

Hi-Fi

WORLD

NO.26 DECEMBER 1956

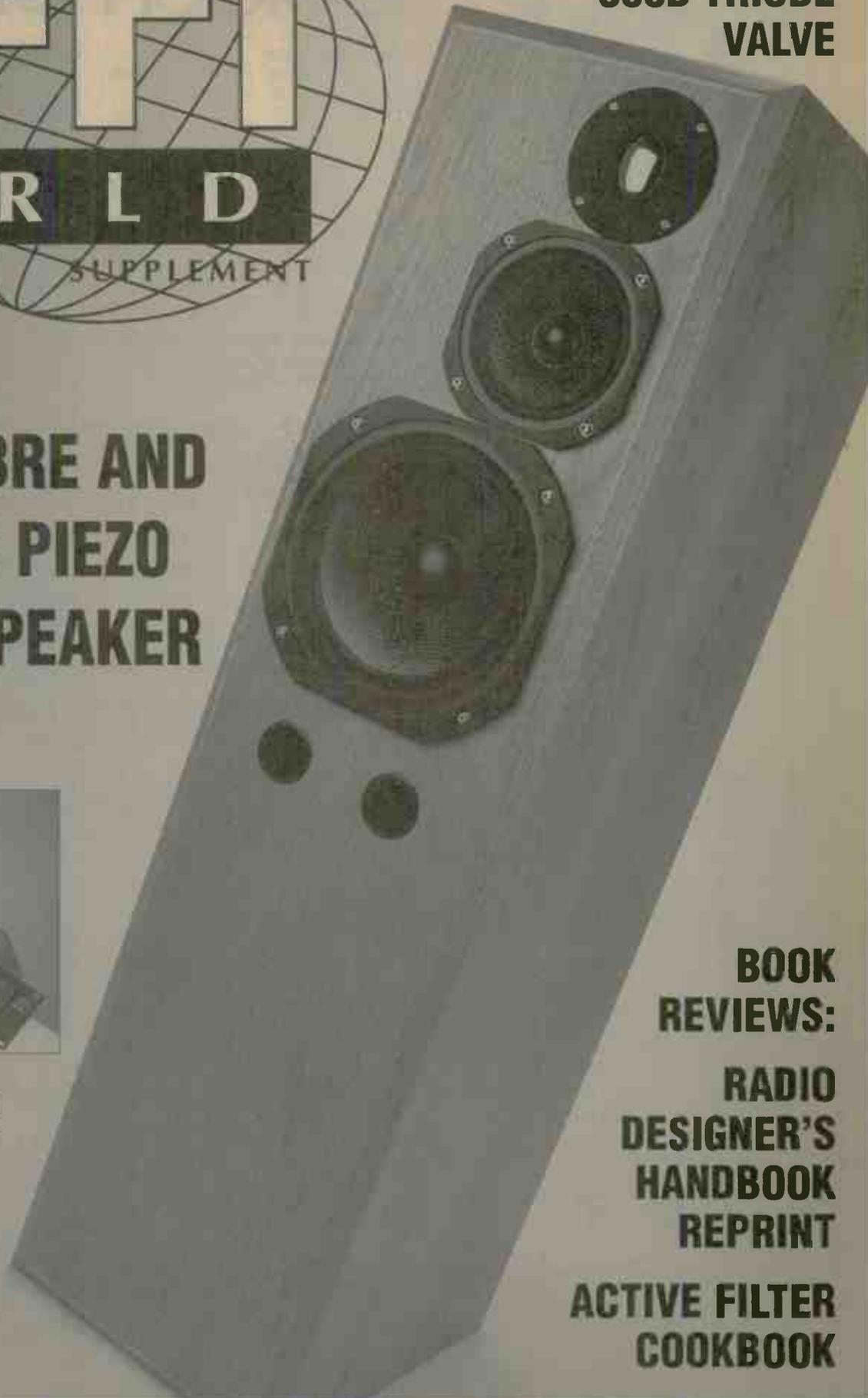
SUPPLEMENT

**FIRST TEST OF
SOVTEK'S RUSSIAN
300B TRIODE
VALVE**

**KLS3 GOLD:
CARBON FIBRE AND
GOLD DOME PIEZO
TWEETER SPEAKER**



**BSS OMNIDRIVE
FDS-388:
VERSATILE
ACTIVE
CROSSOVER**

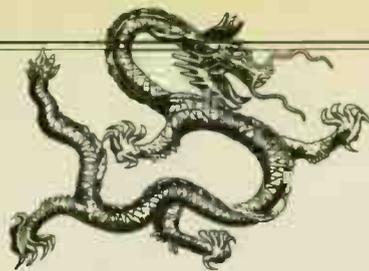


**BOOK
REVIEWS:**

**RADIO
DESIGNER'S
HANDBOOK
REPRINT**

**ACTIVE FILTER
COOKBOOK**

FREE D.I.Y. SUPPLEMENT No. 26



Golden Dragon

RETAIL PRICE LIST

| Golden Dragon Pre-Amplifier Tubes | Singles |
|-----------------------------------|---------|
| 6AQ8/ECC85 | £6.50 |
| 12AT7A/E81CC/ECC81 | £6.95 |
| 12AU7A/E82CC/ECC82 | £6.95 |
| 12AX7A/E88CC/ECC83 | £6.95 |
| 6DJ8/E88CC/ECC88 | £10.95 |
| 6SN7GT/ECC33 | £8.95 |

Special Quality Golden Dragon Pre-Amplifier Tubes

| Singles | |
|---|--------|
| E81CC-01 Gold Pins Low Microphony Low Noise | £10.50 |
| E82CC-01 Gold Pins Low Microphony Low Noise | £10.50 |
| E83CC-01 Gold Pins Low Microphony Low Noise | £9.50 |
| E88CC-01 Gold Pins Low Microphony Low Noise | £14.50 |

Golden Dragon Triodes

| | Singles | Pairs | Quads |
|-----------|---------|--------|---------|
| 2A3 4PIN | £22.50 | £50.00 | £100.00 |
| 2A3 OCTAL | £22.50 | £50.00 | £100.00 |
| 211 | £28.50 | £60.00 | £120.00 |
| 811A | £11.50 | £25.00 | £50.00 |
| 845 | £36.50 | £75.00 | £150.00 |
| 805 | £36.50 | £75.00 | £150.00 |

Golden Dragon 300B Range

| | Singles | Pairs | Quads |
|----------------|---------|---------|---------|
| 300B Super | £79.00 | £160.00 | £320.00 |
| 4.300B | £84.00 | £170.00 | £340.00 |
| 4.300BLX Super | £124.00 | £250.00 | £500.00 |

Please enquire of any tube types not listed. We have an inventory of over 2,500 different types in stock.

Golden Dragon Power Tubes

| | Pairs | Quads | Octets |
|-----------------------------|--------|---------|---------|
| EL34/6CA7 | £25.00 | £50.00 | £100.00 |
| E34L | £29.95 | £60.00 | £120.00 |
| EL84 | £8.95 | £19.00 | £38.00 |
| E84L | £12.50 | £25.00 | £50.00 |
| 6L6WGB/5881 | £25.00 | £50.00 | £100.00 |
| KT66 | £25.95 | £52.00 | £104.00 |
| KT88 (Hair Design) | £57.95 | £116.00 | £232.00 |
| KT88 Super (Laminated) | £67.95 | £136.00 | £272.00 |
| 6L6GC | £19.95 | £40.00 | £80.00 |
| 6550A | £42.95 | £86.00 | £172.00 |
| 6550A Special (Gold Plated) | £64.95 | £130.00 | £260.00 |
| 50CA10 | £84.95 | £170.00 | £340.00 |
| 807 | £25.00 | £50.00 | £100.00 |
| KT66 Super | £65.00 | £130.00 | £260.00 |
| KT90 | £65.00 | £130.00 | £260.00 |
| KT90 LX | £75.00 | £150.00 | £300.00 |

Ceramic Sockets and Hardware

| | Standard | Gold Plated |
|----------------------------------|----------|-------------|
| Locking 4 Pin (300B etc.) | £6.95 | £15.00 |
| 4 Pin UX4 (300B etc.) | £2.50 | £3.50 |
| Jumbo (211 etc.) | £12.50 | £25.00 |
| Octal Chassis (EL34 etc.) | £1.25 | £3.50 |
| Octal PCB (EL34 etc.) | £1.25 | £3.50 |
| B9A Chassis (pre amp) | £1.25 | £2.50 |
| B9A PCB (pre amp) | £1.25 | £2.50 |
| Screening Can & Skirt (pre amp) | | £8.50 |
| Damping Can (pre amp) | | £4.50 |
| Power Valve Retainer (EL34 etc.) | | £5.50 |

Golden Dragon

| | |
|--------------------|--------------------|
| 274B | £14.50 each |
| 350B | £29.95 pair |
| EL156 Octal | £75.00 pair |
| EL34 Super | £25.00 pair |
| EL34M | £25.00 pair |

Carriage charge £2.50 on any U.K. order. Cash with order or Visa - Mastercard accepted. 24 Hour Answerphone Service.

We have a vast range of tubes available from manufacturers all over the world including rare and vintage types. A 70 page booklet of valves available is updated monthly and can be provided at a cost of £2.50 per copy including U.K. postage or you may telephone our Sales Desk for a prompt quotation. Prices exclude VAT. Please add VAT at 17.5%.

A selection from our stock of over 2,500 different audio quality valves. Please enquire for items not listed

| | | | | | | | | |
|-------------|------------|-------|-------------|----------|-------|--------|--------------|-------|
| ECC81 | BRIMAR | 4.50 | M8162/ECC81 | MULLARD | 8.50 | 12AT6 | BRIMAR | 2.50 |
| ECC81 | TEONEX | 3.50 | M8137/ECC83 | MULLARD | 24.00 | 12AV6 | RCA | 2.50 |
| ECC82 | TEONEX | 3.50 | 0A2WA | TEONEX | 4.50 | 12BA6 | WESTINGHOUSE | 3.50 |
| ECC83 | TEONEX | 3.50 | PCC88 | BRIMAR | 3.50 | 12BH7A | USA | 12.00 |
| ECC85 | TEONEX | 3.50 | PL36 | MAZDA | 3.50 | 12E1 | STC | 15.00 |
| ECC88 | TEONEX | 4.50 | PL519 | THORN | 5.95 | 13D3 | BRIMAR | 6.50 |
| ECC88 | BRIMAR | 4.50 | TT100 | GEC | 65.00 | 85A2 | MULLARD | 6.50 |
| ECF82 | RCA | 3.50 | U19 | GEC | 8.50 | 300B | TEONEX | 50.00 |
| ECL86 | TEONEX | 3.50 | UCC85 | MULLARD | 3.50 | 807 | TEONEX | 6.50 |
| EF86 | TEONEX | 4.50 | 2A3 | TEONEX | 15.00 | 1625 | RCA | 6.50 |
| EF804S | TELEFUNKEN | 36.00 | 5Y3WGTA | SYLVANIA | 4.50 | 5687 | USA | 6.50 |
| EL34 | TEONEX | 6.50 | 5V4G | BRIMAR | 3.50 | 5814A | GE | 5.50 |
| EL86 | MULLARD | 4.50 | 6AG7 | RCA | 3.50 | 5881 | USSR | 6.50 |
| EL504 | TEONEX | 3.50 | 6A7G | RCA | 8.50 | 6072A | USA | 8.95 |
| EL519 | PHILIPS | 15.00 | 6B4G | TEONEX | 29.50 | 6146B | TEONEX | 8.50 |
| GZ32 | MULLARD | 8.50 | 6C8G | RCA | 3.50 | 6158 | BRIMAR | 6.50 |
| GZ37 | MULLARD | 4.50 | 6K7G | RCA | 3.50 | 6189 | SYLVANIA | 4.95 |
| GZ34 | TEONEX | 5.50 | 6L6GC | TEONEX | 4.50 | 6189W | GE | 5.95 |
| G237 | GEC | 5.50 | 6SN7GT | TEONEX | 4.50 | 6201 | GE | 6.50 |
| KT66 | TEONEX | 6.50 | 6V6G | RCA | 6.50 | 6463 | USA | 4.50 |
| KT88 | TEONEX | 12.50 | 6V6GT | TEONEX | 4.50 | 6550A | TEONEX | 12.50 |
| M8136/ECC82 | MULLARD | 8.50 | 6X4 | TEONEX | 4.50 | 6870 | BRIMAR | 11.50 |

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Supplement Contents

All rights to the designs are reserved by World Audio Design Ltd. They are published for single use by private individuals. They are not to be used for commercial gain without prior permission from World Audio Design Ltd. All of the projects in this supplement have gone through rigorous listening and test procedures. The performance and specification of these projects can only be guaranteed on kits bought directly from World Audio Design Ltd.

KIT NEWS

This is where to find out about all the latest components and hardware for the DIY hi-fi enthusiast.

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KLS3 GOLD LOUDSPEAKER

A new version of Audax's oval piezo-electric gold dome tweeter has been introduced and we put it to use in our KLS3 design. With carbon fibre midrange and bass drivers, this is one of the most advanced loudspeakers you'll find anywhere.

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SOVTEK 300B VALVE

The long awaited Russian 300B triode valve from the Sovtek factory in St Petersburg is in production. We take a look at the first samples.

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BSS OMNIDRIVE FDS-388

The Omnidrive is a high performance, versatile active crossover that can be used with any loudspeaker. Dominic Baker puts it through its paces.

