Power House
KEL80 Monoblocs - 80Watts of pure valve power
VISATON, who have been a sustaining member of the Audio Engineering Society for many years offer a vast range of speaker kits that give unrivalled sound quality & performance. From all round loudspeakers that are suitable for enthusiasts of any experience, to the top class high-end systems that require some advanced woodworking skills, the vast range of kits on offer means that there is something for everyone, whatever your tastes.

All kits are supplied with straightforward instructions & cabinet dimensions. No soldering is required for the “Alto” series as the crossovers come ready wired & fixed to gold plated connection terminals. The more advanced kits in the range do require some soldering.

Visaton Drive Units

Visaton have set a goal for their loudspeakers, and that is: “The completely natural reproduction of music, including the emotions that the artist tries to express”. Loudspeakers therefore have to perform with much more than just high power levels. A balanced frequency response as well as maximum transparency will give the optimum reproduction of all types of music from pop bands to symphonic orchestras.

Latest High-End Drive Units:

- **RHT 12** - High End Ribbon Tweeter (outstanding performance, must be heard)
- **AL 130/170** - 5.5” & 6.5” aluminium cone, cast chassis, bass/mid drivers
- **GF 200/250** - 8”&10” glass fibre cone, cast chassis, dual-coil bass drivers

**Help with your own Ideas**

At South Coast Speakers we want to help you realise your own ideas. We offer a full alter-sales service to help with any construction problems & general queries. We can also cater for specific needs with custom designs & projects.

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1) **Crossover Design**
   You must send us your drive units. We will then design & optimise a crossover network specifically for those units.

2) **Cabinet Design**
   In order to achieve optimum performance from the bass driver the cabinet must be the correct volume for that driver. Given the parameters of the unit we will supply cabinet dimensions together with port tube length & diameter if required.

3) **Full Test Service**
   We use a sophisticated computerised measurement system to fully test your loudspeaker with regard to frequency response, phase and impedance. We can also test driver units & supply you with the actual Thiele/Small parameters values. This will ensure that you have the correct values for your calculations.

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We can repair or up-grade your existing loudspeakers, bringing them up to 1998 specs. Upgrades include: Replacement drivers, OFC internal cable & new crossover components. Estimates are provided free of charge and without obligation.

**Listening Room**

Our Showroom has a comfortable listening area modelled on the average family living room, giving you, the customer, a realistic idea of how your kit speaker will sound when you have completed construction & plug them in at home. There are 15 kits on demonstration ±2 from time to time.

We are here to help you, offering informed & friendly advice so please ask.

FREE  Loudspeaker Kit & Drive Unit catalogue & price list (including some useful hint and tips)
Telephone / Fax: 01703 - 703221
Kit News
All the news that's kit to print in the world of DIY.

KEL80
Big Brother is watching you! We unveil our heftiest amplifier kit yet, the KEL80 monobloc. Four output valves will promote a healthy glow in all valve fans.

BOOK REVIEW:
Fundamentals of Valve-Radio Technique
by J Deketh

DIY Q & A
Once again, World Audio fields a strong team, while our correspondents bowl as many bouncers as they can.
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Specifications:

- 50W R.M.S. into 8 ohm
- 775mV I/P for rated O/P
- Short Circuit Protection
- I.E.C. fused mains inlet
- Indented gain control
- Compatable with Hifi Amps
- CD Players, Studio Mixers
- Computers etc.

FEATURES:-

- Power 50W R.M.S. into 8 ohm
- 775mV I/P for rated O/P
- Short Circuit Protection
- I.E.C. fused mains inlet
- Compatible with Hifi Amps
- CD Players, Studio Mixers
- Computers etc.

The PP50 Studio Loudspeaker Amplifier is designed to meet the exacting demands of the professional market but has the quality of sound reproduction normally associated with Highend Audio. Although having a small footprint, it has a full 50W R.M.S. output that makes a useful addition to an existing loudspeaker cabinet or custom made loudspeaker enclosures. The panel is designed to fit flush through a cutout approximately 170mm x 150mm in the rear of a Loudspeaker cabinet. Individual artwork available for OEM users. The PP50 Studio Loudspeaker Amplifier is designed to meet the exacting demands of the professional market but has the quality of sound reproduction normally associated with Highend Audio. Although having a small footprint, it has a full 50W R.M.S. output that makes a useful addition to an existing loudspeaker cabinet or custom made loudspeaker enclosures. The panel is designed to fit flush through a cutout approximately 170mm x 150mm in the rear of a Loudspeaker cabinet. Individual artwork available for OEM users. The PP50 Studio Loudspeaker Amplifier is designed to meet the exacting demands of the professional market but has the quality of sound reproduction normally associated with Highend Audio. Although having a small footprint, it has a full 50W R.M.S. output that makes a useful addition to an existing loudspeaker cabinet or custom made loudspeaker enclosures. The panel is designed to fit flush through a cutout approximately 170mm x 150mm in the rear of a Loudspeaker cabinet. Individual artwork available for OEM users.

