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NOVEMBER 2001 No61

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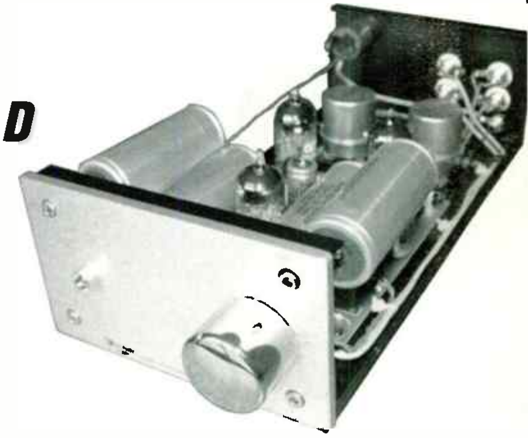

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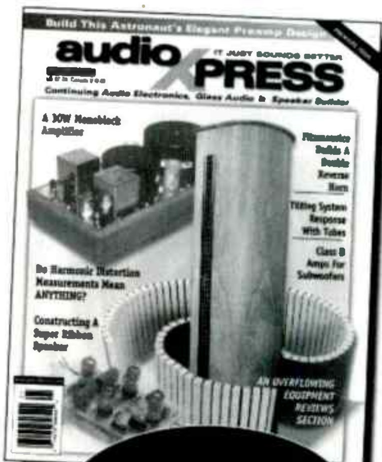

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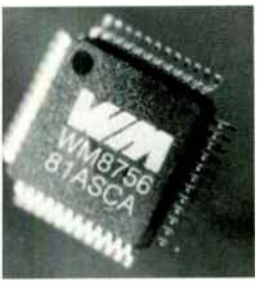
KIT & COMPONENT NEWS

WOLFSON LAUNCH DVD-A AND SACD AUDIO CHIPS



OK, so you might not be planning to build your first SACD player quite yet, but all the same here's how they do it, just in case you do decide to take on Sony tomorrow. Everything is so complex nowadays, manufacturers build their products using specialised chip sets, rather than attempting to come up with in-house solutions. Wolfson microelectronics, based in Edinburgh, (www.wolfsonmicro.com) join companies like Zetex in the UK offering specialist chips for advanced audio use. Wolfson tell us they have just introduced two new six-channel audio digital-to-analogue convertors (DACs), the WM8746 and WM8756. Both provide DVD-Audio playback, but the 8756 also provides SACD playback. It has separate inputs for PCM at up to 192kHz sampling rate with word lengths from 16bit to 32bit, and for 64x Direct Stream Digital (DSD) for SACD. Wolfson claim their proprietry multi-bit sigma-delta DAC architecture provides class leading linearity with distortion down at -97dB (0.0014%).

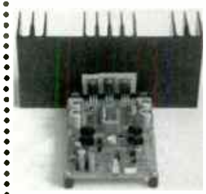
The simpler WM8746 is a PCM only version which provides DVD-Audio only.

The introduction of dedicated audio chips such as this is usually followed by a spate of product launches by Britain's hi-fi manufacturers. Wolfson pointed out to us that at present you can have either a DVD transport or an SACD transport, with decoders, but not one transport that does both, because DVD and SACD discs are different and a transport would need to be able to sense disc type. Doubtless they'll come along in due course. Until then expect to see a rash of DVD-A or SACD players from manufacturers, software availability permitting.

RADFORD AND QUAD REPAIRS

Woodside Electronics tell us they are again offering a repair service for Woodside and Radford valve products. They can provide replacement transformers for Quad II power amps as well. Contact Mike Davis on 01758-741026 or e-mail m.davis@virgin.net

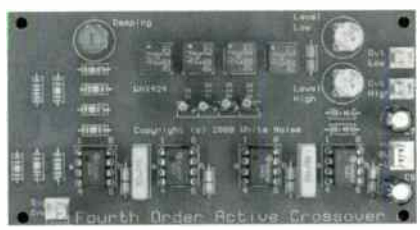
KITS BY THE BUCKETLOAD



From Whitenoise in Glasgow come a whole variety of kits for you DIYers.

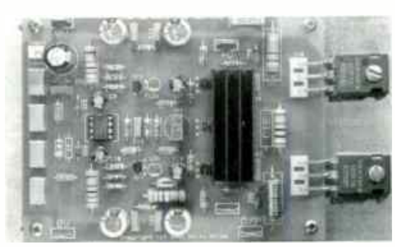
The DVA100 is their new entry level power amplifier providing 80W into 8ohms with extremely low distortion across the audio band. Prices start at £75 for a stereo pair of standard kits.

The MOS125 is an improved successor to their successful MOS100 power amplifier. The MOS125 delivers in excess of 100W into 8ohms with low distortion and a pleasing sonic signature, they tell us. It is fast and detailed, but without any dryness. A version of this amplifier providing 250W into 8ohms is also available. A stereo pair of 100W standard kits costs £113 and a stereo pair of 250W kits is priced at £153.



The White Noise active crossover is a 24dB per octave state variable filter with individual gain controls on the high and low pass outputs. The crossover frequency is user settable and can be fixed or variable. The active crossover is ideal for use in active loudspeaker and subwoofer projects or as a general purpose audio filter. A stereo pair of standard active crossover kits sells for £83.

If you want to listen to your favourite music without disturbing others then the White Noise headphone amplifier is ideal. It will drive all types of headphones to high levels with low distortion and excellent resolution. It incorporates short circuit protection and can be operated in either Class AB or Class A. A standard headphone amplifier kit, including power supply costs £65.



The White Noise phono stage has MM and MC circuitry which employs three gain blocks and distributed RIAA equalisation, accurate to within 0.1dB across the entire audio band. Each gain block has its own regulated power supply driven from a board level main regulator. This means that there are a total of eight voltage regulators per channel giving an absolutely silent power supply. The audiophile version of the phono stage has RIAA equalisation accurate to within 0.05dB. There are Class A gain blocks and the highest quality passives throughout. The stereo phono stage kits come in at £104 for the standard version and £304 for the audiophile version. And finally to power the active crossovers, headphone amplifiers or phono stages you need a superlative power supply. Almost all regulated power supplies have unwanted high frequency or radio frequency corruption on their supposedly direct current outputs generated by the regulation feedback loop. High and radio frequency signals leaking into audio circuitry is known to smear the sound. The White Noise power supply uses cascoded regulator circuitry to eliminate these artefacts and provide up to 1A of pure DC at any user presettable output between +/-3V and +/-40V. A standard cascode power supply kit retails at £45. Further details of these products are available on the web or in our free catalogue from White Noise, 11, Station Road, Bearsden, Glasgow G61 4AW.