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BOOK REVIEW:

ACTIVE FILTER COOKBOOK

Want to turn your system active? Get this book to find all you need to know about active filters.

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RADIO DESIGNERS HANDBOOK

Famous amongst valveheads, Fritz Langford-Smith's Radio Designers Handbook is one of the most complete reference works on valve electronics. Since original copies are becoming increasingly rare, Vintage Audio have reprinted it to satisfy demand.

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DIY LETTERS

The only place to write to, whether you're after advice on your DIY hi-fi projects or you want to let us know about that special component you've built.

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CRICKLEWOOD ELECTRONICS ANSAR SUPERIOR
ANALOGUE POLYPROPYLENE CAPACITORS 50k

The secret's in the installed film!



Manufactured specifically for high end audio, these polypropylene capacitors offer exceptional value for money as they use a specially imported high purity metallized polypropylene film, ensuring smooth, detailed and transparent sound quality and extremely low distortion - whether they are placed directly in the signal path such as in crossovers or for decoupling etc. Ideal for replacing old, worn and leaky capacitors.

| Part No | Value | Price |
|---------|------------------|--------|
| CW100M | CAP PROPYL 100nf | £1.25 |
| CW150M | CAP PROPYL 150nf | £1.25 |
| CW220M | CAP PROPYL 220nf | £1.25 |
| CW330M | CAP PROPYL 330nf | £1.25 |
| CW470M | CAP PROPYL 470nf | £1.25 |
| CW680M | CAP PROPYL 680nf | £1.25 |
| CW100µ | CAP PROPYL 1µf | £1.25 |
| CW150µ | CAP PROPYL 1.5µf | £1.50 |
| CW220µ | CAP PROPYL 2.2µf | £1.50 |
| CW330µ | CAP PROPYL 3.3µf | £1.85 |
| CW470µ | CAP PROPYL 4.7µf | £2.00 |
| CW680µ | CAP PROPYL 6.8µf | £2.50 |
| CW100µ | CAP PROPYL 10µf | £3.50 |
| CW150µ | CAP PROPYL 15µf | £4.50 |
| CW220µ | CAP PROPYL 22µf | £6.50 |
| CW330µ | CAP PROPYL 33µf | £9.95 |
| CW100µ | CAP PROPYL 100µf | £20.00 |

Low value capacitors are extremely used in amps & preamps (especially in tone controls, bias & treble etc). By changing to polypropylene you can enjoy an enhanced lighter, brighter sound especially in the treble and mid bass range, and a transparent lower bass improvement. Close tolerance & high stability ensure that both channels can be very closely matched.

| Part No | Value | Price |
|---------|------------------|-------|
| CPH47P | CAP PROPYL 47pF | £0.35 |
| CPH100P | CAP PROPYL 100pF | £0.35 |
| CPH150P | CAP PROPYL 150pF | £0.35 |
| CPH220P | CAP PROPYL 220pF | £0.35 |
| CPH330P | CAP PROPYL 330pF | £0.35 |
| CPH470P | CAP PROPYL 470pF | £0.35 |
| CPH100 | CAP PROPYL 100pF | £0.35 |
| CPH150 | CAP PROPYL 150pF | £0.35 |

| | | | |
|--------|-----------------|------|-------|
| CPH2 | CAP PROPYL 22nf | 250V | £0.35 |
| CPH47 | CAP PROPYL 47nf | 63V | £0.50 |
| CPH100 | CAP PROPYL 10nf | 63V | £0.65 |
| CPH220 | CAP PROPYL 22nf | 63V | £0.85 |
| CPH470 | CAP PROPYL 47nf | 63V | £1.00 |

Low Impedance High Temperature
(105°C) Radial Electrolytics ± 5%

Superior electrolytics at affordable prices. The low impedance end resistance maximises signal purity, whilst the superior temperature characteristics allow the capacitor to remain very stable under the most varying conditions.

| Part No | Value | Voltage | Price |
|---------|---------------------|---------|-------|
| 1H50 | LD 2 HI TEMP 1µf | 50V | £0.25 |
| 2H250 | LD 2 HI TEMP 2.2µf | 50V | £0.25 |
| 4H963 | LD 2 HI TEMP 4.7µf | 63V | £0.25 |
| 10H63 | LD 2 HI TEMP 10µf | 63V | £0.25 |
| 22H33 | LD 2 HI TEMP 22µf | 63V | £0.30 |
| 47H33 | LD 2 HI TEMP 47µf | 63V | £0.35 |
| 100H63 | LD 2 HI TEMP 100µf | 63V | £0.50 |
| 220H50 | LD 2 HI TEMP 220µf | 50V | £0.75 |
| 470H63 | LD 2 HI TEMP 470µf | 63V | £1.25 |
| 1000H35 | LD 2 HI TEMP 1000µf | 35V | £1.50 |
| 2200H50 | LD 2 HI TEMP 2200µf | 50V | £2.25 |
| 4700H25 | LD 2 HI TEMP 4700µf | 25V | £2.50 |

Elna Solder Lug Reservoir
Capacitor 10,000µF 80V

Choosing the right electrolytic for power supply use is very important - especially when allowing maximum current flow for quad treatment & bias response. Elna capacitors are produced the world over for their exceptional audio attributes.

| Part No | Value | Price |
|----------|--------------------|--------|
| 10000C80 | CAL ELNA1000µF/80V | £11.00 |

Monacor Air Cored Inductors



A range of professional air cored inductors for 80 or 40, crossovers/filters for use up to 300W. 1.2mm (enamelled) copper wire wound on air spooled plastic bobbin.

| Part No | Specification | Price |
|---------|--------------------|-------|
| P1 | 2.2mH 0.150 8x19mm | £2.00 |

Monacor Ferrite Inductors



A range of professional high efficiency ferrite cored inductors with very low ohmic losses for 80 or 40, crossovers or filters for use up to 400W. 1.4mm enamelled copper wire (1.3mm on F1000) wound on plastic bobbin.

| Part No | Specification | Price |
|---------|--------------------------|--------|
| F220 | 2.2mH 0.150 40mm 55x3mm | £6.50 |
| F330 | 3.3mH 0.20 330W 65x33mm | £9.50 |
| F470 | 4.7mH 0.250 140W 65x33mm | £11.00 |
| F810 | 6.8mH 0.350 120W 65x33mm | £12.00 |
| F1000 | 10mH 0.450 100W 65x33mm | £13.50 |

Quality Valves
Affordable range of High Quality Valves

| Part No | Description | Price |
|---------|------------------|--------|
| 6550C | OUTPUT VALVE | £26.00 |
| 6L6GT | OUTPUT VALVE | £4.50 |
| 6SN7GT | OUTPUT VALVE | £4.50 |
| 6V6GT | OUTPUT VALVE | £3.95 |
| ECC81 | TRINODE | £4.50 |
| ECC82 | TRINODE | £4.50 |
| ECC83 | TRINODE | £4.50 |
| EF86 | LOW INDS PENTODE | £3.50 |
| EL34 | OUTPUT VALVE | £8.50 |
| EL84 | OUTPUT VALVE | £3.50 |
| G234 | RECTIFIER | £6.50 |
| KT88 | OUTPUT VALVE | £20.00 |

Valve Holders - High quality valve bases
Chassis mounting with screw fittings

| Part No | Description | Price |
|---------|----------------------------------|-------|
| B9AC | B9A VALVE HOLDER CERAMIC | £1.50 |
| B9AJ | B9A VALVE HOLDER CERAMIC x 2.00 | £2.25 |
| CC | SCREENING CAN | £2.25 |
| OCTC | OCTAL VALVE HOLDER CERAMIC £2.00 | £2.00 |
| OCTP | OCTAL VALVE HOLDER CERAMIC £1.50 | £1.50 |

Fully Gold Plated Phono (RCA) Plugs
With spring coil cable grip



| Part No | Description | Price |
|---------|-------------------------------------|-------|
| PPG5A2 | PAIR GOLD PLUGS for up to 5mm CABLE | £1.50 |
| PPG6A2 | PAIR GOLD PLUGS for up to 6mm CABLE | £1.50 |

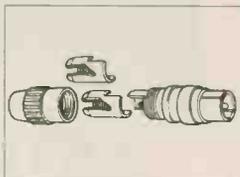
Very High Quality Phono (RCA) Plugs



Very high quality satin grey metal with helmy gold plated connectors. Top coil cable grip & PTFE insulators. Very thin metal.

| Part No | Description | Price |
|---------|-------------------------------------|-------|
| PPG6H2 | GOLD PTFE PLUGS for up to 6mm CABLE | £3.50 |
| PPG8H2 | GOLD PTFE PLUGS for up to 8mm CABLE | £3.50 |

Neutrik Pro Audio Super Quality Gold Plated Phono (RCA) Plugs



Neutrik pair of plugs, each with a 3.5mm diameter cable grip, 3.5mm x 3.5mm x 3.5mm cable grip.

Wide range of cables. These connectors make contact with ground first at insertion to eliminate pop.

| Part No | Description | Price |
|---------|-------------------|------------|
| PN2 | NEUTRIK PRO AUDIO | £12.00/par |

Extra High Quality Gold Plated Phono
Oxygen Free (RCA Leads (pairs))



Available in 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.

| Part No | Length/Cable | Price |
|---------|-----------------|--------|
| LPP1QG | 0.8 Metres/Pair | £5.50 |
| LPP2QG | 0.8 Metres/Pair | £5.50 |
| LPP3QG | 1.5 Metres/Pair | £6.50 |
| LPP4QG | 1.5 Metres/Pair | £6.50 |
| LPP5QG | 5 Metres/Pair | £11.00 |
| LPP6QG | 5 Metres/Pair | £11.00 |

Bass Reflex Tuning Ports



A range of adjustable plastic ports for use in various sizes of loudspeaker cabinets. d=adjustable length (mm)

| Part No | Dimensions | Price |
|---------|-----------------|-------|
| R35 | d=35mm 110-210 | £2.50 |
| R50 | d=50mm 150-280 | £3.00 |
| R70 | d=70mm 120-245 | £3.50 |
| R100 | d=100mm 180-310 | £5.50 |
| R85 | d=85mm 140-310 | £6.50 |

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WATFORD VALVES

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ST ALBANS FAX
HERTS AL2 3TS 01923 679207

CHRISTMAS CRACKERS

SVETLANA SV6550C NEW TRI-PLATE ANODE WITH A GOLD PLATED GRID. THE BEST KT88 TYPE. CRACKING OFFER AT £16.00 EACH WITH FREE MATCHING.

SVETLANA LATEST EL34 MULLARD SOUND £8.50 EACH

TUNGSTRAM EL84 A MUST FOR LEAKS £6.00

| PHILIPS / G.E. | SPECIALS |
|----------------|------------|
| ECC81/6201 | ECC83 E.1 |
| ECC82/6189W | E34L TESLA |
| ECC83/12AX7WA | 12BH7A |
| ECC835/5751 | 6CA7/EL34 |

| NEW OLD STOCK | SOVTEK |
|---------------|---------------|
| ECC88 BRIMAR | 12AX7WA/WB |
| EF86 MUL | 12AX7WXT |
| EL84 | 12AX7 PREMIUM |
| 6L6WGB/5881 | EL34 |
| 6SL7WGT | EL84M |
| 6SN7WGTA | 6L6/5881 |
| 6V6GT | 6922 |
| 6550A | 7199 |

HAPPY CHRISTMAS TO ALL OUR CUSTOMERS.
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RESTORATION. Messrs, Leak, Walker, Radford *et al.* got it right! Yesteryear's great designs are, in the main, fine. They certainly don't need converting into something else, which seems to be a current trend. We will carefully restore your classic using modern high-quality components; this alone frequently improves the sound quality enormously. We will not, though, alter the original design in an attempt to "improve" it. Enjoy owning and listening to a Classic... not a latterday fad.

REPAIR/CALIBRATION. Even the finest equipment's will suffer an occasional breakdown and need meticulous repair, calibration and alignment. The only standards we recognise and work to are Manufacturers Original. Our Test & Measurement facilities are probably the best in this sector of the industry... and we know how to use them!

KIT-BUILDING. There are numerous kits around nowadays. They all require skill/experience to build satisfactorily and, in the case of valve equipment, safety. Some designs are good, otherswell, let's just say their 'designers' would benefit from a sojourn on that celebrated desert island with only Terman and Langford-Smith for company! **Whichever kit you choose, though, it will benefit from a professional build.** We will build it, de-bug it and give you a set of Final Test figures from your sample.

KIT-RESCUE. In trouble? It won't work? *Nil desperandum.* Contact us, about a rescue/re-furbish.

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AUDIO LABORATORIES (LEEDS)

KIT NEWS

DIY SEISMIC ACTIVITY

Aimed at DIY-inclined lovers of bass is the ASM 100 from Visaton. This ready-built active subwoofer module contains a low-pass filter along with a 125w power amplifier. With a



crossover frequency that can be set at 50, 100 or 200Hz and adjustable input level, the ASM is intended for use with kit subwoofers. Available from Hart Electronic Kits, the £185.29 ASM 100 comes complete with plans for a matching compact, domestically harmonious subwoofer.

Hart Electronic Kits
Penylan Mill,
Oswestry,
Shrops.
SY10 9AF
Tel: 01691 652894

ALIVE AND KICKING

Famous Czechoslovakian valve manufacturers Tesla have just started production of a special E34L power pentode. The valve, which is claimed to offer greater treble detail than the standard version, is available from Watford Valves at a price of £8.50+VAT. Pairs of the E34L also come with a free matching service during December.