Specifications:

- Power 50W R.M.S.
- I.E.C. fused mains inlet
- Indented gain control
- Compatible with Hifi Amps
- CD Players, Studio Mixers
- Computers etc.
THE BIG NOISE

Daringly named kit firm White Noise have just added two new items to their expanding range of products. Although more audio-conservative minds may boggle, White Noise's latest amplifier MOS250 is intended to produce (have a guess) 250 Watts steady-state into an 8Ω load. This solid-state power-house is available ready-made at £76.99, as a complete kit (£62.99), or else as a series of modules, or indeed simply as a PCB for you to source your own parts. Do remember that these prices apply to one channel only - you will need two for stereo.

Furthermore, White Noise's Active Power Supply kit may be just what the doctor ordered for the hum-afflicted. This device employs active filters to process the supply for a ripple-free DC output. The manufacturer claims this design is free of triangular-wave corruption. Active Power Supply kits are available in the same way as the MOS250 amplifier: ready-built and tested (£69.99), complete kit form (£54.99), plus modular or PCB form.

We hope to be looking some of White Noise's products in a future issue of Hi-Fi World's DIY Supplement. If you're unable to wait, a free catalogue is available from:

![White Noise
11 Station Road
Bearsden
Glasgow
G61 4AW
Tel: 0141 942 2460](image)

△ They're not flying saucers, they're MOSFETs - The MOS100 Power Amplifier Module.

DRIVING FORCE

South Coast Speakers, well-known in the kit business are diversifying into the ready-made market with an interesting project: the 'Excalibur - reference'. In contrast to most loudspeakers nowadays, the Excalibur - reference has no less than five drivers, plus a passive ABR unit. Driver details are:

1. Ribbon tweeter
2. 4.25in coated paper midrange
3. 5.25in uncoated paper midrange
4. 8in coated paper lower midrange
5. 10in doped paper driver
6. 10in doped paper passive radiator

No excuses for failing to move the air here!

South Coast say that the bass extension of the Excalibur - reference is 'to die for'; to test this for yourself in relative safety, contact:

South Coast Speakers
58 Wilton Road
Southampton, Hants.,
S015 5SZ
Tel: 01703 703221
website: www.southcoastspeaker.co.uk

Hot stuff from Billington

Billington Export Ltd is pleased to announce that their latest Wholesale Valve Catalogue will be available in November 1999. Also, for the adventurously curious, Billingtons also produce a catalogue of large and interesting display valves. (These items are large size, non-working items suitable for display purposes only). You can but ask!

![Billington Export
Units E1 & E2,
Gillmans Industrial Estate,
Billingshurst,
West Sussex RH14 9EZ
Tel: 01403 784961](image)

Transform Your Kit.......

News from Audio-Links: the Scunthorpe-based company are offering a custom C Core and R Core type transformer service, individually made to order, for power supplies or mains isolation conditioners. Specimen prices are £165.70 for a 350VA model or £284 for a 530VA model. They offer a very low external field, extremely low harmonic generation and, because of its large precision core, very high energy storage capacity between cyclic peaks. In addition it acts as a huge mains filter, attenuating mains-borne interference including r.f., h.f., and mains spikkes. Resulting in a much improved supply to equipment which is smoother, cleaner and far, far quieter.

In addition to this, Audio-Links stock the Danish Audio Connect CT1 attenuator priced £110.70. For the even more fastidious, Audio Links make their own attenuators, based on a switch by Elma of Switzerland. Contacts are hard gold plated directly onto copper contacts. Advantages claimed for these are better performance, increased choice of configuration and superior resistors (0.1% 15ppm).

Three main options are available in mono or stereo form for Series or L Pad attenuators at present: switch (with wafers) only, complete 47 or 94 resistor kits; fully-built attenuator. Both the kits and the built versions are calculated for customer requirements, so the most useful sequence of steps can be readily customized. Audio-Links believe that they are at present alone in offering this service as standard.

The attenuators in both kit and built form are available in values: 5kΩ, 10kΩ, 20kΩ, 50kΩ, 100kΩ, 250kΩ, 500kΩ, 1MΩ.

Audio-Links
7 Fairmont Crescent
Scunthorpe
North Lincolnshire
DN16 1EL
Tel: 01724 870432
Nick Lucas and Gary Devon pull the wraps off our latest tubular project, the KEL80 80Watt valve monoblocs.
Following the success of our budget KEL34 40watt kit amplifier, we decided to apply the same thermionic formula to a 'bigger brother' design, and so the new KEL80 monoblocs were born. Heading up the input stage we have the wonderfully linear 6AU6 working into a 5687 phase-splitter. The output stage utilises two pairs of EL34 pentodes in parallel-push-pull mode, allowing KEL80 to turn out 80Watts into an 8ohm load, enough to drive almost any loudspeakers.

Since KEL80's output transformers have 4ohm as well as 8ohm taps, there's also the option of bridging two monoblocs. By connecting the signal inputs and the speaker outputs together in parallel, two 8ohm-tapped monoblocs will provide a full 160Watts of valve power into a 4ohm load. And with an input sensitivity at around 380mV for full output, the £590 KEL80s will happily partner both passive and active pre-amplifiers.

In keeping with our philosophy of affordability thanks to elegant circuitry, the KEL80 is a simple but highly effective design which its creator, Gary Devon, will discuss later.

**TRANSFORMING KEL80.**
The heart of any valve amplifier is the output transformer; cos-cutting or lack of expertise here will always show as inferior sound. To achieve a broad frequency response that will not waver even at full power, the OPT needs to be both large and carefully wound. Therefore KEL80 boasts a size 120-lamination, 2.5in. stack that weighs in at a chunky 6kgs.