White Noise can be contacted on 0141-942-2460 (Tel), 0141-587-7377 (Fax), or david.white38@ntlworld.com (email)

World Radio History

KIT BECOMES KAT

Last month we described our new KiT6550 40W valve amplifier. This month Nick Lucas concludes with a description of the kit, and our power amplifier derivative, KaT6550.

In last month's DIY Supplement (No. 60), details were given of our latest valve amplifier, the KiT6550. It's a 40W integrated amplifier, with valve rectification and a choke equipped 'pi-filter' power supply, using a pair of Svetlana 6550C power tetrodes in push-pull at the output (though any 6550 or KT88 can be used). At the front end is an ECF80 pentode/triode, acting as an input amplifier and phase splitter.

In part one of this article last month we gave a detailed description of the amplifier, an explanation of the circuit and its measured performance. In this second part we cover the kit and Simon Pope describes sound quality. But before this I must mention our new release of the KaT6550, the power amplifier version to please all you pre-amplifier users.

The KaT6550 is essentially the KiT6550 devoid of all the phono sockets (except those for the preamp input), the selector, tape/source switch and volume potentiometer. This removes the need for any control devices, apart from the on/off switch that is located at the rear left corner - hence the blank front panel. The signal enters via a pair of phono sockets that feed directly to the input valve. With an input sensitivity of 500mV the KaT6550 can be operated by both a passive and active pre-amplifier.

THE KIT

The kit meets the same standards, or higher, of commercial product. As we are not using printed circuit boards all valve sockets are chassis mounted and are of the white ceramic variety. These project up through the chassis without exposing the ring fittings. Three lengths of tag boards are provided each carrying 18 pairs of terminals. Onto these all the components sit, one for each channel and the remainder for the power supply. The components we supply are of high standard, namely Hua Lien TA axial electrolytics, Panasonic M series radial electrolytic and Philips orange 386 series for the signal capacitors, carbon film resistors and copper wire for all low current links.

We have worked a deal with our valve supplier to get the best prices on the valves to keep the price of a valve set to the minimum. This can be the limiting factor to some people, but hopefully not any more. The amplifier weighs in at a whopping 19kg with dimensions 390mm(w) x 330mm(d) x 190mm(h) with valves or 220mm(h) with cage.

BUILD

The KiT6550 and KaT6550 kit will offer more of a challenge than most due to their use of

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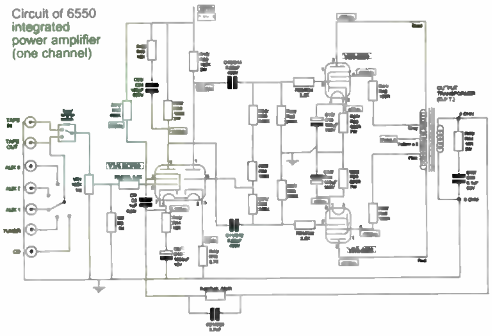


Circuit of 6550 integrated power amplifier (one channel)

hard wiring. Rest assured there are plenty of diagrams to guide you through, all the same. As long as you follow the instructions carefully it should be plain sailing. There are no tricky set-up procedures as the output tubes are auto-biased. The fiddliest part is the pre-amp section of the KiT6550, due to the use of single screened wire (better separation and sound quality than twin screened). We provide 10m and this adds up to a lot of wiring. As long as you take it slow and steady then you will be fine. We have a help-line manned 9am to 5pm weekdays, and a help e-mail address, namely help@worldaudiodesign.co.uk and a full back up service to the point of arranging collection of your amplifier to fix all problems.

SOUND QUALITY by Simon Pope

KiT 6550

I tested the sound quality of the 6550 with a variety of musical styles and sources and found it to be a highly engaging performer with a great sense of vitality and involvement. Bob Marley's seminal 'Exodus' on vinyl LP (using the WAD modular valve PHONO II phono stage) had a way with rhythm and timing that was very impressive. The track 'Natural Mystic' highlighted the amp's full and deep bass response and the treble had a smoothness that was detailed yet pleasantly sweet.

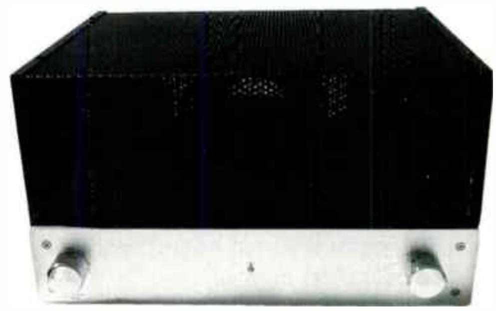
Others characteristics of the 6550 were revealed in a CD of Mahler's 'Das Lied von der Erde' where a realistically deep sound stage was created and instruments had an appealing warmth, together with space and light around them. It made for great realism.

If you favour attack and rhythmic grip, together with a smoothness of sound that is incredibly easy to live with, the KiT6550 could well be the kit amp for you.

KaT 6550

I tested the power amplifier version of the 6550 kit amp with the aid of our World Audio Design PAS II passive preamplifier. The KaT6550 has all the rhythmic attributes of the KiT6550 but with a tad more clout and presence to the overall sound. Bob Marley's vocals were positioned slightly further towards the front of the soundstage, for example, and the drums and bass had a tight and cohesive feel.

Classical music sounded open and airy, with woodwind instruments light and spacious and brass especially engaging, with a snappy and metallic realness. Add to this the fact that strings (especially violins) remained smooth and lyrical - and the orchestral timbres highly natural - and you have a recipe for valve amp success. The 6550 is one for those who like a valve sound married to the attack and clout of a good quality solid-state design. ■ ⏏



A cover is available if required to prevent children or pets from coming into contact with the hot valves.