Watford Valves
3 Ryall Close,
Bricket Wood,
St Albans,
Herts.
AL2 3TS
Tel: 01923 893270

BURR-BROWN BABY

Audiocom of Saundersfoot in Pembrokeshire now have in stock the latest member of Burr-Brown's high quality audio op-amp family. Succinctly titled the OPA134, it is being produced as a cheaper version of the OPA132P (available from Audiocom at £5.95). The 134 can be used to replace near-ubiquitous op-amps like the NE5534, JRC 2114 and LM741, that are used in pre-amplifiers, active crossovers and CD player outputs. Audiocom claim the OPA134 (with its impressive 0.00008% THD) offers a more open and dynamic sound with better treble than the aforementioned ICs.

Audiocom
2 Swallowtree Gardens,
Saundersfoot,
Pembrokeshire
SA69 9DE
Tel: 01834 814036

NEW GOODIES FROM MAPLIN

A new Maplin catalogue should be available as you read this, containing several new products of interest to the DIY hi-fi enthusiast. First of these is the Svetlana EL34 valve. The EL34 is one of the most popular output pentodes, being used in Mullard's classic 5-20 amplifier. Svetlana make one of the best versions of the EL34 - strong, reliable and clean sounding. So whether



you're re-valving an old guitar amp., or building the classic 5-20, a trip to Maplin may be worthwhile.



Also in the new catalogue is a range of electrolytic capacitors from one of the oldest British based manufacturers, Dubilier. The flame red cased DJ3 series are compact high performance electrolytics with a 105°C rating.

Maplin Electronics
P.O. Box 3
Rayleigh,
Essex
SS6 8LR
Tel: 01702 554155

PANASONIC POTENTIAL

The latest addition to Audio-Links' components catalogue is Panasonic's new high-end stereo potentiometer. This boasts a laser-trimmed track to give a channel balance accuracy of 0.5dB and silver contacts and terminals. The potentiometers come in two values, 10k and 100k, and are available in either manual or motorised form.

Audio-Links are also offering a high quality cable kit for converting Rega arms to balanced operation, as well as a 75ohm digital cable and connectors called 'Blue Light'.

Audio-Links
7 Fairmont Crescent,
Scunthorpe,
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HART

The Home of *Hi-Finesse*. Its not what you do,
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We have always led the field for easy home construction to professional standards, even in the sixties we were using easily assembled printed circuits when Heathkit in America were still using tagboards! Many years of experience and innovation, going back to the early Dinsdale and Bailey classics gives us incomparable design background in the needs of the home constructor. This simply means that building a Hart kit is a real pleasure, resulting in a piece of equipment that not only saves you money but you will be proud to own.

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- K1100 Complete STANDARD Stereo Amplifier Kit £415.21
- K1100S Complete SLAVE Amplifier Kit, £353.62
- K1100M Complete MONOBLOC Amplifier Kit, £271.20
- RLH11 Reprints of latest Amplifier articles. £1.80
- K1100CM Construction Manual with full parts lists £5.50

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With its powerful 125 watt output and versatile filtering the ASM 100 is the ideal universal active driver module for all subwoofer requirements.

- ASM 100 Module, complete with IEC mains lead, instructions and ASM - W20 cabinet drawings. Pt. No. V7000. £185.29
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All these drive units have been carefully selected for their individual virtues, and collective excellence, the tweeter for instance being a high end unit with exceptional pulse response as a result of its combination of Kapton former, aluminium diaphragm and aluminium voice coil.

Nominal Power Rating is 150W, Max. Music Power 250W, Impedance 8 ohm, Mean Sound Pressure 91dB. Speaker kit comes with all parts to make a pair of speakers, but not the cabinet parts. Crossover units are factory assembled, ready to fit.

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DRIVE UNITS.



BG30NG 30cm. (12") Woofer. High efficiency, (95db) for sealed or vented cabinets. Peak power handling 250watts. 8 ohm. £69.61

W200S 20cm. (8") Woofer. Long throw unit with rubber surround and extended rear pole to give no less than 20mm cone displacement. Ideal for compact sub-woofers such as ASM-W20. 8ohm. £36.68

NG8 Protective Metal Grille. £5.66



W100S 10cm (4") Low/Midrange. Coated paper cone, rubber surround, high temperature voice coil. Suitable as woofer in mini enclosures or midrange in 3-way systems. 4ohm. £18.06

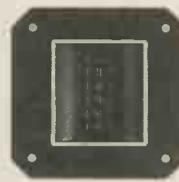
NG4 Protective Metal Grille. £3.20

FRS8 8cm.(3.3") Fullrange driver. Linear frequency response between 200 and 20KHz. Large Magnet, 20mm voice coil and rubber surround. 8ohm. £8.36



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SC5 10mm Magnetically shielded Tweeter for use in surround sound centre speakers. 8ohm. £9.24



RHT12S High End Ribbon Tweeter. Superior double magnet construction gives an exceptionally low distortion and linear response from 4,000 to 30,000Hz. Cabinet cutout diameter 95mm. 8ohm. £87.77

DHT9AW-NG Hi-Tech, Hi-Fi, horn type tweeter. Frequency response from 3,500 to 38,000Hz and very good pulse response due to aluminium cone, Kapton voice coil and aluminium wire. Peak power handling 150W. 8ohm. £31.99



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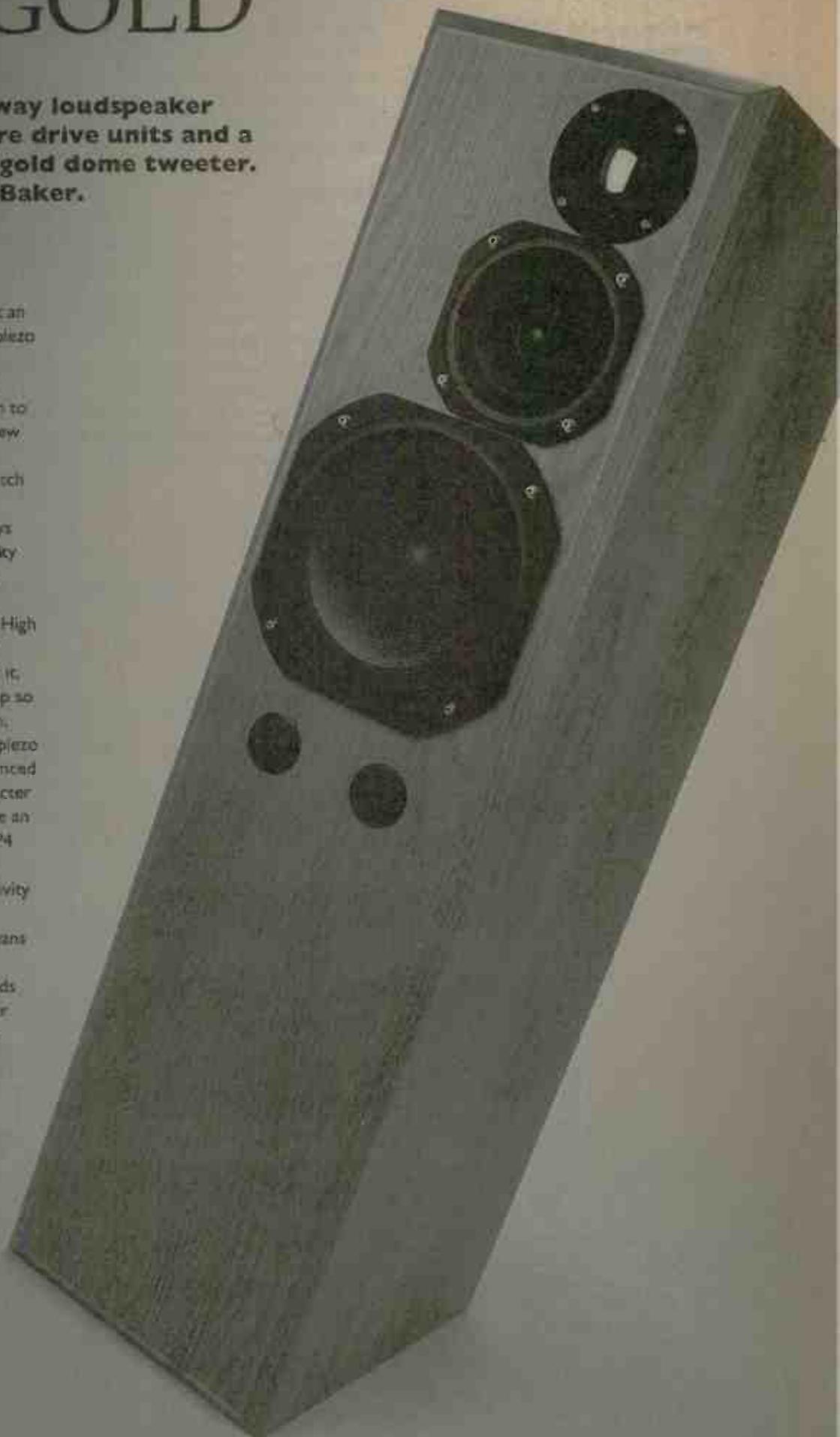
KLS3 GOLD

A high technology 3-way loudspeaker employing carbon fibre drive units and a special piezo electric gold dome tweeter. Designed by Dominic Baker.

Audax recently told us about an improved version of their piezo electric oval gold dome tweeter. Previously, it only reached down to 5kHz or so, not far enough to meet most midrange drivers. The new version goes lower, a crossover frequency of 4kHz allowing it to match a greater range of drive units.

The HD-3P as it is known, always had dear extended treble of a quality quite unlike any other tweeter. It is finely detailed and unusually sweet. Previously, to use this tweeter a 2" High Definition Aerogel midrange driver developed by Audax had to partner it, being the only unit able to extend up so far; we used one in our KLS6 design. But I had always wanted to try the piezo tweeter in our KLS3 speaker, convinced that the bright tone and clear character of the carbon fibre drivers would be an ideal match for it. The new TP1X2P4 tweeter allowed us to do just that.

Importantly, KLS3's 90dB sensitivity and smooth impedance curve are retained in the new design. This means that it still offers all of the same important benefits as before. It needs less power to drive than most other loudspeakers and is a near resistive load, making it an ideal choice for low power, zero feedback amplifiers. That's always been a great strength of KLS3, one we would not compromise.



BUILDING KLS3Gold

The construction for KLS3Gold is essentially very similar to that of the original KLS3 design. There is really only one change needed, that being the different cut-out for the TPIX2P4 tweeter.

The cabinet is constructed from 25mm MDF. This gives wide gluing surfaces which makes build easier and removes the need for screws or pins. I'd recommend using Evostick Resin "W" glue and then clamping the whole using stretchy carpet tape. Once dry, the cabinet should be extremely rigid.

Critical to performance is the cabinet lining, in this case thick, felt carpet underlay. The whole inside surface of the midrange chamber should be lined with carpet felt, lightly glued in

place. A double layer on the rear wall of this chamber will give a smoother sound as it absorbs more of the internal energy that would otherwise rebound back out through the carbon fibre cone, adding colouration.

TESTING

A simple test, to reduce the risk of any damage to your amplifier when you first plug in, can be carried out with a simple multimeter. The whole loudspeaker (put the bi-wire links in) should give a DC resistance figure of around 4Ω. Don't worry, this is not the impedance, because it is measured at DC (0Hz). Impedance rises to give an average of around 8Ω between 20Hz-20kHz. A reading of below 1Ω indicates a fault.

