc which most manufacturers supply on data sheets with their drive units.

This package is a little unsophisticated: it doesn’t support a mouse and the instructions are

Boxcalc’s display is plain, but adequate. Plots of impedance, power, max SPL etc. can also be shown.

Continued on page 25
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CAD PACKAGE

Continued from page 25

basically one side of A4, but that's all you need. It is easy to use and the graphics are clear and intelligible. I picked out a few drive units and optimised the cabinets for them. Using the data from Boxcalc I used LEAP and MacSpeakerz to check the results - and as you'd expect they were identical.

This is one of the cheapest packages on the market, it is simple to use and gives the enthusiast DIYer all he or she might need to get started on a box design. And it comes with a good library of drive unit parameters already programmed in, so the chances are you will find the data for the drive unit you want to use already entered.

**NETCALC**

This is Boxcalc's sister package. As the name suggests, it's a network or crossover designer. In fact, I feel that this, if it works well, is much more use to the hobbyist than a box designer. There are a number of good, and easy to understand, books around that show how to calculate a basic box from simple Thiele-Small parameters. However, to get a crossover to work well, and integrate two drive units smoothly, expensive loudspeaker measuring equipment is a must. If this package can successfully replace such equipment, then it will open up DIY loudspeaker design to a much wider audience.

To assess Netcalc, I decided to input the parameters of a drive unit, optimise a crossover for it and then check the results with our measuring equipment. To do this you have to draw in the response and impedance curves of the drive units you wish to use. Again, in most cases these are supplied by the manufacturer and entering them in is easier than it sounds. For this bit a mouse is extremely useful, since it makes the drawing process faster.

Once you have drawn in the response and impedance curves of the drivers you wish to use the crossover can be designed. There are two ways to do this. A Standard crossover is selected by the computer and it will automatically compensate for impedance if you ask it to. There is also a Free option, which allows you to build your own crossover network with individual components. I only wanted to use a simple second order network to start with and I also wanted to add a series resistor to the treble arm to level match the two units; the tweeter I had selected was more sensitive than the bass driver. So I chose the Free option.

Once the basic crossover has been constructed, it can be optimised. Pressing the ALT-O keys does this automatically, but it is more interesting to vary the value of the individual components yourself, observing the changes they have on the response. Whilst you are doing this a target response is displayed for you which in this case was a second order filter with fr -3dB being at 2.8kHz.

This gives you something to aim for with your response. When the individual crossover network for each drive unit has been optimised, the net overall response of the system can be viewed. Mine had a big suck-out in it in the crossover region to start with, but it is here that the package becomes really useful. The individual network for each channel can now be modified to smooth the response. You can vary each component to put in peaks, move the peaks up and down, move the crossover point to get more or less overlap, add extra components to compensate for lumps or dips, etc, etc. Within an hour or so I had entered the response and impedance for each driver, designed the crossover and then tuned it to give a flat response - good eh?

The practical measurements showed it to be usefully accurate too.

This is a superb package. It really teaches you what the effect of varying each individual component of a crossover will do to the response. It gives you a good feel for how the crossover is interacting with the drive units - it's got to be better than ploughing through the equations each time you want to make a change.

Boxcalc £69
Netcalc £79

Netcalc and Boxcalc are available from:

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D.I.Y. Letters

TUNING MORELS

I've been an avid reader of your magazine since its inception and particularly enjoy the DIY sections. I've recently acquired a pair of homemade speakers. On looking inside I find the drivers are by Morel, the tweeter is the MDT30 and the bass unit the MW166. These are mounted in a closed box of approx. 13 litre internal volume made from 1/2in. MDF. Internal surfaces are lined with foam. The crossover is 3rd order to the tweeter. An inductor is fitted in series to the bass unit with a capacitor/resistor circuit across the driver presumably for impedance equalisation.

My question, which I hope you may help me on, is this. The sound is smooth and clear but it lacks punch and excitement. There also seems to be some mild mid-range resonance. Certainly these speakers seem slower and less involving than the Monitor Audio 14s I normally listen to, although they do have a slightly sweeter treble.

I have the feeling that there's a good speaker in there somewhere trying to get out. Is the problem with the crossover, box damping, or choice of drive units? I enclose a diagram of the crossover with component values as far as I can ascertain.

I'm sure this must be a problem faced by many people who like to build their own speakers i.e. how do you get a fast dynamic sound, whilst still retaining smoothness and tonal correctness?

J. A. Luntz
Church Stretton
Shropshire

Firstly, let's start with the box. I entered the data for the Morel MW166 bass unit into our loudspeaker design CAD package. A sealed box of 13 litres does give a flat response down to around 55Hz (-3dB), but peaking up the bass a little will give them a little more punch. In addition the -3dB point of 55Hz can be improved upon.