Located ahead of the OPT is a 250VA toroidal mains transformer of a similar specification to that fitted to the KEL34, although this time it's encapsulated in a black can and mounted externally. Encapsulation further reduces electronic and mechanical noise on an already extremely quiet transformer.

**ALL A-BOARD.**
For ease of assembly, all of KEL80's parts (bar

### KEL80 PARTS LIST (for 1 monoblock)

<table>
<thead>
<tr>
<th>RESISTORS</th>
<th>CAPACITORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWER SUPPLY</td>
<td>POWER SUPPLY</td>
</tr>
<tr>
<td>R1 3.9K, 6W</td>
<td>C1 470uF, 450V</td>
</tr>
<tr>
<td>R2 33K, 3W</td>
<td>C2 470uF, 450V</td>
</tr>
<tr>
<td>R3 13K, 0.66W</td>
<td>C3 4700uF, 16V</td>
</tr>
<tr>
<td>R4 36K, 0.66W</td>
<td>C4 100uF, 83V</td>
</tr>
<tr>
<td>R5 100R, 1W</td>
<td>C5 10uF, 450V</td>
</tr>
<tr>
<td>R6 100R, 1W</td>
<td>C6 100uF, 450V</td>
</tr>
<tr>
<td>R7 180R, 7W</td>
<td>C7 220uF, 25V</td>
</tr>
<tr>
<td>R8 180R, 7W</td>
<td>C8 220uF, 25V</td>
</tr>
<tr>
<td>R9 3.3K, 0.66W</td>
<td>C9 220uF, 25V</td>
</tr>
<tr>
<td>R10 3.3K, 0.66W</td>
<td>C10 220uF, 25V</td>
</tr>
<tr>
<td>R11 100R, 1W</td>
<td>C11 0.68uF, 630V</td>
</tr>
<tr>
<td>R12 not used</td>
<td>C12 0.68uF, 630V</td>
</tr>
<tr>
<td>R13 180R, 7W</td>
<td>C13 1uF, 250V</td>
</tr>
<tr>
<td>R14 180R, 7W</td>
<td>C14 470uF, 10V</td>
</tr>
<tr>
<td>R15 3.3K, 0.66W</td>
<td>C18 470pF, 160V</td>
</tr>
<tr>
<td>R16 3.3K, 0.66W</td>
<td>BRIDGE RECTIFIER</td>
</tr>
<tr>
<td>R17 220K, 0.66W</td>
<td>BR1 mains HT, 1200V, 1.5A</td>
</tr>
<tr>
<td>R18 220K, 0.66W</td>
<td>Samikron SKEB500C3200/2200</td>
</tr>
<tr>
<td>R19 10K, 3W</td>
<td>BR2 bias, 200V, 2A</td>
</tr>
<tr>
<td>R20a 68K, 1W</td>
<td>General Semiconductors 2KBP02M</td>
</tr>
<tr>
<td>R20b 82K, 1W</td>
<td></td>
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<tr>
<td>R21 15K, 1W</td>
<td></td>
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<td>R22 15K, 1W</td>
<td></td>
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<tr>
<td>R23 1M, 0.66W</td>
<td></td>
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<tr>
<td>R24 390R, 0.66W</td>
<td></td>
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<tr>
<td>R25 330R, 0.66W</td>
<td></td>
</tr>
<tr>
<td>R26 27R, 0.66W</td>
<td></td>
</tr>
<tr>
<td>R27 39K, 3W</td>
<td>BR3 heater, 200V, 2A</td>
</tr>
<tr>
<td>R28 100R, 0.66W</td>
<td>General Semiconductors WO2G</td>
</tr>
<tr>
<td>R29 2.2K, 0.66W</td>
<td></td>
</tr>
<tr>
<td>R30 1K, 0.66W</td>
<td>TRANSFORMERS</td>
</tr>
<tr>
<td>R31 10K, 0.66W</td>
<td>OUTPUT &amp; output transformer</td>
</tr>
<tr>
<td></td>
<td>MAINS toroidal transformer</td>
</tr>
<tr>
<td>SIGNAL</td>
<td>HARDWARE</td>
</tr>
<tr>
<td>R5 100R, 1W</td>
<td>Mains Switch</td>
</tr>
<tr>
<td>R6 100R, 1W</td>
<td>PCB fuse-holder</td>
</tr>
<tr>
<td>R7 180R, 7W</td>
<td>Fuse cover</td>
</tr>
<tr>
<td>R8 180R, 7W</td>
<td>Fuse, 1.6A, slow blow</td>
</tr>
<tr>
<td>R9 3.3K, 0.66W</td>
<td>Phono Socket</td>
</tr>
<tr>
<td>R10 3.3K, 0.66W</td>
<td>BFA speaker sockets</td>
</tr>
<tr>
<td>R11 100R, 1W</td>
<td>Mains Lead</td>
</tr>
<tr>
<td>R12 not used</td>
<td>Strain Relief</td>
</tr>
<tr>
<td>R13 180R, 7W</td>
<td>Feet</td>
</tr>
<tr>
<td>R14 180R, 7W</td>
<td>Wire (various)</td>
</tr>
<tr>
<td>R15 3.3K, 0.66W</td>
<td>Screws (various)</td>
</tr>
<tr>
<td>R16 3.3K, 0.66W</td>
<td>Octal PCB-mount valve base</td>
</tr>
<tr>
<td>R17 220K, 0.66W</td>
<td>BFA PCB-mount valve base</td>
</tr>
<tr>
<td>R18 220K, 0.66W</td>
<td>8TG PCB-mount valve base</td>
</tr>
<tr>
<td>R19 10K, 3W</td>
<td>Chassis</td>
</tr>
<tr>
<td>R20a 68K, 1W</td>
<td>VALVES + PCB</td>
</tr>
<tr>
<td>R20b 82K, 1W</td>
<td>Printed circuit board</td>
</tr>
<tr>
<td>R21 15K, 1W</td>
<td>Tesla EL34</td>
</tr>
<tr>
<td>R22 15K, 1W</td>
<td>6AU6</td>
</tr>
<tr>
<td>R23 1M, 0.66W</td>
<td>5687</td>
</tr>
<tr>
<td>R24 390R, 0.66W</td>
<td>SAFETY GLOVES</td>
</tr>
<tr>
<td>R25 330R, 0.66W</td>
<td>1 pair</td>
</tr>
<tr>
<td>R26 27R, 0.66W</td>
<td></td>
</tr>
</tbody>
</table>
KEL 80 MONOBLOCK CIRCUIT DIAGRAM

