

Hi-Fi WORLD SUPPLEMENT

No. 6 DECEMBER 1993

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TRANSMISSION LINE
LOUDSPEAKER FROM
TABULA RASA

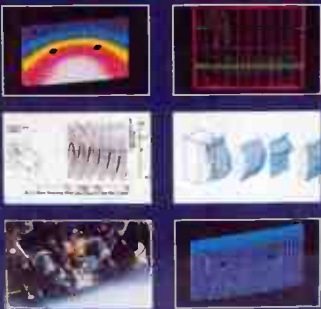


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D.I.Y. Supplement

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★★★ Good news for home constructors ★★★

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Heavy duty power cable, double shielded and double grounded US patented design actually improves sonic performance (I don't know why either, but it does and the difference is not subtle!)

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Read Alan Sircom's review in the December 1992 issue of Hi-Fi World and call Wollaton Audio 0602 284147 for more details.

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KIT NEWS

KEVLAR SPEAKS!

Scan-Speak have replaced their 7" polypropylene drive unit with a Kevlar-coned version, trading on the lightness and improved rigidity which Kevlar offers. They have also launched an 8" drive unit employing the same material for the cone, and both units use long-throw voice coils made of aluminium, with an aluminium former.

Scan-Speak have also been busy with the needle and thread, if their new textile tweeters are anything to go by (tasty



treats for Moth amplifiers).

The D2010 is a three-quarter inch (19mm approx.) coated textile tweeter employing the same diaphragm and voice coil as the D2008 model, and their other three new tweeters are 19mm, 28mm, and 38mm designs using hand coated textile domes for "unusually fine detail and clarity".

Wilmslow themselves are working on a new kit using the 7" Scan-Speak drive unit mentioned above, along with their 2905 tweeter in a 15 litre cabinet. This kit also employs the usual high-quality components such as polypropylene capacitors and air-cored inductors, and will be followed by similar designs, for instance, one using the larger 8" Kevlar Scan-Speak unit.

Unfortunately the price was unavailable at the time of going to press.

Wilmslow Audio, Wellington Close,
Parkgate Trading Estate, Knutsford,
Cheshire WA16 8DX Tel: 0565 650605

SPECTRAL MANIFESTATIONS

Spectra Dynamics have been cooking up some interesting polymers recently, and have come up with one which is suitable for damping the standing waves and cabinet resonances which often plague loudspeakers.

This anonymous polymer is available in specially-shaped panels for the DIY 'speaker builder to insert. They are sold under the name of 'Deflex' panels, and cost £7.95

Spectra Dynamics,
Talargoch Trading
Estate, Meliden Road,
Dyserth, Clwyd LL18
6DD, Tel: 0745 570194

BANDOR TRANSMISSIONS

Bandor are currently working on a transmission line loudspeaker cabinet which they claim to be almost absolutely foolproof. Apparently its beauty and simplicity lies in the cabinet design, since all panels can be cut from a single sheet of high-density board, and it comes with a gizmo to guide the screws in at the correct angle, so even that's taken care of!

The 'speaker itself is a 4' high floorstander which goes down to around 15Hz, so you'd better check your foundations before ordering. Unfortunately, no more details are available as the 'speaker is still in the R&D stage, but the projected price should be a little under £400. Once this one's complete, they'll

also have a slightly smaller version available. **Bandor Loudspeakers, Design and Development Studio, 11 Penfold Cottages, Penfold Lane, Holmer Green, Bucks. HP15 6XR Tel: 0494 714058.**

LIBERTY

Liberty Instruments, of the good ol' US of A, have announced a 'full-featured' Fast Fourier Transform, impedance and network analyser for use with IBM compatible computers.

The Liberty analyser is called IMP, as is the Falcon Speakers product featured in last month's Kit News column. Liberty's IMP is a graphics-based software package which enables "extraction of quasi-anechoic acoustic measurements, transient response analysis, correction for microphone response, merging of data from multiple measurements", and much more.

The 'M' software with which it is provided gives on-line help, mouse capability, and much more, allowing overall ease of use. The whole package includes a microphone and clip probes, all for US\$599, or around £400 for those closer to home.

Liberty Instruments Inc. P O Box 1454,
West Chester, OH 45071, USA.



AUDIO INNOVATIONS

Report a good response to their first foray into the kit world, the Classic Stereo 25, as reviewed in our last supplement. However, don't hold your breath for their next product, as they're waiting to gauge the response to the '25 'in the long term' before they commit themselves. We don't think they'll be disappointed.