MEASURED PERFORMANCE

using Svetlana 6550C tubes

Power	40W
Frequency response (3dB)	15Hz – 60kHz
Sensitivity	500mV
Distortion (1W)	0.08%
Noise	-90dB

The KaT6550 & KiT6550 amplifiers are available as a kit from World Audio Publishing Ltd

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KaT6550-K240/120 (with valves)	£580.00	£495.00
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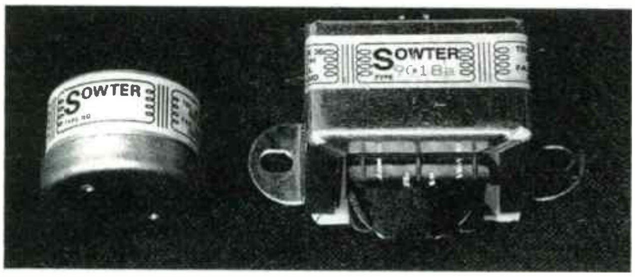

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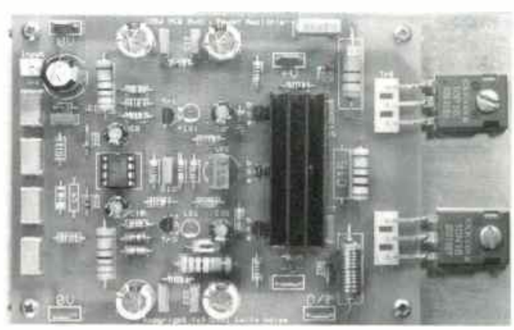

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ARE TETRODES TOP?

Are Beam Tetrodes the Ultimate Audio Valve?

by Andy Grove.

6550C - Tetrode

Beam tetrodes (or beam power tubes) were specifically developed for audio, which makes them the only device ever which holds this proud honour. All other active devices are basically general purpose, even the triode.

Lets take a look at the requirements for an audio device in a real world amplifier.

Firstly distortion. Now there is distortion and there is distortion. Musical theory teaches us that the pure octaves of a tone, that is the second, fourth and so on harmonics are always harmonious with the fundamental, thereby making even harmonic distortion the least objectionable.

The third harmonic is the musical "fifth" of the fundamental and is harmonious with the fundamental but will cause dissonance with chords of relative simplicity. Therefore a small amount of third harmonic is acceptable, but above a few per-cent it will cause audible distortion.

The fifth harmonic is harmonious with the double octave of the fundamental, but as the frequency difference is greater this harmonic is more audible than the third so fifth harmonic should be kept low.

Higher order odd harmonics are always objectionable and are therefore entirely undesirable. In fact as the ratio between the higher order even harmonics and the fundamental is high it is desirable to keep these low too.

Harmonic distortion is related to the curvature of the transfer characteristic of the whole amplifier. Simple, soft curvature produces low order harmonics, sharp discontinuities produce high order distortions. This curvature is also responsible for intermodulation. The curvature multiplies one signal by another causing modulation and sidebands.

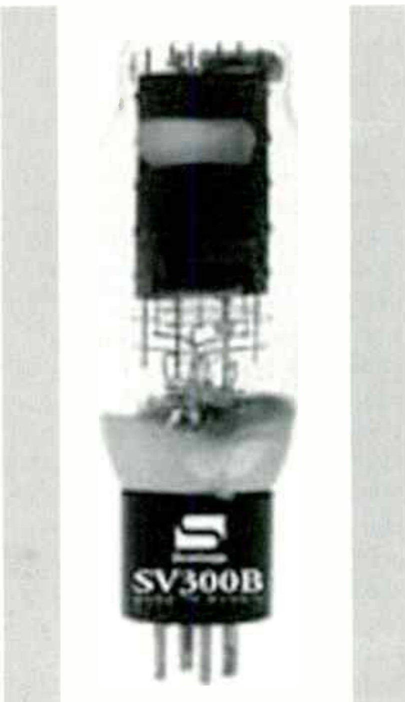
Simple curvature produces low order IM products, complex curvature produces high order I.M. products. High order I.M products are extremely objectionable; this is the nasty grain that can be heard with some Class B solid-state amps. Generally the distortion in a power amplifier is caused by the high signal level stages, predominantly the output stage and it's driver if a zero gain buffer is used at the output.

We can represent the curvature of the transfer function by a power series, the sum of a series of terms of ascending power. This equation can be arrived at by taking n (where n is an integer) readings from a plot of the curvature. Form n simultaneous equations and use a matrix and Gaussian elimination to solve. The approximation becomes more and more accurate as the number of terms approaches infinity. The various powers correspond to the order of harmonics produced by the curvature. If the curvature produces only even harmonics all of the coefficients for the odd power terms in the series will be zero, and vice-versa for only odd order curvatures.

So for our first lineup let's consider the various devices' curvatures:

BIPOLAR TRANSISTOR

A bipolar transistor has a curvature which is best represented by an exponential function. Probably the simplest equation used to describe the bipolar transistor is the Ebers-Moll equation, more complex models include the Gunnel-Poon model. For the purposes of this proposition we need only consider the simplest form of the exponential function to see the crux of the argument. It can be seen that the power series, which represents the exponential function, has an infinite number of terms, including an infinite number of odd terms, although they do diminish quite quickly due to the factorial coefficients. Bipolars also suffer



300B - Triode

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from the Early effect and are extremely temperature sensitive. This excacerbates the problem as the parameters of the device will be modulated by the signal as the junction temeperature changes. This results in high order IMD under dynamic conditions. One other problem with bipolar transistors is that they require considerable power to drive them, this generates distortion further back in the chain. One other point, it is a common misconception that bipolar transistors are current controlled devices. They are not. They are transconductance devices, a change in base-emitter voltage causes a change in collector current. The base current is an unfortunate side effect of the base-emitter diode junction.