KLS3 Gold - PARTS LIST

DRIVE UNITS

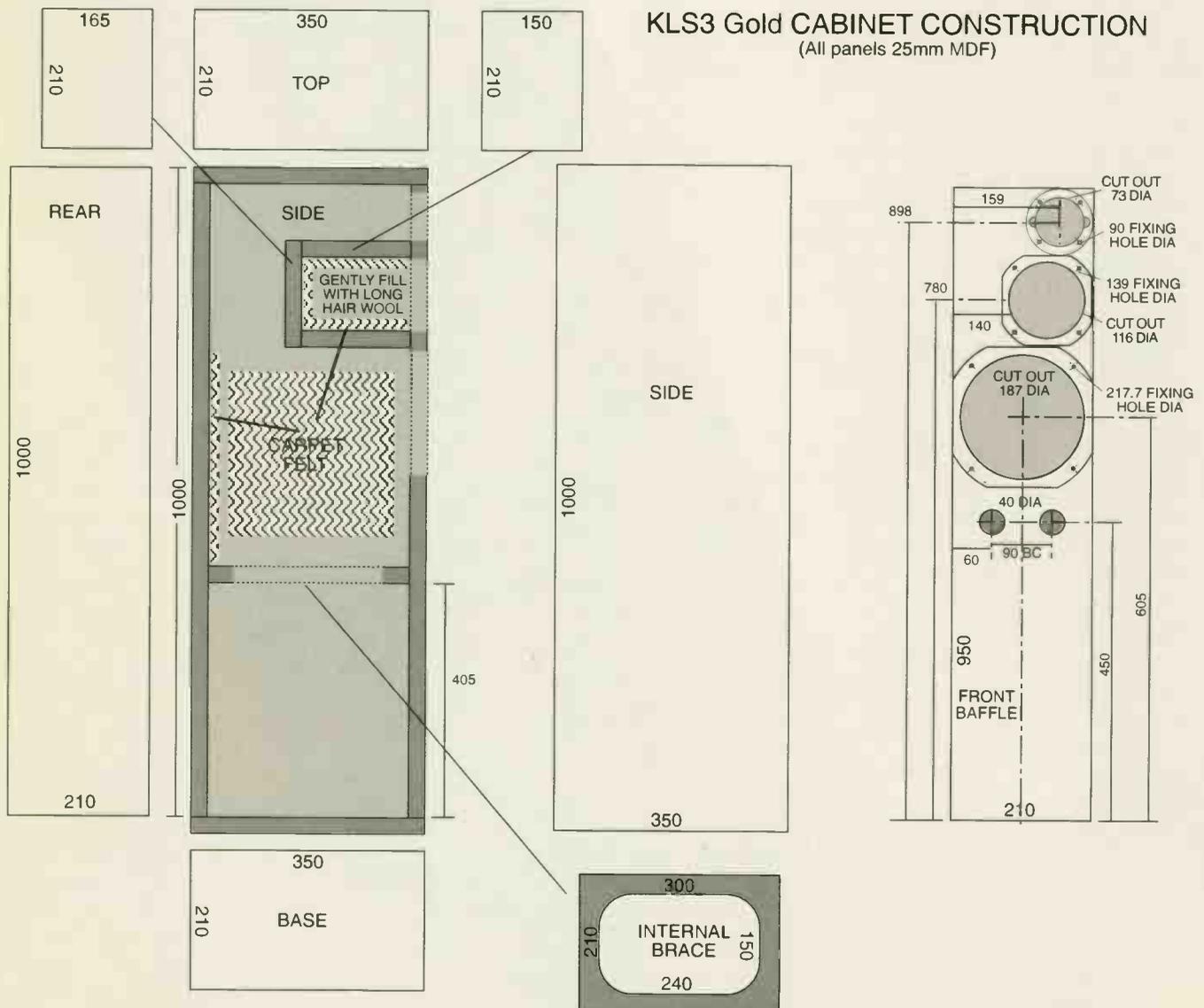
| | |
|----------|---------|
| BASS | HM210C0 |
| MIDRANGE | HM130C0 |
| TWEETER | TPIX2P4 |

CROSSOVER COMPONENTS

| | |
|----|----------------------------|
| R1 | 4.7Ω/5W |
| R2 | 15Ω/10W |
| C1 | 2μF Solen |
| C2 | 8μF Solen |
| C3 | 120μF Alcap |
| L1 | 0.5mH/1mm wire/air core |
| L2 | 12mH/1mm wire/ferrite core |

REFLEX PORTS

38mm diameter x 85mm length

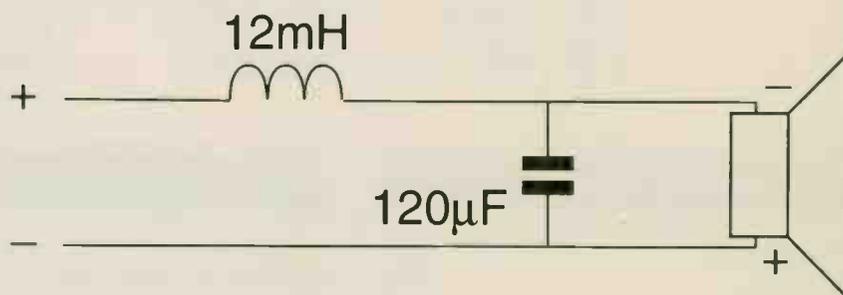
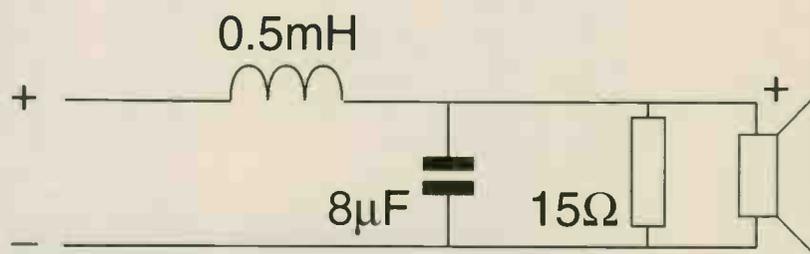
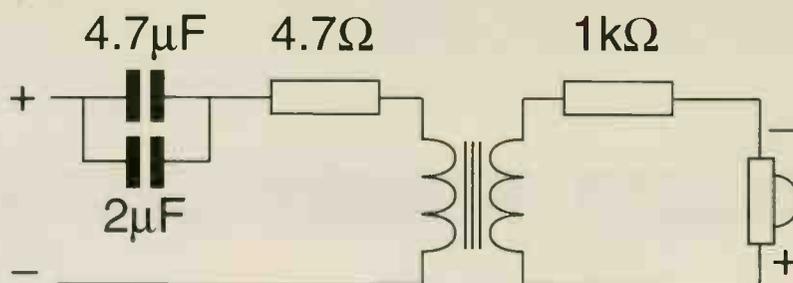


KLS3Gold CROSSOVER

The new TPIX2P4 tweeter, developed from the original piezo electric gold dome tweeter, makes it possible to lower the treble crossover point of KLS3 far enough to meet the 4" carbon fibre drive unit.

The TPIX2P4 is a 4Ω load. To reduce sensitivity to match that of the 4" carbon fibre midrange driver, the 0.68Ω resistor factory pre-set on the circuit board is replaced with 4.7Ω. This series resistance is seen by the amplifier added to the 4Ω nominal impedance of the TPIX2P4 tweeter, bringing it nicely up to 8Ω.

Because this series resistor reduces the amount of power seen by the TPIX2P4, it was then possible to lower the crossover point by a small amount so that it integrated perfectly with the midrange driver. The result is a very smooth response that will give a balanced, accurate sound.



MODIFYING KLS3 TO KLS3Gold

If you have already built KLS3, modifying the original design is fairly straight-forward and shouldn't take more than a couple of hours.

1. Remove the bass driver from your KLS3s so that you can get to the crossover and terminal dish.
2. Remove the parts of the crossover that feed the tweeter (0.9mH inductor, 2µF capacitor, 3.3Ω resistor) and solder on two wires to connect to the circuit board of the TPIX2P4 tweeter.
3. Using high quality solder (preferably silver loaded) mount the 2µF capacitor from the original KLS3 crossover in parallel across the 4.7µF capacitor on the input side of the TPIX2P4's circuit board.
4. Remove the 0.68Ω resistor on the input side of the circuit board and replace it with 4.7Ω 5W. At the same

time attach two wires to the output side of the board to be passed out through the tweeter cut-out in the front baffle.

5. Remove the original TW025M1 tweeters from your KLS3s and store them carefully. You may want to use them again.
6. Now you can wire the TPIX2P4's circuit board to the input terminals. Fix it to the rear of the cabinet above the terminal dish.
7. Don't take the TPIX2P4 tweeters out of the box yet. They have a different fixing hole radius from the TW025M1 tweeter used in KLS3, so the old holes need to be filled with dowel plugs or wood filler and new ones made. You can leave the original holes if you think you may want to revert back to the TW025M1 tweeter at any point. They are covered by the

TPIX2P4's face plate and sealed off by a thin foam gasket made from draft excluder fitted to its rear. It is worth masking off the midrange driver and the cut-out of the bass driver before you start, to prevent dust and damage.

8. Pass the wires through the tweeter cut-out, solder them to the TPIX2P4 tweeters and fix them firmly in place. Finally, put the bass drivers back in.

NOTE. The surface of the TPIX2P4 tweeter can easily be damaged. Leave the unit in its box until the last minute to reduce the risk of damage. Tempting though it may be, don't touch the dome. Also, beware that pets and small children seem to be drawn by a mysterious force towards the shiny gold dome; it may be advisable to fit a thin grille - your bank manager will approve.

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Long known as specialists in rare tube brands, Billington Export provides a line of premium-grade valves to fill the increasing demand for hard-to-find tubes! BILLINGTON GOLD features specially tested valves selected for long life, low microphony and low noise. Versions with gold plated pins are available. BILLINGTON GOLD brand comes from a variety of countries around the world. We have carefully chosen the best manufacturer for each type, with an

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| 6BH6 RCA | 2.48 | DG7-32 Tungfram Hungary | 21.00 |
| 6CG7 Yugoslavian | 6.75 | ECC81 Mullard UK (CV4024) | 7.50 |
| 6V6GT STC UK | 5.93 | ECC82 Mullard UK (CV4003) | POA |
| 6X4W Raytheon USA | 3.00 | ECC83/ECC803S Tesla | 13.13 |
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| 13E1 STC UK | 120.00 | GZ32 Mazda | 9.00 |
| 85A2 Mullard | 4.50 | GZ37/CV378 Mullard UK | 5.93 |
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SOUND QUALITY

KLS3 in its original form had clean, clear and unaccentuated treble. All the same, the addition of the gold dome piezo tweeter brought about a fairly significant improvement. On Tori Amos' Boys For Pele CD (always a test of midrange and treble quality), harpsichord was purer, smoother and more natural, lacking nothing in the power and impact stakes. Piano showed the same improvements, with an upper midrange and treble that was almost unassuming in its freedom from roughness and coloration.

Vivaldi's Four Seasons' period violins showed what that tweeter could do for control and power. Where the original soft dome tweeter had sounded slightly brash, its successor was smooth and powerful. It produced a more open soundstage as well, giving the performance a real feeling of space and atmosphere. Tonally, strings were more accurate and notes seemed to flow more easily from the instruments.

Guinea pig number three was John Lee Hooker and Boom, Boom. Here, percussion was particularly crisp and detailed, each rivet in the cymbal's rim, for example, clearly etched. Snares cut out from the 'speakers with real dynamic edge and impact, adding an incisive speed to the proceedings. But the most obvious beneficiaries of the piezo tweeter were the voices of the polyphony of Magnificat, Vol. 1, which enjoyed more power and separation, sounding beautifully open and focused.

Jon Marks

NOEL KEYWOOD SAYS

Being accustomed to the airy treble of stripped down electrostatic loudspeakers, and the incredible brilliance and shine of the Tonigen ribbon tweeter (which has an astonishingly flat frequency response), I was eager to hear what Audax's little creation could do, all £450 of it!

First I hit it with violins, for this is where most speakers really foul up. The Audax pulled out its greatest ace immediately: I've never heard such sweet vibrancy, nor such wonderful insight into strings. With this tweeter you hear individual strings vibrating; violin becomes a rich and alive instrument, rather than a homogenous and often coarse sounding simulcrum. Where the Tonigen ribbon could be accused of being a little too bright and metallic in this area, the Audax comes across as honeyed.

The strident chords of Steve Earle's steel strung guitar on Guitar Town slice out from the Tonigen in a fashion that defies conventional dome tweeters, be they metal or fabric. The Audax sounds less surgical, and less alarming too, but it offers a more natural sense of precision and resolution.

Listeners always spot the Tonigen immediately. It's a tweeter you must grow used to. The Audax is more neutral, less challenging and has better dispersion characteristics of course.

Noel Keywood

MEASURED PERFORMANCE

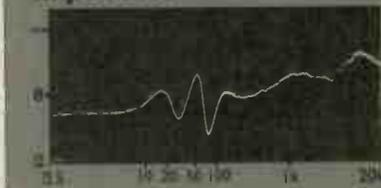
Like the original KLS3 design, KLS3Gold is sensitive enough to be driven by most amplifiers. Producing 90dB SPL at 1m from a nominal watt (2.83V) pink noise signal, KLS3Gold can be driven loud with few watts. Its impedance curve is smooth too, making it suitable for zero feedback amplifiers with high output impedance. Overall impedance averaged out at 8.5Ω, again suggesting that they won't demand much current to drive. 10-20watts should be more than adequate in most rooms.

The frequency response is smooth and balanced. There is a little upper treble lift, but curiously they don't sound at all bright. The treble is very clean from the piezo tweeter though, and doesn't tend to draw attention to itself. DB

Frequency Response



Impedance



KLS3 Gold is available through World Audio Design.

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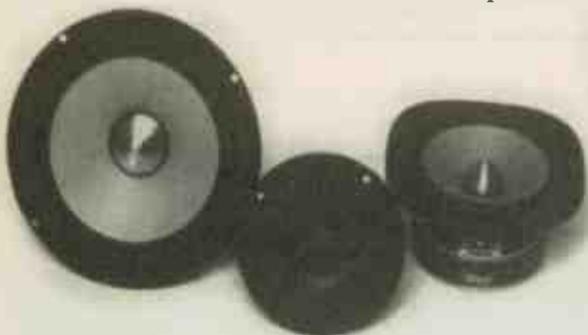
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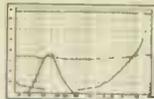
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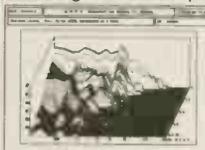
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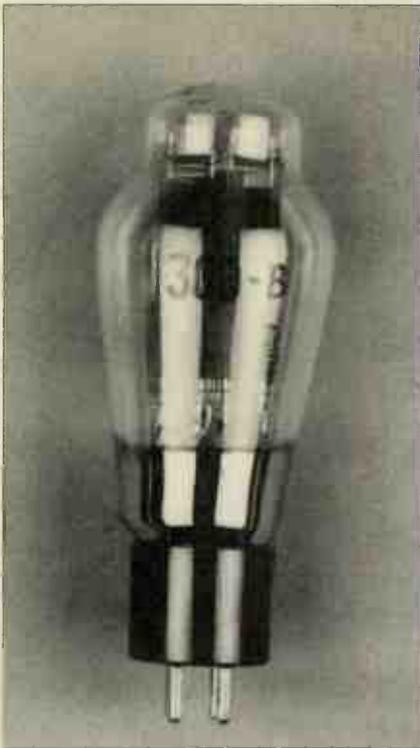
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SOVTEK 300B

The Sovtek factory in St. Petersburg have produced their first batch of Russian made 300B triodes. Dominic Baker was first to get his hands on a pair.