Audio Innovations, Audio Components Ltd. Albany Court, Albany Road, Granby Ind. Est. Weymouth, Dorset DT4 9TH. Tel:0305 761017

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The Standard version has a passive input selector circuit with Alps Precision Low-noise volume and balance controls, switchable CD, Tuner and Pre-amp inputs and an optional stereo bargraph output level display. The 'Slave' version has stereo power amplifiers and standard power supply. The 'Manabloc' version again has the standard power supply but since it is only driving one power amplifier higher than normal output power is achieved with total channel separation. The slave and manabloc versions enable very sophisticated bi-amping and active crossover systems to be constructed.

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HART

Mainhattan High-Rise

Nick Lucas and Simon Cooke get to grips with a pair of floorstanding kit loudspeakers from Germany

These Mainhattan kit loudspeakers are produced in Germany where kits form a much larger proportion of the audio market than they do over here. The CT 77 loudspeakers are a two-way transmission-line design, which stand around 110cms tall and cost £135 for the drive units and hardware, with the black resin finish cabinets costing £160 on top of that, so they currently come in at around £295 all told, but the UK importers, Tabula Rasa, will apparently be reviewing their prices soon, with the accent on reduction rather than increase.

Despite being 'kit' loudspeakers, the cabinets come ready-built, as does the crossover network, which leaves very little wiring left to do, which is, in some ways, a disappointment, but a boon for those who feel less than confident handling cabinetry and electrics.

BUILDING THE CT 77s

The CT 77s come with much of the work already done. All that they need for completion is for the two drive units to be soldered to the crossover leads, the crossover secured inside the cabinet, and the binding posts connected to the crossover internally, via the leads provided. All that then remains is for the drive units to be screwed into place, so the whole job should take under an hour and requires only a minimal amount of skill with a soldering iron. The following is a brief list of steps in building the kit.

Our man with a screwdriver says -

Firstly, the crossover unit, which came pre-soldered on its own board, needed to be screwed into place. Reaching in through the large cut-out for the bass/midrange driver, it was positioned centrally with respect to the port, and screwed down. There were no pre-drilled holes, so this job was just a little fiddly. The reason for the absence of holes could be that, according to the instructions, the crossover should have been screwed internally to the rear of the cabinet. The guide holes have probably been drilled there, rather than on the interior baffle, but the design of the cabinet renders fixing the crossover here impossible.

From the crossover, leads were run into the base and threaded through the port provided for the terminal plate in the rear panel. Soldering the terminals was easy, and then the terminal plate was screwed home.

Returning to the front of the 'speaker



cabinet, the tweeter leads were brought through the cut-out and soldered, ensuring that there was no contact between these terminals and the tweeter magnet, which could cause a short circuit.

When soldering the tweeter, don't lay it face down on the table, as this constructor did. Suspend the tweeter by resting it on a couple of blocks, books, cassette cases or something, so that the dome is not squashed. If you should happen to deform the dome, delicately run your finger around it, spiralling from the edge to the middle and it will pop back into shape. Remember that, although these domes are quite tough, careless handling can easily cause damage, so be gentle!

The holes for the tweeter are pre-drilled, so all you have to do is screw it into place. Once that was done it was time to position the acoustic damping foam panels and wool as described in the manual, and put the kettle on.

Coming back to the 'speakers, the last

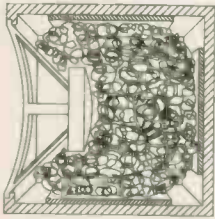
pair of leads from the crossover were soldered to the drive unit. Be especially careful, when doing this, to avoid dropping solder onto the paper loudspeaker cone, by heating the bare wire with the iron for a few seconds before slowly adding the solder. Once that was done, all there was to do was to line up the drive unit with the pre-drilled guide holes and screw it into place, by which time the kettle had boiled, and we went off to make the tea, then came back to listen to the products of this Herculean labour.

All in all, the instructions were clear and concise, and all the relevant parts easy to identify. These are very easy loudspeakers to build for anyone with a modicum of manual skill and a little experience with a soldering iron. If you've never tackled a loudspeaker kit before, these are easy and just a little concentration should be enough to see you through.