FET

FETs have a primarily square law characteristic, a curvature which can be represented by the power series, but where the odd order coefficients are always low, right from the beginning. But FET.s are also sensitive to temperature just like all solid state devices, so they too will have their characteristic parameters modulated by the signal. Also if one takes a look at a real FET characteristic curve it is a bit of a messy affair. There are definitely large odd order components in there. It looks like the Pentode's curvature.

PENTODE

Pentodes have a primarily square law characteristic but, like the FET, the curves severely bunch up at low voltages and high currents, this is indicative of large, odd order coefficients in the power series. But like the FET they are predominantly low order in nature, mainly third and fifth.

TRIODE

Triodes have an almost pure square law curvature. Within the region which they are used there they transconductance increases with increasing current and decreases with decreasing current. There is a point at which we reach saturation caused by limited emission from the cathode, but under normal operation the space charge always supplies sufficient electrons. One hidden problem with the triode is the Miller effect loading of the driver stage at high frequencies. Triodes also require a prodigious drive voltage, this of course causes distortion in the driver stage.

BEAM TETRODE

Beam tetrodes once again have a nearly pure square law characteristic. Low odd order terms in the power series from day one. The harmonic generation of the beam tetrode will be much the same as the triode. The beam tetrode has a higher input impedance than the triode and requires far less driving voltage.

EL34 - Pentode

Taking into account the above, some things start to make sense. Bipolar amplifiers always seem to sound a lot sharper and brighter in the treble, and sometimes plain grainy, compared to amplifiers built using the other technologies. This could be due to the production of high order harmonics and IMD. Now although the overall THD may be very small, if the amp is producing signals at 7 kHz from bass lines I'm pretty sure it'll be audible. A true audio signal will produce a hash of grunge at across the audio band due to intermodulation. As most musical energy is in the midrange, there will be a lot of hash at higher frequencies, hence grain and brightness.

A quick word on feedback. Feedback causes the curvature of the amplifiers characteristic to straighten but also to become more complex in shape. The effect of feeding the distorted output signal back into the input turns the curvature function into a series of functions of itself. The function of a function, the function of a function of a function and so on. This has the effect of lowering the amplitude of the harmonics but also spreading them out into higher orders. Another problem is that of amplifier stability. Most amplifiers have an open loop response that resembles that of an integrator. This is called "dominant pole compensation" basically the feedback diminishes at 6db per octave with increasing frequency. Therefore just whether you need the feedback to lower the amplitude of the grunge, it isn't there. Taking stock of the feedback problem it would seem most logical to make sure the amplifier is as linear as possible to start with, and apply feedback carefully. That implies Class A operation.

Next is the problem of efficiency or available power output for a given device dissipation. The odd man out in the above set of candidates is the triode. This old boy is far less efficient that the others because, under negative grid drive, the we can never approach the diode line of the valve. So power output is limited unless the grid is driven positive. This is the idea behind such valves as the 811, 805 and 812. These are designed to have their grids pushed hard positive to extract more power. The problem with this however is that when the grid changes from a negative potential to a positive potential it starts to conduct as a diode. This causes a sharp discontinuity in the curvature introducing high order amplitude distortions. Similar efficiencies can be achieved by all of the other device types, if we disregard the heater power required by the valves.

The next consideration is the damping of the load. This is quite important, but the reasons why are misunderstood. Nearly all modern loudspeakers are designed to work with an amplifier of essentially zero output impedance, a voltage source. This is because since the seventies most amplifiers have been high feedback solid state

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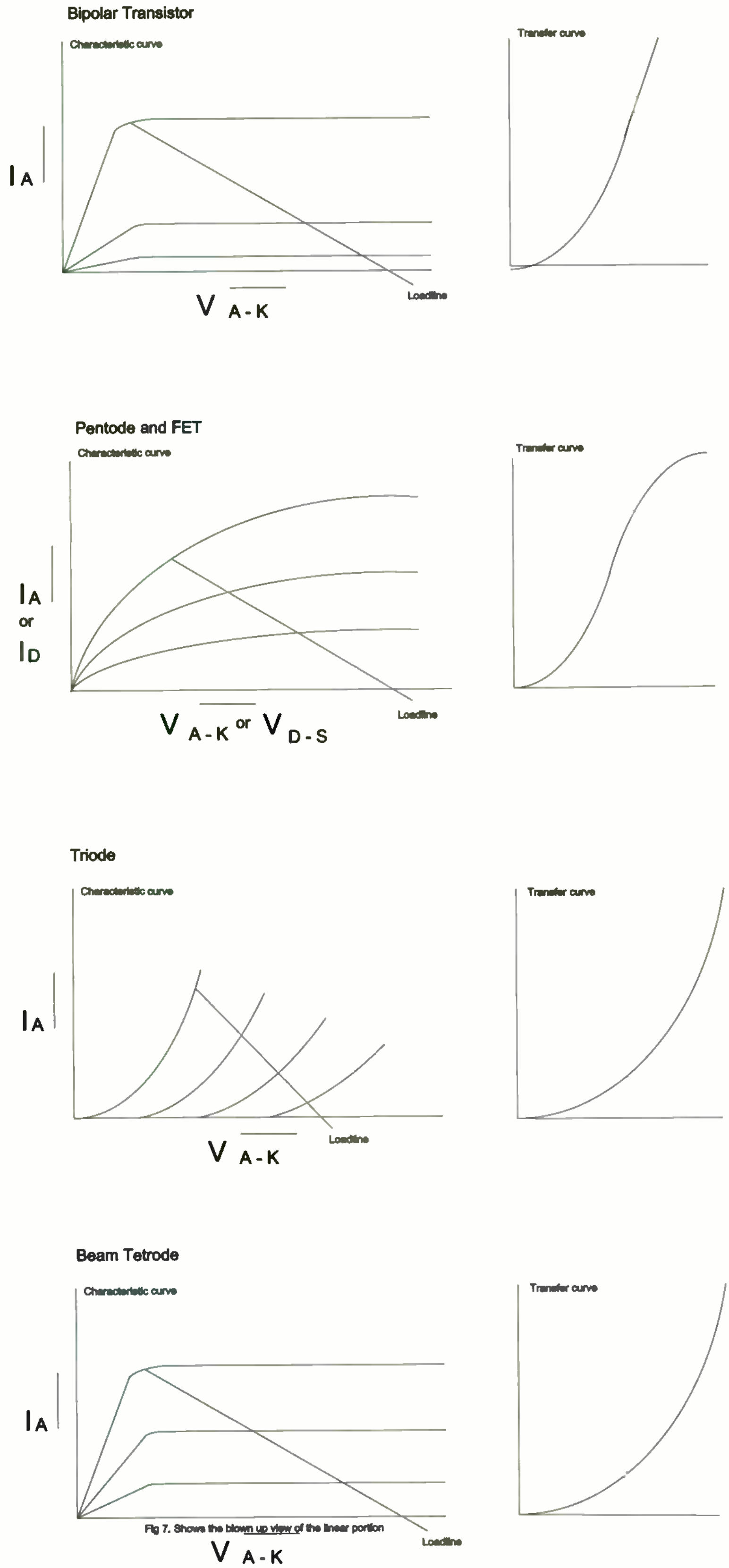