POWER SUPPLY UNIT

For 230V/240V operation, join windings in series, pin brown & grey together and adjust.atican 230V/240V and blue is 0V.

For 110V/120V operation (join windings in parallel, join brown & grey together, becoming 110V and blue & violet together, becoming 0V.

VALVE PIN LAYOUT

V6-6AU6
V5-6AII
V1-EL34
V3-EL34
V2-EL34
V4-EL34

Views are from underside valve or valve holder
A = heater 30V d.c. for 1 x 6AU6 and 4 x 5687 B = heater 30V d.c. for 1 x 5687 and 4 x EL34

World Radio History
A Components-side view of KEL80 printed circuit board

The transformers, power switch, gold-plated BFA speaker sockets and the phono inputs are located on a printed circuit board. This heavy-duty PCB measures 120mm by 215mm by 2.4mm thick, and is highly resistant to all those hard-core valve heads who insert their valves with sledge-hammer delicacy.

KEL80's external dimensions are 435mm(l) by 140mm(w) by 175mm(h) with the valves inserted. The chassis consists of a box and base plate in 16 swg steel beneath a black powder-coat finish topped off with white, silk-screened lettering. Robustly constructed, each monobloc weighs 12kgs.

Our valve selection includes the JJ-branded Tesla EL34, a very impressive performer with a beautiful tone and well-defined bass. The 6AU6 and 5687 are currently out of production, but never fear - there are plenty around, especially in the World Audio stores. The 6AU6s we use are of Russian origin, while the 5687s are American Sylvania types.

With the aid of the instruction booklet with its many diagrams, building KEL80 is straightforward. PCB population is 'electronics by number' thanks to the PCB tab illustration, and once the board has been completed, there are only 20 PCB-to-external connections via terminal pins. There is no need to set valve bias - all you have to do is make sure some speakers are wired up!

The high tension (HT) lines reach 500V, but don’t let this scare you off. As part of the kit we provide electrical safety gloves that provide protection up to 650V. And as far as amplifier damage sustained through mis-assembly goes, rest assured that KEL80 is a rugged animal and will walk away unscathed from any short-term distress. We also provide a help-line number and e-mail address for all constructors' inquiries and, if the worst comes to the worst and you cannot get the amp running, we will sort out your problems for a nominal fee (around £50). NL

CIRCUIT DESCRIPTION.

KEL80's circuit is very similar to KEL34's in that it uses a triode-connected pentode, the venerable 6AU6, directly coupled to a common-cathode phase-splitter as its front-end. In this case, however, the phase-splitter is a 5687 double-triode, a high-transconductance, high-power, special-purpose valve from the US which features in our 300B kit too.

This valve was used to try to reduce the output impedance of the phase-splitter section as far as possible, in order to drive the input capacitance of the parallel EL34s. A cathode-follower could have been interposed between the phase-splitter and the output valves, but added complexity, including the extra power supply required, is invariably detrimental to the sound.

The 5687 is a really good-sounding valve, very powerful and somewhat dark. A 7044 will work equally well in there, giving a rather drier and brighter balance. Then there's the 'lean, mean, fighting machine' E182CC, which is very clear and strong.

The output stage is four EL34/6CA7 valves in parallel push-pull, class AB. There is a good chunk of Class A available for regular listening levels, with the clout of 80watts available for musical peaks and annoying the neighbours.

RADIO ACTIVE.

KEL80's grid-stoppers are necessary to prevent parasitic oscillation when paralleling valves, especially high transconductance types like the EL34.

I once built an amp using two paralleled 211s in single-ended mode, and while testing the output stage using an external power supply, I found that my digital meter was going crazy whenever I tried to measure any voltages on the circuit. Worse, I noticed that the meter would read garbage if it got close to the circuit, without even being connected. Hmm, I thought, time to connect the scope. Lo and behold, I discovered massive oscillation at about 1MHz, and I mean MASSIVE - the anodes were swinging 2000V peak to peak! My meter, and even more disturbing, my body were being irradiated with high-power RF. I thought it was warm! Grid and anode-stoppers put paid to that situation though.

