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Contents

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

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

AUDIO TECHNOLOGY SORCERER
Nick Lucas builds a do-it-yourself CD convertor, using the high quality Burr Brown PCM163P DAC chipset.

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.

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

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**World Radio History**
CADULTELOGUE 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 if 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:

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Antique Electronic Supply,
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Arizona.
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Fax: (602) 706-8789

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Herts Hi-Fi
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Smug Oak Business Centre, Lye Lane,
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Tel: 0923 893711

CZECH 300B VALVE OFFERS POWER

A new, high power 300B equivalent will soon 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 40 watts of the standard design to 65 watts. Maximum ratings are 500 volts across the valve and 130 mA 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 2000 hours/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 - 50 watt 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 130 mm high overall, and 50 mm in diameter, this new valve has a tubular bulb made from thick glass, giving it a heavy, chunky feel. Its power handling ability will endure 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

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

PM 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 Keywood 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 unit. Now look at the peculiar sensitivity characteristic of the concrete ship, 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 drivers are more exciting. Concrete loudspeakers and concrete ships, it seems to me, appear and sink with equal speed.

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 basson 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 1kHz. 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, 7kHz 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 (there are others) that is non-resonant, so 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, winnow or ceiling however, but 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 situated 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 unry. 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 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.
### Audio Note A60 Series Specifications

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### Audio Note A60 Series Features

- **High Performance, High Performance, High Performance:**
  - Frequency response: 20 Hz to 20 kHz
  - Dynamic range: 100 dB
  - Signal-to-noise ratio: 110 dB
  - Power handling: 500 W
  - Impedance: 8 ohms

### Audio Note A60 Series Connectors

- **Input:** XLR, RCA
- **Output:** XLR, RCA

### Audio Note A60 Series Cables

- **XLR interconnect cable:** 0.75 m
- **RCA interconnect cable:** 0.75 m

### Additional Information

- **Audio Note A60 Series offers high-quality audio components for demanding audiophiles.**
  - Exclusive design and manufacture ensure superior sound quality.
  - Designed for use with premium home entertainment systems.
  - Ideal for stereo and home theater applications.
  - Custom-built for optimal performance.

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### Technical Specifications

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<td>Power handling</td>
<td>500 W</td>
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<tr>
<td>Impedance</td>
<td>8 ohms</td>
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### Additional Features

- **Interchangeable Connectivity Options:**
  - XLR inputs and outputs provide flexible connectivity.

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### Contact Information

- **Audio Note:**
  - Tel. +44 0273 220511
  - Fax. +44 0273 737498
  - Sales +44 0273 885511
HDA DRIVER NOTES

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 6Ω minimum, but rising inductive reactance above 500kHz 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 HM130Z0 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 HM130Z0 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 disembodying 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 HM130Z0 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.

Literally 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 HM130Z0, 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
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.

(See diagram) The large 5.25in unit has one; the smaller 4in unit obviously needs one.

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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 optic, 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 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 an anodised alloy black front panel. An LED indicator on the front panel changes from red to green as the converter 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...
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
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 straightforward. 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.

**SOUND QUALITY**

Next to the reference Pink Triangle Da Capo converter, 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 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 one'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 converter, it's a chance to get a top quality sound, for an affordable price.

DB

**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

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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 TL60 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 rice-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, fitters and a feedback network around VI aN I b 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 fitters 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 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 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 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. Philips make a good polyester capacitor.

"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."

Andy Grove gives some useful advice to anyone attempting to restore the ROGERS CADET III.
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**SPECIAL QUALITY TYPES**

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**AMERICAN TYPES GE.**

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<td>6146B</td>
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</table>

**NOTE:** The above can be supplied with ultra linear taps at no extra cost, and fully shielded, open frame or drop through as required.

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**STANDARD TYPES**

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**SPECIAL QUALITY TYPES**

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**AMERICAN TYPES GE.**

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<td>6146B</td>
<td>15.00</td>
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**HI-FI WORLD SUPPLEMENT DECMBER 1994**
Resistors:

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<tr>
<th>R1</th>
<th>4.7k</th>
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Silicon Rectifiers:

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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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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 marvellous amplifier.

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<table>
<thead>
<tr>
<th>Value</th>
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</tr>
<tr>
<td>EL84</td>
<td>75</td>
</tr>
</tbody>
</table>

- Compare favourably to brand names costing much more.
- Good valves at economical prices.
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- Low capacitance factor
- All units proof voltage tested at 65% of their rated Voltage.

**Price**

<table>
<thead>
<tr>
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</tbody>
</table>

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<table>
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</tr>
</tbody>
</table>

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**Contacts**

- Tel: 081 452 0161, 081 450 0995 Fax: 081 208 1411
- 00 Cricklewood Broadway London NW2 3ET

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**Cricklewood Electronics Ltd**

41 Cricklewood Broadway London NW2 3ET

Tel: 081 452 0161, 081 450 0995 Fax: 081 208 1411

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Preamp

Resistors:

| R1 | 470k | 1/8W | Hi Stab |
| 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 | 82M | 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 | Polysty |
| C3 | 40uF | 16V | Electro |
| C4 | 0.1uF | 400V | Polysty |
| C5 | 400pF | 400V | Polysty |
| C6 | 4.7nF | 400V | Polysty |
| C7 | 100pF | 400V | Polysty |
| C8 | 1.2nF | 125V | Polysty |
| C9 | 1.5nF | 125V | Polysty |
| C10 | 0.1uF | 400V | Polysty |
| C11 | 47nF | 160V | Polysty |
| C12 | 16uF | 350V | Electro |
| C13 | 16uF | 350V | Electro |