Nick Lucas
SOUND QUALITY

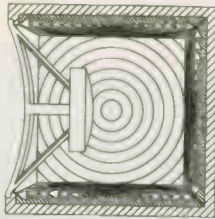


**THE PAST &
THE PRESENT**



Inside a Typical Cabinet

**LISTEN TO
THE FUTURE**



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Get the music out of your system, and let your speakers breathe!

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**PURPOSELY DESIGNED HI-TECH SPEAKER LININGS
NOT BY-PRODUCTS FROM ANY OTHER INDUSTRY**

THE FACTS

Standing Waves are additive at some frequencies and cancelling at others, thus causing irregularities in the response. It is therefore necessary to reduce them to a minimum.

Resonance is the nightmare of speaker enclosure design and is responsible for most of what is normally termed "colouration" and "muddle".

In practice the speaker enclosure exerts a considerable influence over the sound of a complete system. If not controlled properly, unwanted acoustic output can give subjective colouration.

Speaker manufacturers have set the trend of fitting out enclosures with bitumen, wool, and foam etc., in an attempt to combat these problems.

However, trying to absorb energy falls short in performance terms, and can muffle the sound, especially in reflex designs where air flow is critical. The infill wool and foams move with high sound pressure levels and this can become audible.

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Spectra Dynamics have combined advanced polymer technology with computer aided design to reduce unwanted cabinet distortion to an absolute minimum.

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"NEW APPROACH STUNS THE EXPERTS"

**"BIGGEST BREAK-THROUGH IN 20 YEARS"
"RESULTS NEVER ACHIEVED BEFORE"**

**"THE MUSIC IS FASTER, BRIGHTER,
CLEANER, WITH DEEP, CONTROLLED BASS"**

**"THE ONLY REAL CURE FOR BOX NOISE
AND STANDING WAVES"**

The finished Mainhattans are quite overbearing to look at, being finished, in our sample at least, in heavy-looking matt black resin.

My first impression of the sound was similar to the visual aspect, meaning that it was basically stolid and heavy. Extended listening refuted this, although a little heaviness remained as a trait throughout the performance.

In detail, the bass response of the Mainhattans was very impressive; they just kept going down, down, down. In fact, they're the sort of 'speakers that have you worried about waking the local troglodytes more than your neighbours, they go so low. However, the bass remains firmly ensconced in the cabinets, rather than shaking the foundations. In all, it seemed a little unwilling to come out and play.

That said, the tone and overall musicality of the bass was very good, and detail was resolved well, which is something a lot of 'speakers have trouble with so far down the spectrum.

The midband was clean and easy on the ear, although the sound was a little uninhibited and splashy, with strings being especially liable to bounce out of the stage and around the room, but even this

trait was far from overwhelming, being exacerbated by the acoustics of the listening room, and the instruments behaved impeccably for most of the time.

Treble notes were, again, easy on the ear, being soft and nicely textured. All the information was resolved, and details such as cymbals had a beautifully portrayed metallic quality when struck. The tweeter fell down with sharp transients, however, by losing the textures. The cymbals which had sounded metallic when struck rhythmically jangled harshly when hit with any real force, and this diminished the interest of rock tracks just a little for me.

Staging was adequate, but the Mainhattans are 'boxy' speakers which did not string a stage out across a room unless the source material was especially good.

Detail, on the other hand, was excellent, and the textures and tones, as well as all the finer details which recreate the atmosphere of studio or live recordings were all there, brilliantly resolved from even the worst material. Details which I have never before heard on some of my favourite recordings were suddenly crystal clear. It is a rare experience to play a track

that you have known for the better part of, say, twenty years and, suddenly, to hear new details and information. To say that I was impressed would be a gross understatement.

Overall then, a very capable loudspeaker which excelled in its ability to resolve tone and detail, although it was somewhat held back by the reticence of the sound when it came to projecting out of the boxes, but if you're thinking of buying them, don't let that hold you back. A good source will wrinkle these 'speakers out and, with all the resolution at their disposal, they'll engress you.

Simon Cooke

Mainhattan Acoustics CT 77
 TABULA RASA
 136 Kilnwood
 Walters Ash
 High Wycombe
 Bucks
 HP14 4UR
 Tel: 0494 565116

MEASURED PERFORMANCE

This loudspeaker is simple in principle yet interesting in its abilities. It uses the oft-discussed, but less commonly used idea of a long transmission line to return radiation from the rear of the speaker cone in-phase at low frequencies to reinforce low frequency output from the front of the cone. The line has to be a long one to do this, making for an impractically large loudspeaker, at least on paper.

