Hi-Fi WORLD

NO.24 OCTOBER 1996 SUPPLEMENT

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We offer below a selection of our CVC PREMIUM range of audio valves. These CVC BRAND valves are from selected world wide sources, processed in our special facility to provide low noise/hum/microphony PRE-AMP valves and POWER VALVES burnt-in for improved stability and reliability. Use this sheet as your order form. If you require matched pairs, quads or octets etc. Please allow £1.00 extra per valve for this service and mark alongside the valve type number 'M2,M4, M8' etc as required.

Price list and Order Form for CVC PREMIUM Audio Valves

PRE-AMP VALVES	Unit Price	Qty	Total Price
ECC81/12AT7WA	5.00		
ECC82/12AU7WA	4.50		
ECC83/12AX7WA	5.00		
ECC85	5.00		
ECC88	4.50		
ECF82	5.00		
ECL82	5.00		
ECL86	5.00		
EF86	4.50		
E80F Gold Pin	9.00		
E81CC Gold Pin	6.20		
E82CC Gold Pin	6.20		
E83CC Gold Pin	6.20		
E88CC Gold Pin	7.20		
6EU7	6.00		
6SL7GT	4.00		
6SN7GT	4.50		
6922	5.00		
7025	6.20		

POWER VALVES	Unit Price	Qty	Total Price
EL34/6CA7	7.50		
EL34 (Large Din)	8.50		
EL84/6BQ5	4.00		
E84L/7189A	5.50		
KT66	9.20		
KT77	12.00		
KT88	12.50		
KT88 (Gold Special)	19.80		
2A3 (4 or 8 Pin)	14.50		
211	22.00		
300B	50.50		
6C33C-B	27.00		
6L6GC	6.50		
6L6WGC/5881	8.00		
6V6GT	5.00		
6080	12.00		
6146B	10.20		
6336A	46.00		
6550A	11.00		
6550WA	13.50		
6550WB	13.50		
7581A	11.00		
807	8.00		
811A	10.50		
812A	34.00		
845	30.00		
Total carried forward ...			

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GZ32	7.00		
GZ33	7.00		
GZ34	6.00		
GZ37	6.00		
5U4G	5.00		
5V4GT	4.00		
5Y3GT	3.50		
5Z4GT	3.50		

SOCKETS ETC	Unit Price	Qty	Total Price
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B9A (Ch or PCB) Gold	3.00		
Octal (Ch or PCB)	1.80		
Octal (Ch or PCB) Gold	4.20		
4 Pin (For 2A3, 300B)	3.30		
4 Pin Jumbo (For 211 Etc.)	11.00		
4 Pin Jumbo Gold (For 211 Etc.)	15.00		
5 Pin (For 807)	3.00		
7 Pin (For6C33C-B)	4.50		
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Anode Connecter (For 807 Etc.)	1.50		
Anode Connecter (For PL519 Etc.)	1.60		
Retainer (For 6L6WGC Etc.)	2.00		

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TOTAL EXC VAT	£	
VAT @ 17.5% (UK/EEC ONLY)	£	
TOTAL TO PAY	£	

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NAME: .....
ADDRESS: .....
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..... Post Code: .....

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D.I.Y. Supplement

Contents

KIT NEWS

AMERICAN DREAM GOES RUSSIAN

After two years of hard work, New Sensor's investment in a project to develop a Sovtek version of the legendary 300B valve has finally borne fruit. Vladimir Shadeev, Russia's famous valve designer, led the work on the valve with assistance from Irusha Bitukova (Director of Sovtek) and Dr Nikolai Kuzmin (Chairman of Reflector, Russia's biggest power valve factory). Mass production is due to start as we go to press, with New Sensor as the valve's exclusive worldwide distributor.

New Sensor
20 Cooper Square,
New York City
NY 10003
Tel: (212) 529-0466

OVERTURES FROM FARNELL

Fresh from Farnell is a pair of new power amplifier ICs for those who have an aversion to discrete components. Stirringly titled the LM1876TF and LM4700TF, these chips form part of National Semiconductor's Overture range. Both are designed to operate free from pops and clicks when switched on or off, and can supply 20w stereo and 30w mono respectively. With prices set at £2.65 for the former and £2.02 for the latter, they could form the basic building blocks for either multi-amped or active systems.

Farnell
Edinburgh Way,
Harlow,
Essex CM20 2DF
Tel: 01279 626777

FAIR'S FAIR

Good news for all audio collectors and boffins suffering from withdrawal symptoms - Audio Fair is back in 1996. The fair, which plays host to electronic components and records as well as modern and vintage audio equipment, is scheduled for Sunday 20th October at Watersmeet on Rickmansworth High Street. £2 is all it costs to gain entry between the hours of 10.30am and 4pm. **For more information contact Graham Tricker on 01895 833099.**

THE RETURN OF WILMSLOW

Lovers of DIY hi-fi will be relieved to learn that Wilmslow Audio is now up and running again under new owners Shaun Williams and Terry Sharpe. The company has been relocated to Leicester, where a new price list and catalogue covering over 1400 components is being compiled.

Wilmslow Audio
68 Carlton Avenue,
Narborough,
Leicester.
Tel: 01565 650605

CABLES FROM CAMBRIDGE

Founded in 1988 to manufacture and supply high purity conductors for corrosion testing, Cambridge Scientific Supplies are now turning their attention to the world of hi-fi. They offer ready made interconnects, the CSS-025 (£99/stereo metre) and CSS-037 (£112/stereo metre), made from 99.99% pure silver and terminated with WBT plugs.

For those with DIY inclinations, CSS are also selling silver wire for use in modifying amplifiers, loudspeaker crossovers, etc. This comes in four diameters, 0.25, 0.37, 0.5 and 1mm, the first two wrapped in PTFE insulation while the others are uninsulated. Prices range from £8/metre up to £20/metre. To ensure the best possible connections, CSS also have two gauges of silver solder (22 and 24swg).

CSS
12 Willow Walk,
Cambridge CB1 1LA
Tel: 01223 811716

BILLINGTON GLOWS ON

Billington Export, the valve suppliers, are continuing to expand their catalogue. New arrivals are a Russian 6550B3 with zirconium getter, Svetlana's SV811-3 and 811-10, and an EL34 from Tesla who have recently re-started production. Billington are also reducing the prices of all their Chinese components.

Billington Export
Units E1 and E2,
Gillmans Ind. Est.,
Billingshurst,
West Sussex RH14 9EZ
Tel: 01403 784961

HIGH SENSITIVITY LOUDSPEAKER

Dominic Baker designs and builds a high sensitivity loudspeaker using Audax professional drive units.

Back in our October 1993 DIY Supplement we published the design of our second kit loudspeaker, KLS2. Using a Richard Allan 8in. bass driver and an Audax 14mm polymer dome tweeter, it was impressively sensitive, producing 94dB for just 1watt of input. To this day, we haven't produced a design as efficient, due to the lack of suitable drive units. And few commercial loudspeakers come close.

The Richard Allan bass driver used in KLS2 was discontinued a while back, so we lost our only design capable of producing more than 90dB sensitivity. That is until now, and the arrival of KLS8.

For quite a while I've had my eye on Audax's range of professional drive units, a number of which claim sensitivities well above 90dB, some even stretching above the magic 100dB. But until production started on the new PR125T1 horn loaded tweeter, there hadn't really been a viable replacement for KLS2 suggesting itself.

The PR125T1 is a horn loaded version of Audax's 25mm fabric dome tweeter, similar to the one we use in KLS3. The spec. suggested a whopping 97dB, sensitivity along with good power handling, so I ordered a pair straight away.

To accompany them, I chose a bass driver also from the professional range, the PR240M0. This is a powerful 10in. paper cone driver with an impressive specification. The voice coil uses edge wound flat wire on a fibreglass reinforced Kapton voice coil former and is connected to gold-plated terminals. It has a strong cast chassis, and best of all, a sensitivity of 95dB.

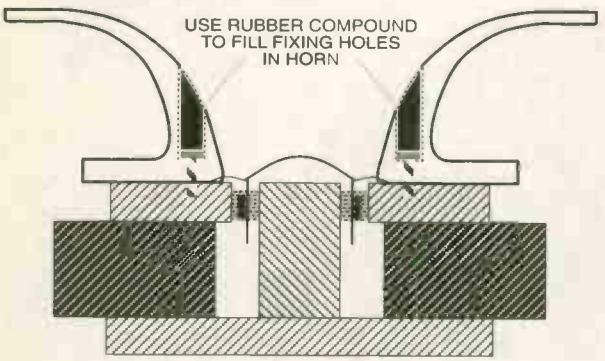
With all the right ingredients to hand, KLS8 was born. It is sensitive like the original KLS2, but has greater bass depth and impact, as well as improved power handling.

TWEETER MODIFICATION

The horn fitted to the front of the 25mm fabric dome tweeter increases its sensitivity dramatically, from around 92dB to 97dB. Unfortunately, because this horn has to be fixed to the four holes in the tweeter's top plate, there are four deep recesses in the sides of the horn. These cause a deep and sharp suck-out as shown in the response plot below.

This suck-out is narrow enough not to be too noticeable subjectively, but I found a simple modification that would rid the problem completely. The suck-out is most likely caused by a standing wave effect in the cut-outs for the screws. This was confirmed, when, after a small piece of sticky-back foam had been stuck in each, the suck-out in the response reduced significantly.

The suck-out can be removed completely by smoothly filling over these holes with a black rubber compound, following the flare of the horn. This is simple enough for those of steady hand, but if you're the slightest bit worried, just stick to foam pads. If you do decide the rubber compound route, be especially careful not to spill anything into the horn and down onto the tweeter's fragile fabric dome.



CABINET DESIGN

KLS8 uses a large, sealed or infinite baffle enclosure. The cabinet completely encloses the rear of the drive unit, the springiness of the air in the box providing the correct loading. Although not as efficient as an equivalent reflex design, a sealed cabinet does tend to give a tighter, faster bass quality.

KLS8 is a largish standmounter, its cabinet some 50litres in internal volume. This gives a system Q factor of around 1.1. A Q factor of 0.707 gives a nominally flat response, but I chose to build-in a little bass lift, just 2dB, but enough to provide good punch and drive in the bass. Its lower -6dB limit is 42Hz, low enough to play fundamentals well.

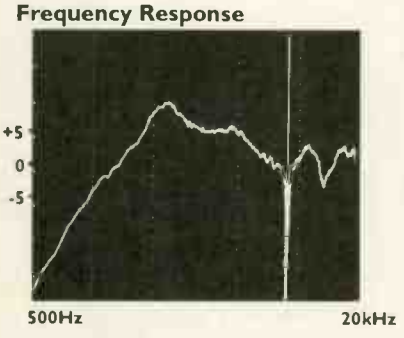
There is a little room for those who want to experiment with the PR240M0 driver. Raising Q to 1.2, reduces the box to around 40litres, giving a bass lift of 3dB, but a lower -6dB limit of 45Hz. Reducing Q to 1.0 increases box size to around 70litres, reducing bass lift to 1dB, but lowers the -6dB point to 40Hz.

THE CROSSOVER

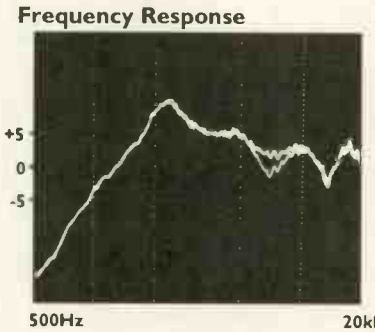
TWEETER CROSSOVER

Audax's PR125T1 horn loaded tweeter has a lot of energy concentrated between 1-5kHz. A simple 2nd order crossover, which gives a useful roll-off rate but doesn't compromise efficiency badly, and which I wanted to use to ensure a good phase relationship with the bass driver, wasn't enough to control this satisfactorily. To remove this lump of energy, I choose to use a parallel notch filter (capacitor, inductor and resistor in parallel), tuned across a wide band.

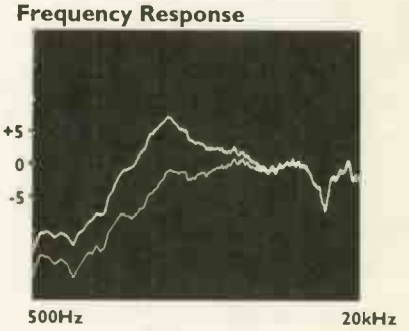
With in place, the tweeter's response already looked a lot smoother and better controlled. With the simple 2nd order filter added, the response flattened right out, and the correct roll-off rate and crossover point were set. The tweeter then needed a little attenuation (3dB) to match the midrange output of the bass driver, achieved by the L-pad resistor network.



As standard, the horn loaded 25mm fabric dome tweeter has a deep and sharp suck-out at 8.8kHz. I quickly found that this was due to the moulded cut-outs in the horn profile which take the fixing screws that hold the horn to the driver.

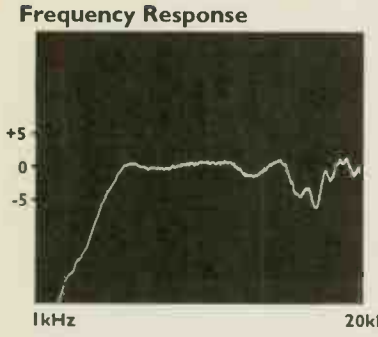


Just a small piece of sticky back foam helped to alleviate the problem, as shown in the bottom trace. The top trace shows the modified tweeter with the cut-outs fully smoothed over.



Next I began on the crossover. A parallel notch filter was used first to remove the 'lump' of energy between 1-5kHz and flatten the response.

Frequency Response

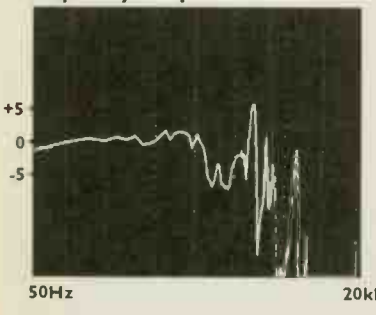


Once the response had been flattened, it was a fairly straight-forward task to align the crossover. A 2nd order design was chosen, along with an L-pad resistor attenuator.

BASS/MID CROSSOVER

Again, as with the tweeter, the bare response of the PR240M0 bass driver was measured first. It looked promising,

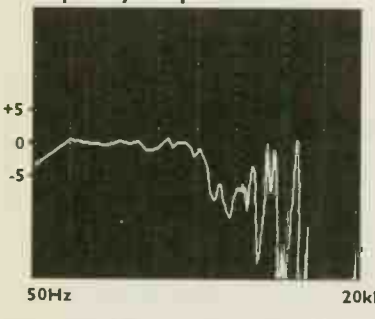
Frequency Response



The bare response of the PR240M0 was promising, in that up to around 1.2kHz or so it was smooth and flat. Unfortunately, above this there were some strong peaks as the cone moved into its 'break up' region.

in that up to around 1.2kHz or so it was smooth and flat. Unfortunately, above this there were some strong peaks as the cone moved into its 'break up' region.