The feedback network is slightly different to KEL34's as it includes an extra couple of resistors to reduce the dissipation in R29, on top of a resistor to reduce the overall feedback at extreme high frequencies. The bass network is similar, with C14 increasing LF feedback. This can be modified to change the bass presentation. Small value will reduce the extension and give the bass a speedier sound, maybe for Dance, whereas a larger value would be good
The secret's in the metallised film.

CRICKLEWOOD ELECTRONICS

CPP150P CAP PROPYL 150pF 250V 10.35
CPPI00P CAP PROPYL 1000pF 250V 10.35
CPP47P CAP PROPYL 47pF 250V 80.35
CPP7K CAP PROPYL 7k 11.00

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Part No. Value Voltage Price
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11050 LD-2.25 TEMP 275F 50V 0.25
47050 LD-2.25 TEMP 125 63V 0.25
10050 LD-2.25 TEMP 1000V 63V 0.25

Cheap polypropylene you can enjoy an

very Important for keeping down hum whilst allowing

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CPP9F CAP PROPYL 22µF 63V £ 0.85
CPP10F CAP PROPYL 10µF 63V £ 0.65
CPP10F CAP PROPYL 220µF 63V £ 1.25
CPP20F CAP PROPYL 22µF 63V £ 0.85
CPP20F CAP PROPYL 47µF 63V £ 1.00

Crossover or filters for use up to 400W. Use enamelled copper wire (1.3mm on 61000)

Part No. Value Voltage Price
47030 LD-2.25 TEMP 125 63V 1.25
47030 LD-2.25 TEMP 125 16V2 1.25
47030 LD-2.25 TEMP 125 16V3 1.25
47030 LD-2.25 TEMP 125 16V4 1.25

Monacor Air Cored Inductors.

Part No. Value Voltage Price
47030 LD-2.25 TEMP 125 16V2 £ 1.25
47030 LD-2.25 TEMP 125 16V3 £ 1.25
47030 LD-2.25 TEMP 125 16V4 £ 1.25

A range of professional high efficiency toroid core inductors with very low losses. Use for B10 or A10 crossovers in Phase for use up to 400W. Use enamelled copper wire (3.0mm on 61000)

Part No. Value Voltage Price
50006 LD-2.25 TEMP 125 16V3 £ 1.25
50006 LD-2.25 TEMP 125 16V4 £ 1.25
50006 LD-2.25 TEMP 125 16V5 £ 1.25
50006 LD-2.25 TEMP 125 16V6 £ 1.25

Monacor Ferrite Inductors.

Part No. Value Voltage Price
50006 LD-2.25 TEMP 125 16V3 £ 1.25
50006 LD-2.25 TEMP 125 16V4 £ 1.25
50006 LD-2.25 TEMP 125 16V5 £ 1.25
50006 LD-2.25 TEMP 125 16V6 £ 1.25

Super Monacor Ferrite Inductor catalogue design book with many applications and designs £6.00 (£6.50 including VAT) + £1.00 POST.

Monacor Ceramic Capacitors.

Part No. Description Price
47030 LD-2.25 TEMP 125 16V2 £ 1.25
47030 LD-2.25 TEMP 125 16V3 £ 1.25
47030 LD-2.25 TEMP 125 16V4 £ 1.25

High quality valley value bases. Chassis mounting with screw fixings.

Part No. Description Price
47030 LD-2.25 TEMP 125 16V2 £ 1.25
47030 LD-2.25 TEMP 125 16V3 £ 1.25
47030 LD-2.25 TEMP 125 16V4 £ 1.25

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for organ music. However, there really aren't many speakers around which can take 80 watts of power at sub-50Hz frequencies without flapping and making sounds like the morning after seven pints of Guinness and a curry (if you're unfortunate enough to know what I mean!)

The power supply is all very down to earth, with the half-HT voltage feed to the screen grids of the EL34s. A regular capacitor-input filter with a solid-state bridge is used for rectification. Have fun! GD

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<tr>
<td>KEL80 - K240/120:</td>
<td>£590.00</td>
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Fundamentals Of Radio-Valve Technique

By J. Deketh

Fundamentals Of Radio-Valve Technique by J. Deketh, a Philips Technical Library book, was originally published in 1949 by Philips of Holland, then one of the primary valve manufacturers in Europe. This reprint is by Audio Amateur Press and forms part of their extensive re-issue catalogue.

The book contains an in-depth examination of valve theory, manufacture and application, especially in radio circuits. It comprises 33 chapters, organised in a logical manner progressing from essential principles to final applications, plus appendices. Chapters one to five introduce and develop the theory of electron emission and the behaviour of electrons in a vacuum. These chapters are short, snappy and very informative. I've not seen such a concise description of the fundamentals of emission from oxide-coated cathodes before, a very complex electrochemical process. Here the reader can assimilate the essentials without having to plough through acres of complex maths. The method of calculating the characteristics, amplification factor and transconductance are introduced, along with the behaviour of the various grids in the valve under AC conditions is next on the agenda. With the logical layout of the book the reader can assimilate the essentials without having to plough through acres of complex maths and technobabble. Other interesting topics are the space charge which surrounds the cathode, and secondary emission.