Note: Triode and Beam Tetrode curves are parabolic

designs. If a loudspeaker designed for a zero impedance is driven with an amp which has a finite impedance two problems arise. Firstly the bass alignment is altered. The Qts is the rms sum of the mechanical Q, Qms and the elctrical Q, Qes. This electrical Q is measured with the voice coil shorted out. Pu more resistance in the voice coil circuit and the Qts goes up. This affects high Q reflex alignments the most causing a hump in the bass at resonance. The other problem which arises is that of changes in frequency response caused by the crossover not being terminated by the expected zero impedance. The response starts to take on the shape of the loudspeaker's impedance curve.

All of the active devices mentioned above, apart from the triode, are essentially high impedance transconductance devices. Therefore they will present a high output impedance unless used as zero gain buffers, or with some other form of local feedback around the output stage. The triode has a reasonably low internal impedance and can be used without feedback and still achieve a workable impedance after the output transformer's stepdown ratio. However as we know, by using some form of feedback, either local, or global or both, we can achieve a suitable output impedance. This negates the triode's advantage over the other devices in this area.

Now lets have a look at what we have discovered. Firstly for ultimate audio purposes the exponential characteristic of the bipolar automatically excludes it from the list, we can already see that the extended harmonic and intermodulation products definitely point towards it being an industrial grade component. The FET and pentode have similar characteristics, rich in low order harmonic components, but without the extended spectrum of the bipolar transistor. We are left with the two, in my opinion, best devices for audio output stages. The triode and the beam tetrode. Both of these have the same type of square law characteristic. The main selling points which bring the beam tetrode on top is it's efficiency and ease of drive. The accelerator grid greatly increases it's apparent perveance giving more watts for your pound. This allows operation deep into Class A without as severe a dissipation penalty as the triode. The beam tetrode requires far less driving power than the triode. This allows for the use of local feedback either into the cathodes or screen grids, lowering the output impedance to that of a triode, or probably lower given the tetrode's higher transconductance, before global feedback is applied. And less driving voltage requires less of the driver stage, generating less distortion there. ■

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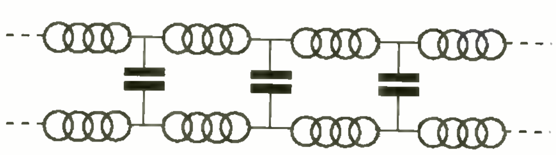
BUILD A MAIN

Neville Roberts gets into a twist with his mains lead. You can too.



As I progressed up the hi-fi ladder towards the goal of perfect realism, or so I thought, upgrades became harder to quantify in terms of measurable improvements and I increasingly relied on subjective analysis of the changes achieved, if there were any that is!

An area where this applies is mains power leads. Having noticed some correspondence on the World Audio Design bulletin board on this subject I thought I would share my experiences, together with a low-cost alternative to expensive ready-made cables.

A few years ago, a friend lent me a mains cable he had purchased from a supplier of quality cables and invited me to try it. This was still in my 'transistor' period and I was somewhat sceptical of expensive leads being worth the money. After a trail period, I concluded that I couldn't detect any difference with the cable and returned it to my friend, with my bank balance intact!

Time passed and my transistor amplifiers were gradually replaced with valve equipment in the form of a WAD K5881 Mk II and the WAD Series II Modular Pre-Amp. Following various component upgrades, I was again pressed to try a quality mains lead. This time, to my dismay, I really could detect a significant improvement - tighter, cleaner bass, open treble with better imaging. Rats!

However, I thought that there should be no reason why I could not construct a power cable of comparable quality myself, and at a fraction of the cost. My reasoning was that there must be two main factors that contribute to this significant improvement. One would be the lower resistance and higher power handling capacity of the lead and the other some sort of filtering effect.

A lead is essentially a transmission line for the power with series inductance and parallel capacitance distributed along the length of the lead, and this must act as an RF filter (Figure 1). To increase this effect and lower the resistance of the cable, I chose to use 6 pairs of 14/.0076 wire (or 14/.2 for you metric buffs!) conductors, twisted together, and a length of 32/.2 earth lead. Each pair is rated at 3A, so the resultant cable would be 18A.

How was I going to twist the conductors together? My thoughts were to twist pairs of blue and brown wires together and then plait the six pairs around the earth conductor. For advice on how to plait wires, I decided to consult an expert in this field - my 13-year-old daughter! I was duly shown how to plait three wires to make a flat ribbon. I would then wrap the two ribbons around the earth lead. The resulting 'Emma Weave' cable was duly constructed, but it soon became clear that the earth wire refused to stay inside the ribbons despite my attempts to bend the ribbons around it.

The second attempt involved arranging the six pairs of wires radially around the earth wire and plaiting three pairs together once, then moving to the next three and so on around the wire in an attempt to envelope the earth lead. Alas, this turned out to be more complicated than it seemed and after about half an hour and about six inches of completed cable later, I abandoned this approach!

Finally, I settled on the following technique. I individually twisted together 6 pairs of blue and wires brown by knotting a pair together at each end, slipping one end over a door handle and threading a pencil through the other end.