Frequency Response



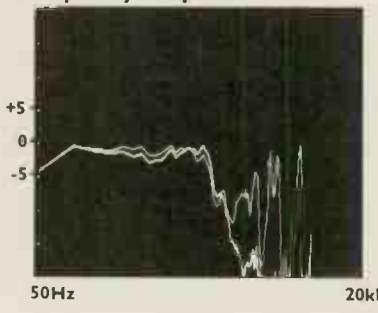
What especially worried me was the strong peak (+5dB above the main driver's output) at 3kHz, right where the ear is sensitive to sharpness. Again I used a parallel notch filter, which reduce this peak from +5dB to -3dB below the driver's main response.

This results in a lumpy response that can be heard as a roughness, but isn't normally a problem because the crossover is set to roll-off the response before the break up region. In this case though, the strong peak (+5dB above the main driver's output) at 3kHz, right where the ear is sensitive to sharpness could not be suppressed sufficiently with a 2nd order filter.

So, again I used a parallel notch filter, this time tuned much more sharply by omitting the resistor (the resistor in the tweeter section widens and shallows the notch). This reduced the peak from +5dB to -3dB below the driver's main response, ie. attenuated it by 8dB, enough to keep it well below the main response.

With the addition of the 2nd order filter, the cone's break-up region was removed, leaving a smooth and flat response below. The first visible peak dropped to around 15-20dB below the main driver's output, ensuring a smooth sound even at high levels.

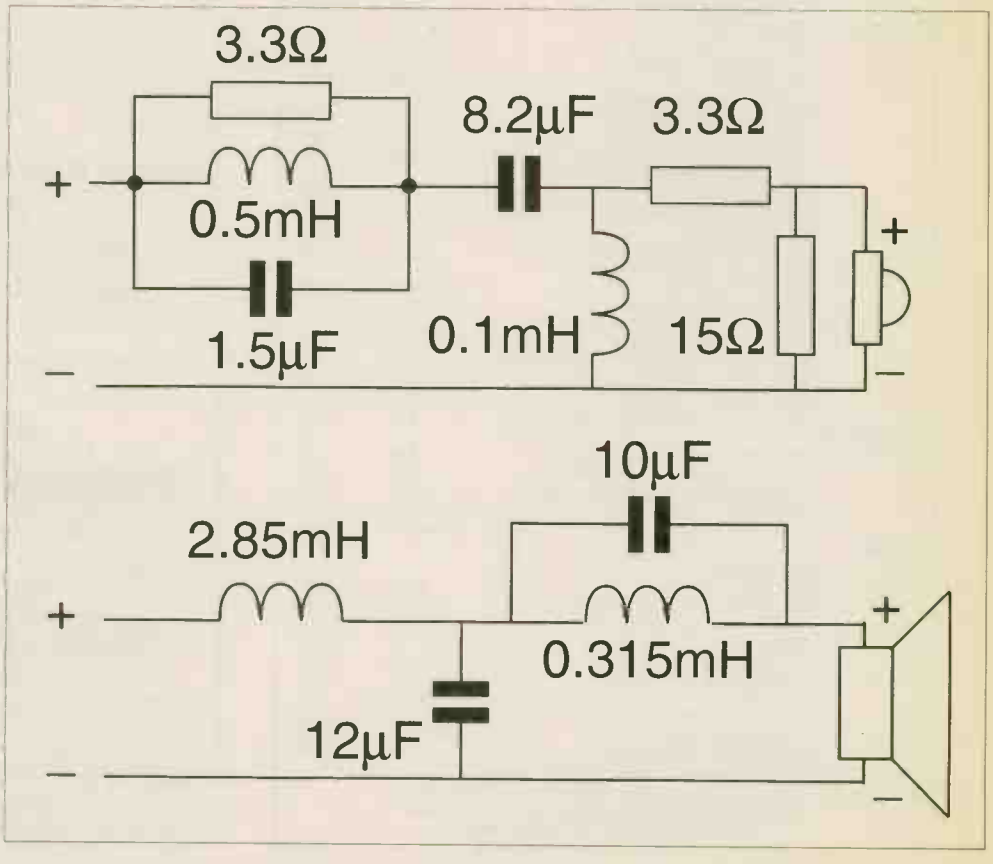
Frequency Response



Next, to completely remove the influence of these peaks, I used a 2nd order filter. The first visible peak dropped to around 15-20dB below the main driver's output, ensuring a smooth sound.

IMPORTANT NOTE

It may be tempting to use different components to those specified for this design, ie. different grade capacitors, thicker wire gauge inductors, but don't. The notch filters used rely on the characteristics of the components to work properly. For example, the resistance of the inductor in a notch filter affects its performance. You are likely to unbalance the sound for the worst if you use different components to those specified.



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Our aim at Riverside Audio is to enable the home constructor to build valve amplifiers which combine superb sound quality with the professional finish of the best high-end products - at a low price. Our rigorous and conservative designs ensure that you get long and trouble free service from your amplifier. We offer our amplifiers in various forms, from circuit designs, through printed circuit boards, to full kits and even fully assembled amplifiers for those who cannot wait to listen to them.

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 £16; 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, specifications, as well as circuits for using each transformer, £2.50 each.

The chassis, comprising main chassis and transformer cover, is hand polished, welded 1/16" stainless steel - NC machine tooled 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, 2xECF80. 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 13 A plug, £15.

We normally ship within three working days. If we do not have the item in stock we will advise you of expected delivery and confirm before despatch. P&P (in UK): £2 for each part of £40, maximum of £10; manuals free of charge. Assembled units despatched by courier free; courier service on other items £10.

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	Replacement 301 control knobs On-Off/Speed select	pair 20.25	2.55
	Replacement 301 suppressor unit	5.65	2.25
	Replacement 301 motor pulley (-2%), (-1%),(Std), (+1%)	each 12.65	2.25
	Replacement 301 Chrome plated mounting bolts	set 4.70	2.25
	Recommended Lubrication set - early 301/standard 301/401 - please specify	5.60	1.85
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BUILDING KLS8

The cabinets for KLS8 are made from 18mm MDF, which is strong and easy to machine. It is easier and far quicker to cut the holes for drive units and terminal dish before you start to glue the cabinet together. It also reduces the amount of dust inside the cabinets which can find its way into the open voice coil of the bass unit. and eventually cause rubbing.

The plans below show the general construction. Remember to do a dry run first to check that all the panels fit snugly together. In my case, even though the MDF was cut by a professional woodworker, it had to be sanded to size for a perfect fit.

Using Evostick Resin-W, apply the glue to the edges of the panels. They can then be slid into place, their 18mm thickness being enough to stand steady without panel pins. Any excess glue that oozes from the joins can be wiped away lightly with a damp cloth.

To ensure that the panels are firmly pressed together, either place suitable heavy implements on top of the cabinet, or use thick, stretchy carpet tape wrapped around the cabinet to pull the pieces together. After this last step, check that the cabinet is square and that all the sides are flush. The glue should still be wet enough to allow the panels to be gently pushed into line.

Once the glue is dry - overnight is normally enough for it to reach full strength - the cabinets are ready for their internal damping to be fixed into place. Carpet felt should be glued onto the sides, top, bottom and back of the enclosure.

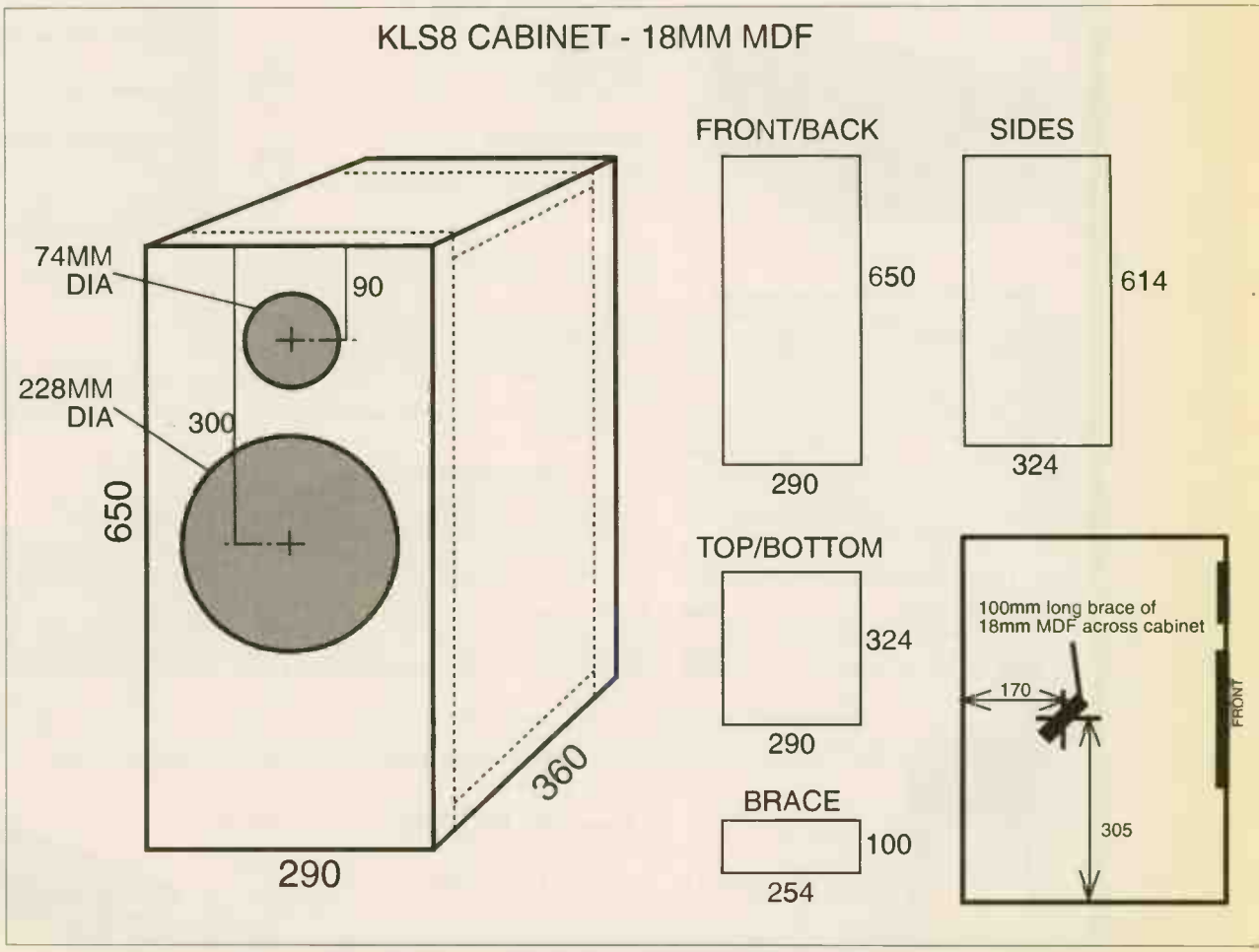
The whole cabinet, is then lightly stuffed with long hair wool, to further absorb reflections and reduce the effects of standing waves. The long hair wool normally comes in knotted bundles, tease it out gently for best effect. Of course, you are free to experiment with other forms of panel treatment: BAF and Deflex pads for example. But we find that the combination of soft carpet felt glued to the panels together with long hair wool stuffing to be extremely good, as well as being cost effective.

Mount the crossover on a separate board, a piece of ply wood is ideal. Because inductors, being magnetic components, have a field around them, they need to be spaced well apart and at right angles to each other to minimise inductive coupling. The components can be fixed to the crossover board with PVA glue, but I find a hot-melt glue gun holds them in place just as well, but the glue is more easily removable.

The drive units can now be soldered to the wires from the crossover and screwed into the front baffle. The tweeter should have wires attached using slide-on terminals to prevent heat damage from a soldering iron. A foam gasket made from draft excluder (you can get it in any hardware shop) should be stuck to the rear of the drive unit frames where they mate with the cabinet, to give a good air-tight seal.

TESTING

A simple test to reduce the risk of any damage to your amplifier when you first plug in, is to check the DC impedance of the loudspeaker using a simple multimeter. Using the resistance setting they should measure around 7Ω across the terminals. This simple test will indicate a short with a reading below 1Ω.



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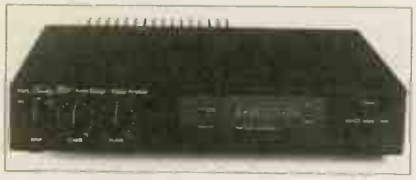

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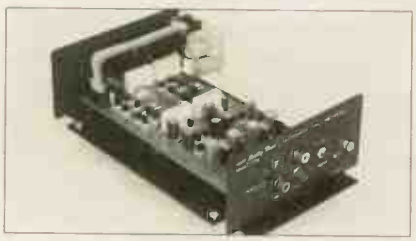

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L4	0.315mH 0.71mm wire/air core

SOUND QUALITY

Eschewing my favourite session starter, the Sons of Champlin, I dipped my toe into the waters of the choral music contained in The Golden Age Volume 1 - Europe, which Peter Herring reviewed last month. Tonal colour and separation were both good - identifying individual voices in the polyphony was easy. A broad soundstage gave the different vocal parts room to intermingle without becoming confused, and captured the setting of St. Jude's on the Hill clearly.

Of a rather less subtle nature was the dance music of Total Eclipse Volume 1. Throbbing, artificial bass lines and frostily clinical electronic percussion gelled to produce a stirring performance, literally, as my internal organs started getting involved in the music at high volume levels. The Audax 10in. drivers remained stable and clean even running flat out tracking the drum machine beats of 'Nautilus'.

Still grinning from elevated adrenaline levels, I popped a copy of Orff's Carmina Burana into the Audiolab 8000CDM/Da Capo combination. I couldn't resist a splash of old faithful, so 'O Fortuna' found itself on repeat for a while. The more natural constituents of this CD didn't possess quite the same dynamic impact as the wholly artificial 'Nautilus', but packed an impressive punch nonetheless. The music's air of mystery and awe-full power, emphasised by the orchestral pyrotechnics, permeated KLS8's suitably edge-of-the-seat rendition.

Jon Marks

MEASURED PERFORMANCE

Our KLS8 design has a smooth and well mannered frequency response. There is a slight reduction in energy at the crossover point where the 10in. bass driver only just manages to get high enough to meet the horn loaded tweeter, but it does get there. It is possible to fill-in this gap by running the bass driver higher, but at the expense of some roughness from break-up.

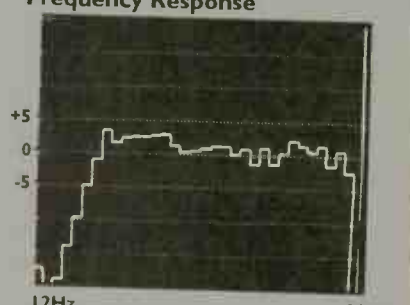
There's good bass output from KLS8 too, something that can be a struggle with sensitive designs, where the trade off is normally stronger. KLS8 is an infinite baffle design, which helps here. Low bass rolls off slower at -12dB/octave rather than -24dB/octave, so there will be more low bass output adding weight to the sound.