The next four chapters bring these fundamentals together in an explanation of the internals of the valve and how they are constructed during manufacture. Deketh goes step by step through the various procedures, backing up the text with plentiful pictures of strange machinery drawing glass and ladies hand-assembling valves. Chapters nine, ten and 11 are equally concise in their coverage of the very basic concept and operation of a radio receiver; conventions in representing valves in circuit diagrams, and the nomenclature of the various types: diode, triode, etc. From here on in the author starts dealing with the "meaty" bits, the more 'electrical' side of the valve. Transfer characteristics, amplification factor and transconductance are introduced, along with the behaviour of the various grids in the electron stream. Naturally the working of the valve under AC conditions is next on the agenda, taking into account the internal capacities under the spotlight. Knowledge of how these arise and how they interact is vital for successful radio design, and they have a major impact on audio frequencies too. Chapters 15 and 16 will be of great interest to valve amp builders in the discussions of distortion and how it stems from the curvature of a valve's characteristic. These parts of the book are quite mathematical, although they shouldn't be beyond the understanding of someone with a good fundamental grasp of maths. The method of calculating the distortion which is going to be produced by a valve from its loadline is a very useful tool since it allows you to decide on a suitable load condition.

This idea is taken even further in the second of these two chapters, which goes into detail on the use of exponential series to represent the valve's geometric curvature in an algebraic form. The book's bias towards radio receivers means time is also spent going over modulation and intermodulation by the valve's curvature. In line with the logical layout of the sections, the power stage of the radio set comes under scrutiny next. This chapter is very good but it does get a bit too theoretical. The various modes of operation such as single-ended, push-pull, Class A and Class B are investigated in both triode and pentode form, albeit in an algebraic rather than a graphical manner.

Chapters 18 and 19 explain the basics of rectification, the former with the rectification (detection) of a radio signal in a receiver. When the rectification theme progresses to power rectification, the treatment is again quite theoretical in nature, but towards the end of the chapter there are some great rules of thumb. The next four chapters are mainly of interest to radio enthusiasts, and cover oscillators, frequency conversion, gain control and automatic volume control in radio sets.

Next we come to a chapter on the noise generated by valves. This section involves some maths but, once more, you need to know this stuff when designing pre-amps. It opens by introducing the actual processes inside the valve which cause noise, and closes by providing some formulae with which to calculate it. Chapters 25 and 26 are dedicated to the short-wave properties of valves and tuning indicators, leaving chapter 27 to handle negative feedback. The coverage is necessarily mathematical, but the analyses are straightforward because only the general concepts are covered. The text explains why feedback is used - to reduce distortion of various forms and the various forms it can take, as well as how it may be practically implemented. However, stability is only mentioned in the last section of the chapter, and isn't treated in depth.

The following two chapters discuss the terrible twins of valve amplifiers, hum and microphony, and where and how these arise. The knowledge gained here will go a long way towards understanding and then eliminating them. Next is a couple of chapters which I believe are unique in a book of this sort. They examine the ageing effects which occur in a valve over its lifetime and the impact of secondary emission on valve performance. As Philips were such a vast valve manufacturer, they amassed a wealth of knowledge on these subjects. The penultimate chapter considers all sorts of power supplies for radio sets: batteries, AC/DC, and even in-car. There are no real high-power audio power amplifier supplies due to the fact that this book is primarily aimed at the table radio designer. The final chapter is just a few pages on receiver sensitivity.

The appendices are very comprehensive, with all kinds of information on resonant circuits, filters, skin-effect and so on. Overall this book is a 'must-have' for both the amplifier-builder and the valve radio enthusiast. It's quite technical, but a reference text like this has to be. Deketh was (or is) obviously an expert engineer with an enormous amount of experience under his belt. This is apparent from the easy way in which he explains the various techniques discussed in the book and the intuitive way in which they are organised. GD

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J. DEKETH

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Heater floatation

I’ve really enjoyed your magazine over the last few years, especially the articles on classic equipment. I have a particular interest in valve gear and the Quad ESL57 electrostatics, and appreciate the range of material you have provided and the levels of interest you have created - except for the consequent rise in ESL57 prices! These interests have led to the following notes and queries, initially spurred by a comment in one of Gary Devon’s replies in the DIY letters section of the July issue. He noted that the performance of ECC82 Shunt-Regulated Push-Pull stages can deteriorate badly due to the heater/cathode insulation of the upper valve degrading. However, for some reason ECC83s and 6SL7s seem to be OK.

One of the problems with SRPP stages is that the cathode of the upper triode is at a large potential above earth, whilst the heater power supplies are usually earthed on one side or the other. This leads to a significant heater-to-cathode voltage. The manufacturer's specification typically sets a limit of about 180V maximum cathode-to-heater voltage for both the ECC82 and ECC83, with the cathode positive with respect to the heater (the limit is lower if the polarity is reversed). I suspect this factor is behind the deterioration, and that the reason the ECC83 and 6SL7 fare better is that they are higher impedance, lower current valves.

This hypothesis gets some support from the fact that the high-spec equivalents, the E82CC and E83CC, have different detailed specifications, with the maximum potential difference between heater and cathode of the E82CC being restricted to 100V. Jones (1995, below) has indicated that the main damage mechanism is bombardment by stray, positively-charged ions. The energy of such collisions, and thus the damage, will be increased for surfaces at greater negative potentials. Whilst on this subject, it is interesting to note that lesser voltages have been invoked in discussion of heater deterioration. There’s the hypothesis that the use of DC for heaters leads to deterioration through the heater insulation ‘creeping’ under the influence of the roughly 6V potential across the length of the filament! Personally, I prefer DC, and real fanatics can always reverse the polarity from time to time.