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QUALITY IS LEAD

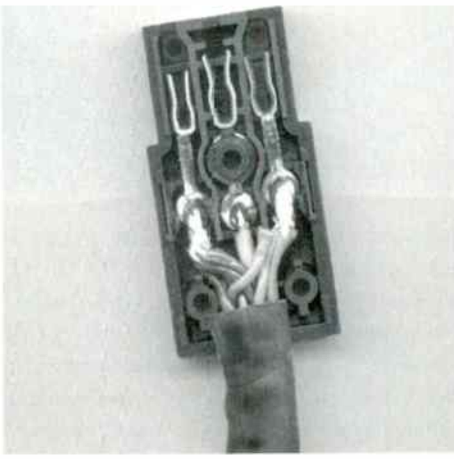
The best way I can describe the process is by holding the cable taut in my left hand, I twisted the cable by 'winding up' the pencil as if it were a propeller on a rubber band powered model aeroplane. When complete, a final tug on the wire meant that it stayed twisted together after removing from the door handle. This process was repeated with the remaining five pairs of blue and brown conductors.

Finally, I taped the six pairs of wires around a length of earth wire and then proceeded to twist the pairs around the earth wire. This resulted in the cable shown in Figure 2 and a pair of very sore hands! I would recommend gloves for this in future.

Three leads were needed, one for the power amp, one for the pre-amp and one for the distribution box supplying power to all the equipment. The lead lengths required were 1m, 1.5m and 2m so I used 40m of blue, 40m of brown and 5m of green/yellow which will make about 5m of finished mains cable.

Having cut the cable and some sheathing to the required length I set about the task of feeding the resultant cable into some 1cm diameter sheathing. This involved tying a length of nylon string to one end of the cable, threading the string through the sheathing, attaching the other end to a fixed object (a chair, door handle, the wife, etc.) and pulling the sheathing over the cable. Not an easy job, and in hindsight I would have used some sort of lubricant such as silicone grease or some 'Sleeve Oil' available from Maplins for the purpose.

The blue and brown leads were separated at each end, then I twisted the six brown and six blue leads together and soldered them up to make one 'solid' cable that just fitted into the holes on a 13A mains plug (Figure 3). The same was done at the other end, but I removed the fixing screws in the 3-pin IEC Euro socket ('kettle' plug) and soldered them in, as shown in Figure 4. The cable restraints were not needed as the sheathing makes a very neat job and just fits snugly into the plugs and sockets anyway.



Although my twisted cable is not as neat as commercially available products, it doesn't matter as the sheathing makes the final cable look very professional (Figure 5) and it is the sound quality that counts. The wires, plugs and sheathing were from Maplin and the whole lot, including VAT and postage, came to just over £27 for three cables - and you can choose you own colour for the sheathing!

You will notice that I have chosen to use a 13A fuse in the mains plug. All of my equipment is individually fused with appropriate fuses and I decided that it was unnecessary to put a lower rated fuse in the plug from a safety point of view. There is a school of thought that argues that low-rated fuses can have a detrimental effect on sound quality and that all fuses should be replaced with high rated cartridges. I personally do not agree to any compromise on safety, but consider the equipment fuses adequate for the purpose and hence the use of 13A cartridges in the main plugs.

Was all the effort worth it? Absolutely! As I found with the borrowed lead, there was a significant improvement - tighter, cleaner bass, open treble with better imaging and more detail. I must state, however, that I have not been able to carry out any scientific testing of the cable to prove or disprove that it works, apart from basic continuity safety tests with a meter. All my comments are purely subjective; it just seems to work well. Take it from me as a converted sceptic, high quality mains cables do work, and at the price, you can't go wrong. ■

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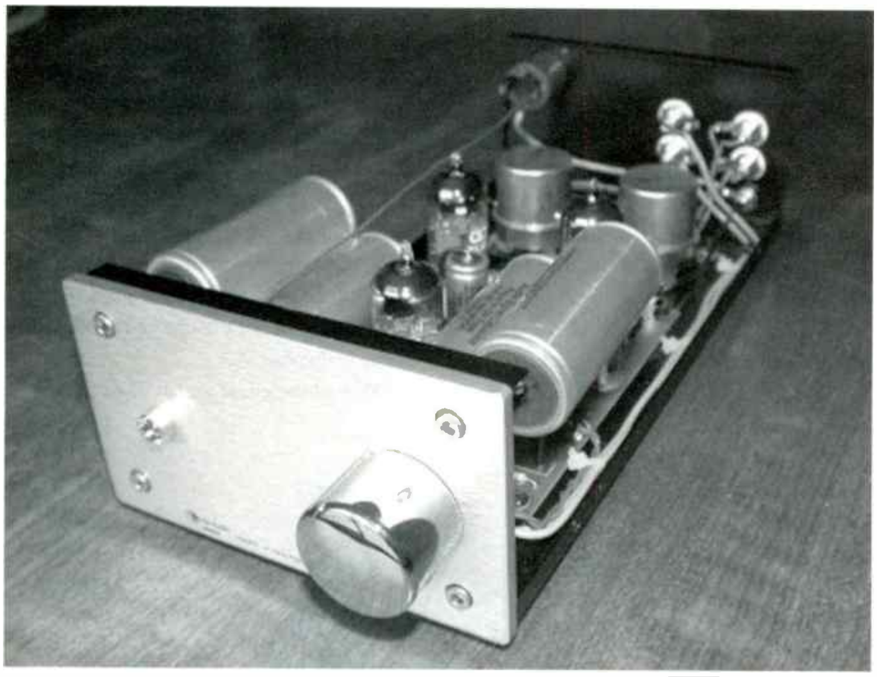
PRE-AMP UPGRADE