In practice, other effects can come into play to make the technique work. Internal sound damping material reduces the speed of sound, which makes the line seem longer than it is. Reinforcement can come from the floor, which explains why TDL put their port always at the base of the cabinet.

Mainhattan get line length by making the cabinet very high - no less than 110cms (3ft 7in). As a result, the speaker has an imposing presence, a bit like the monolith in 2001. The line inside is tapered and exhausts at the top of the rear panel through a large port. However, although this could be construed as a form of reflex, the impedance trace actually confirms its behaviour more as a true line, since true transmission lines should give a single, damped bass resonant peak - and this one does.

In fact, the impedance trace is an unusually well controlled one - and it is not what I expected either. Speakers from across the briny (going East) usually have a four ohm impedance, yet this one has an unusually high overall impedance of 12 when measured

with pink noise. The impedance trace shows why: eight ohms is a minimum value and it rises above this level across the midband, due to rising voice coil inductance of the bass/midrange driver, a common enough characteristic.

What this means is that the speaker loads an amplifier lightly, but it will not draw current and, therefore, power. As a result, it doesn't utilise amplifiers especially well and it is insensitive. I measured 84dB sound pressure level for a nominal watt (2.84V) of input, so this speaker will need to be paired with fairly powerful amplifiers, preferably of 50W or more.

But do the Mainhattans, for all their size, have deep bass? The answer is a firm "yes", according to our analyser. Forward radiation extends down to 50Hz - a very low frequency subjectively. The rear port peaks at 63Hz but extends down even further, to 20Hz, far below most domestic loudspeakers. Together with raised low frequency output from 60Hz up to 250Hz (upper bass), I'd expect a full, warm sound, with good bass speed and impressive bass depth, but possibly some apparent slowness in the low bass.

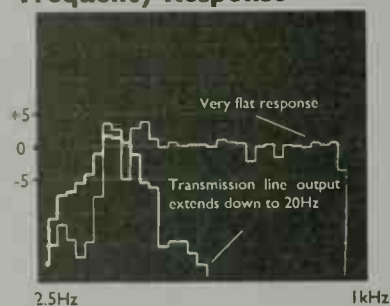
Continental-European loudspeakers usually have treble peaks. These speakers do not. On the contrary, their tweeter exhibits a flat response up to 18kHz or so, suggesting it should give smooth treble free from accentuation.

Mainhattan sent us a jar of magic gunk to paint onto the bass/midrange cones to reduce colouration and it worked well. The measured performance also altered a little, with improved

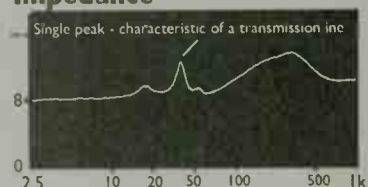
extension at the unit's higher frequencies.

The Mainhattans possess a better measured performance than most commercial loudspeakers and they deliver the sort of 'impressive' bass so many people demand. They're a very well engineered design. **NK**

Frequency Response



Impedance



AUDIO NOTE

AUDIO NOTE AUDIO COMPONENTS PARTS & PRICE LIST.

We have decided to offer a range of the ultra high quality components used in most of the Audio Note amplifiers to the discerning "do-it-yourself" valve amplifier enthusiast. These components include specially made valve bases, paper in oil signal capacitors, copper & silver foil signal capacitors, Black Gate graphite electrolytic capacitors, acid/corrosive-free silver solder, audio output transformers, valves and many other useful bits for upgrading old or constructing new valve amplifiers.

All prices are excluding Vat, which, if you live inside the EEC will be added to your purchase, after the addition of postage and packing costs.

We accept VISA, Mastercard, Access, Diners, and Amex, to pay this way, we will need your address, card no. with start and expiry dates, you can also pay by bankers draft, Eurocheque or cheques drawn on a UK bank account. Please note that there is a minimum charge on credit card transactions of £20.00.

Delivery is normally about 7 days from receipt of cleared funds, but please allow up to 60 days for some items, if not stock at the time or order.

If any of you reading this have possession of any books which contain information relevant to the subject of Audio Design and which would be useful to share with others, please let us know either by fax or telephone. There is an award of £20.00 (payable in valves or other bits, post free) to anybody who sends us a book which contains useful information about valve amplifier design or theory.

Circuits, Valve Data & Basic Technical Information.