I came up with this solution for you, after experiment. If you insert a reflex port, 2inch diameter and around 10inches long (final size will have to be determined by listening and fine tuning) the bass peaks up by around 2.5dB at 80Hz, which will give speed and slam, and the bass extension moves down to a much more respectable 43Hz, low enough to play fundamentals properly.

Although you give most of the values of the components in the crossover, you do not mention what type of components are used. In the treble arm, both the 2.2µF and 6.8µF capacitors should be high quality polypropylene, the Solen 400V series should give best results. The inductor should be also be a high quality component: speak to Wilmslow Audio about the best type to use - Tel: 0565 650605. As the capacitor in the bass arm is also a low value, this too can be polypropylene.

Working back through the equations it looks like you have a crossover point of just below 6kHz for the tweeter. This, out of interest, suggests that the inductor you couldn’t identify is around 0.16mH. The bass/mid unit is rolled off at around 3kHz. However, if a standard value of 8Ω is picked for the ‘166 driver, you may have a suck-out in the midband caused by the two units not integrating properly. I'd suggest making the treble filter second order at around 4kHz, as we recommended when we tested the MDT30 in the December '93 supplement. Use a 4µF capacitor in series with the tweeter and a 0.4mH inductor from tweeter to ground. The simpler crossover will not only improve the treble quality, but will also raise the treble level by 2dB or so. In this case the 10Ω resistor may have to be increased, you can tune the treble by ear until you get a balance you like.

One other little thing you might like to try is placing a Deflex panel behind the MW166. This is a new type of acoustic damping that promises excellent results (see the review in this issue). The Deflex panels are available from The Speaker Co. Tel: 0625 500507.

Obviously, these are all just ideas and without measuring your loudspeakers we can’t guarantee they will work perfectly, but at least they’ll give you a good starting point, giving you...
plenty more to try on these long and dark winter nights. DB

OHMS LAW
I have just read DIY Supplement No. 6 and feel I must comment about a couple of items contained within.

The first point concerns the single-ended valve amplifier. You state that valve V2 draws 1mA producing +14V bias across resistor R12. Ohms law states the voltage across a resistor is equal to the product of current flowing through the resistor and the resistance of the resistor, V = IR using Ohms law surely the above bias voltage is incorrect and the bias voltage should be +0.82V with the 820R resistor shown.

The second comment refers to your reply to Malcolm Berege’s letter concerning increased technical explanations. I agree that the pages of the main magazine are not the place for technical explanations. All of your electronics projects (valve or silicon) have been accompanied by circuit details, theory of operation etc. If these articles are not of a technical nature please explain what constitutes a technical explanation.

Finally, please keep up the good work. The DIY supplements are excellent, how about producing supplements on a monthly basis for addicts like myself?

Mr Andrew Dean
Milverton
Somerset

Yes, indeed you are correct to say that the bias voltage at the grid should be 0.82V, in theory. As you know there is a tolerance of 5% say, could be anything between 780Ω and 860Ω, and the value will also change with temperature. By quoting +14V, not +1.0V, it is taken to mean that the voltage should be nominally 14V. There’s no point in becoming too pedantic about all this or what was a simple fact becomes wrought about with qualifications.

Although the explanations that go with each of the circuits are technical, they are only technical to a basic and, we hope, understandable level. We avoid lengthy mathematical equations and derivations and instead try to explain how a circuit works in more understandable terms. We aim to provide even those with a limited knowledge of electronics an insight into how the circuit functions. Hopefully, this makes the DIY supplement, and the designs in it, more approachable for a wider audience. DB

LANDMARKS
I had to giggle when reading David Wyllie’s letter in December 1993’s HFW. His letter talks of post-war ‘landmark’ amplifiers reaching ‘new levels of excellence’. In my view, this is cobbler’s. Williamson is in no way as good as pre-war, state-of-the-art triode design. ‘New levels of compromise’ would be a more fitting statement.

Audio amplifier design peaked in the mid-1930s. After that time designers became obsessed with reducing the cost of the equipment. The use of feedback allowed the designer to achieve certain design compromises to attain the same level of measured performance as the very expensive triode designs, while at the same time cutting costs. The output transformer could be poorer spec. The power supply could have a AC ripple content - Good old Uncle Feedback will hide these problems. Only thing is, it tends to hide some of the music as well!

As for the 5-10, it can’t really hold a candle to the Williamson, but it did cost less

BAD VIBRATIONS
Thank you for the D.I.Y. element of your magazine, it’s a breath of fresh air in a boring black-box world.