Best thing of all about KLS8 though, is its whopping sensitivity. Supplied with just 1watt (2.83V) of pink noise signal they'll deliver back 93dB sound pressure level. You'd need four times as much power to get the same sound level from a typical 87dB sensitivity loudspeaker.

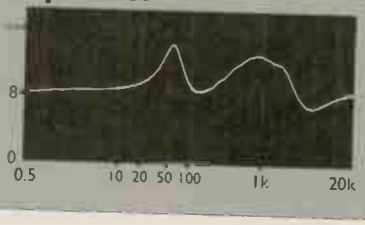
Overall impedance measured 8.6Ω, suggesting they are an easy load too. The impedance curve confirms this, staying well above 6Ω across the whole audio band. There is an impedance rise through the midrange, reaching around 20Ω just above 1kHz. But this shouldn't be a problem even for zero feedback designs. KLS8 should match just about any amplifier. In a small room where high levels aren't required, just 5watts should give adequate sound level.

DB

Frequency Response



Impedance



THERE IS A DRIVE UNIT PACK AND KIT AVAILABLE FOR KLS8. PLEASE SEE PAGE 74 IN THE MAIN ISSUE FOR ORDERING DETAILS OR CALL WORLD AUDIO DESIGN ON TEL: 0171 289 3533

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AN-WIRE-[illegible]	AN-SP [illegible]	single core 15 strand 99.99% litz silver speaker wire	106.38
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Order Code	Type	Value	Price Ex. UK Vat
[illegible]	Stereo Potentiometer Attenuator	1[illegible] Ohms	221.75
[illegible]	Stereo Potentiometer Attenuator	5[illegible] Ohms	221.75
[illegible]	Stereo Potentiometer Attenuator	100K Ohms	237.75
[illegible]	Stereo Potentiometer Attenuator	[illegible] Ohms NEW	262.55
[illegible]	Stereo Potentiometer Attenuator	500K Ohms NEW	267.45
SWITCH-[illegible]	2 Channel [illegible]	6-way adjustable	98.75
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VBASE-170	4-pin UX4 Vel-type for 300B/2A3/801A	Chassis	Silver	14.75
VBASE-175	4-pin UX4 [illegible]	Chassis	Silver	4[illegible].95
VBASE-19[illegible]	4-pin [illegible] 4 for 211, [illegible]4C/845	Chassis with bayonet	Silver/chrome	59.95
VBASE-150	5-pin [illegible]5 for [illegible]7	Chassis	Gold	9.75
VBASE-[illegible]	7-pin B7 for 6X4, OA2	PCB	Silver	6.15
VBASE-[illegible]	7-pin B7 for 6X4, OA2	PCB	Gold	7.85
VBASE-110	7-pin B7 for 6X4, OA2	Chassis from above	Silver	6.75
VBASE-115	7-pin B7 for 6X4, OA2	Chassis from above	Gold	7.95
VBASE-160	8-pin [illegible] for EL34, 6550, [illegible], GZ34, 6L6G etc	Chassis	Silver	5.65
VBASE-165	8-pin [illegible] for EL34, 6550, 5[illegible], GZ34, 6L6G, etc	Chassis	Gold	8.65
VBASE-0[illegible]5	9-pin B9 for E[illegible], ECC[illegible], 5687, 6350	PCB	Silver	3.5
VBASE-01[illegible]	9-pin B9 for ECC[illegible], ECC[illegible], 5687, 6350	PCB	Gold	5.75
VBASE-015	9-pin B9A for ECC[illegible], ECC[illegible], 5687, 6350, etc, etc	Chassis from above	Silver	4.45
VBASE-020	9-pin B9A for ECC83, ECC[illegible], 5687, 6350, etc, etc	Chassis from above	Gold	6.75
VBASE-[illegible]25	9-pin B9A for ECC83, ECC[illegible], 5687, 6350, etc, etc	Chassis from below	Silver	4.95
VBASE-03[illegible]	9-pin B9A for ECC[illegible], ECC88, 5687, 6350, etc, etc	Chassis from below	Gold	7.15
	TOPCAPS			
VBASE-100	[illegible]	For 807 pentode etc	Nickel	9.75

You may want to start your project with less overall cost, and for this purpose we can offer the following "industrial grade" ceramic valve bases.

[illegible]

Order Code	Type / Valve	Mounting	Price Ex. UK Vat
VBASE-2[illegible]5	7-pin for OA2, 6X4	PCB	2.55
VBASE-205	8-pin for EL34, 6550, KT66, 6L6G	Chassis with bracket	1.45
VBASE-2[illegible]	9-pin for ECC8[illegible], ECC88, 5687, 6350	Chassis with shield	1.85

AUDIO NOTE SELECTED AUDIO VALVES

Our valves are selected from the best available sources and are tested to the same stringent standards that we apply in the production of our own amplifiers; they fall into two categories: standard production items and rare, mostly NOS, New Old Stock, valves which are no longer in production. We have compiled a special list of the NOS items, which is available [illegible] a stamped self addressed envelope; if you live outside the UK send US$ 2.00. You should be aware that the valves on this list are NOT cheap, but we have stock of original GE, RCA and [illegible] Electronics 211, both standard versions and graphited anode type for the US military, 845 [illegible], VT25, [illegible], VT42, 801A, WE[illegible], STC 4[illegible], Mullard GZ34, CV1377, [illegible] [illegible] 1 [illegible] Chatham 5R4WGY and many others.

Standard Stock Items

Order Code	Valve type	Description/Recommendations	Price Ex. UK Vat
[illegible]	[illegible]	Sovtek/double triode	2.95
VALVE-[illegible]	[illegible]	Sovtek, high gain super low noise	3.95
[illegible]	[illegible]	Sovtek, super low noise low microphonic audio [illegible] of [illegible]	2.85
VALVE-[illegible]	[illegible]A	[illegible] USA [illegible] Silver [illegible] GE USA low [illegible]	[illegible].45
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	Sovtek double triode, [illegible]	4.75
[illegible]	[illegible]	[illegible]/ECG USA, [illegible] good sound	
[illegible]	[illegible]	Russian made version of this small pentode	6.45
[illegible]	[illegible]	[illegible]/ECG USA, double triode mil spec	5.95
VALVE-[illegible]	[illegible]	[illegible] best ECC82 available from new production	[illegible].95
[illegible]	[illegible]	double triode [illegible] base	3.75
[illegible]	6SN7GTA [illegible]	double triode original US-made, low microphony super sounding	[illegible].95
[illegible]	[illegible]	Russian double triode [illegible] base	3.25
VALVE-0[illegible]	[illegible]	US-made double triode, line driver	[illegible].35
[illegible]	5A[illegible] Sylvania USA	double triode, powerful driver used in [illegible]	9.85
VALVE-0[illegible]	E180CC 7[illegible]	double triode very powerful driver, pre-[illegible] of [illegible]	[illegible]
VALVE-0[illegible]	[illegible]	Sovtek [illegible]	2.65
VALVE-0[illegible]00	EL34 [illegible]	Russian small power pentode	1.55
[illegible]	[illegible]34, [illegible]SWA	Russian small power pentode, mil spec version	4.51
[illegible]	[illegible]GT	Sovtek small power tetrode	2.45
[illegible]	[illegible]	Russian medium power pentode	2.75
[illegible]	[illegible], KT66, [illegible]WGC	Sovtek medium power tetrode	4.51
[illegible]	[illegible]	Sovtek medium power tetrode, standard base	5.55
[illegible]44	[illegible] Fat Bottle	Sovtek power tetrode	8.85
VALVE-04[illegible]	[illegible]	Sovtek power pentode	6.45
VALVE-04[illegible]	[illegible]	power triode, Audio Note branded and tested to our specifications, Chinese manufacture	56.45
VALVE-0500	[illegible]211	power triode, Audio Note branded and tested to our specifications, Chinese manufacture	29.45
VALVE-052[illegible]	[illegible]845	power triode, Audio Note branded, tested and tried, Chinese made	33.45
VALVE-054[illegible]	6C33	powerful Russian made regulator, indirectly heated triode	24.65
VALVE-0560	6AS7/6080	strong [illegible] regulator, [illegible] heated triode	6.45
VALVE-0580	2A3 4-pin or 8-pin for Audio Innovations Second [illegible] Amplifiers	directly heated small power triode, Chinese made	17.95
VALVE-0600	5R4G Russian	HT-rectifier	3.75
VALVE-[illegible]	[illegible]	HT-rectifier	2.25
[illegible]	[illegible]	HT-rectifier	3.95
[illegible]	[illegible]Z4, [illegible]	HT-rectifier	8.75
[illegible]	[illegible]Z4, CV1377 [illegible]	HT-rectifier	49.95
[illegible]	[illegible], CV[illegible]	HT-rectifier, equivalent to GZ32/34, but better sounding	9.55
VALVE-0740	5R4WGB Cetron USA	Very powerful HT-rectifier, 2.50[illegible] at 100m[illegible]	24.55
VALVE-076[illegible]	6X4	HT-rectifier, very good for pre-amplifiers, 7-pin base, Russian reverse pin version	3.75
VALVE-078[illegible]	[illegible]X5	HT-rectifier, for pre-amplifiers & power amplifier front-ends, UOX base, Russian made	4.25

Please note, our 300B's are manufactured in China by Gold Dragon, Shuguang, but are tested [illegible] under real working conditions to parameters somewhat more stringent than is otherwise done. No, they do not sound quite as good as original Western Electric or RCA 300B's or STC 4300A's, nor do they carry the same premium price; please consider the following: unless you have absolutely tons of money or you happen to have them in your attic, do not consider original 300B's; it is in most cases far better to invest the money in more permanent features of the amplifier, power [illegible] better output transformers, better signal caps or resistors or the like; valves wear out, [illegible] passive components last much longer. A pair of original WE 300B's cost at least £ 1,200.00 on a good day, so instead of being obsessed by getting the best valves at any price, think in terms of an overall price compromise; you can get some fabulous [illegible] passive components for the difference in cost between a pair of Chinese 300B's and the original WE's, and in most cases, the improvement in sound quality is greater than what the WE 300B's will contribute. And the contribution to sound is permanent; consider that when you plan your project or re-valve your existing amplifier.

Resistors

We endeavour to stock the entire E12 range of all the different makes of resistors that we stock except the very lowest ohmic values, which are extremely costly; as a rule we do not stock values below 10 Ohms or above 3M3. Whilst we always try to have every [illegible] E12 value in stock, this cannot be guaranteed; delivery [illegible] on the values and [illegible] film resistors can be very long indeed, however, since most are used in our production of finished products, there will generally be stock available within 4 weeks.

Beyschlag

We offer three quality levels of resistor quality, all are 1%, starting with the Beyschlag metallfilm, which are slightly [illegible] as are the vast majority of other makes of metal film resistors, but nevertheless very good sounding, as used in all our UK-made amplifiers up to and including quality Level 3, the [illegible]/P3/P4 300B no-feedback triode amplifiers.

Beyschlag 1 watt 1% [illegible] up to 510KOhm: £ 0.1[illegible], above 500KOhm: £ 0.13 each

HOLCO

Better sound quality can be achieved with the H2 1 watt 1% non-magnetic resistor, which we regard as the best "industrial grade" metalfilm resistors available. They have one small drawback, as they are quite fragile, and require careful handling; do not bend the legs too close to the body. HOLCO resistors are sensitive creatures and become noisy very easily.

HOLCO resistors type H2 50ppm cost: £ 3.06 each from 1 R0 to 5R0; £ 0.8[illegible] each from 5R1 to 19[illegible]; £ 0.[illegible] each from 2[illegible] to [illegible] Ohm; £ 0.41 each from 231 KOhm to 1 [illegible]; £ 1.[illegible] each from 1[illegible] to [illegible]; £ 1.[illegible]4 each from 2M1 to 4M0; and £ 2.21 each from 4M1 to 5M0

Shinkoh Tantalum Film Resistors

This is definitely the best [illegible] resistors available, forget the VISHAY, which may be ok in high feedback transistor amplifiers, but in our opinion quite [illegible] to the qualities of real Audio [illegible], i.e. directly heated triode amplifiers running feedback free in single-ended Class A!; this is where you will need the tantalum film resistors for the best results.

The 1/2 watt Shinkoh tantalum resistors are non-magnetic and cost £ 2.26 each

Some values are available in 1 watt from Shinkoh at £ 4.60 each, list of stock available

AUDIO NOTE 1/2 WATT TANTALUM RESISTORS

With our [illegible] range of tantalum resistors [illegible] all the time, and Shinkoh becoming less and less able to supply, we have found it necessary to [illegible] the 1/2 watt values in addition to the 1 watt already offered; the AN-Tant are non-magnetic and share all other aspects of the Shinkoh except the colour; they will be available by the time you read this in the following values: [illegible]

The 1/2 watt Audio Note tantalum resistors cost £ 1.99 each

AUDIO NOTE 1 WATT TANTALUM RESISTORS

Up to now the tantalum film resistors have been extremely difficult to get, however, after much persuasion and against a minimum quantity guarantee from Audio Note Ltd., the manufacturers have agreed to widen the range of 1/2 watt and manufacture the 1 watt range which becomes an exclusive range for AUDIO NOTE; we consider this to be major breakthrough, since without a reasonable range of values at the 1 watt rating it is pretty difficult to get the very best out of the best circuits. The 1 watt Audio Note tantalum film resistors are available in the same values as the 1/2 watt, with the addition of the 1 [illegible] and 1 [illegible]5

The AUDIO NOTE 1 watt 1% tantalum resistor values are £ 3.70 each

AUDIO NOTE 2 WATT TANTALUM RESISTORS

Firstly to complement the range of Audio Note 1 watt tantalum resistors we have started stocking a limited number of 2 watts, [illegible] 1 Meg, 1 M5 and 2 Meg

The AUDIO NOTE 2 watt 1% tantalum resistors cost £ 5.85 each

We shall now be working on getting a fuller 2 watt range and start stocking the 3 Watt tantalum resistors as well, and who knows perhaps we will be able to build amplifiers in a year's time that have all tantalum resistors in all parts of the circuit.

AUDIO NOTE PRECISION CARBON FILM RESISTORS

In addition to the non-magnetic tantalum resistors, we are going to stock a range of precision goldplated carbonfilm resistors; in many cases the carbonfilm resistor is preferable if you are building an amplifier based on an old circuit, like for example the WE91 or another circuit of similar vintage. We shall be stocking values suitable for projects like the WE91 in 1/2 and 1 watt values; these resistors are made especially for us by a major manufacturer.

They cost for the 1/2 watt: £ 3.30 each; 1 watt: £ 4.85 each; 2 watt: £ 6.69 each

ALLEN BRADLEY 1 Watt 5% Carbon Film Resistors

Due to popular demand, and a general lack of other sources, we have started stocking a range of Allen Bradleys carbonfilm resistors; many experienced DIYers, like my friend Herb Reichert, consider these the very best sounding [illegible].