The 300B audio output triode has gained popularity at an alarming rate over the last few years. If you want to go down the zero feedback single-ended route, there is little other choice. A single 300B gives a usable amount of power (around 8-12watts) from a relatively low HT voltage (less than 500V). This makes the associated circuits simpler and easier to design and build than, say, a 211 needing upwards of 900V HT and a more complex driver stage.

This, coupled with its seductively sweet and open sound, has made the 300B the popular choice of serious valve audiophiles throughout the world. It was originally developed in Bell Labs for Western Electric's cinema amplifiers. Western Electric also used the 300B in several vintage amps, the most well known being the WE91 which used a 310A pentode to drive the 300B.

It was originally made by two companies, Western Electric in the US and STC in the U.K. The STC version had a 4 in front of the type number making it the 4300B. In fact STC was originally a subsidiary of Western Electric and went by the same name. ITT acquired Western Electric International in the twenties and the name became STC in the UK. There are still some original 300Bs available from specialist valve suppliers, but expect to pay £200-300 for them.

Until now, affordable 300Bs have only been available from China, the Golden Dragon 300B being the most popular, priced at £79. There is also an LX version, using a titanium anode and Western Electric are said to be working towards re-manufacture of a 300B using the original tooling. But for a while now we have known about the Sovtek factory's plans also to produce a 300B. The first batch was manufactured a short time ago, and we were lucky to get a pair of the first samples. Price in the UK isn't fixed at the moment, but in the US it's \$59 each. So it looks like the Sovtek 300B is going to be affordable, and if their other valves are anything to go by, reliability shouldn't be a problem either; we've never had a single Sovtek 5881 tetrode fail in over three years.

TESTING THE SOVTEK 300B

A quick test using our USA Dept. of Army TV-7A/U valve testing station gave the following results for Mutual Conductance (change in plate current divided by the corresponding change in grid voltage). A value of 60 would be a perfect result.

| | |
|-----------------------|---------|
| SOVTEK 300B | |
| No. 1 |58 |
| No. 2 |56 |
| GOLDEN DRAGON 300B | |
| No. 1 |52 |
| No. 2 |53 |
| GOLDEN DRAGON 300B LX | |
| No. 1 |50 |
| No. 2 |46 |

This is only a simple test to validate that the valve is functioning as it should; the Sovtek 300B passed with flying colours here.

SOUND QUALITY

Of course, the proof is in the listening. For the audition I used a single-ended 300B prototype amplifier. It is of similar design to our own 300B push-pull amplifier, but running in single-ended mode with appropriate driver and output transformers. The prototype was built using very high quality components: Black Gate electrolytics, silver and copper foil polypropylenes, Shinkoh tantalum film resistors and a choke input power supply using 50µF polypropylene smoothing capacitors.

I had Golden Dragon 300B and 300B LX valves on hand as a reference for the new Sovtek types. Plugging in the Sovtek 300B I noticed that the small locating pin was in a different position. It was where the pin on a 300A is, but fortunately for me, the chassis the prototype was built on had cut-outs for both 300B and 300A valves, as does the World Audio Design 300B push-pull amplifier.

Compared to the standard Golden Dragon 300B, the titanium anode 300B LX has a brighter tone and a clearer sound. The standard 300B can be a little dark sounding by comparison, but still retains all of that wonderful atmosphere and low level detail. The Sovtek 300B seemed to slide in somewhere in between, having much of the clarity of the LX version, but a slightly richer balance. This was a promising start.

Another thing I noticed was the Sovtek's more dynamic and strident sound. It seemed to have more get up and go, lending a strong and dynamic punch to bass lines. I can't wait for full production to begin.

For further information, contact New Sensor Corp., New York. Tel: (212) 529 0466.

BSS OMNIDRIVE FDS-388



Dominic Baker investigates a versatile digital active crossover that can be used with any loudspeaker.

If I had a pound for every time someone wrote to us asking how to design an active crossover for their 'speakers, I'd be able to afford a BSS Omnidrive FDS-388. What is a BSS Omnidrive FDS-388? Used primarily in studios, clubs and large outdoor sound systems (the sound systems at the Ministry of Sound in London and Paris's Elysée Montmartre are both controlled by BSS Omnidrive FDS-388s), this box of tricks is just about the most

comprehensive and flexible active crossover you'll come across.

Looking more like a piece of advanced test equipment than hi-fi, the FDS-388 splits the signal from your pre-amplifier into two, three or four bands. These are then fed directly to your power amplifiers and their respective drive units. So the FDS-388 completely does away with the need for a passive crossover. However, unlike many active crossovers on the market, it can also be

tweaked to give exactly the sound balance you want.

The Omnidrive doesn't come cheap though, carrying a price tag of £2500. But then this is no simple box stuffed full of op-amps. The Omnidrive converts the incoming signal from analogue to digital, so the processing is carried out wholly in the digital domain. This allows filtering, equalisation, delays, etc to be set without incurring the usual penalties such as phase shifts.

ACTIVE CROSSOVERS

THE DON'TS

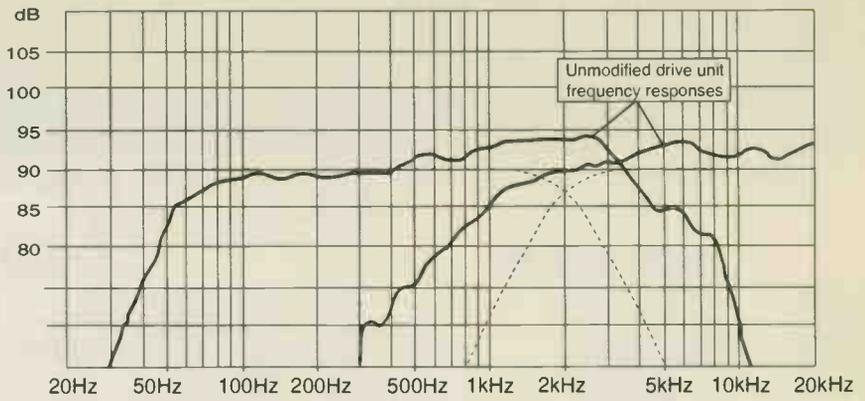
At first glance active crossovers appear surprisingly simple. Get a copy of the Active Filter Cookbook, for example, and you'll quickly be able to calculate a simple circuit based around a single op-amp that gives you exactly what you think you need; a flat response and a nice, smooth roll-off. While this may look spot on, apply it to a real drive unit, as in the diagrams opposite, and it'll be unlikely that the results are as good as the theory.

Very few drive units have a flat frequency response. Most bass/mid and midrange drivers have a rising response, due to voice coil impedance. This will give you a lift in your response, rather than the ruler-flat result the books seem to suggest. Correcting this basic problem is fairly easy, but there may also be dips and peaks strong enough to influence the sound that need to be smoothed out.

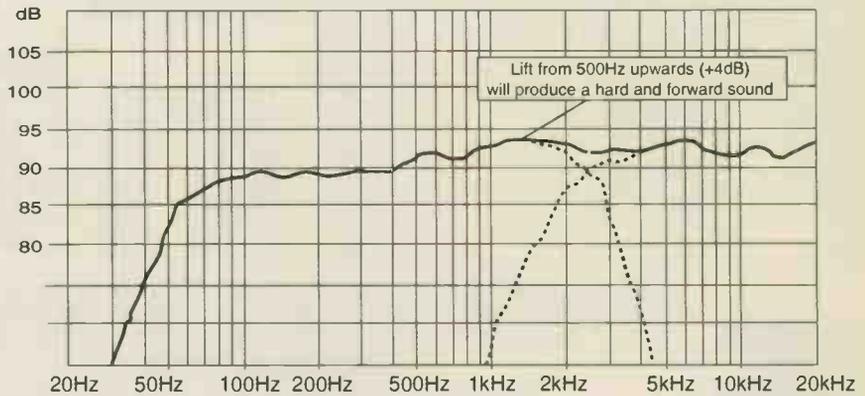
THE DOS

With equalisation applied, in this case a falling response applied to the bass/mid driver, the rise is flattened. This results in a far smoother response and a more balanced overall sound.

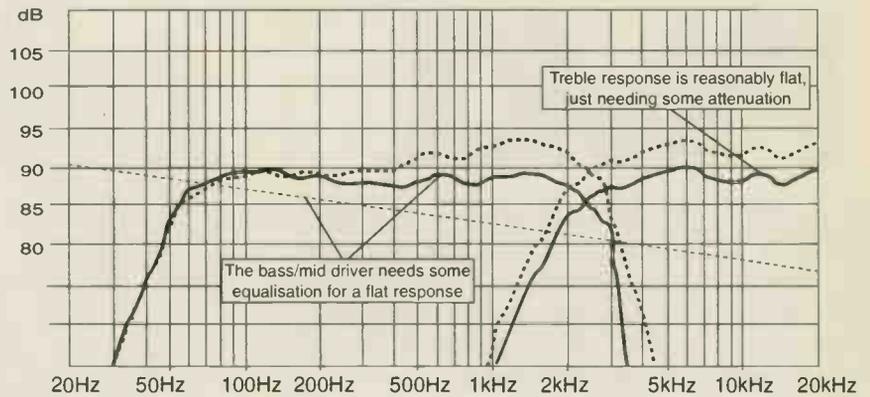
Then there are the phase shifts to deal with, caused when the acoustic centres of the drivers aren't in line. To see these effects and determine how they will affect performance, you need to invest in test equipment and put in the hours developing a dedicated active crossover for your 'speakers. Or, with some help from a consultant like Tony Seaford of Marton Music, you could use something like the BSS Omnidrive, which is versatile enough to cope with just about any situation. Because the Omnidrive allows the user to define exactly how the active crossover will perform, it can be adapted to just about an 'speaker.



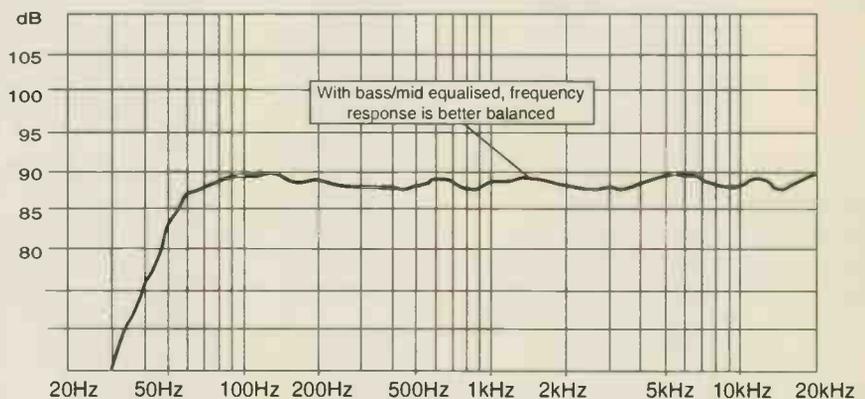
Above are the response curves for two standard Audax units. Neither are flat in their operating range, the bass/mid driver especially showing a rising response with frequency.



Using a simple Butterworth aligned active crossover doesn't correct for the drivers' non-flat responses, the result being an uneven response.



Using simple equalisation, in this case a shelving response applied to the bass/mid driver, the rise towards high frequencies can be corrected.



With treble level attenuated to match, the final overall response is now far better balanced.

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The Riverside 4040 is our integrated amplifier. It features dual mono construction and has five line level inputs and both 4Ω and 8Ω outputs. The output stage is configured in the classic McIntosh connection, which gives stable, wide-band operation even with difficult loudspeaker loads. The stainless steel chassis and transformer cover are hand polished to a mirror finish, and come with a semi-matt black valve cover. 4xEL34, 4xECC83, 2xECC82. A full description, including circuit diagram, is given in the 4040 reference manual, £6.50. Kit £780, fully assembled £995.

Technical specification: dual mono construction, 40W/channel, 12Hz to 25kHz power bandwidth, distortion <0.1%, five line level inputs, tape output, 230/240V mains input.

Stereo amplifier circuit board: board only £49.50; component pack (including valve bases), add £63; populated board £125; full valve set, add £45. Power supply board: board only £20.50; component pack, add £44; populated board £66. Input board: board only £15.50; component pack, add £15; populated board £33.

The output transformers are configured for the McIntosh connection and have excellent low frequency response and a primary reflected impedance of 3800Ω. Full connection instructions provided. Price £70. The mains transformer is wound for dual mono construction, as this gives superior isolation between channels which sharpens imaging and eliminates inter-channel ground loops in the amplifier. Primary 0-230-240V. Secondaries 2x295V@0.25A (0.4A int.), 2x70V@30mA, 2x6.3V@5A. Price £60. Other primary voltages can be supplied to special order. Data sheets giving connection diagrams and specifications, as well as circuits for using a transformer, £2.50 each.

The chassis, comprising main chassis and transformer cover, is hand polished, welded 1/16" stainless steel - NC machine tooling for a perfect fit and clean finish. Each kit also includes a mesh valve cover and baseplate, finished in

semi matt black. Price £310. Also available in mild steel finished in black, £195. For those who wish to use one of these high quality chassis for their own projects, details of the chassis are given in the 4040 reference manual, £6.50.