With regard to tweaking machinery, I have always made a practice of carrying out simple things learnt in the far off days of packing platters and plinths of turntables with plasticine. I have found improvements to the sound of all the tin boxes of electricians can be made by lining the boxes with this simple cheap material. However, I have discovered how to make a quantum leap in the sound of all hi-fi components for ridiculously small amounts of money.

This all came about through reading a review of the Tannoy 605LE which stated that the capacitor was packed in a type of Blue-tak, because “it sounded better”. As all hi-fi electronics are packed with these components I decided to drag an old Technics SL-P11 I CD out of the loft, have a listen, then wrap the tin cans in Blue-tak and reassess the sound. The improvement was immense - and all for the sum of 99p. I have subsequently carried out this process on my Rotel 965BX, Cyrus amp etc. and all have become markedly more airy, detailed and tuneful. I noticed during this process that lots of the components soldered vertically into the boards were actually at various angles and touching each others and decided, after listening to the improvements wrought by the Blue-tak, to carefully re-align them so that none were touching. This little tweak further improved the sound, though to a much lesser degree.

The foregoing just goes to prove that even those of us with little knowledge of electronics can still make improvements to modern equipment with a little thought.

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The foregoing just goes to prove that even those of us with little knowledge of electronics can still make improvements to modern equipment with a little thought.

It goes without saying that equipment must be unplugged to carry out this work and that care must be taken not to sever any of the connections - and you will obviously bid bye-bye to any guarantees.

I was interested to notice that some aspects of the sound of my old Technics player are actually better than the Rotel despite it being an old 14 bit model. It has a much more airy, detailed midband and treble and a bigger soundstage, but a less focussed and less solid bass, but the difference is much less than 10 years of progression and press hype would have led one to believe. In fact, I often turn to it in preference to the Rotel. Strange, huh?

Anyway I hope this will be of some interest to you and your readers. Please keep up the good works.

P Stephenson
Darlington
than a third to build and its measured performance was just as good, if not better. It used 26dB of negative feedback, 6dB more than Theo Williamson's. This extra feedback was possible because it was a three-stage amplifier against Theo's four stages, therefore minimizing phase shift.

Another 1950s obsession was the use of so called 'forward feedback'. Very loosely, the idea was to increase the amount of feedback by 'forward feeding' part of the signal to the output, thus increasing the feedback by 'forward feeding'. Very against Theo's four stages., feedback was possible because it was a three-stage amplifier.

Throughout the 1950s improvements were made. 1955 saw 'FM' radio, 1957 saw the first Stereo records. By 1960 the quality of the music available was so high it has never been surpassed.

No one cared if amplifier quality dropped slightly, after all they measure better these days don't they?

All of the top boffins at the time were obsessed with buying costs down. Take the original Leak TL12 point one amplifier, and had good results. Whilst we would recommend this tweak to anyone interested in trying it, do be aware of the risks of electric shock even though we have taken this a stage further with your CD player, and had good results.

Tannoy discovered that an improvement could be made by wrapping the capacitors in their LE loudspeakers in Blue-tak, which damped down this 'ringing'. It's interesting that you have taken this a stage further with your CD player, and had good results.

One of the discussions we have with our capacitor supplier is how tight we want the wrap of the foil to be, and how strong its case, since both affect sound quality. Our 300B polypropylene power supply capacitors are specified in these areas, and as results will be energised without the mains disconnected. The capacitors used in the power supplies of all hi-fi equipment hold charge for some time after the equipment has been switched off. If you are not qualified in electronics and do not know how to test for safety, leave the item you wish to tweak disconnected for at least 24 hours before opening the case. DB

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Every time you point out, Tannoy loudspeakers in Blue-tak, which damped down this 'ringing'. It's interesting that you have taken this a stage further with your CD player, and had good results.

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Everything has a resonant frequency, and this 'ringing' can be destructive to the sound quality of hi-fi. As you point out, Tannoy discovered that an improvement could be made by wrapping the capacitors in their LE loudspeakers in Blue-tak, which damped down this 'ringing'. It's interesting that you have taken this a stage further with your CD player, and had good results. Whilst we would recommend this tweak to anyone interested in trying it, do be aware of the risks of electric shock even though we have taken this a stage further with your CD player, and had good results.
beasts can in no way match the strength and efficiency of a solid metal magnet.

I recently had the pleasure of measuring an early Voight unit. Off 1 R.M.S. watt at 1 kHz, 1 metre distance I measured 103dB - now that's sensitive!

In its cabinet (Tractrix horn on the front of the unit, and to the rear quarter-wave loading, another Voight patent) frequency response was -6dB at 48Hz and pretty flat to 21 kHz. Not bad for a single drive unit.