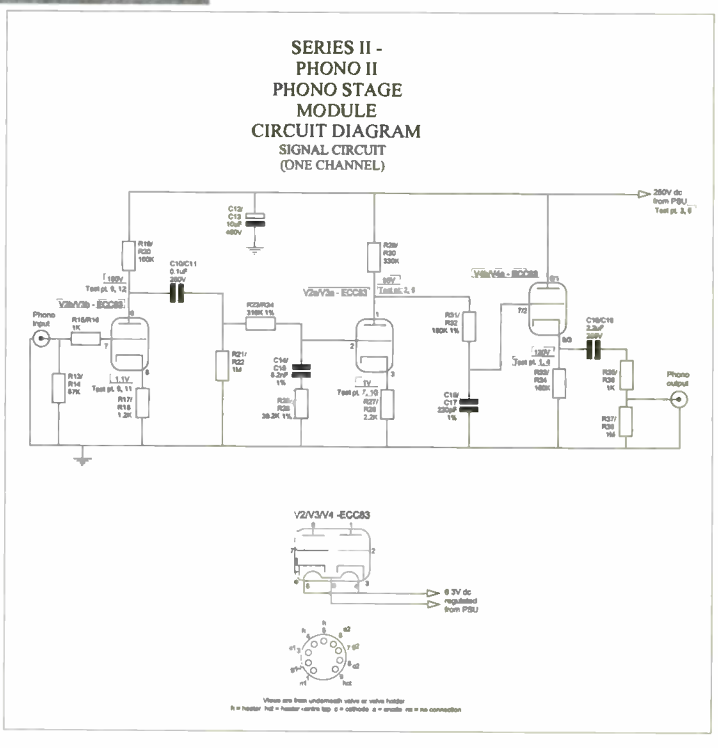
Neville Roberts upgrades our Series II preamps with special components and is convinced about the wonders of DIY.



The WAD Series-II Modular Pre-Amp, as supplied, is a high quality kit of excellent design. The point of having a valve pre-amp is to provide any necessary gain and, more importantly, buffering and drive for the power amplifier. Essential to any quality valve equipment are high-grade audio transformers and the Series-II certainly has these. However, there is scope for improvement with some of the other passive components. Any upgrading process is a law of diminishing returns and the dilemma facing kit suppliers is finding the balance between quality and cost. It is therefore appreciated that many will be perfectly content with the sound of their Series-II 'as supplied'. What is presented here is an approach that will give real discernable improvements to the Series-II without going 'over the top'.

In my case, the Series-II was purchased to replace a high quality, but transistorised pre-amp and drive a WAD K5881 Mk II. Having built the kit with the supplied components, it was clear from the outset that there was now considerably more detail in the sound than with its transistorised predecessor, although I felt that the bass was a little thinner than I was used to. Maybe I was confusing this bass "lightness" with "tightness"? The sound was also brighter, making strings sound a little on the harsh side. So the question was: where do I go from here?

Following the positive experience I had with upgrading my K5881 with Black Gate electrolytics, paper-in-oil capacitors and Shinkoh resistors in strategic places, I decided to give my Series II the same treatment. The first thing I did was to replace the cathode electrolytic of the Pre-II with an equivalent Black Gate electrolytic (C8/9) and all the resistors with Shinkohs. There were no problems with fitting in the new components. The replacements were pretty much the same size as the items they were replacing and anyway



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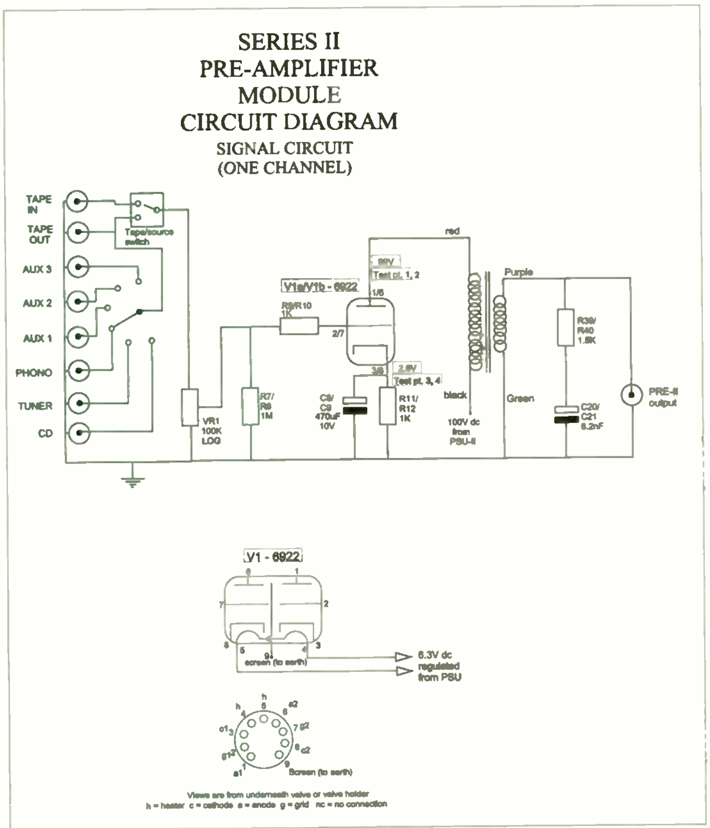


there is plenty of room on the circuit board (Figure 1).

After the prerequisite hour or so of "burn-in" for the Black Gates, I was amazed at the improvement. All the detail was there, not a hint of harshness and the bass extended to a depth that I had not experienced before, with clarity and tightness too.

Spurred on by success with the Pre-II, I turned my attention to the Phono-II. Looking at the circuit, it seemed a good target for some paper-in-oil capacitors. There was no problem with finding a replacement for C10/C11 0.1uF 250V. As can be seen in Figure 2, the replacement paper-in-oils were accommodated on the circuit board by drilling an extra hole to the left of the space for the old component and fitting the capacitor vertically.

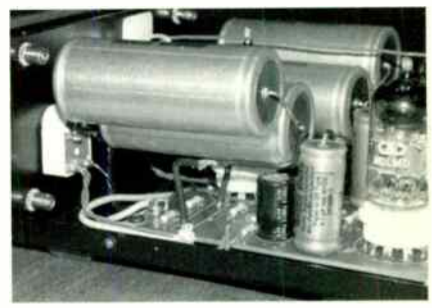
Replacing the 2.2uF 250V of C18/C19 was a different story however! After some investigation, I decided to use two 1.4uF 400V paper-in-oils in parallel. Alas, each capacitor is somewhat larger than the available space on the PCB. To be precise, they are over 2.5" long and 1" in diameter and I had to get four of them in there somehow!