Available in the E12 range of values, the 1 watt cost £ 1.43 each

HIGH WATTAGE WIREWOUND RESISTORS

As a new item we shall start offering a range of 2 - 15 watt wirewound resistors; we shall be starting with a small range and expanding it as we go along; at the moment the following is available; all these resistors are 5% tolerance and glazed

Order Code	Wattage	Value	Tolerance	Price Ex. UK Vat
RES-03[illegible]	6 watt	47R	5%	0.86
RES-03[illegible]	6 watt	100R	5%	0.86
RES-0345	5 watt	47[illegible]R	5%	0.86
RES-03[illegible]	7 watt	1K[illegible]	5%	0.86
RES-0369	6 watt	2K2	5%	0.86
RES-0[illegible]	6 watt	15K	5%	0.86
RES-0381	6 watt	20K	5%	1.32
RES-03[illegible]	9 watt	100[illegible]	5%	1.32
RES-0384	9 watt	1K5	5%	1.24
RES-0386	9 watt	[illegible]8	5%	1.24

More values will be added over the next 6 months, together with some non-inductive wirewounds!

BLACK GATE ELECTRON TRANSFER High Performance [illegible] foil capacitors.

Firstly I would like to [illegible] state that any rumours about Black Gate capacitors being unavailable or discontinued are totally [illegible] malicious and incorrect. AUDIO NOTE is currently the sole source in Europe that holds any significant range of values in stock; we use roughly 1000's in production, as we were the first company to realise the tremendous benefit that Black Gate capacitors offer, and we are to date the only [illegible] audio company in the world to incorporate Black Gate capacitors [illegible] in our finished products. There are very few audio parts that promise a guaranteed improvement when replacing practically any other part, but this is what the BLACK GATE capacitors actually do. Exchanging any electrolytic capacitor anywhere in the circuit of an amplifier or in the crossover of a speaker will greatly improve sound quality. We are working on some guidelines onto where, how and which types of Black Gates to use in different circuits; the first such technical guideline is available now and is called "Improving your CD-Player" and can be obtained by sending a stamped addressed envelope to us requesting this [illegible]. All AUDIO NOTE Level 2 Signature products use Black Gate Electron Transfer in critical signal/power supply positions. It is very important to note that all BLACK GATE capacitors take time to [illegible] or stabilise, when first put in circuit; depending on type and application the "maturing" time can be between 100 and 300 hours. Black Gate call this the "[illegible] process", see enclosed list of available values. We feel, however, that this process takes longer [illegible]!

We are about to stock the entire range of values on the enclosed list, so a separate [illegible] is attached to the list of Black Gate program available. Ask us to send you this list as it is too long for an advertisement or to [illegible] in our standard component list; wherefore it's not included in full here; as always, we appreciate a stamped self addressed envelope, it greatly influences the [illegible] this end.

The high voltage power supply capacitors type SKz have been replaced by an even better version, the WKz-type, [illegible] the price has increased [illegible] as well; we have purchased a large back-up stock of the SKz's [illegible] of other Black Gate in Japan had left in stock!), so I am keeping the SKz-type on the price list until we run out of stock of each SKz [illegible]; meantime we have introduced the Cerafine high voltage capacitors as a cheaper alternative.

IMPORTANT NOTICE!

PLEASE NOTE: THE PRICELIST FOR BLACK GATE CAPACITORS IS A GUIDELINE ONLY, DUE TO THE CONTINUOUS [illegible] OF THE JAPANESE YEN, IT IS IMPOSSIBLE TO PRINT UP-TO-DATE PRICES MONTHLY [illegible] WHEN YOU ORDER

Order Code	Value	Voltage	BG-Type	Recommended Use	Price Ex. UK Vat
CAP-9[illegible]0	47mF	25[illegible]	PK	Anywhere	1.65
CAP-9005	33[illegible]	35[illegible]	PK	Anywhere	1.75
CAP-9[illegible]10	[illegible]47mF	50[illegible]	PK	Anywhere	1.[illegible]5
CAP-9015	1mF	50[illegible]	PK	Anywhere	1.12
CAP-9020	2.2mF	5[illegible]	PK	Anywhere	1.23
CAP-9[illegible]5	[illegible]	5[illegible]	PK	Anywhere	1.38
CAP-9[illegible]0	4.7mF	5[illegible]	PK	Anywhere	1.[illegible]8
CAP-9[illegible]5	1[illegible]mF	5[illegible]	PK	Anywhere	1.87
CAP-9[illegible]0	22mF	5[illegible]	PK	Anywhere	2.68
CAP-9045	22[illegible]	1[illegible]	Standard	Anywhere	2.82
CAP-9[illegible]50	3[illegible]mF	1[illegible]	Standard	Anywhere	3.42
CAP-9055	47mF	1[illegible]	Standard	Anywhere	4.11
CAP-9060	3[illegible]	1[illegible]	Standard	Anywhere	6.68
CAP-9[illegible]5	1.0mF	5[illegible]	Standard	Anywhere	2.97
CAP-9070	47mF	50[illegible]	Standard	Anywhere	4.41
CAP-9075	[illegible]0mF	1[illegible]	Standard	Anywhere	4.73
CAP-9[illegible]0	1.00mF	5[illegible]	Standard	Anywhere	5.47
CAP-9[illegible]5	220mF	50[illegible]	Standard	Anywhere	10.41
CAP-9[illegible]0	1.0mF	100[illegible]	Standard	Anywhere	3.71
CAP-9[illegible]5	22mF	[illegible]	Standard	Anywhere	6.31
CAP-9100	47mF	[illegible]	Standard	Anywhere	8.54
CAP-91[illegible]5	[illegible]mF	[illegible]	Standard	Anywhere	7.75
CAP-9110	220mF	[illegible]	Standard	Anywhere	22.18
CAP-9115	[illegible]00mF	1[illegible]	Standard	Anywhere	8.22
CAP-91[illegible]0	[illegible]000mF	50[illegible]	Standard	Anywhere	24.55
CAP-9125	220mF	16volt	Standard	Anywhere	4.35
CAP-91[illegible]	470mF	1[illegible]	Standard	Anywhere	6.35
CAP-9135	2700mF	16volt	Standard	Anywhere	13.45
CAP-9140	10,000mF	80volt	Standard	PSU smoothing	234.55
CAP-9145	4700mF	16[illegible]	Standard	Anywhere	14.25
CAP-9150	47mF + 47mF	5[illegible] 55[illegible] surge	SKz-Type	PSU filter capacitor	85.95
CAP-9155	[illegible]00mF + [illegible]00mF	[illegible]	SKz-Type 550v surge	PSU filter capacitor	101.95
CAP-9160	[illegible]00mF	5[illegible]	SKz-Type 550v surge	PSU filter capacitor	72.75
CAP-9165	220mF + 220mF	350[illegible]	SKz-Type	PSU filter capacitor 400v surge	92.65
CAP-917[illegible]	[illegible]00mF + [illegible]00mF	350[illegible]	SKz-Type 400v surge	PSU filter capacitor	75.35
CAP-9175	[illegible]00+[illegible]00mF	500[illegible] 550v surge	WKz-Type	PSU filter capacitor	195.35
CAP-918[illegible]	47+47mF	500volt 550v surge	WKz-Type	PSU filter capacitor	159.85
CAP-91[illegible]5	[illegible]	[illegible]	WKz-Type	PSU filter capacitor	144.65
CAP-9190	[illegible]00+[illegible]00mF	[illegible]	WKz-Type	PSU filter capacitor	151.74
CAP-9195	2[illegible]0+22[illegible]mF	[illegible]	WKz-Type	PSU filter capacitor	181.95
CAP-92[illegible]0	22[illegible]	[illegible]	VK-Type	coupling or filter capacitor	18.95
CAP-9205	15[illegible]mF	[illegible]	VK-Type	PSU filter capacitor	41.23
CAP-921[illegible]	[illegible]47mF	[illegible]	F-Type Low ESR	Low impedance use anywhere	1.11
CAP-9215	2[illegible]mF	6.3[illegible]	F-Type	As above	1.22
CAP-92[illegible]	[illegible]mF	6.3[illegible]	F-Type	As above	1.56
CAP-92[illegible]	2[illegible]mF	[illegible]	F-Type	As above	2.11
CAP-92[illegible]	2200mF	6.3[illegible]	F-Type	As above	4.76
CAP-92[illegible]5	47mF	1[illegible]	FK-Type Ultra low ESR version	comparable to film caps	7.15
CAP-9240	100mF	16[illegible]	FK-Type Ultra low ESR version	comparable to film caps	13.7[illegible]
CAP-9245	220mF	16volt	FK-Type Ultra low ESR version	comparable to film caps	15.95
CAP-9250	10[illegible]mF	25volt	FK-Type	As above	14.28
CAP-9255	22[illegible]mF	25volt	FK-Type	As above	21.43
CAP-926[illegible]	1[illegible]mF	50volt	FK-Type	As above	15.71
CAP-92[illegible]	1000mF	50[illegible]	FK-Type	As above use anywhere	58.71
CAP-927[illegible]	2200mF	35volt	FK-Type	As above use anywhere	55.71
CAP-92[illegible]	[illegible]mF	6[illegible]	FK-Type	As above use anywhere	101.43
CAP-92[illegible]	10mF	100[illegible]	FK-Type	As above use anywhere	32.85
CAP-92[illegible]	2.2mF	50volt	C-Type	For circuits with DC potential difference	2.07
CAP-929[illegible]	4.7mF	50volt	C-Type	For circuits with DC potential difference	3.35
CAP-929[illegible]	[illegible]mF	50volt	[illegible]	For loudspeaker crossover networks	12.65
CAP-930[illegible]	10mF	50volt	Bipolar	as above	16.85
CAP-9[illegible]	22mF	50volt	Bipolar	as above	23.95
CAP-931[illegible]	47mF	50volt	Bipolar	as above	36.95
CAP-931[illegible]	[illegible]47mF	50volt	BG-N Type	For PSU decoupling	12.35
CAP-93[illegible]	2[illegible]mF	6.3volt	BG-N Type	For super low noise PSUs	11.85
CAP-932[illegible]	10[illegible]	16volt	BG-N Type	For super low noise PSUs	24.45
CAP-93[illegible]	470mF	16volt	BG-N Type	as above	28.95
CAP-93[illegible]	4700mF	35volt	BG-N Type	as above	210.45
CAP-934[illegible]	[illegible]mF	50volt	BG-N Type	as above	5.45
CAP-934[illegible]	4.7mF	50volt	BG-N Type	as above	6.65
CAP-9350	10mF	50volt	BG-N Type	as above	7.55
CAP-93[illegible]5	47mF	5[illegible]	BG-N Type	as above	13.75
CAP-93[illegible]	100mF	50volt	BG-N Type	as above	20.35
CAP-9365	1[illegible]00mF	50volt	BG-N Type	as above	99.95
CAP-93[illegible]	2[illegible]00mF	[illegible]	BG-N Type	as above	4[illegible]3.35

In our component list you will find a listing of all available Black Gate values, together with sizes, [illegible] range etc.

Lastly, we can supply a range of more modestly priced components, still good quality, but [illegible] industrial grade, if you like.

CERAFINE Powdered Ceramic Electrolytic Capacitors.

We have at long last secured a reliable source for these fine power supply filter capacitors, a must in any single-ended project of NOTE! We will start with two values, at 350 and 500 volt, 100+100mF each, as these cover Black Gates where the prices for the BG's are prohibitive. We have increased the range of Cerafines we stock quite recently, and strongly recommend all the Cerafines as a far superior replacement or substitute for ordinary electrolytics, and at the prices offered that should be within most budgets. All power supply Cerafines are supplied with a capacitor clamp and are upright mounting.

Order Code	Value	Voltage	Recommended Use	Price Ex. UK Vat
CAP-[illegible]	100+100mF	350 volt	Power supply filtering	19.95
CAP-[illegible]	2[illegible] + 2[illegible]mF	35[illegible] volt	Power supply filtering	2[illegible].95
CAP-[illegible]	4[illegible]	[illegible]	Power supply filtering	12.[illegible]5
CAP-[illegible]	47+47mF [illegible]	[illegible] volt	Power supply filtering	19.95
CAP-[illegible]	[illegible]	[illegible]	Power supply filtering	29.95
CAP-[illegible]	[illegible]	[illegible]	Power supply filtering	29.95
CAP-[illegible]	[illegible]	[illegible]V 1500 volt	Power supply filtering	39.95
CAP-[illegible]	[illegible]	[illegible]	Power supply filtering	34.95
CAP-[illegible]	[illegible]	[illegible]	Power supply filtering	34.95
CAP-9530	[illegible]	[illegible]	Heater filtering	4.95
CAP-[illegible]	[illegible]	[illegible]	Bypass anywhere	2.95
CAP-9[illegible]	[illegible]	5[illegible] volt	Bypass anywhere	1.95
CAP-9[illegible]40	[illegible]	1[illegible] volt	Bypass anywhere	8.95
CAP-9560	[illegible]	[illegible]	Bypass anywhere	2.95
CAP-9570	470m[illegible]	[illegible]	Anywhere	5.55
CAP-958[illegible]	22 [illegible]	5[illegible]	Anywhere	1.15

We shall continue to expand the range of Cerafine electrolytics over the next few months, so keep an eye on this space! POTENTIOMETERS. Best available from sound quality, price viewpoint, made by Noble in Japan, high quality conductive plastic [illegible].

Volume Controls

Order Code	Impedance	Construction	Price Ex. UK Vat
SWITCH-[illegible]	[illegible] Stereo, logarithmic	Frame type, PCB mounted	4.95
SWITCH-21[illegible]	[illegible] Stereo, logarithmic	[illegible] type, PCB mounted	18.65

A better alternative is the KO-[illegible] volume controls which are used in pre-amplifiers like the M7 line, M7Line, and in a mono version on the input on the NEIRO, JASSAU, KEGON and GAKU-ON; these are very good sounding pots by any standard.