Connector kit: twelve gold plated phono connectors, two sets of loudspeaker terminals, an IEC mains socket with integral fuse and switch, and an IEC mains lead with fitted 13A plug. £51.50. Cable kit: all cables required for the 4040, £6.

The Riverside P2 phono preamplifier is designed to partner the Riverside 4040 for those who enjoy the vinyl sound. Equalization is provided for moving magnet output to line level. The P2 features a high accuracy feedback RIAA equalization circuit, ensuring a natural tonality, a regulated high voltage supply per channel and cathode follower outputs. 3xECC83, 1xECC81, 2xECC80. Full details and circuit diagram in the P2 reference manual, £6.50. Kit £225, fully assembled £275.

Technical specification: 47kΩ input impedance, 1kΩ impedance output for driving long interconnects.

Stereo circuit board: board only £25; component pack, add £37.50; populated board £70; full valve set £20.

The mains transformer is wound for dual mono construction and is toroidal for low leakage flux. Primary 0-230-240V. Secondaries 2x295V@20mA, 2x6.3V@0.45A, 16V@1A. Price £30. Other primary voltages can be supplied to special order. These transformers are also suitable for power supplies in preamplifiers and other line level valve circuits - see data sheet for details, £2.50.

The chassis (main chassis and transformer cover) is made from mild steel. Each kit comes complete with a mesh valve cover and baseplate, finished in black. Price £110. For those who wish to use a high quality chassis for their own projects, details of the chassis are given in the P2 manual, £6.50.

Connector kit: four gold plated phono connectors, IEC mains socket with integral fuse and switch, and IEC mains lead with fitted 13A plug. £15.

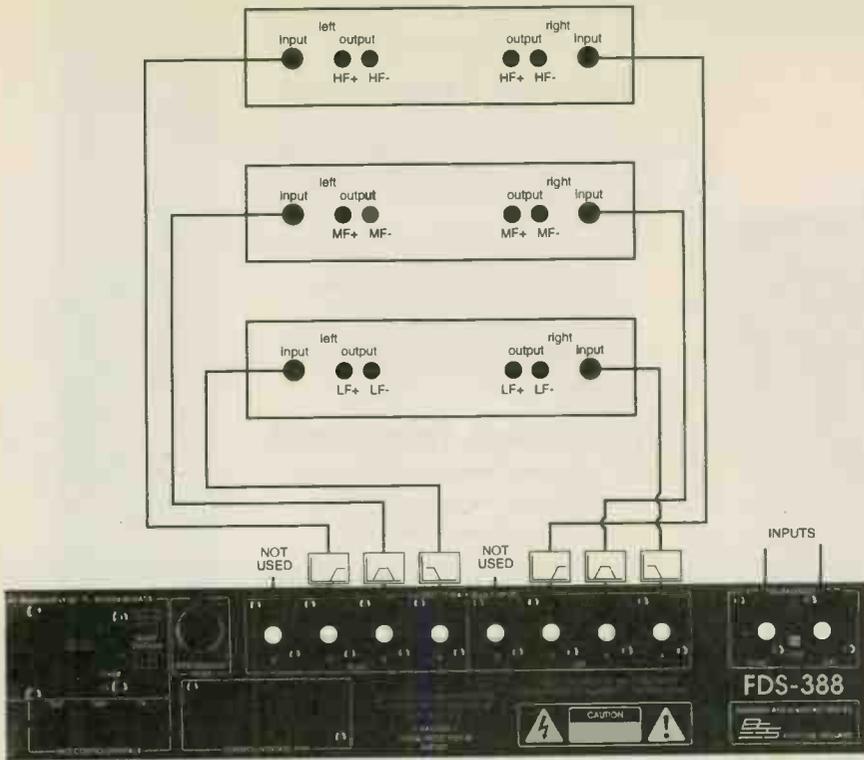
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WIRING UP

The Omnidrive is an active crossover with four stereo channels. This means it can be connected to a pair of loudspeakers with up to four crossover bands. I tried the Omnidrive in a three-way system, leaving one stereo channel unused. This spare channel could control an active subwoofer, for example.

A Sugden pre-amplifier was put into service feeding an analogue signal to the Omnidrive. Its output was then passed on to three Rotel RB-980BX stereo power amplifiers, one each connected directly to treble, midrange and bass drivers. Reflecting the fact that the Omnidrive is aimed at the professional market are its XLR sockets. Neutrik very kindly supplied the necessary XLR-phono convertors, enabling me to use Chord Co. Siren interconnects throughout.



SETTING UP THE OMNIDRIVE

I used a Sugden pre-amplifier to feed the Omnidrive, which in turn fed three Rotel RB-980BX 120W power amplifiers. The Rotel amplifiers were connected to Focal T120K tweeters,

an analyser and B&K microphone, I began to set up the system. First, I dialled in the delay times that would bring the notional acoustic centres of the drivers together. This is actually easier than it sounds - the Omnidrive's display toggles between time in milliseconds and distance in either feet or metres.

I know the drivers in this system especially well, so I was immediately able

then moved on to the equalisation screen. After much tweaking of both equalisation sections, I managed to get a very flat response. A similar process was used for both treble and bass, the final band-curves shown below in the picture of the Omnidrive's display.

It took around two hours to get a ruler-flat response. But the joy of the Omnidrive is how much it can be tweaked. With the flat response stored in one of the 60 memories, you are free to fiddle. I experimented with treble lift, midrange emphasis, bass boost, limited low frequencies to give added punch, etc.

I would advise anyone considering the Omnidrive to get a specialist consultant to set it up for you with proper test equipment. A day's work should yield a super-flat response along with five or so optional responses stored in memory to give you a range of different sound balances.



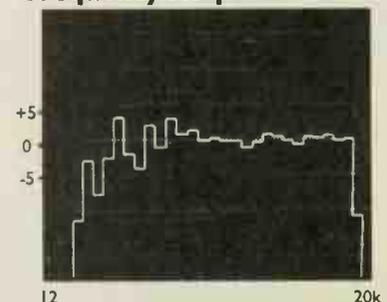
Focal Audiom 7K midrange drivers and Audax PR330M0 bass drivers. These were arranged in a large, three-way system with an open baffle for midrange and treble. It might sound like an attempt to mimic Ministry of Sound's set-up on a domestic scale, but the Sugden preamplifiers warmth allied to the Rotels' clean power driving highly sensitive loudspeakers gave a sound with effortless dynamics and control. But more of that later.

Using our Hewlett-Packard FFT

to set the crossover points well below where the drivers start to break up. A flat, Butterworth alignment was chosen with 4th order roll-off rates. Higher order roll-offs give a more consistent sound in big three-way systems, overlap between drivers being kept to a minimum.

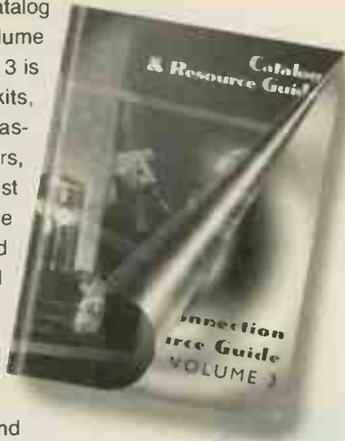
Looking at the plot on the FFT screen confirmed that the midrange driver was more sensitive than both bass and treble, and had a rising response as well. I chose 6dB of attenuation and

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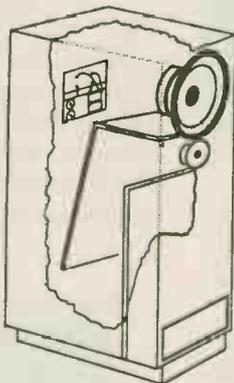
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HOW IT WORKS

INPUTS

The BSS Omnidrive FDS-388 can be fed from either digital or analogue sources. With the optional digital input card, it is possible to feed the FDS-388 from a digital pre-amplifier, like Meridian's 518. Our review sample, though, had already been set-up to take analogue signals. The signal is converted to digital by the high quality in-built 20-bit resolution analogue to digital convertor. This digital signal is then passed on to the processor stages.

Unlikely to appeal to domestic users, but interesting nonetheless, is the optional Meteorology probe. This measures changes in temperature and humidity and corrects the system's high frequency response and time-delays accordingly.

PROCESSING

1) DELAY STAGE

Here you can programme the Omnidrive to give up to 635milliseconds of delay, more than enough to bring together the acoustic centres of drive units, for example. Driver polarity can

also be set.

2) CROSSOVER

There are two crossover stages, both giving up to 2nd order high-pass and low-pass roll-off rates. This means there's a range of crossover options open to you - no crossover roll-off, or 1st through to 4th order rates. You could, for example, choose a 3rd order high-pass roll-off for the treble, but leave the low-pass section turned off so that the response runs up to 20kHz. For midrange a 3rd order low-pass to match the tweeter's roll-off could then be selected, along with a 4th order high-pass to limit low frequency excursion and improve power handling. The crossover can be user-set at any frequency, allowing sections to be overlapped or run in parallel if necessary.

Filter shapes provided are Bessel, Butterworth and Linkwitz-Riley. Gain is also set at this stage. The processor itself offers +/-15dB while there's a further +/-6dB from the front panel trim controls.

3) EQUALISATION AND PHASE

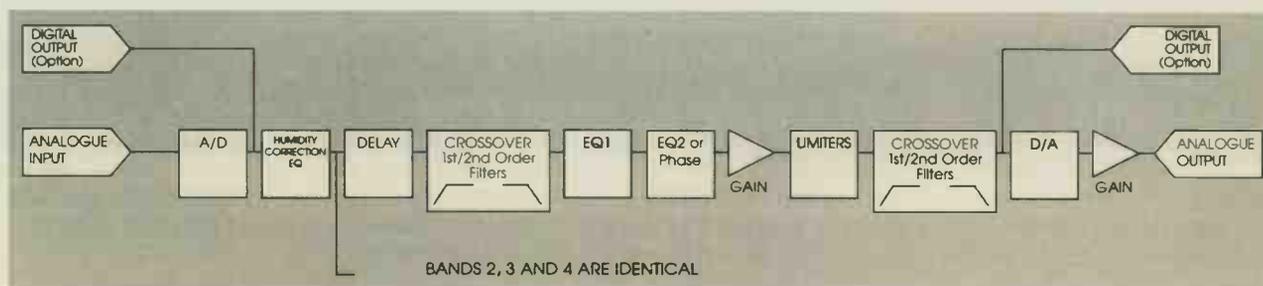
This is where the Omnidrive starts to get clever. There are two equalisation

sections available for each band. The first equalisation section can be selected to be high shelving, low shelving, or bell-shaped. So treble cut, bass boost or midrange presence can easily be achieved. The second section can be set either to do exactly the same, or adjust phase, allowing the phase of each driver to be precisely controlled.

So you can already see that, with up to 4th order filtering (both high-pass and low-pass), selectable crossover points and shapes, two sets of equalisation and phase adjustment, gain control, and delay, all acting on four stereo channels, the Omnidrive is able to cope with just about any situation, making it extremely versatile.

OUTPUTS

Finally, once all the processing has been performed, each stereo band is converted back to an analogue signal and fed to its power amplifier. An alternative would be to fit the digital output card, then feed each stereo band to its own outboard DAC. This would, however, mean splashing out on three DACs and three stereo power amplifiers for a three-way loudspeaker system.



SOUND QUALITY

It's difficult to come to a conclusion as to exactly how the Omnidrive sounds - there's very little to compare it to. But once tweaked to my satisfaction, it gave a crisp, dynamic and effortless sound with a sense of massive power and dynamics. The Rotel power amplifiers have a very fast, clean sound, which worked well with the highly sensitive Focal and Audax drive units of my loudspeakers. The end result was an impressive speed and attack to transients.

With no passive crossover components between amplifiers and drive units, control was outstanding too. The system could be played at extremely

high levels without the slightest hint of compression or hardness setting in. It was also subtle when necessary. The Omnidrive's internal ADC and DAC are obviously capable of resolving great detail - the sound it produced was more open and spacious than the passive tri-amped system I'd been running before.

With the ability to tweak the sound to an almost infinite degree, you might think I'd be spending all my time changing settings and adjusting levels. This is not the way to get the best from the Omnidrive though. Once properly set-up, it creates a full scale sound that is as close to a live performance as I've heard in domestic surroundings. Some may

even find it a little too clean with its freedom from the normal distortions, both harmonious and detrimental, that occur in a conventional system.

At £2500, the Omnidrive isn't cheap. But compared to other full-blown active systems it doesn't price itself out of consideration either. Used in a digital-based system alongside a digital pre-amp like Meridian's 518, I can see it starting to represent good value for money. And it's versatile enough to be used with any loudspeaker, so you're not limited to the handful of designs that have dedicated active crossovers. In a truly top-flight system, the Omnidrive certainly proves its worth.