This was a bit of a "How do you get four elephants in a Mini?" problem, but I managed it by putting them lengthwise on stilts so they fitted in the top left and right corners of the case (Figure 3). It is important to ensure that the 'stilts' are strong enough to hold the capacitors and soldered on both sides of the printed circuit board to give the necessary strength to the assembly. It is also important to position the capacitors so that they fit snugly into the corners of the lid so that, when assembled, the capacitors are held firmly in position. I also strongly advise the use of sleeving to ensure that there is no risk of touching other components. Although appearing flimsy, the result is surprising firm when the lid is in place.

I reconnected and powered on - what a difference! I was now getting the same excellent bass that I was enjoying with my other sound sources, but with the extra detail and depth that only records seems to be able to produce. I can genuinely say that the results are truly breathtaking! There is really nothing to compare with a first class direct-cut vinyl.

Finally, a couple of small modifications that I can thoroughly recommend are purchasing an additional mains on-off switch and knob and fitting this to the Phono-II to enable it to be switched on independently from the pre-amp. I am sure that I am not alone in using my CD player at least as much as my record deck and this modification saves wearing out the valves in the phono stage unnecessarily.

I also fitted a matching blue LED and fed it from the 6.3V DC heater supply. The switch and knob is of the same type as used in the PSU-II and the two poles are used to switch the heater and HT supplies. Care is needed when drilling the front panel and a good tip is to put a strip of adhesive tape across the panel before drilling. This reduces the likelihood of scratching and tends to stop the drill bit slipping. The switch and LED were positioned to mirror the layout of the PSU-II, thus making the Series-II a very elegant trio of units.



To summarise, I recommend Black Gate electrolytics, paper-in-oil capacitors and quality resistors (at least in the signal path) to obtain what is quite frankly a startling improvement in sound, almost as much as was achieved from the installation of the Series-II in the first place. The system copes admirably with everything from the delicate sound of a harpsichord playing Vivaldi to the magnificent splendour of a piece of Bach organ music.

In conclusion, it is worth pointing out that it seems that paper-in-oil capacitors as well as the Black Gates seem to need a period of settling in after installation. Let the system run with music playing, not just powered up with no input, for an hour or so before attempting any subjective assessment of sound quality. I think you will find the effort of upgrading worthwhile and it won't break the bank! ■ ⏏

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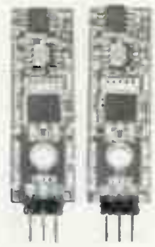

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CPW220N	Ansar 220nF 630V	32 x 9 0	2 00
CPW330N	Ansar 330nF 400V	32 x 8 0	2 00
CPW470N	Ansar 470nF 400V	32 x 9 0	2 00
CPW680N	Ansar 680nF 400V	32 x 10 5	2 00
CPW1U0	Ansar 1uF 400V	32 x 12 5	2 00
CPW1U5	Ansar 1 5uF 400V	32 x 14.7	2 00
CPW2U2	Ansar 2 2uF 400V	43 x 14 8	2 50
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CPW22U	Ansar 22uF 400V	55 x 39 3	7 50
CPW25U	Ansar 25uF 400V	55 X 42 0	7 50
CPW30U	Ansar 30uF 400V	55 x 44 7	9 00
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CPP220P	Propax 220pF 630V	0 40
CPP330P	Propax 330pF 630V	0 40
CPP470P	Propax 470pF 630V	0 40
CPP680P	Propax 680pF 630V	0 40
CPP1N0	Propax 1nF 400V	0 40
CPP1N5	Propax 1 5nF 250V	0 50
CPP2N2	Propax 2 2nF 250V	0 50
CPP3N3	Propax 3 3nF 250V	0 50
CPP4N7	Propax 4 7nF 160V	0 50
CPP6N8	Propax 6 8nF 160V	0 50
CPP10N	Propax 10nF 63V	0 60
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4U7Y100	Lo Imp Hi Temp 4 7uF 100V	0 30
10Y63	Lo Imp Hi Temp 10uF 63V	0 30
22Y63	Lo Imp Hi Temp 22uF 63V	0 30
47Y63	Lo Imp Hi Temp 47uF 63V	0 40
100Y63	Lo Imp Hi Temp 100uF 63V	0 60
220Y50	Lo Imp Hi Temp 220uF 63V	0.80
470Y63	Lo Imp Hi Temp 470uF 63V	1 50
1000Y35	Lo Imp Hi Temp 1000uF 35V	1 50
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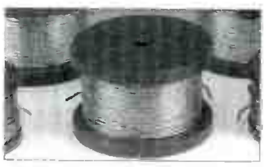
CAB5	Alcap 5uF	0 40
CAB6U8	Alcap 6.8uF	0 50
CAB8	Alcap 8uF	0.50
CAB10	Alcap 10uF	0 50
CAB16	Alcap 16uF	0 80
CAB20	Alcap 20uF	0 80
CAB25	Alcap 25uF	0 80
CAB35	Alcap 35uF	0 80
CAB50	Alcap 50uF	1 00
CAB60	Alcap 60uF	1 00
CAB80	Alcap 80uF	1 00
CAB100	Alcap 100uF	1 50

Monacor Air Cored Inductors.



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P22	220μH 0 15Ω 48x19mm	£2 50
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P68	680μH 0 35Ω 59x19mm	£4 50
P100	1mH 0 4Ω 59x19mm	£5 50
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F330	3 3mH 0 2Ω 330W	65x39mm	£9 50
F470	4 7mH 0 25Ω 140W	65x30mm	£11.00
F680	6 8mH 0 35Ω 120W	65x39mm	£12 00
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ECC81	DOUBLE TRIODE	£5 00
ECC82	DOUBLE TRIODE	£5 00
ECC83	DOUBLE TRIODE	£5 00
ECL82	TRIODE PENTODE	£4 00
ECL86	TRIODE PENTODE	£4 00
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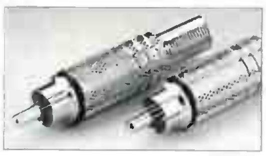

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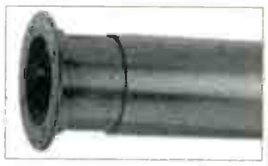

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