Order Code	Impedance	Construction	Price Ex. UK Vat
SWITCH-271	[illegible] Stereo, logarithmic	Encapsulated	32.25
SWITCH-272	[illegible] Mono, logarithmic	Large Encapsulated	70.65
SWITCH-273	[illegible] Stereo, logarithmic	Large Encapsulated, high quality	107.45

Balance Controls

Order Code	Impedance	Construction	Price Ex. UK Vat
SWITCH-[illegible]	100K Ohm	Frame type, PCB mounted	5.45
SWITCH-4210	100K Ohm	Encapsulated type, PCB mounted	19.25
SWITCH-[illegible]4	[illegible] KO-OH	Encapsulated, PCB mounted	32.25

[illegible] TYPE SWITCHES

Order Code	Type	Function	Construction	Price Ex. UK Vat
[illegible]	Standard	6-way, 2 channel adjustable	PCB mounting	5.95
[illegible]	Standard	6-way, 2 channel adjustable	PCB mounting	30.65

This switch is adjustable 2 - 6 way, it has gold plated contacts and a stainless steel ball for best possible [illegible] protection and contact. The KO-OH offers 8 way [illegible] quality sealed switch, 6 way 2 [illegible] at 90.65 each

RCA, [illegible], BANANA PLUGS, RCA SOCKETS, SPEAKER & [illegible] TERMINALS & LOUDSPEAKER [illegible]

RCA Plugs

Order Code	Type Description	Price Ex. UK Vat
[illegible]-060	Standard Gold plug	1.55
CON-[illegible]	AMC [illegible] plug	3.65
CON-[illegible]1	AN-P AUDIO NOTE gold plug	8.51
CON-007, 378	AN-P AUDIO NOTE Solid Silver plug, teflon [illegible], non-magnetic	25.53

RCA Sockets

Order Code	Type	Mounting	Price Ex. UK Vat
CON-0[illegible]2	RCA socket nickel plated	Chassis mounted	0.41
CON-[illegible]	RCA socket gold plated	Chassis mounted	1.65
CON-[illegible]4	AN-CS AUDIO NOTE non-magnetic, teflon insulated socket, gold plated	Chassis mounted	3.65

BNC Plugs & Sockets

Order Code	Type	Price Ex. UK Vat
CON-050	Standard BNC plug	3.45
CON-051	BNC Silver plated socket chassis mounted	2.05

Banana Plugs, Loudspeaker Cable Spades, Chassis Loudspeaker Terminals

Order Code	Type Description	Price Ex. UK Vat
CON-[illegible]	AUDIO NOTE banana plug, gold plated, spring loaded tension	2.45
CON-065	AUDIO NOTE Loudspeaker Cable spade, silver plated, non-magnetic	4.65
CON-0[illegible]	AUDIO NOTE [illegible] Speaker Terminal, chassis mount, nickel plated, red or black	1.85
[illegible]	AUDIO NOTE [illegible] Speaker Terminal, chassis mount, gold plated, red or black	2.75
CON-028-029	AUDIO NOTE [illegible] Speaker Terminal, chassis mount, fully gold plated, 1 [illegible], red or black	4.75
CON-[illegible]15	Ground Terminal, chassis mounted and nickel plated	1.45

Our range of components is constantly expanding, as we find new or better suppliers, so stay in touch by reading our adverts in Hi-Fi World and Hi-Fi News.

FERRITE RINGS

In many systems, especially ones using transistor based amplification, there is often a problem of incoming RF mixing into the feedback loop, especially from connected CD-players; clamping a ferrite ring around the cable between the CD-transport and the DAC or the output of the DAC or CD-player and the pre-amplifier input yields surprising results. A set of two Ferrite rings costs £ 8.50

ORDER CODE: CON-018

AUDIO NOTE Moving Coil, CD Line & Input Matching Transformers

I have received many requests for moving coil, CD and input matching transformers, and since we already make and use them, it might be a good idea to offer them for general sale. Common to all of these small signal transformers is that they come in a mu-metal screening can with a threaded spindle with a nut for mounting.

Order Code	Type	Colour code	Primary/Secondary Impedances - Main Use	Price Ex. UK Vat
TRANS-465	TT7687	Brown	3 & 12 [illegible] 10[illegible], copper wired MC matching	51.50
TRANS-470	TT7688	Red	15 & [illegible] 1[illegible], copper wired MC matching	51.50
TRANS-4[illegible]	TT769[illegible]	Yellow	3 & 12 [illegible] 1[illegible], copper wired High Quality MC matching	78.70
TRANS-455	TT7691	Green	15 & [illegible] [illegible] centre tapped copper wired High Quality MC matching	78.70
TRANS-450	TT7692	Blue	150 & 600 [illegible] 2[illegible]5 & 10K [illegible], copper wired high Quality line matching	78.20
TRANS-475	TT7693	Violet	25 & 1[illegible] [illegible], copper wired High Quality line matching	78.20
TRANS-410	TT7694	White	150 : 1500hm copper wired High Quality line matching	101.50
TRANS-415	TT7694[illegible]	Clear	150 : 600Ohm copper wired High Quality line matching	1[illegible]1.50
TRANS-4[illegible]0	TT7695	Silver	150 - 150 Ohm silver wired High Quality line matching	378.60
TRANS-476	TT7696	Black	3 & 12 [illegible] - 100[illegible] silver wired MC matching	378.[illegible]0

The moving coil [illegible] transformers are suitable for all moving coil cartridges; the low impedance versions are suitable for cartridges like the Audio Note Io, most better Ortofons, the Goldring, Koetsus and some Kiseki's, the high versions are meant for Goldring Eroicas, most Denons, Clearaudio, Van den Hul cartridges, the Io and a few higher output Kisekis.

The line matching transformers can be used in a number of applications, as inter-component isolation and matching [illegible] we recommend between CD-Player and pre-amplifier, to separate earth planes and RF transfer), as pre-amplifier input or output transformers or whatever else you can think of.

We shall expand this range to include more types as we go.

AUDIO NOTE Chassis Sets

We have decided to offer for sale the two [illegible] chassis, that we use for production of the OTO/SORO/DAC range of UK-made AUDIO NOTE products. Chassis's are notoriously difficult to get on a one-off basis, so here you are. We are only selling the chassis that we have rejected for production, due to minor [illegible] in the finish; they still look alright, but are not strictly of a flawless, finished product quality.

Order Code	Type	Width/Depth/Height	Price Ex. UK Vat
[illegible]-005+010	Chassis 1 Aluminium	[illegible]	£ 84.50
[illegible]-055+[illegible]4	Chassis 2 Aluminium	[illegible]	£ 69.5[illegible]
[illegible]	Chassis 1 Copper	[illegible]	£ 198.50
[illegible]-059+010	Chassis 2 Copper	[illegible]	£ 165.50
[illegible]	[illegible] KIT THREE [illegible]	[illegible] 50 mm	£ 78.90
[illegible]	[illegible] KIT THREE [illegible]	[illegible] 50 mm	£ 116.70

You have to specify, when you order, whether you want chassis 2 for pre-amplifier or power amplifier use; the pre-amplifier has inputs on the side of the [illegible] cover, the power amplifier has many more ventilation holes, top and side. If you want a PCB with the [illegible] sockets [illegible] with the [illegible] cover, add £ 19.75 to the cost of the chassis and remember to specify this when you order. Please note that no copper [illegible] lid is currently available [illegible] Chassis 2. From time to time we will have more damaged or scratched chassis's; if you are not bothered about the looks or general appearance or you intend to refinish the chassis anyway, you can have one of these for 50% of the above prices; just thought you should know, so enquire if this is of interest.

AUDIO NOTE COMPLETE KITS

As mentioned earlier, we are developing a range of complete kits, to give those of you who have the ability, but do not have the time to develop a project from the ground, so to speak, [illegible] to be able to offer the best possible quality price relationship the kits we offer will be good basic circuits, with no frills power supplies and components; all kits have input volume control to allow use of a single source like CD-player direct in.

The AUDIO NOTE KIT ONE

Based around the justly famous 300B directly heated triode, we see this kit as the introduction to real Audio Amplification, as it covers all the important aspects of design necessary: Single-Ended, No-Feedback, Class A, Directly Heated Triode, to become a member of this exclusive club of amplifiers.

Kit One has one 300B per channel running at 420 [illegible] with 75 [illegible] giving 9/1[illegible] watts of the cleanest power you will ever hear; the [illegible] consists of a [illegible] and a 5[illegible]7 double triode driver stage running in SRPP. The power supply is a capacitor-choke-capacitor with a 5U4G HT rectifier; the heaters are AC heated. Component quality is similar to our Level 1 finished products; AUDIO NOTE paper in oil signal capacitors, Beyschlag 1 watt 1% metalfilm resistors, good quality electrolytics (sorry NO Black Gates!) and a simple, attractive stereo chassis in grey [illegible]. [illegible] cover is extra. We have several upgrade kits available for Kit One, ask for details.

Price £ 799.00 excl. Vat, which includes all valves (yes, also the 2 x 300B [illegible]) but not postage/packing which to [illegible] £ 12.00, top cover is £ 99.00 extra. Kit One is also available with a polished chrome chassis and chromed transformer bell-ends; this makes the Kit One a real "stunner!" Add £ 200.00 to total £ 999.00. The Kit One is available now.

KIT ONE ORDER CODE: AN-KIT-001

The Kit One has recently been awarded the title "The Greatest Audio Bargain of the Twentieth Century" by Dick Olsher (ex-Stereophile) in a review on the Internet, not bad!

The AUDIO NOTE KIT TWO

Kit Two features a single 6550 tetrode running in Single-Ended mode, yielding some 17 watts of pure Class A, valve rectified HT for the output stage, stereo chassis, and 6SN7GT input and 5814a/ECC82 SRPP driver stage, [illegible] and chassis as Kit One. Kit Two is currently only available without valves for £ 570.00 excl. UK Vat. If used with Chinese 6550's no claims for faults in powersupply or output transformers will be accepted!!!

Price £ 599.00 excl. Vat, includes valves, but not postage/packing; cover is extra at £ 99.00. With polished chrome chassis and chromed bell-ends on the transformers: £ 799.00

KIT TWO ORDER CODE: AN-KIT-002

The AUDIO NOTE KIT THREE

Kit Three features 2 x 300B per channel running in single-ended parallel yielding 16/17 watts in pure Class A; the kit is on two mono chassis, with valve rectified HT supplies, no global feedback; it uses a 6SN7GT double triode as input valve and a pair of 5687 double triodes running in SRPP as drivers. The KIT THREE is essentially a mono version of the Kit One with double the power; the same component choices and on two chassis' instead of one.

The KIT THREE costs £ 1,550.00 and is available now. Cover is £ 97.50 extra per chassis (£198.00 for two). Polished chrome chassis and bell-ends is also available at £ 400.00 extra. Several upgrade kits are available for Kit Three as well, ask for details.

KIT THREE ORDER CODE: AN-KIT-003

The AUDIO NOTE KIT FOUR

The KIT FOUR is really our introduction to valve amplifier kit building: circuit and power supply mounted on one single printed circuit board, with two OTO - type push-pull output transformers, all mounted in a small P15E type chassis, covering everything, so nobody will be able to see that you have succumbed to the lure of the valve amplifier, which is sweeping the world. The circuit consists of two 6V6GT tetrodes running in Push-Pull class A, yielding about 10 watts, driven by a 6SN7GT and a ECC83 input stage. Easy to build, even for the beginner.

The KIT FOUR costs £ 249.00 as of March 1st, 1996

KIT FOUR ORDER CODE: AN-KIT-004

The AUDIO NOTE Pre-Amplifier Kit

A kit loosely based on the AUDIO NOTE M7tube pre-amplifier circuit is now available, initially we offer it in 3 versions, with the basic version, Version One consisting of only the instruction manual, the trackless PC boards for [illegible] the circuit, the mains transformer and the choke costing £ 99.00 exclusive of UK Vat. The trackless PC Boards are available at £49.95

Version Two, includes version one with the addition of a set of basic components: Beyschlag resistors, Roederstein Polyester signal caps, standard electrolytics, standard valve bases but no valves, Noble 1-wire volume and balance controls with PCB, input sockets with PCB, output sockets with PCB, but no chassis, at a cost of £ 199.00

Version Three, adds the valves (4 x ECC83/12AX7WXT, 2 x ECC82 and 1 x 6X4R) and the chassis, and upgrades the volume and balance pots to Noble encapsulated types. A complete pre-amplifier kit of the highest quality at £ 299.00 exclusive of UK Vat at 17.5%.

Versions offering more sophisticated components will be introduced when we have enough parts in stock to support them; the most obvious upgrade would be to replace the Roederstein polyester with Audio Note paper-in-oil caps, either aluminium foil or copper foil and caroboni that with Audio Note tantalum film resistors. Audio Note silver wiring wire, change the PSU electrolytics to 6072A/12AT7 s or use 6SN7WGTA Sylvania, change/ECG, instead of the ECC82's (please note that you need a different pcb board for this), further improvements could be introduced with Cerafines or Black Gates, silver signal caps, copper chassis etc.

Write to:

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KNOW YOUR

Andy Grove introduces you to the pentode valve and its varients.

Despite today's fascination with triodes, output pentodes are still the most widely used form of thermionic power device for audio. But before considering their anatomy it is necessary to take a look at the pentode's ancestors, the tetrode and of course the triode.

In the early days of radio a valve was needed which possessed good characteristics at radio frequencies. The triode suffers from the 'Miller Effect', which causes a multiplication of the effective anode to grid capacitance, by a factor of the stage's gain. Also the inherent electrostatic feedback mechanism in triodes between anode and space charge reduces the maximum attainable gain.

The answer to these limitations was to put another grid between the control grid and the anode and connect it to a fixed DC potential. The extra grid forms a screen (hence the tetrode's other name, the screen grid valve) between anode and control grid, blocking the electric field. Miller Effect is reduced and gain increased; yippee. . . well not quite.

Tetrodes were great for small signals, such as in RF amplifiers, being reasonably linear. But this was only over a limited range of anode voltage, making them unsuitable as power devices. The problem is 'secondary emission'. This effect happens suddenly at a particular anode voltage for a given screen voltage causing a sharp 'kink' in the characteristic.

Obviously, such a kink would be catastrophic for linearity in a power stage. Philips came up with the answer in 1927 with the B443, having patented the idea in 1926. They put another grid between the screen grid and the anode, this time connected to the cathode or a similar ground potential so it was negatively charged. Secondary electrons are reflected back to the anode and the kink is reduced or removed. The grid was named the 'Suppressor Grid'.

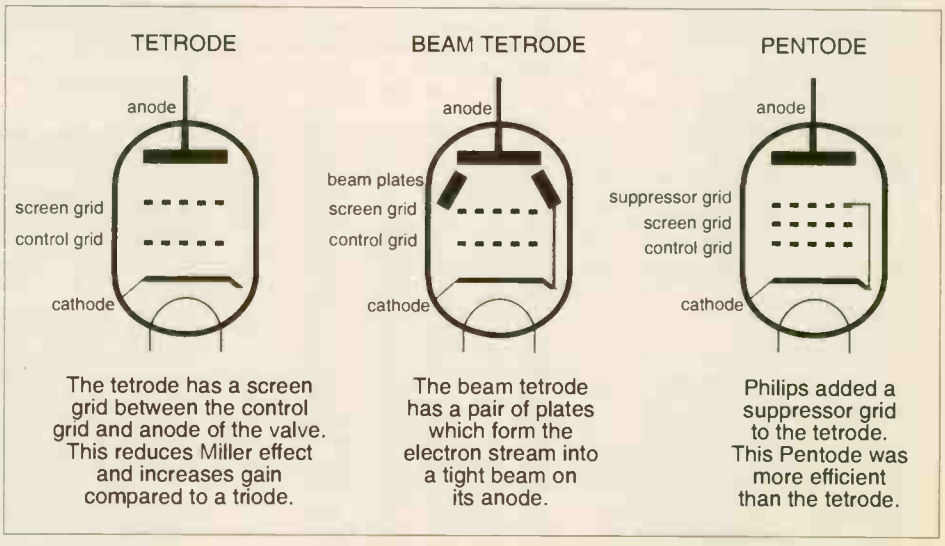
Without the kink in the way the Pentode (a valve with 5 elements) could give a large un-distorted voltage swing and pass a large current at low anode voltage, making it more efficient than a comparable tetrode. High sensitivity, making it easy to drive, along with high efficiency, giving more power for the pound, was a recipe for success and the pentode more or less eclipsed the tetrode.