Voight's basic units are still made by Lowther Voight Ltd. of Bromley, Kent. Although the chassis have changed over the years and different models with varying sizes of magnet have been introduced, the basic paper cone and double wound voice coil (it is wound on the inside of the former as well as the outside) have remained unchanged. Sadly Lowther chose to introduce some ceramic magnets called 'High Ferrics', these are good, but not in the same league as the ALuminum Nciol CObait types. Thankfully ALNICO magnet types are still available. The actual material used is Ticonal G.

I do not believe that Mr Wyllie has had a serious listen to a single-ended valve amplifier. He could have a go at this little circuit, but be warned, you may find its 3.5 watts quite compelling. Especially if you're using some old Voight speakers!

Haden Boardman, Audio Classics, 8 Lowe Mill Lane, Hindley, Wigan, Lancashire. WVN 2 3AF

VALVES AND KEILIDHS
Since reading your magazine I've become interested in valve amplifiers and DIY hi-fi.

Can you think of an amplifier, either integrated or pre and power, of the valve type which would drive a pair of Linn Keilidh's. My front-end is a Meridian 200/203 CD player combination.

In the Keilidh owners manual it says that the speakers should be used with an amplifier of at least 80W per channel into 4ohms, which doesn't sound like a valve amp!

Building one of your kits amplifiers is tempting, would they be a match?

Also, do you think that you could give advice on building some of your amps, starting with the very basics i.e. what a capacitor or resistor do, what the colour bands mean or how best to solder components and how to measure components and circuits. Hi-Fi World appears to be a great "hands on" hi-fi magazine. Brilliant. I look forward to my next copy of Hi-Fi World.

Keith Wilding 38100 Braunschweig Germany

You can get 80 watts from a valve amplifier without too much difficulty, other than size and weight, due to the immense transformers required. Tim de Paravicini produces behemoths known as 549s that turn out an easy 200 watts, for example. Bear in mind, however, that for high power, fixed-bias working (it gives more power) substantially in Class B is most practicable, but it often gives glassy hard, remorseless treble, so listening tests are required before purchase. Valve amps can deliver power, but to do so they become heavy and expensive - and sound quality can suffer.

You need a four ohm tapping on the output transformer too. Velleman, a German kit manufacturer, make a high power valve amplifier, which may interest you. We urge you to listen before buying though.

Alternatively, our own K5881 can be monoblocked by paralleling its 8ohm taps to give 45 watts output into four ohms, but you'll need two kits. N.K.

LIVE VOLUMES
Hello again. After reading so much about valves these days I feel I want to up-grade my Audiolab 8000 C/P to a good quality DIY KIT valve amp that would match my Quad ESL63s and Accuphase 70V CD player, and give a sweeter sound with more involvement and bigger soundstage, or go for a Quad 606 power amp? I would still use the 8000 pre-amp and later on go for another pre-amp if you recommend so.

I would be happy to have your recommendations. I also use a self-powered subwoofer connected to the 2nd pre-amp output of the 8000C, which is practical for volume control. I would appreciate your recommendations on speaker cables for my present system and also the suggested up-grade (I now use QED 79 strands).

I mainly listen to Jazz and Classic music at live volumes preferably.

I love Hi-Fi World and all the people who make it what it is. "A friendly magazine".

Jean-Paul Haggar Alexandria EGYPT

There aren't so many valve amp kits around, but as you are probably aware, we do make a 30 watt/ch. 300B amplifier that we run with Quad ESL-63s to give an incredibly open and spacious sound. However, "live" volumes usually mean very loud and we'd hesitate to say that 30 watts provides this, even from valves. You can either buy two and monoblock them (60 watts/ch.), which is very expensive, but popular all the same. Or you could consider a Velleman valve amplifier kit from Maplin Electronics (0702-552911, fax - 0702-553935), but we cannot get one for review and would recommend you hear it first, since high power valve amps aren't necessarily of the highest audio quality, because of the unacceptable cost/weight penalties incurred when designed properly.

Aquad 606, on the other hand, provides oodles of power at far less cost, but it is not convincingly better in sound quality than your current Audiolab 8000P, which can drive the Quads as loud as they can go.

The only other option is to buy two K5881 kits and monoblock them to get around 45 watts/ch., but you'll get a little less volume than at present. N.K.
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#### Special Quality Golden Dragon Pre-amplifier Tubes

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#### Gold Plated Ceramic Valve Bassos

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### A SELECTION FROM OUR VAST STOCK OF VINTAGE AND AUDIO QUALITY VALVES.

Please enquire for items not listed.

#### Golden Dragon Valves

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For further details please contact Clive Norris.

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