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Active Filter Cookbook

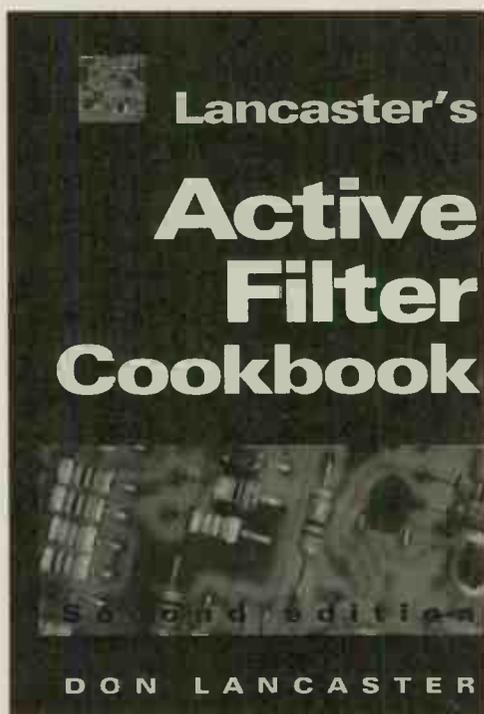
by Don Lancaster.

Reviewed by Noel Keywood.

Great book this. I've a gatty original published by Howard Sams & Co, of Indianapolis, Indiana, in 1975 and it has served me well. For this book tells you how to get an audio filter up and running in no time at all. If you're more concerned with other matters, as I was when developing the filter unit for my Quad ESL-63/Celestion SL6000 crossover (Supplement No19, December 1995), a book like this is a godsend. It makes component value calculation a five-minute task, so the real job in hand can take precedence - not number crunching.

I suppose it's a funny thing to say, that a book on filter design allows you to think about things other than filter design, but that is why I have always valued the Active Filter Cookbook. Out of interest, Celestion's low pass filter made much of the electronic filter alignment they used (Linkwitz-Riley), which in my view was irrelevant. The bass driver it subsequently fed was behaving in an unruly manner, being a large paper cone affair reputedly used for guitar work. Yet in spite of major problems in the mechanical domain, fine details in the electrical domain were touted as important. That, I suspect, is because engineers strong on theory can get to grips with filter maths. and find there's a neat, quantifiable outcome to talk and feel proud about.

I like to see it the other way around and the Active Filter Cookbook is a great tool for those who do. Faced with the considerable mechanical and



acoustical issues raised by loudspeakers, it's invaluable to have a book from which a quick filter can be cobbled up, to form an electronic crossover unit, for example. I've staggered and tuned filter sections, with the indispensable aid of real-time response analysis using pseudo-random noise analysed by an FFT. This has allowed me to build a filter to achieve very specialised and specific purposes, in the case of loudspeakers.

However, with this book, you could decide to build a record warp filter at 10am Saturday morning and have it up and running by Saturday afternoon, no sweat.

Having said this, I am assuming, of course, that you have basic test equipment, including a signal generator,

signal level meter (dB) and, preferably, an oscilloscope. You could cobble something up using 9V PP9 batteries and no test equipment, but I have to say that the sort of person most likely to do this with success is also the person least likely to need to: that's a person with experience.

Talking of which, you do need some basic understanding of electronics and how op-amps work before entering the kitchen with this cookbook. Not much, for sure, and Chapter 2 does go over the subject in good detail, but you do not get the sort of schematics we publish with our kits, for example. There's enough maths for those who want to inspect the assorted variables and how they interact. Supporting tables of component values, impedance transformations, frequency scaling techniques and various other well conceived short cuts are also included.

The book is fairly comprehensive in its filter types. There are, of course, high-pass, low-pass and band-pass types, from low to high orders. Various dampings are discussed, covering overdamped to underdamped (peaked). With these little gems alone you can perform most audio filtering functions.

A late (9) chapter on tuneable band-pass and band-stop (notch) filters is unfortunately brief for those who might like to consider building a distortion or wave analyser. This chapter races on to the elliptical filter, commonly used to eliminate pilot tone and subcarrier from the output of FM tuners, dispensing with the subject in a page or so.

It's a pity the book peters out with a lame chapter (10) on uses for filters, replete with over-inked pictures of 1970s products, plus some amusing interests of the time such as quadrature art and psychedelic lighting. Far out, man - hand me the flares.

But I have to say that Mr Lancaster's basic offering is still superb for those who want to cobble up an effective filter at light speed, because they have a job for it to do. I thoroughly recommend the Active Filter Cookbook for this purpose. It's been a great help to me ●

The Active Filter Cookbook is available from Heinemann Publishers, Tel: 01865 314301.

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Radio Designer's Handbook

F. Langford-Smith

Reviewed by Andy Grove.

The Radio Designer's Handbook is often quoted as being the "Bible" of valve electronics. I keep a copy of the fourth edition on my desk at work and one at home; Hi-Fi World guards two in-house copies. Most people seriously interested in valves have one, or are desperately trying to buy one. Which isn't so easy because the first edition was published in 1934 and the popular fourth edition in 1952. The book has been out of print for a long time and is only rarely available second hand.

Both demand and price have prompted Vintage Audio to reprint. But whereas the original was one book, the reprint is larger format and comes in two volumes, each with a quality hard cover.

The Radio Designer's Handbook concentrates on audio and radio design. Other fields have been omitted to keep it a reasonable size, but it's still pretty chunky. It was written by a team of engineers who cross checked their work to eliminate errors and ensure that the information could be relied upon. This is a textbook of basic audio and radio theory from the forties and fifties. This period, when basic understandings were still being refined, was rich in theoretical work. The book moves from such theory to practical circuits and designs. As such, it imparts great insight into valve technology.

There is a comprehensive contents listing. There are so many chapters and sections this part is really useful, but eventually you get so familiar with the book you can just flick through and find what you want - usually! Nearly every topic is covered, from the theory of thermionic emission all the way to complete amplifier and receiver design.

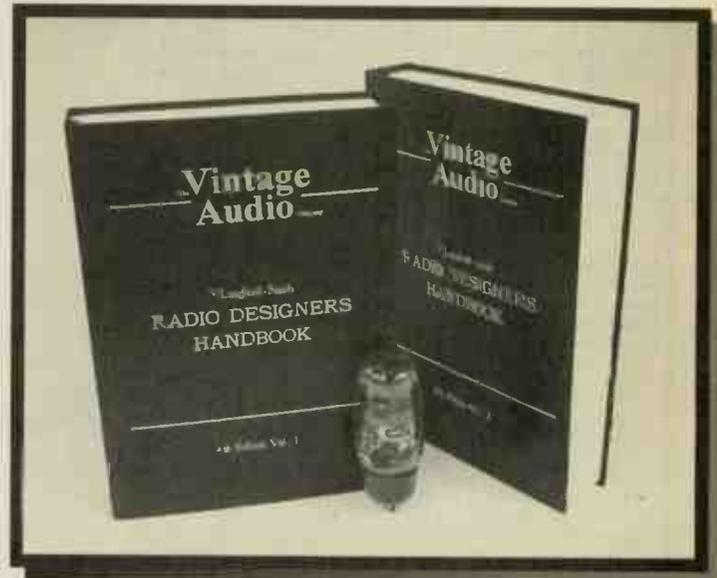
All types of radio and audio valves are described. Diagrams illustrate the currents and voltages associated with the various electrodes and there are load-lines plotted onto the characteristic curves of real

valves such as the 6J7, 807 and so on. These curves are used to demonstrate how distortion is produced by a valve and to predict the distortion with a given load. Grid current, inter-electrode capacitance, power and voltage ratings and just about everything else you need to know about audio to low radio frequency operation of the valve is covered.

Later chapters describe electronic theory needed to use valves. The section on networks starts with DC theory and progresses to AC theory, covering capacitors and inductors in their own sections, then the various resonant combinations are introduced. These sections are necessarily very mathematical. Later on in the book is a section on mathematical methods for the electronic engineer. Of course, at the time there were no calculators as such, nor Spice programs, so there are masses of nomograms throughout the book.

There is an entire chapter devoted to transformers and iron cored inductors and the characteristics of the different core materials of the day are described. Also there are details on winding methods and formulae and nomograms to calculate performance. There are few books with such data, one reason why the Radio Designer's Handbook is so sought after.

Part 3 of the book, entitled Audio Frequencies, holds most interest for the modern day experimenter. It starts with simple RC coupled triodes and ends up with rather odd loudspeaker crossovers. The voltage and power amplifier sections are excellent. Choosing a suitable operating point, biasing schemes, loading, coupling and more are all discussed in detail. Proper setting up of each stage is essential for electrical performance and sound quality, and from this book you can



learn the necessary procedure and set the operating points exactly where you want them. Both single-ended and push-pull operation is covered with both pentodes and triodes. Pros and cons such as distortion versus efficiency are analyzed.

Later chapters deal with receiver design, so if you are into designing your own valve radio, this book is superb. Coil winding calculations, antennae, oscillators and all the other juicy bits are here, but of course a lot of developments in radio technique came after this book. Power supplies come very late on, quite why I don't know, but again the treatment is fairly comprehensive and a procedure for valve rectified PSUs is outlined.

The Radio Designer's Handbook really is an excellent reference for the practising valve engineer, but it is necessarily quite mathematical in its approach. By this I don't mean it is a sterile wasteland of abstract equations. The mathematics is used to reach a useful understanding of parameters that affect operation and in most cases practical design calculations are provided, often in conjunction with graphical analyses.

Someone once said to me that the only way to design a valve circuit was to put a potentiometer on each electrode and twiddle them until it worked. My opinion was "go away and get some knowledge!" The Radio Designer's Handbook contains most of that knowledge. It's essential reading ●

A two-part, bound reprint of the Radio Designer's Handbook is available from Hi-Fi World's Library, Price £59 + £7p&p

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D.I.Y. Letters

UPGRADING K588 I

I have recently built your K588 I valve amplifier kit. This is to replace my previous amp (a well known transistor project of over 100 watts). I built this about 7 years ago and have been more than pleased with its sound quality so far.

The K588 I is better in every respect - deeper and

more tuneful bass, sweeter treble and far better separation of instruments and vocals. It also appears to go louder. This is not just wishful thinking on my part as my wife also commented on the improvement, and is equally pleased.

Regarding the technical side, apart from the anodes being crossed it worked first

time. I made some small changes - the input cap is now an ERO polypropylene. Would a paper in oil be even better? I also fitted the mains switch on the rear of the chassis to minimise the wiring. Most of the wire used is PTFE silver-plated equipment wire. Hum is non-existent with the inputs shorted. Would it also be advantageous to wire a 4u7 630v Polypropylene cap say between output transformer centre tap and power supply ground, one per channel, or to wire one across each half of the main cap, i.e. C12/13?

**Pete Durey
Hastings,
East Sussex.**

Component changes can be used to sculpt the sound, and to give overall better sound quality if well chosen. When bad sound quality can be attributed to the components, cheap electrolytic capacitors are usually the prime suspect in most equipment.

Although most modern components offer half decent sound, some really stink. The top sounding electrolytic capacitors are Black Gates, although their operation is somewhat different to a standard Elco. There are audio types available from Sanyo (OS-CON), Nichicon (Muse) and Elna (Cerafine).

As far as I know, only the Cerafine and Black Gate capacitors are available in sizes and voltages suitable for valve power supplies, whereas all of them offer types suitable for cathode bypass caps. It is possible to go over to plastic or paper capacitors for the power supply, but because of the physical size you

need acres of space on your chassis to fit a reasonable energy reservoir - if you like solid bass, these caps can be a pain.

The other sound killer is the coupling cap. Here, there is a great variety available, all offering a menu of different sounds. Some sound horrible, really bright and synthetic, while others are smooth and detailed. The better plastic dielectrics are Teflon, polystyrene and polypropylene, usually in that order. Some of the cheap audio grade caps like Solen or Ansar are quite good for the money, but there are some really super ones out there. The Hovland MusiCap seems to be gaining favour in the valve world, and of course there are the ubiquitous paper in oil types which are available in aluminium, copper and silver foil versions from Audio Note.

The biggest difference in sound quality from coupling caps comes from the fact that where the cheaper ones are metallized film, the better ones use a film/foil construction. In the metallized type, the plates of the capacitor are made up from particles which are sprayed on, while, as the name suggests, the foil type uses a real solid foil electrode. And if the capacitor manufacturer is going to the trouble of using a foil, the dielectric is usually of decent quality too.

Bypassing PSU caps with smaller value capacitors can have mixed results - usually the upshot is just more perceived treble. You can also hear the different sonic characters of the two capacitors, if they have different dielectrics. Bypassing can sometimes work, but it is better to go over to a better quality



K588 I is an ideal base for experimentation, with its large, easily accessible chassis and hard-wired construction.

PSU capacitor in the first place. My advice is to try it and see; to you it might sound great, with a real sense of presence and atmosphere. It would not be in keeping with paper in oil coupling caps though, which have a smooth, integrated sound.

Most carbon and metal film resistors sold in the catalogues are really cheap and nasty, cost 0.0001 pence per thousand and are for use in washing machines, so expect wishy-washy sound. If it's carbon films you're after, use Allen Bradley. For metal films, your choice is a bit more complex. Some swear by the ultra-expensive Vishay Bulk Foil resistors, while others such as myself use the non-magnetic Shinkoh Tantalum Film resistors (most resistors use a nichrome film). Check the resistors in your amp with a magnet and you will see they are attracted to it



Hovland's Musicaps have a fine sound. An ideal upgrade over standard audio grade capacitors.

because your signal is passing through steel leads, not copper or silver.

There are Beyschlag, Holco and Caddock resistors as well, the Beyschlag being the best 'standard quality' metal film resistor, the Holco a step nearer to Nirvana and the Caddock on a similar plane as Vishay and Shinkoh. There are also wirewound resistors (I use

some Welwyn types even though they have steel leads) and ultra-precision types available from Welwyn and Rhopoint. There are the American Mills wirewounds as well, which are regarded as the best, but be warned, they are huge - the 3W type is 3 inches long! AG

MORE POWERFUL PROGRESSION

I think this letter may be of interest to you and your readers.