There is another output valve commonly called the 'beam tetrode' or 'beam power tube', developed by RCA to get around the Philips patent. In these valves there is no suppressor grid, but a pair of plates form the electron stream into a tight beam onto the anode. The various elements in the valve are specially arranged to eliminate secondary emission induced kinks. Generally, a beam tetrode is more linear than a similarly rated pentode and posseses a sharper 'knee' which produces less odd-order distortion. These beam valves were more or less restricted to the U.K. and the U.S.A. European manufacturers like Philips (who own Mullard and the Pentode patent), Telefunken, and so on, only really produced output pentodes.

Pentodes and beam tetrodes are a good place to start experimenting as they are generally cheaper than decent sized triodes, which allows a realistically powered amplifier to be built on a budget. Their greater sensitivity reduces the number of valves needed, but as a downside pentodes produce more odd-order harmonics and because they have a high internal impedance require feedback for satisfactory speaker damping.

There are plenty of circuits available for the following selection of pentodes. A word of warning though; Mullard especially played the specification game to the full, quite often rating their valves at the limit. Modern day valves won't withstand the same punishment, and even original EL34s were prone to blow up if used at Mullard's maximum recommended conditions. Also, they seemed to be a bit creative when quoting power outputs on their valves, so don't be disappointed when you can't get the powers stated in the data books. Just be philosophical and make the best of it.

Many thanks to Billington Export, Tel: 01403 784961, for supplying the valves pictured.



The tetrode has a screen grid between the control grid and anode of the valve. This reduces Miller effect and increases gain compared to a triode.

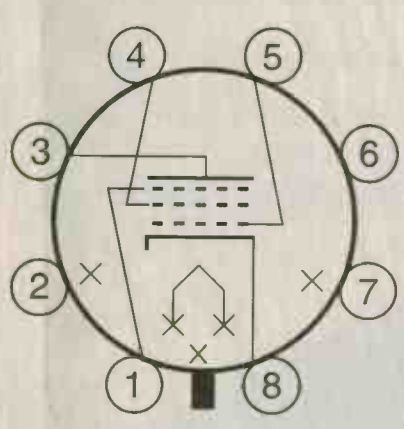
The beam tetrode has a pair of plates which form the electron stream into a tight beam on its anode.

Philips added a suppressor grid to the tetrode. This Pentode was more efficient than the tetrode.

PENTODES

The EL34

The EL34 is the classic output pentode, designed by Philips/Mullard. Its 25W dissipation and high power output made it very successful; I can't imagine just how many have been used in Marshall guitar amps alone over the years! EL34s were rated for an output of 100W in push-pull Class B, with 800V on the anodes. The well known Mullard 5-20 circuit used EL34s to give 35W in Class AB, and the superb Marantz 8B which was based on the 5-20 used '34s as well. The Unison Research Simply Two uses one per channel in single-ended mode.



EL34

There have been a few variants over the years as versions were made by several manufacturers, including the Siemens EL34, the G.E. 6CA7 and the Gold Lion KT77. Some of these had reliability problems such as melting glass (Siemens) or internal short circuits (some Mullards), and the valve underwent considerable development during its life.

The EL34 is quite often used in "Ultra Linear" mode which has an influence on the overall sonic flavour of the output stage, creating a rounder quality, but possibly removing the edge from transients. Generally EL34 amps have a warm sound with strong bass and a sugary treble, and can be very musical if the circuit is well executed. The 6CA7 and KT77 are beam tetrodes and seem to be more dynamic in their presentation. In cathode bias amps they can be fitted without modification in most cases, re-biasing may be necessary in fixed bias amps.

Modern Chinese and Russian valves sound good, but aren't as rugged as the original valves. The early Tesla EL34s were excellent, but the new ones don't have such a good reputation so don't go for the 100W Class B job. Class A operation at low voltages is best for reliability and sound quality. There are several versions of modern '34s. The current Russian ones include a copy of the Siemens type and the 6CA7 beam tetrode. Golden Dragon make the EL34 and the higher grade E34L so there is plenty of choice. Perhaps the best way to operate EL34s would be in a 5-20 with reduced H.T., say 350V. Use a 330ohm cathode resistor per valve. Expect around 20W with a 6.6k transformer.

The 6L6 and its cousins

The 6L6 was one of the first beam tetrode valves. It began life with a dissipation of 19W and a metal envelope. The grown up 6L6GC had a fat glass envelope and a dissipation rating of 30W. The 6L6 was, and still is, a very popular valve. In fact it's probably the most popular audio power valve ever.

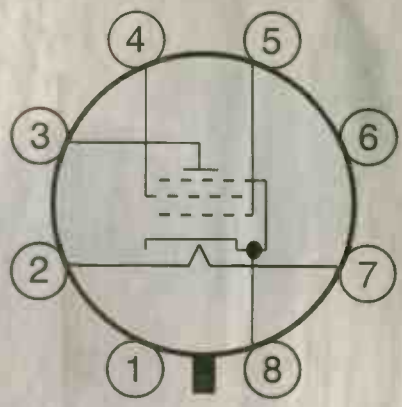
All manner of amplifiers have used 6L6s over the years, including the original McIntosh circuit and the new Rogers E20 and E40 amplifiers, and of course most American guitar amps.

As there are many variations on the 6L6 theme it is important to identify which type is used in your amplifier and replace with valves of an equal or higher rating. One of the best modern replacements is the Sovtek 5881 which is very rugged and can replace most 6L6 types without modification. The only downside is that compared to, say, the Golden Dragon 6L6GC, power output will be reduced by approximately 20%

and the sound isn't quite as sweet.

The Russian 6L6GT needs to be treated with respect as the anode has a low maximum dissipation rating (19W), and it would be unwise to run the Chinese 6L6GC at the full GC ratings if extended life is required. However sound quality is good in both cases.

The 6L6 spawned some very interesting offspring, for example the 5881, the 7581, the EL37 and the KT66. The KT66 is considered to be the highest form of the 6L6 genre. It possesses higher ratings and importantly is more linear. To replace KT66s use either the Russian 5881 or if you can, USA 7581s which are similar. The EL37 is in fact a Pentode made by Mullard. Like the KT66 it has higher emissive capabilities, but is limited to 25W dissipation against 30W of the '66. The 807 is a more rugged 6L6 with 25W anode rating and a 600V maximum voltage. The base is totally different, a UX5, and the anode connection is via a top cap. The British military used an equivalent to the 807, the 5B254M.

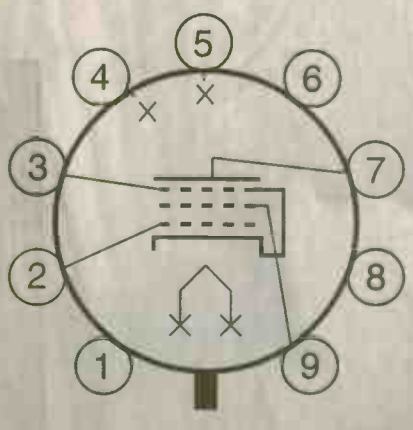


6L6

The sound quality varies depending on the type used but generally is very sweet but also open and clear, more so than the EL34. The KT66 really is the best medium power pentode/tetrode, midrange is just so vibrant. It needs to be operated properly to get the most from it though, it is easy to swamp the sound with the driver stage's character. It is difficult to suggest an operating condition because of all the possible permutations, but the K5881 output stage would make a good starting point, Vb=450V, Rk=560 per valve, with the screen taken to B+, and Rla-a=10k for 20 very clean watts.

The EL84

The EL84 has to be one of the sweetest of all the output pentodes. It is a lovely little valve with a sweet, detailed and dynamic sound, especially if you have sensitive speakers and can go S.E. The EL84 was introduced at the same time as the EL34, as a successor to the EL42, but it seems it was better sorted by the Mullard team. It is very linear and efficient, it works at low voltages and is very easy to drive, plus it's cheap - the ideal valve for the audio experimenter. The '84 has found a place in the Mullard 5-10 and the G.E.C. 912, the basis for many modern amplifiers, and the Audio Note Oto and Oto S.E. amps.



EL84

Luckily there isn't such a confusing array of EL84s as with, say, the 6L6. The best ones were made in Europe by Mullard, the standard EL84 and the upgraded E84L, or G.E.C. with the N709. The American types are the 6BQ5 and 7189. The latter is a higher voltage version purportedly giving 20W from a pair. The modern Russian EL84 and EL84M are great, the M version is very rugged and, in relation to its spec., is cheap. Golden Dragons are also good, if a trifle more expensive.

For replacing EL84s in existing amplifiers I would use the Russian EL84M solely on reliability and longevity grounds; the Chinese valves have a more musical tone, but may not last as long in some amplifiers, especially ones which use a high H.T. voltage such as the Beard BB100.

For experimenters I would recommend an operating condition of Vb=265V, Rk=150, Rl=4.5K for one S.E. valve, power around 4W. Or 8k for a p-p pair, power then around 12W. Use the EL84M or the Golden Dragon E84L, it's worth the few pence extra for the higher grade valve.

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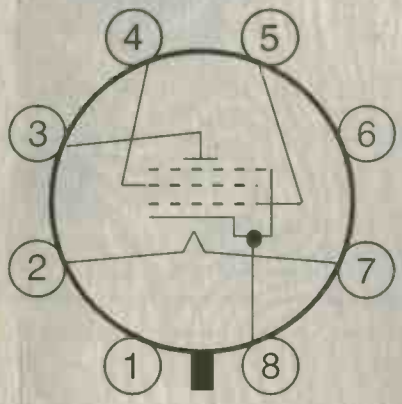
The KT88 and 6550

The 6550 is the heart and soul of all those big, expensive French and American super-amps, like Jadis and Audio Research. The 6550 is more or less a beefed up 6L6. Anode dissipation is 35W, and sounds like tempered steel version of it. For me it has excellent strength and authority, but it just isn't as musically appealing as the 6L6. The obtainable power is high, McIntosh squeeze 75W from a pair, substantially into Class B I may add. However, 50 to 60W is quite normal in fixed bias Class AB though and in Class A 30 to 35W is possible; here sound quality improves substantially. The Classic McIntosh MC275 and the modern Jadis JA200 are two excellent examples of the potential capabilities of the 6550 if treated correctly.

There are a few types of 6550 around. The best type without a doubt is the Tung-Sol, but these are very rare now. The last of the G.E. 6550s are supposed to sound good, but their glass is eggshell thin and they don't look that well made. The Sovtek 6550 has been withdrawn, and I found it gave very little power output, leaving the various Chinese types such as Golden Dragon or the Russian Svetlana 6550; the latter has an excellent reputation.

The KT88 was developed by M.O.V. (G.E.C.) and is similar to the 6550. However it is like a turbocharged version, having a higher rating in terms of voltage and power and as a result gives more output. Original KT88s are rare now and the only satisfactory replacement in hi-fi gear is the Golden Dragon. Go for the Super version. These aren't anywhere near as indestructible as the originals, but at least they sound good and give the correct power output.

Beware of using too high an H.T. voltage on the screen grid! Run 6550s or KT88s at a lower voltage for a sweeter sound. Don't bother with the 50W G.E.C. circuit because it never seems to work properly.



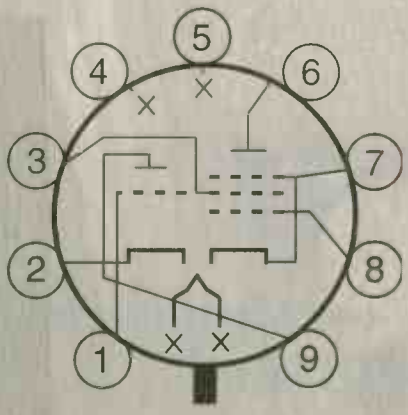
KT88/6550

The ECL86

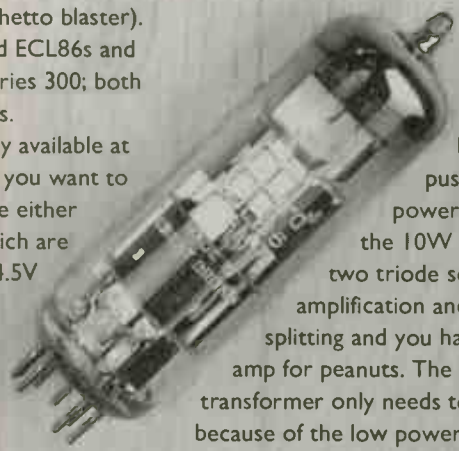
The ECL86 would usually be found in the audio output stage of a valve TV set, but there are a few amps which use it and it's good for the experimenter. The ECL86 sounds excellent, like a micro EL84, sweet and clean. The ECL86 has an ace up its sleeve in that it is a triode-output pentode, you get a free triode in the envelope which saves money on valves (the triode is an ECC83 section). The output pentode section has a dissipation rating of 9W, nearly as much as the EL84. It is feasible to make a 10W amplifier using only two ECL86s per channel, and the sound would better anything you could buy for the money (you could maybe get a ghetto blaster). Later Rogers Cadets used ECL86s and the Audio Innovations Series 300; both are good low priced amps.

ECL86s are commonly available at mega cheap prices, and if you want to be a real skinflint then use either the PCL86 or UCL86 which are even cheaper but have 14.5V and 44V heaters respectively. The Mullards are the best ones and because this valve is not all that fashionable they can be bought for a few quid each. Otherwise Yugoslavian, Czechoslovakian or Russian types are available at bargain basement prices, allowing for a few blow-ups during the development process.

Run the ECL86 pentode sections at Vb=275V, Rk=220, and with the screen grid taken to Vb. The load should be 9k for a push-pull pair, power output around the 10W mark. Use the two triode sections for amplification and phase-splitting and you have a complete amp for peanuts. The output transformer only needs to be small because of the low power and the PSU will be cheap using low priced 385V electrolytics.