As an important aside on DC voltage regulation, it is essential not to turn on the voltage too fast (high-current capability AC sources can also be hard on heaters). I chose an RC time constant of a few seconds for the heater voltage to come up to 6.1VDC. See also Jones (1995) on the topic of “cathode poisoning”. The solution to the SRPP cathode deterioration problem is relatively simple, and involves floating the filament power supply for the SRPP valves at about 150V positive to earth. This should not stress the insulation on the heater transformer winding too much. The practice will improve conditions for the upper stages of any stacked-valve circuit, or a single-valve stage with high cathode impedance, such as the cathode-follower or concertina phase-splitter. I have put this into practice using a simple voltage-divider from the HT rail, guided by the suggestion that, for most configurations, no more than 150k should be used in the cathode circuit. For example, for three such stages on a 400V rail, a 50kohm to 63kohm divider (133k total, which runs at about 3mA and wastes only 1.2watts) should satisfy all requirements.

Richard Barton
rh.barton@btinternet.com

Thank you very much for your letter Dr Barton.

The ECC82 and ECC83 are very similar valves. They form part of a series which, if memory serves, was designed in the Fifties for widespread, low-cost commercial service in TV’s, radios and audio equipment. They share identical anodes and cathodes, with the only differences cropping up in the grids. Of course, I could be wrong and the two types could have different cathodes, but the heater ratings are the same, suggesting that my brain hasn’t totally given up the ghost yet.

It could be that the ECC83 is just as problematic as the ECC82. I’ve been lucky with the original Mullards I’ve used, but friends and colleagues agree that it mutates into a noisy, microphonic little so and so when used in SRPP or as a cathode-follower. The majority of the ECC83s I’ve tried recently have been the Russian-sourced items which obviously have good heater-to-cathode insulation as I’ve never had any real noise problems with them as SRPP front-ends or phase-splitters, even in

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large production runs.

Eventually all valves become noisy to a greater or lesser extent when they have a heater-to-cathode voltage present. A friend of mine, a well-known keyboard player, uses a modified Hammond organ as part of his set-up. The power stage has been removed and the output taken to a slave power amp from what used to be the phase-splitter. The 12BH7 employed there is always becoming noisy. The problem didn’t show up when the output valves were driven from this point because of the higher signal level.

Heater-to-cathode degradation in indirectly-heated valves is caused by migration of metal from the cathode, and especially the heater, into the alumina insulation between the heater wire and the cathode. This reduces the insulating properties of the material in an erratic way. In fact, alumina is used in chemistry for chromatography, which relies on a similar separation. This migration mechanism occurs over the life of the valve. If there is no potential between the heater and cathode, then not much usually happens apart from an increase in hum over time. AC heaters are used. But if there is a potential present, the result is popping and rustling noises. If you are only using the valve as a power amplifier phase-splitter, you’re unlikely ever to notice. Believe me, it’s a real pain at the input of a phono stage though!

The maximum recommended heater-to-cathode voltage exists not only for pure breakdown reasons, but more because of the fact that a DC potential across the heater-to-cathode insulation causes an electrolytic action which greatly exacerbates the migration of metal into the alumina. Mil Spec or similar specification valves have tighter ratings than their commercial equivalents because they have to be ultra-reliable. For example, the 5961, 5962, and 5963 valves were designed for applications such as servos at nuclear missile silos. A failure there could be a little embarrassing to say the least! To ensure extreme reliability, the heater voltage, heater-to-cathode voltage and anode power dissipation have to be tightly controlled. A more relaxed specification is permissible for commercial valves because failure wouldn’t be so catastrophic. Using DC for indirectly-heated valves should cause no problems with heater-to-cathode insulation. On the other hand, difficulties can occur with directly-heated versions, especially those with dull emitters like the 300B, which have an oxide-coated filament. Indirectly-heated valves were developed to overcome the problem of not having the theoretical ideal of a uniform electrical potential over the emissive surface of the cathode. Various attempts were made at "unipotential cathode" valves, culminating in the type we know today, which has a heater wire inside a metal tube covered with an insulating aluminium oxide coating. The chemistry of the coating is very complex, and it partly relies on the electric potential from the anode for its operation.

The potential across the oxide layer reduces a small amount of the barium oxide to metallic barium. This permeates to the surface of the cathode to form a very thin, possibly monomolecular layer, and it is here that the electrons are emitted. With a directly-heated valve, the heater voltage can interfere with this effect. AC heaters allow an even coating of metallic barium to form over the surface of the filament. If DC is used, the coating will be uneven, lessening the maximum emissivity and shortening the life of the valve. However, there are many other mechanisms at play when it comes to valve life, and using DC is normally OK. Ion bombardment is not an issue for valves running anode voltages lower than 800V to 1000V because first, the vacuum should be very good, and second, any ions present cannot reach a high enough velocity to cause damage. In high-voltage, high-power transmitter valves, the anode dissipation is very high, so the vacuum will be worsened by emission of gas from the anode. On top of this, the high voltage accelerates the ionised gas to a sufficient velocity to destroy an oxide-coated cathode. This is why very large, high-voltage valves use a thoriated-tungsten or pure-tungsten bright emitter cathode, which is much less sensitive to damage but less efficient. When operating very high power transmitter valves, the heater voltage is reduced after the valve has run up in order to keep the cathode at the correct temperature. The bombardment effect imparts so much energy to the cathode that it causes it to heat up. The thermal shock to a heater wire when first turned on can be quite severe, causing it to fatigue and break, so some sort of slow warm-up device can be a good idea. The best is a PTC thermistor surge suppressor.