I have built an amplifier based on your valve 4watt SE design published some while ago. I have modified the design slightly to provide more gain and output power (about 8 watts). Basic changes are; the ECC83 has both halves strapped in parallel, with anode & cathode resistors halved in value. The output stage has one 6080 in each channel in parallel SE working. The output transformers are

Sowter SE12, intended for parallel SE 300Bs. These are massive beasts and have separate anode windings which give approx. 900Ω impedance each, which appears to suit 6080s well. There is no overall feedback. The

remote power unit has completely separate transformers, rectifiers and chokes etc, for each channel. The amplifier and power unit have a mixture of Black Gate electrolytics and paper in oil capacitors. Resistors are mixed carbon and EE10 Vishay. It may sound expensive to build, but using ex-Govt mains transformers and chokes and chassis etc. has kept the price down.

All L/S units are mounted in a brick dividing wall, between lounge and adjoining room (lounge 25' x 19'). The system is 3 way. The tweeter is a Visaton ribbon, midrange a Volt BM220 DS and bass KEF 1814 units (remember these!) The results are very good, natural on voice, piano etc. and very good on pipe organ.

D. R. Chandler
Llanfyllin,
Powys.

Your amplifier sounds interesting and quite a bit different from the original circuit. One problem though; the 6080 isn't a very linear valve, so taking the feedback off will allow through distortion which will affect the sound. Your extensive modifications, external power supply and experiments with the circuit suggest to me that you should go the whole hog and build a 300B SE amplifier - the results will be well worth it. In fact, I'm sure you will be totally amazed. Proper directly heated output valves are miles ahead in terms of sound quality and low distortion.

The primary impedance of your transformers seems a bit too low for two 300Bs in parallel at 900 ohms though. They would want about twice that, so maybe yours are for four valves, which would be expensive. What you could do is use the transformer you have, but connect an 8 ohm speaker to the 4 ohm tap, meaning the valves would see a primary impedance of 1.8k instead of 900 ohm. The frequency response will hopefully still be satisfactory and you could then use two 300Bs per channel.

Use the ECC88 as the driver valve and the ECC83 as the input. You would then have a very good amp, as long as everything was set up correctly. You

may have to search through a few books for the valve specs. and suitable operating conditions, but I assume you have already done a bit of that to be sure your modifications to the original 4W SE circuit would work. You will need about 430V (supply voltage) for the 300Bs, with 750 ohm, 12W cathode resistors for each. Bypass these with 220uF 100V caps. Then set up each half of the ECC88 with 8mA anode current and 130V on the anode - the load resistor should be around 15 or 20k rated at 6W. Each ECC83 section will need 100V on the anode and 1mA current. You can look up the rest in the books and discover for yourself. AG

DIY SPEAKER SEASON

Now that the DIY hi-fi season (winter) is fast approaching, I need your help in sorting out my latest project.

Firstly, a little background info: CD player - Marantz CD-63mkII KI-Signature, a superb player as you rightly say. Amplifier - World 5-20 monoblocks - built and modified by myself. Speakers - 135 litre transmission lines, 1275mm x 300mm x 500mm cabinet construction based on TDL monitors, but using KEF units like the R50 design. Crossover on R50 using air core inductors and polyprops. Cabling - Maplin bi-wire speaker cable (OFC), Maplin hi-grade audio cable and phono connectors.

My query concerns the speakers. Although they sound superb with fantastic bass extension (listen to that 32ft. organ pipe rattle the windows!), I feel that I need more sensitivity as I have to run the amps flat out for a decent volume level.

Should I replace the KEF units (BI 39, etc.) with HDA

We would like to introduce the

Cambridge Audio R50



Monitor loudspeaker employing transmission line techniques ● Bass unit 30-400Hz (lower frequency depends on room size) loaded with a damped tapered labyrinth ● Mid-range unit 400Hz-3kHz, physically separated from the bass unit to avoid intermodulation distortion, loaded with a damped tapered pipe ● Two h.f. units radiating at ear level 3-10kHz & 10-20kHz+ ● Four way crossover network ● Power handling 25rms watts, 50 music power watts ● Impedance 8 ohms nominal

Cambridge's R50 had an impressive specification, one that few have bettered today.

or carbon-fibre units on a new front baffle or should I start from scratch and build new speakers (one of your kits maybe) bearing in mind I want deep bass as it definitely underpins the music and gives everything a sense of scale and power.

Please do bear in mind that ultimately I aspire to building K5881 PSE. Maybe I'm asking too much, your reply is awaited with interest.

S. Puttock
Chatham,
Kent.

Replacing the heavy KEF cones in your R50s with lighter, faster HDA or carbon-fibre drivers just won't work. They have completely different characteristics, so the misalignment with the cabinet and crossover design would probably make the sound far worse. If you really want HDA or

carbon-fibre driver 'speakers, start from scratch on an all new design. Our KLS3 design would be an ideal choice if you do intend to build K5881PSE.

The R50s though, despite being quite old, do use very high quality drivers. They are inefficient by today's standards, but a pair of well-sorted R50s will still see off a lot of modern competition. If you decide to keep them, it is definitely going to be worthwhile up-grading your amplifiers to something more powerful, with more control and grip in the bass.

A pair of our K5881 kit amplifiers in monoblock mode will give you a much more healthy 45watts. This should get your R50s moving a little better, although you could usefully do with even more

on tap. This really demands solid state amplification. One of the smoothest and most valve-like, if you can say that about any transistor amplifier, is Sumo's Polaris III power amp. We measured over 150watts from this amp, and at £898 it's pretty good value too. I'd strongly recommend you get an audition of something like this just so that you can see the potential your R50s have. DB

Supplement Aug. 95) that the tweeter is connected in reverse phase on the output of the Audax factory supplied crossover.

Now a query: do you plan to do a historical review on Troughline tuners (II, III, Mono, Stereo)? What are the differences between these beasts so beloved by H.F.W.? Do they go up to 104MHz, etc. . .

And what about the idea of a H.F.W. valve tuner kit, surely great even if expensive and a lot of work for you!

In the hope of hearing from you soon.

Jaques Daigneau
Antony,
France.

Stuffing the bass chamber of KLS6 is not normally necessary. Without the long hair wool, it has a lucid and free flowing quality, giving good expression to bass lines.

BUILDING KLS6

For me the project is now to build your KLS6, but I have some questions:

1 - Do bass enclosures need to be stuffed with long hair wool, or is it only the open midrange. And in what quantity?
2 - What about the "Blu-tack phase plug" tweak you used once on the midrange unit (H.F.W. Supplement Dec. 94)?

3 - It seems, on the schematic of the crossover circuit (H.F.W.



Our KLS6 design uses an open baffle midrange driver to eliminate cabinet coloration. The open cavity is filled with long hair wool to absorb rear-firing energy.

Filling the chamber will damp bass a little more, giving a slightly tighter, more damped sound. You may like to try this for yourself, but a better way to tighten bass would be to use light foam plugs inserted into the reflex ports. It's a kit design though, so feel free to experiment - you may find that performance is improved in your system and listening room.

It is important however to use plenty of long hair wool in the midrange chamber. This helps to absorb upper midrange frequencies that would otherwise reflect off the wall behind the 'speakers and blur images.

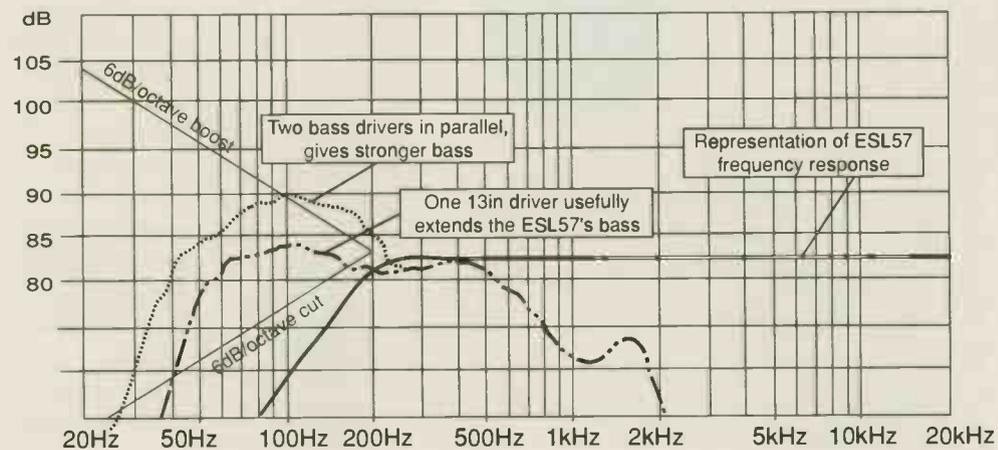
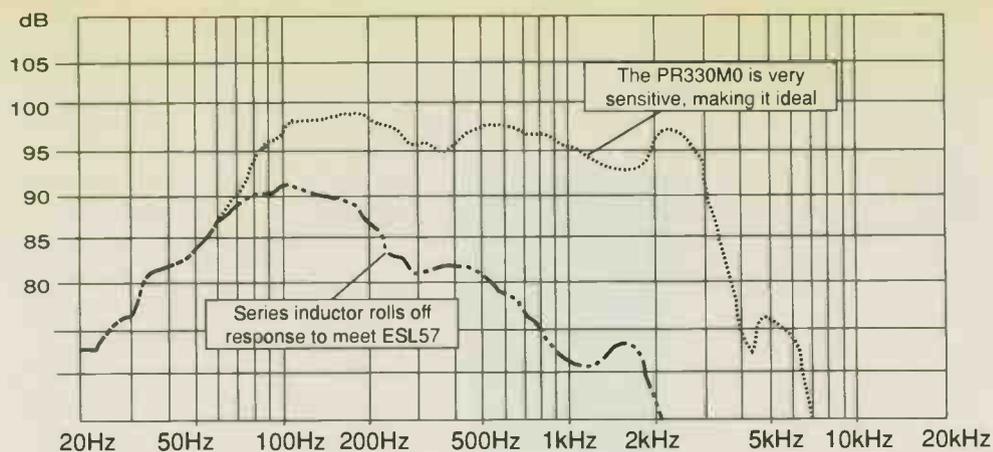
The phase plug did work very well, but the expense of tooling a professional rubber or plastic part and modifying the units would have made cost prohibitive. By carefully aligning the crossover we were able to get very good results without the need for this, reaching a more cost effective solution.

We have covered the Troughline tuner extensively as well as



The Leak Troughline continues to gain popularity amongst audiophiles for its rich, powerful and detailed sound.

Leak's history in the past, so it's unlikely we will also do a history of their tuners in the near future. Basically the later ones are best, being more sensitive and so needing less aerial signal strength for good performance. FM bandwidth is 88-108MHz.



If you're thinking of purchasing one, Graham Tricker of GT Audio (Tel: 01895 833099) will be able to give further advice, as well as offering a restoration service.

A valve tuner eh?

We've thought about it, and would love to develop one. Sadly, at the moment, the cost of RF test equipment needed and the length of development time make it

near impossible. It'd probably take 2 years and thousands of pounds to develop, and although I'm sure it would sound fantastic, its price tag would also be pretty awesome. It's something we won't forget though, so maybe one day. . . DB

SIMPLE OPEN BAFFLE SUBWOOFER FOR ELECTROSTATICS

I was amused to read in your magazine some months ago the advice on how to "upgrade a Quad system." "Buy more music," you said. My Quad-based system struggles on after 25 years, and recently I have started playing with stacked ELS57 pairs, and you're right - I've started buying more music.

Can you advise me on dipole subwoofers and any literature on how to make low frequency speakers? Obviously a boxed speaker won't do, and I can't afford a Gradient or a used SL6000.

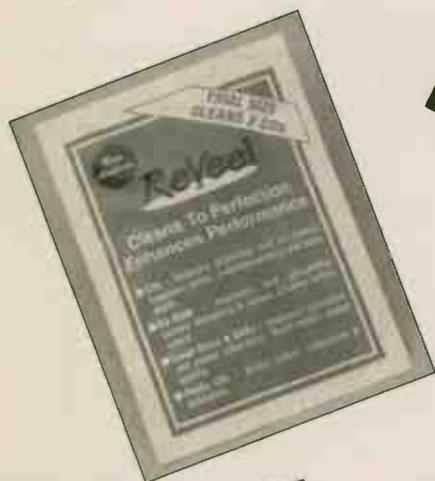
Simon Painter
Clifton,
Bristol.

It strikes me, as I read your letter straight after looking through last month's Supplement hot off the press, that the theoretical open baffle bass system I talked about may be ideal for Quad owners. It is a

simple design using two 13" bass drivers on an open baffle with passive equalisation. Because the Quads are insensitive at 83dB or so, and the two PR330M0 13" drivers in parallel will produce around 104dB, you have approx. 20dB more bass level to play with for passive equalisation.

Unfortunately, although a simple open baffle subwoofer could easily be built using this idea, it wouldn't be cheap, needing 4 x 13" drivers at £145 each, as well as an extra power amplifier. A cheaper system could be built at first just using one 13" driver per channel. There is still plenty of sensitivity to apply enough equalisation to hit 50Hz (-6dB) easily, low enough to play bass fundamentals well. You could then add a second bass driver per channel at a later date if you felt it necessary. DB

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