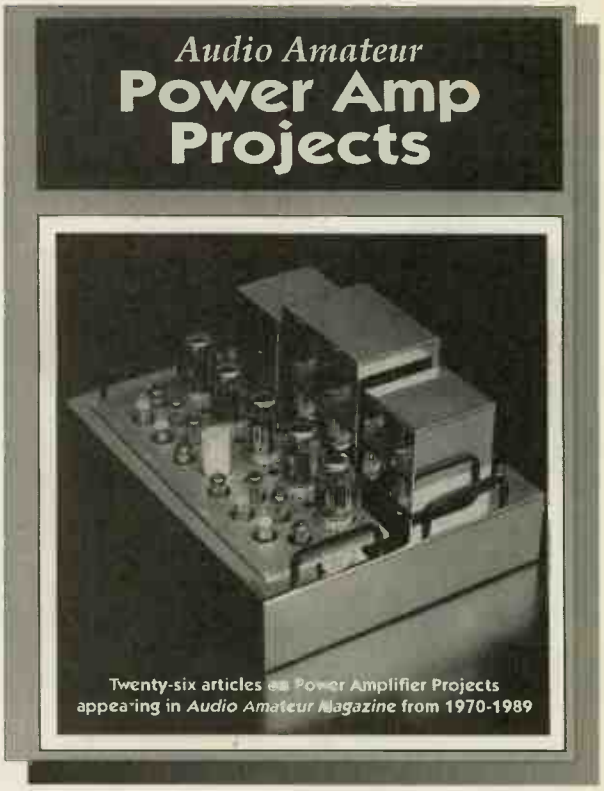


ECL86



Power Amp Projects

Reviewed by Andy Grove.



Power Amp Projects contains a cosmopolitan collection of articles which appeared in the American Audio Amateur magazine over a twenty-year period. Some of the authors of the articles carry legendary status in the international audio world; Arthur Bailey, William Johnson (founder of Audio Research), Nelson Pass (Threshold and now Pass Labs), Reg Williamson and Emo Borberley. Also present are Edward T. Dell, Roger Sanders and a host of other names from around the world. At least some of the authors will be familiar to prospective buyers of the book.

Their articles give an insight into the designer's thought processes, and after reading them you can go away and build their amplifiers too. Of course even these legendary names are not above criticism and any letters which were sent in to The Audio Amateur are printed after the article, together with the designer's reply and justification for their circuit. A few of the letters really do attack with a disconcertingly knowledgeable venom, which sometimes causes a reaction in the author rather akin to being stung by a hornet.

There are a wide array of projects to choose from. For those into valves there are two upgrades for the Dynaco ST70. One is a simple modification while the other, by Edward T. Dell, is a complete re-build to a fully balanced and cross-coupled circuit ala Audio Research. Apparently it still fits the Dynaco chassis. There is also the Super Brute; a high power amplifier using KT88s or 6550s for those who require large quantities of valve audio power. Hybrids are also present. There are designs with solid state input/valve output; three electrostatic speaker direct drive amps, two using 813 output valves and one using 8068 outputs. And valve input/solid state output in the DC300B, the last project in the book (unfortunately it does not contain 300Bs).

MOSFET amplifiers make up the majority of projects in the book though. Some are really elegant and ingenious and should serve as inspiration to the rather conservative solid state amplifier designers we have in Britain. The Borberly 60W MOSFET job with its fully balanced driver stage is a real beauty. It uses a configuration originated by Lender, but it is converted to fully symmetrical operation by Borberly using a dual long tailed pair input stage.

For those who have either super inefficient speakers or ears, or have neighbours they dislike intensely, there is a 500W MOSFET super beast, and considering the popularity of the large Maplin amplifier kits I'm sure it will be a hit with constructors. Nelson Pass has two contributions, a 40W Class A amp and a MOSFET upgrade to the Harman Kardon Citation 12. PCB and chassis layouts are given in most cases which is a real help because physical layout is so important to correct amplifier operation. It should be possible for most semi-experienced constructors to make chassis and PCBs from the diagrams supplied with the articles.

All in all there are some pretty serious projects in this book. Many of the amplifiers may be a bit daunting to the junior experimenter. But the Bailey 30W amplifier is a gem and can be built by a reasonably inexperienced constructor, and the Pass 40 watter should also be a snap - it just goes to show that a good designer can design both ultra complex super amps and very elegant simple designs aimed at the home constructor.

Some of the parts, especially the semiconductors, will not tie up with those available through Electromail or Maplin. This means it will quite often be necessary to either scour the equivalents books or to use your own judgement in selecting a replacement device. Otherwise, you may need to look overseas for the correct device. This isn't as bad as it seems; there are companies such as Newark Electronics which have branches in this country, but hold most of their stock in the US. Also look for adverts from Angela Instruments and Mouser Electronics. Steve Melkisethian at Angela isn't really into solid state, but I'm sure he'll help out if he can.

The presentation of the book is a bit home cooked, but this doesn't really detract from its value as a constructor's source book. For the experimenter who is interested in building something a bit different, there will be something for you in Power Amp Projects; overall it's a great book to have in the library ●

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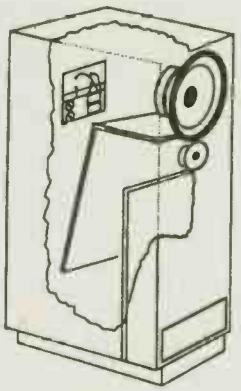

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Build Your Own Electronic Test Instruments

Reviewed by Dominic Baker.

Once you buy an oscilloscope, an item not in this book, you should be able to save money by building test equipment yourself, with a little help from Build Your Own Electronic Test Equipment.

This includes the simple audio frequency digital voltmeter which forms the first project in Chapter 2. It is something that will also aid testing of future constructions. This, although one of the simplest projects, is actually extremely valuable to the audio experimenter. It is an RMS averaging meter specifically for audio work, even including an option of logarithmic display of measurement in dBs - very useful and a normally expensive piece of kit.

The detail this book goes into is impressive. Each project is clearly introduced, explaining how to use the equipment, what it is capable of measuring, some relevant basic measurement theory, a description of the circuit, how to test and calibrate the instrument you've built and even where to source any difficult components, like the plastic for the AF Voltmeter.

Another interesting little project is the AF power meter. This uses a toroidal air-core bobbin onto which you wind 40turns of enamelled copper wire. It acts like a sensing coil, picking up the signal from the loudspeaker cable you pass through the centre of the bobbin. It converts the current flowing in the loudspeaker cable, which produces a magnetic field, into a proportional voltage. Once calibrated, you can view the power delivered to your loudspeakers, perhaps serving as a warning against overload, without affecting drive to the loudspeaker.

Next is a sound pressure meter, which along with a suitable test CD, could be used to plot the frequency response of a loudspeaker with reasonable accuracy. It is a little time consuming plotting the response by hand on graph paper, but very cost effective if you're only going to design one 'speaker for yourself.

Other general measurement instruments useful to the constructor include a digital capacitance meter (useful as the marking on some capacitors can be unreadable), an AC millivoltmeter with ranges from 0.2mV up to 60V, ideal for audio, a combined capacitance/inductance meter, two frequency meters, a wattmeter and more. For any home audio constructor, it's worth having this book just for this second chapter alone.

The third chapter, concerned with generators and analysers, is where things start to get a little more complex; computer analysis works alongside hardware for the Logic Analyser. For those interested in vintage tuners, there's an FM stereo signal generator (87-108MHz) ideal for aligning those old valve stages.

Again there are some simpler and tasty projects for the audio constructor. I zeroed in on the sweep/function generator, a piece of test equipment that goes hand in hand with a 'scope to form the basis of any audio test bench. Although usefully capable of producing sine, square and triangular wave forms from 10Hz to 200kHz, is was a bit of a disappointment to see a distortion figure of 0.5% in the audio band. This isn't important for most test work, but I thought I'd found a cheap sine-wave generator to use with a distortion analyser.

The final two chapters deal with small projects that are useful, though not fundamental to the test bench. These include a MOSFET tester, cable tester and measurement amplifier. For most of the projects a printed circuit board layout is provided, so you can make your own PCBs.

Looping back to the front of the book, there's even an introductory chapter on measurement techniques. I'm running out of room to enthuse about this book, so I'll have to keep it brief. If you're interested in building your own hi-fi and assessing and improving its performance, buy it. ●

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D.I.Y. Letters

PHONO EQUALISATION

It has taken some months but I've persevered and built your solid state phono head amp from the circuit board offered by yourselves. I have taken the plunge and purchased an Ortofon MC25FL cartridge which feeds a Naim Nait 2 amp via an LP12/Naim Aro combination. Now to the crux of the letter.

I switched the whole thing on, hoping for at least some sound through the Rega Elas, but also waiting apprehensively for a bang, and was rewarded by music. However, it was very 'trebly', 'spitty' and had almost no bass at all.

I've checked all of the component values and placements on the board. I used 1% resistors all over, polystyrenes for C2-C8, polyesters for decoupling, large polyprops (Maplin audio grade) for C9, and mains supply is from a Maplin 20 VA transformer, DH 28. I've had to mount the DF08 on a separate board because it did not fit your board pin out, and C1 is Black Gate (470µF) as you recommend.

Please suggest checks or remedies I might undertake to improve matters (I cannot take the cartridge back). If nothing else, your mag has encouraged me to have a go, and I've learnt quite a bit by visiting the library. Keep up the good work.

M. Tracey
Chipping Campden,
Glos.

The head amp should sound really good and clean, not spitty with weak bass. Something is obviously wrong here. There is a few things which I can think of, but it is difficult to fault-find without your board in front of me. First, check that you have the correct circuit diagram because the original article appeared with a mistake on the schematic - all of the values were correct, but a connection was incorrectly placed. Building to this schematic would result in just the symptoms you describe. A corrected diagram was published in the following month's edition.

Make sure that the cartridge is operating into the correct impedance. Some cartridges do not like to see the wrong impedance and can end up sounding pretty horrible. Check the cartridge's data sheet for the right value.

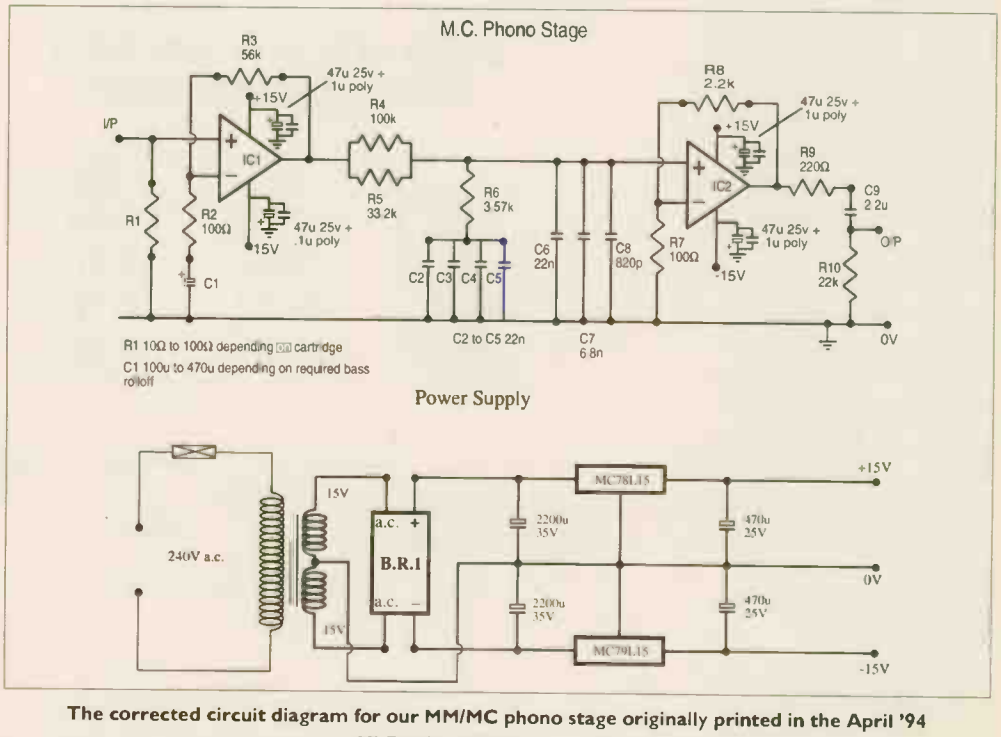
I know how easy it is to go over and over something you have built and not pick up the simplest of wiring faults or a misplaced component. It is a good idea to get a friend to check the board for you; another set of eyes is always a real help. AG

VALVES ON THE LEVEL

I get great enjoyment from reading your magazine each month, in particular the DIY section containing design ideas, circuits, etc.

I wonder if you can help. I currently have a line level pre-amp which uses the ECC82 valve. Reading your article in the April 1995 edition about different pre-amp valves, you suggested that you would use the 6SN7 in place of the ECC82 valve for almost all applications.

From your comments on the valves, I would like to try a design with the 6SN7 valve. Could you supply a circuit diagram of the various biasing components required for this valve to slot into the existing design? This has a 350V supply with a 12V supply for the heaters, connected in



The corrected circuit diagram for our MM/MC phono stage originally printed in the April '94 Hi-Fi World DIY Supplement.

series in the ECC82, generated from a voltage regulator. The power supply employs a valve for the rectification.

If this is possible, what make of 6SN7 would you recommend?

In the future, I may consider a pair of Lowther horns. Will the pre-amp have enough gain to drive a speaker of 100dB+ sensitivity without the need for a power amp?

Phil Tolcher
Southampton,
Hampshire.

For really optimum performance the 6SN7 should be tuned in to the circuit, but considering the voltage levels you are operating at, a direct swap in your circuit should work fine, providing the ECC82 was operating correctly to start with. Alternatively, use a 33k 3W resistor for the anode load and 330 ohms for the cathode resistor for each section, and a 220µF bypass cap. Audio Note can supply parts at any budget level.

The only problem is that the 6SN7 uses a 6.3V heater. You can either swap the 12V regulator with a 5V one and put two 1N4148 diodes between the COM pin and 0V to raise the output voltage to 6.3V, or use a 12SN7 which has a 12.6V heater. This time you can use the supply you already have.

12SN7s are readily available from people like PM components, but the choice of brands may be a bit limited. On the plus side, as the 12SN7 isn't as popular as the 6SN7 (why I just don't know), you can get really superb ones at a good price. Go for well known American brands like RCA or GEC. Probably the best sonically are the earlier Sylvanias which have the flat anodes or the GEC B36. There are some nice specimens made by Brimar as well, but beware of re-badged Eastern European or Russian types - they may be cheaper, but it's just not worth it for the few quid you will save.

Unfortunately, the pre-amp may be able to supply enough power to drive a sensitive horn, but it wants to operate into a much higher impedance than the 8-16 ohms usually present. You will need a power amp of some sort, although only a few watts is necessary. Your 12SN7 line stage will eat the '82 for breakfast in terms of dynamics, clarity and tonal accuracy, as long as you use the right valve brand and fairly decent quality bits. Happy listening. AG

SPEAKING CLOSE TO THE WALL

Please could you advise me whether your KLS4 speakers can be used up against or close to a wall. I am interested in building them, but there seems to be no mention of room placement in the article.

If not, can you recommend a kit or commercial speaker of similar size that would be suitable. My system consists of: Linn LP12, Ittok LVII with Denon DL304, Manticore MB6 power supply and Naim 42/110 with Van den Hul D502 interconnect. Incidentally, the whole system is hard wired - no din or phono plugs, just one high quality terminal block on the back of the power amp.