Cathode poisoning occurs when the oxide coating becomes contaminated and the metallic barium is either not produced or, when it is produced, it reacts with the contaminant. As I stated, the production of metallic barium relies on the anode voltage. For this reason, when there is no anode voltage present, or where the valve is reverse-biased into a cut-off condition, the cathode can lose its emissivity. Some valves, which were designed for computers, have a special cathode which can survive for long periods in a cut-off state. The E182CC is an example of such a valve.

Raising the heater supply to a positive voltage can help with heater-to-cathode breakdown when the cathode is also at a positive voltage, but watch out for the other valves on the same heater supply. If their cathodes are at an "earthy" potential, you can damage their cathodes while trying to rescue the others.
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Dear Hi-Fi World, I am about to embark upon a rebuild of a pair of Leak TL12+s and before I begin I would like some advice, knowing that there are a few valve heads bouncing around within the walls of Hi-Fi World Towers. Upon inspection of my newly acquired TL12+s I was amazed by the neatness of the hard wiring, so much so, it seems a shame to disturb them. But as neither amp works, something must be done. The previous owner said there were a few dry joints, he had managed to fix them a couple of times but had never reached a permanent solution, hence why I have them in my possession and he has a 150.00GBP of my hard-earned cash.

Anyway, my question is this, do I do as he has done and locate the dry joints and clear them up or do I go all out and do a major overhaul? Also, is it a good idea to change the components as well as they look a bit worst for wear? If so which do I use. To give you an idea of my capabilities, I built one of your marvellous K5881 push-pull amplifiers, just after it was released, for a friend of mine. I await your response eagerly.

Mr Douglas

I eagerly volunteered to answer this one as I was in a similar situation a month or so ago when I picked up a pair of TL12+s at a car boot sale, I will not tell you the price I paid for them; the guy who was selling them thought he was selling a pair of antiquated Christmas lights. They were not in good condition!

To answer your questions. Your Leak TL12+s are pushing 40 years old, and most consumer electronics nowadays have a lifetime of 10 years at the most. So your Leaks have done jolly well to get this far! Obviously, component quality has come on in leaps and bounds since then, with components now being specifically made for audio use rather than 'radio'. Obviously the original components are looking to be retired.

There is an argument that the Leak TL12+, or indeed any vintage gear, must have original type components. I feel that your Leak will not be much of a Leak when its components start failing! In this age of tweakers, modern audiophile components are numerous, well-documented and reliable. One component that I do rate from the original Leak TL12+ is the metallised paper signal capacitors; a similar type can...
be purchased from Audionote. You can probably tell that I went for the major overall route. Not only a full component change but a rewire and a total valve socket change as well.

Component selection was based on a low-to-medium budget: I went for Solens Polypropylene for the signal capacitors and standard RS electrolytic capacitors for the smoothing caps. N.B. Do not be tempted to overdo the capacitance here e.g. do not use a 200µF 450V instead of a 16µF 450V (C5) as you may give both the rectifier valve and the power transformer a very hard time. Similarly, don't overdo the values of the decoupling caps; this can cause the dreaded 'motor-boating' under unfavourable circumstances.

For the remaining caps I used polystyrene capacitors for tonal clarity. For the resistors I have used carbon films - a proven winner for valve amps. Metal film resistors do have a tendency to give the sound a slight treble lift. For the wire I stuck to 1.0.6 silver plated copper wire for all low current connections and standard multistrand for heater wiring and speaker output connections. For the valve sockets I used chassis-mount octals from Billington, McMurdo, Part No. SOC 83 (these are of a brown colour not black) and the chassis mount B9A, part No. 9SOC9PMTD. These are close to the originals and fit the pre-drilled chassis snugly. Please note that Leak used self tapping screws for mounting the hardware. Preferring nuts & bolts, I increased the hole sizes slightly with a drill and bit. All the other hardware I kept original.

I tackled the rebuild by removing one of the tag boards, cutting all the connections at the board and using this as a template to rebuild the other. When cleaning up the board it is important to have good ventilation as the old solder has a funny smell and is not good for you! Also, tread carefully as the tabs on the board are very fragile. Leaving one amplifier with its wiring intact while I rebuilt the other was very helpful - it is imperative that you copy the wiring method particularly potentially confusing bits such as output transformer tag layout. Once you have one amplifier fired up and it is operating correctly, then's the time to start the rebuild of the other. The whole job took 25hrs, but as always, time and trouble taken here will give rich rewards in the long run.

For a copy of the TL12+ circuit and many other old Leak designs, write to L & W Services, 9 The Parade, Bramhope, Leeds, LS16 9AF, stating which diagram you need and enclosing GBP 4.00 per copy.
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<table>
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### and a few “Other Brands” (inc. Scarce types).

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