Potentiometers:

| RV1 | Dual 1M | Lin |
| RV2 | Dual 500k | Lin Centre Tapped |
| RV3 | Dual 250k | LOG+5Switch |
| RV4 | Dual 1k | Lin |

Valves:

| V1a/b | ECC807 |
| V2a/b | ECC807 |

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 $\mu$ of 100 the ECC807 has a $\mu$ 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!
Jaguar Standard Kit £235 pr
This kit contains everything you need to build the speakers except the cabinets:
2 x RCF L5/090 Bass mid drivers, 2 x RCF TWT/E Titanium dome Tweeters, assembled Bi-wired crossovers, 2 x F 469 Bi-wire connection panels, 1 metre A101 wadding, 6 x FT 57 Fo damping panels, 2 x reflex tubes, 8 x Grill studs, Speaker cloth, Full set of instructions and plans.

Deluxe Kit £315 pr
As above but includes cabinet kits machined from 25mm MDF fully rebated for ease of construction.

Tornado Standard Kit £275 pr
This kit contains everything you need to build the speakers except the cabinets:
2 x RCF L6/090 Bass mid drivers, 2 x RCF TWT/E Titanium dome Tweeters, assembled Bi-wired crossovers, 2 x F 469 Bi-wire connection panels, 2.5 metres A101 wadding, 12 x FT 57 Fo damping panels, 4 x reflex tubes, 8 x Grill studs, Speaker cloth, Full set of instructions and plans.

Deluxe Kit £385 pr
As above but includes cabinet kits machined from 25 mm MDF fully rebated for ease of construction.

RDP 10 £615 pr
10" Precision Devices Bass driver coupled with a 1" compression driver and CD horn with a high quality passive crossover and DelFlex panels. This speaker has ultimate speed for precise reproduction of all types of music. Trapezoidal cabinet.

HPD 10 £745 pr
As above but with horn loaded cabinet for ultra low bass reproduction which leaves nothing to the imagination. Cabinets come assembled due to the complexity of the design.

BOSS MONITOUR £195 pair
A small infinite baffle trapezoidal cabinet with a top mounted MOREL neodymium dome tweeter and 5" bass mid unit. This speaker has amazing imaging and should be placed close to the wall to achieve optimum results.

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World Radio History
BOOK REVIEW
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 aerials 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 skimped 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.
Introducing The Parts Connection’s first complete DIY kit: the Assemblage DAC-1 Digital Processor.

It comes in a small package (24cm x 5cm x 18cm chassis), but packs a big punch and a very musical sound. Designed for the rookie or first time kit builder, the only tools required are a pencil tip soldering iron, a screwdriver, a wrench, a pair of electronics pliers, and a wire stripper or hobby knife. With only 21 solder joints and a handful of nuts and bolts, this kit goes together in one evening (typically about an hour). It’s as easy as connecting the dots.

The parts quality is top notch. The board comes assembled and tested, implementing the Burr Brown 1702 DAC, a Crystal 8412 input receiver, an NPC 5813 digital filter, Analog Device’s AD844 and 847 op amps and a custom potted toroidal power transformer.

At $449 US, the Assemblage DAC-1 offers an outstanding value in digital conversion and comes with a Satisfaction Guarantee (return it within 30 days of purchase for a full refund) and an Assembly Guarantee (if you can’t get it running, we will!). We challenge you to find a DAC anywhere near this price with better measured performance, component quality, and most importantly, sound quality. Call us for more specific information on the performance or construction features.

To order the DAC-1 kit or to order The Parts Connection 1994 Catalog (for £3), full of a lot of other exciting stuff (including a $10 US discount coupon good on your first order over $100 US), send us your request and mailing address - or call with credit card information.
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 1 x with a 16lb chassis, a 1 inch thick platter, 2 Swiss precision motors with outboard power supply: a very modified Linn Itok and AT OC9 Siston, 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 powerllocks. These drive two extremely power hungry IPI M3 transmission line speakers, that Ivan Leslie himself wouldn't recognise. Other equipment is Nakamichi ZK-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.

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 60μF and for the choke input filter 10H is the quoted inductance figure. All common rectifier data studied hinges around these figures - for instance the SU4/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 EZ 150. 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...
on another factor. Anode series resistance figures are usually quoted in data manuals for various operating conditions mentioned, for capacitor input filter. 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 re-introduction 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 plunging 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 humky, but we are using one hell of a beast in our prototype twin single-ended 211 amplifier, capable of...
The GZ34 was run within its original designer intended, and you may find that no small difference, but as the tweeter 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 1.5kΩ 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

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.

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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 one-off chassis for customers metalworkers will produce.

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 Magnepan 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 fussed 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 short 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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### Price list and Order Form for CVC PREMIUM Audio Valves

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

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

<table>
<thead>
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<th>SIGNATURE:</th>
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Please make cheques payable to: ‘CHELMER VALVE COMPANY’ or pay by ACCESS/MASTERCARD/VISA Please give details:

Total carried forward...

VALVE AMPLIFIERS SOUND BETTER STILL WITH CVC PREMIUM VALVES!

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