Speaker stands are my own design, cast in polyester resin and crushed marble, weighing in at 17kg each. I have Rogers LS7s bolted to the stands. The speakers are far too large for the room I now use and need to be away from walls, etc., hence the reason for writing to you. Speaker cable is Naim NAC A4. What cable would you recommend for the tweeter if I bi-wire? I look forward to hearing from you.

Brian Jeffcoat
Grayswood,
Surrey.

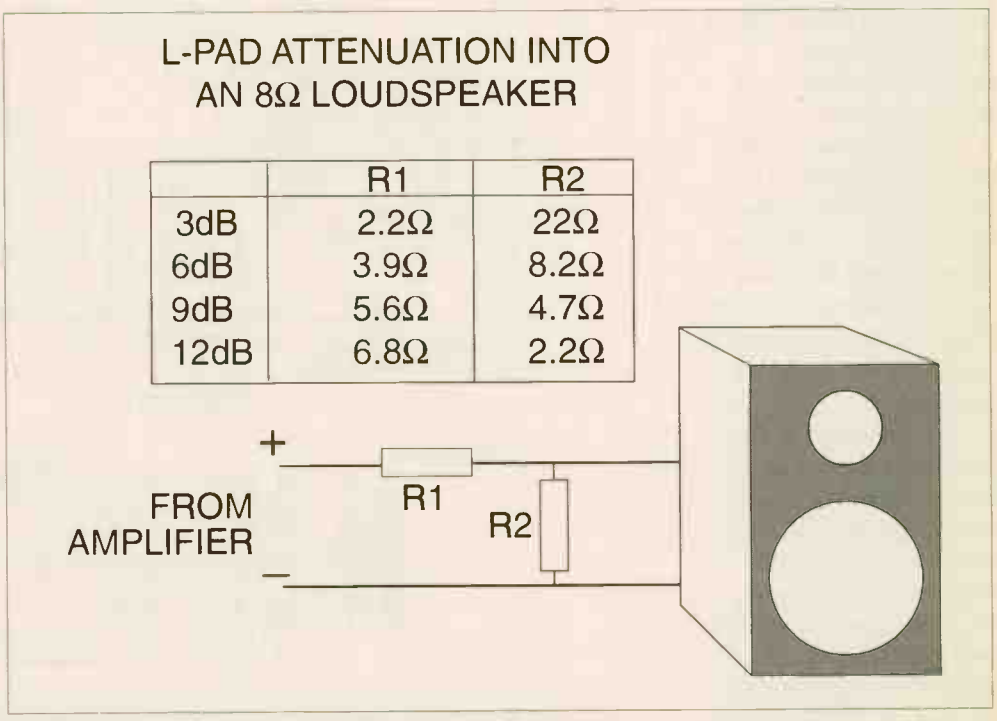
Our KLS4 loudspeakers were designed to be used against a rear wall, so should suit your requirements well. They use a stagger-tuned reflex system, where the two reflex ports are tuned to different frequencies to achieve a wider, flatter boost than a single port tuned to just one frequency. This means they have quite dry bass, but it is tight and tuneful - ideal for near wall placement.

Ortofon's SPK cables have been my faves for a long time now, and I've still to come across any cable that beats its transparency per pound ratio. SPK100 will probably suit best for the treble section, or you could use the bi-wire version, which is basically SPK100 for the treble run, and a slightly thicker version for bass/midrange. DB

A QUIETER LOUDSPEAKER

I much enjoyed your article, 'dB on the level,' in the February issue of Hi-Fi World because I have been wrestling with a problem with my speaker system for some time.

You specifically say at the outset that it is the crossover-driver interface that the article is about and hence, I presume, the arrangement within one



Assuming an 8Ω load, the table above gives resistor values for an L-pad attenuator circuit.

enclosure. My problem is that I have two satellite speaker enclosures which are much more sensitive than my subwoofer enclosure. They are driven by a Technics 40 watt (RMS) amplifier. I have wired them as per supplied instructions, with the satellites connected to the 'A' speaker terminals, and the subwoofer to the 'B' terminals, but as there is only one volume control it makes no difference. I cannot get the bass driver to work.

Despite what you advocate, "a drive unit is not an 8ohm resistor", is it not possible to insert a resistor in series in the line to each satellite to reduce their output in order to get a better balance than I have? And if so, what value would give me some balance? I would greatly appreciate your help.

Incidentally, as a retired pensioner I enjoy your magazine and our mutual interest in hi-fi. The subject is not just the province of the young! Keep up the good work.

George F. Emerton
Holt,
Norfolk.

It is possible to attenuate the signal to your satellites using an L-pad attenuator circuit as shown in the diagram below. This reduces the signal to the satellites without affecting the load impedance that your amplifier sees. I've included a table of values for R1 and R2 to give you a range of attenuation levels, assuming that your satellites are a nominal 8Ω load. 10W resistors should be OK. The values listed are easily available from Maplin (01702 552911) and other electronic component shops. DB

CROSSOVER QUERIES

Please could you explain why loudspeakers need air cored inductors as part of the crossover units? I have a pair of old Acoustic Research speakers which have provided pleasure over many years, but, have finally shown their age by perishing in places such as the bass driver surround. Choosing to replace the drive units rather than buy new speakers led me down the path of also replacing the crossover units (which on the ARs do not have air cores).

Having purchased the various parts from those nice people at Wilmslow Audio I proceeded to wire up the new drive units (Seas) and crossovers (inc. air cores). The resulting sound can only be described as 'muddy' lacking definition in the bass.

Comparing the old and new crossover layouts I decided to disconnect the air cores, leaving a straight signal path to the bass and only the capacitors and resistor in line to the tweeter. The sound was once again clear and 'unmuffled', so hence my opening question, what is the function of the air core and is it more important than the sound.

Adrian Newitt
Upper Sydenham,
Leamington Spa.

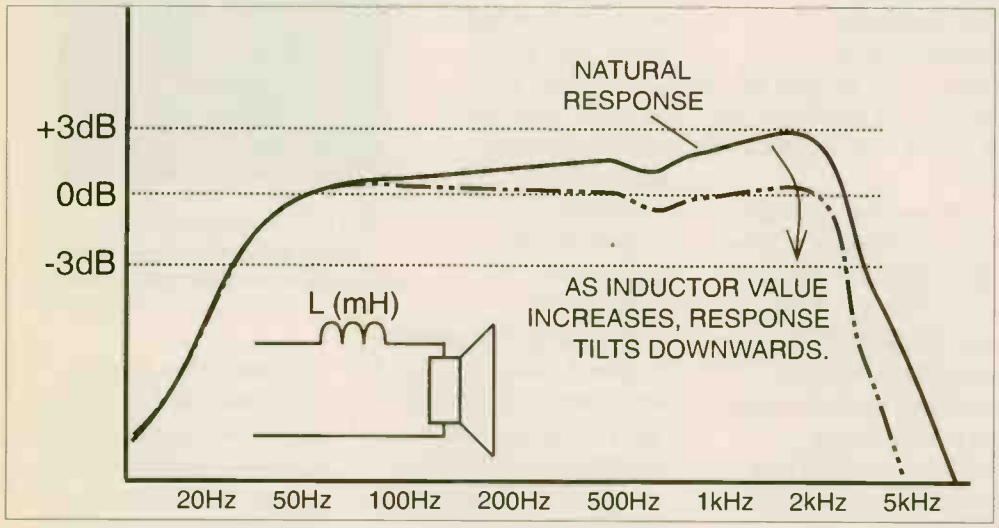
Air core inductors are superior to the ferrite cored ones normally supplied in loudspeakers. Ferrite cores can saturate if they are not large enough, causing a fall in impedance which may overload your amplifier. Some exhibit hysteresis and the core itself can vibrate causing signal distortion. For large values of inductor, like in the bass crossover section of a three way design where an air core is impractical due to its size and the amount of wire needed, a laminated core inductor is normally necessary. Everywhere else an air core type should be the preference.

But this is not really relevant to what you are experiencing. You are getting a little confused here. It is not the fault of the air core inductor that the sound is muffled. The value of the inductor applied to a bass driver affects its response as shown in the diagram below. Most bass units have a rising frequency response, which means they deliver more power in the midrange than in the bass. An inductor tilts the response downwards to balance the sound more evenly.

It sounds as if, in your loudspeakers, the inductor value is too high and/or wound with wire that is too thin. Thin wire has a higher resistance, so less power will reach the drive unit and too large a value will reduce upper bass and midrange, removing important bass fundamentals, punch, speed and midrange detail. This would give the muggy sound you describe. It is not a fault of inductors, more design fault where the wrong inductor value has been used.

Thing is, you may well be getting a better, more open sounding bass with no inductor connected, but the crossover will rely on the phase shift this component introduces to keep the tweeter and bass in phase. I rang Wilmslow who are now under new management, but they were unable to tell me what the crossover design was. It is a simple enough 2nd order design, the culprit inductor being 2.2mH. You need to put an inductor back in, but to get more upper bass, I'd suggest reducing it to 1.5mH or so. This is going to effect the crossover in other ways, but you should be able to achieve a reasonable balance.

I also contacted Radio Components on Tel: 01923 250665 who are the distributors for SEAS drivers. They had a design



Most drive units have a rising frequency response characteristic. A series inductor corrects for this, flattening the response.

a few years back similar to yours which used the same drivers. They suggested reducing the 2.2mH inductor to 1.5mH; it should have a DC resistance of less than 0.4Ω. Also, if there is not one already there, insert a 3.3Ω resistor across the bass driver's terminals. DB

KIT BUILDING MANIA

I am writing to you to congratulate the design team involved in the development of the KLS7, which I purchased from you at the end of December. Although I had a minor problem with a couple of resistors, the speakers were completed early January.

I have been on holiday since completing the kits, but have had a good chance to listen to them. In fact, I have rediscovered my music collection. I have found it very difficult to tear myself away from the music once actually sitting down.

The tweeter has the cleanest, smoothest treble I have heard in a speaker to date, with percussion instruments so clear and without the slightest trace of hardness. The midrange also being very detailed integrates marvellously with the high frequencies and really gets you involved with the music.

Although, as you say in your review of the KLS7, there is no deep bass as such, the bass that is there is very detailed. The imaging of the speaker is superb. I was positive I had an intruder playing triangle in the corner of my lounge last night. Your next task could be to design a subwoofer to complement the KLS7. Now that would be something.

For the record (or CD if you prefer), the rest of my main system comprises a TEAC VRDS-7 CD, your KLP1 pre-amp and Maplin's Millenium 4-20 valve amp, built as two monoblocks, and I think it sounds absolutely brilliant.

Apart from the enjoyment I derive from listening to my system, I have had a lot of pleasure from actually building the kits. I must thank all the firms that I have dealt with over the past three years whilst building equipment from kits. The people I have spoken to by telephone at these companies sound so enthusiastic and are very, very helpful.

Take A Bow:

Hi-Fi World. You got me interested in DIY (especially valve amps).

Maplin Electronics, for fast, friendly service.

Russ Andrews,

Hart Electronics,

Wilmslow Audio.

Thank you all for your help in the past, and hopefully I will be dealing with you at a later date.

When I was building the KLS7s, it occurred to me as I was reading through the instructions that, if a fault ever developed in the crossover, it would be impossible to repair owing to the position of the components on the first brace. This makes access very difficult.

I glued the components to a piece of 1/4in. plywood and stuck it onto the brace using double-sided tape. This allows me to remove the complete crossover if required. Another tip which I found helped was to screw a plinth to the bottom of the cabinet, approximately 37mm larger (all round) than the base of the cabinet. This makes the speaker more stable.

I also used 18mm MDF, and lined it internally with 6mm plywood for the construction of the cabinets, keeping the original internal dimensions as per instructions.

For anyone thinking of building these speakers, if you are capable of building the cabinets accurately, and can use a soldering iron, go for it. These are not cheap speakers, but high quality sounding speakers built cheaply (you are doing the work).

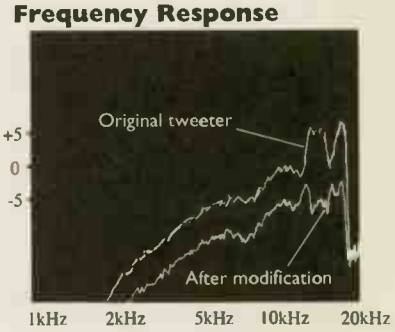
If anyone in my area is interested in hearing the KLS7s, give me a phone call and we can arrange a time.

W. Fotheringham
New Carron,
Falkirk
Tel: 01324 638642

I'm glad you are enjoying our KLS7 design. It was a loudspeaker very much aimed at the audiophile on a budget. I didn't want to compromise on drive unit quality at all, so a 4inch carbon fibre drive unit (the same one as used in KLS4) was chosen to cover the majority of the audio band. Because this driver has a very smooth response that extends well up to 4kHz, the tweeter has very little work to do, just filling in a little top end detail. It doesn't have to handle the basic fundamentals of many instruments, really serving only to reproduce their upper harmonic structure.

The tweeter is a 14mm polymer dome type which we modify. These units have a one-piece voice coil former and dome, so the drive from the coil is transferred very efficiently, giving a fast and crisp sound. But in its basic form there are two strong peaks above 10kHz in the response which make it sound sharp. We modify the face plate of this tweeter to reduce these peaks and give a smoother response, as shown in the plot below.

Frequency Response

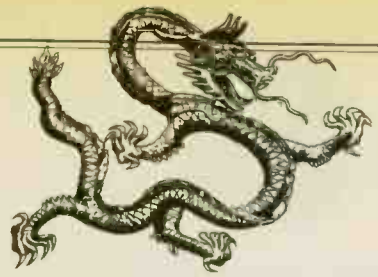


The two peaks above 10kHz in the tweeter's frequency response are suppressed in our modification for KLS7.

The bass of KLS7 doesn't go that deep as you point out, as a result of one of the compromises we chose to make - trading bass weight for speed and sensitivity. If you do want to add a subwoofer, make sure that you get one that has a fast and clean sound. It would be a shame to weigh down the KLS7s with a sluggish sub.

Building one yourself may be the best bet. Production of the Audax PR240Z0 10in. HDA bass unit, which would be an ideal choice of driver, has just started as I write this. You could use a pair for stereo sub-bass, or feed a mono signal to a single driver - it is efficient enough to work well this way. A single driver in a 50litre reflex enclosure tuned with a 3in. diameter port 230mm long, would produce bass extending to 30Hz (-6dB). For a richer, fuller bass, shorten the port to around 150mm, and for a dryer bass, lengthen it to 330mm.

Set the crossover point to around 80Hz, where KLS7 will start to roll-off in a free-field position; i.e., away from room boundaries where the sound will be clearest. If you want to keep the KLS7s closer to a rear wall where bass is reinforced, this crossover point should be lowered, but 80Hz is a useful starting point. Happy building. DB ●



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