If you would like some suggestions to base a future project around, then we shall be happy to provide you with a circuit pack containing good circuits like ONGAKU, KEGON/KASSAI, NIEIRO, GAKU-ON plus several other power amplifier circuits and the M7TUBE pre-amplifier, which is the best pre-amplifier circuit we have come across. Just send a stamped self addressed A4 size envelope, together with £4.00 in small denomination, or if you live outside the UK a US\$ 10.00 bill will do, please do not send International Response Coupons or International money orders, as they cost more to cash than their value.

We can also supply a set of data sheets for the most commonly used valves, ECC82, ECC88/6922, 12AY7/6072A/1025/12AX7WA/ECC83, 6SN7, 300B, 211V14C, 845 EL34/6CA7, 2A3, 6X4, 5U4G, GZ34/5AR4, EL84/6B05, 6V6GT, 6L6G, 5881/6L6WG/6K76. Again send a stamped self addressed A4 envelope together with £3.00 in small denomination stamps or if outside the UK another US\$ 10.00 will suffice.

Since nothing really exists which gives a reasonable background to the subject of valve amplifier circuit design, Guy Adams and I have written and assembled a number of articles and extracts from old books which give some background to the subject, do not expect to become an instant expert, but it will serve as a useful reference, for the beginner as well as the more advanced. Again a small charge is required, this time £6.00, in small denomination stamps with a stamped self addressed envelope, outside the UK, please send US\$ 20.00.

We do accept a UK cheque or bankers draft in Pound Sterling for the above charges as well.

SOUND PRACTICES.

If you are seriously interested in the subject of valve amplifier design, without the usual preconceived notions of what is "good" amplifier design and technology (the traditional view, which has brought us the blessings of the transistor amplifier, has obviously disqualified itself quite monumentally), then SOUND PRACTICES is the magazine to read, here you will find articles about design parameters, DIY articles for amplifiers and speakers, reviews of new and old. In other words the very subjects that none of the self-serving, advertising led traditional press will touch as they do not enhance the business of their normal advertisers. You can buy SOUND PRACTICES from us at £5.00 per copy (there are currently 4 issues available) or by subscription from SOUND PRACTICES P.O. Box 19302, Alexandria, VA 22320, USA. A regular modern world bargain, and there are practically none of those in Audio today. With enough subscription support SOUND PRACTICES may just bring about the "sound practices" that the hi-fi industry has abandoned for so long. So get a subscription!

OUTPUT TRANSFORMERS.

Specifications:
PP = Push-Pull, PPP = Parallel Push-Pull, SE = Single-ended, PSE = Single-ended Parallel. UL signifies 43% ultralinear taps, as a general rule we do not condone the use of UL-taps, as we consider these detrimental to sound quality. ** Dynaco replacement.

All primary impedances are calculated for Class A operation, the main consideration given to maximum dynamic power transfer ability and minimum distortion, rather than meaningless steady state sine- or squarewave conditions.

All our single-ended output transformers are airgapped, and the maximum standing current allowed before saturation is shown in column 5.

All our output transformers have a frequency response well beyond the audible range, typically 20Hz - 40KHz minus 1.5dB, all are IE-cored with high grade silicon steel laminations, wound with oxygen-free copper wire and supplied with either bell-ends or frames, both with flying leads.

We generally overspecify our transformers by 50% power in Push-Pull (which means that a transformer stated as 25 watts will allow about 35-38 watt peaks, our single-ended outputs are generally over specified by 100%, which means that they will instantaneously allow peaks of double the given maximum power through undistorted).

We do not give any further technical information on our output transformers, as we do not wish to take part in technical competitions, our products are designed to criteria which are and will be understood once they are listened to!

In addition to the output transformers offered below, we offer a design service, where we can supply almost any requirement for wideband transformers, whether for microphones, moving coil cartridges, line input, phase splitter interstages, driver or power output, we design and manufacture prototypes in-house, the cost for the paper design is £200.00, prototype cost is calculated on a per base basis. We can also produce production quantities.

Sizes are given as Width/Height/Depth, where depth is the depth of the coil itself and width is the length of the core.

CHOKES & INDUCTORS.

Value	Size	Price Ex. UK Vat
3H/1 00mA		14.00
5H/1 50mA		21.00
10H/125mA	63x74x76 mm	26.00
10H/200mA	98x65x83 mm	33.00

PAPER IN OIL SIGNAL CAPACITORS

These handmade signal capacitors are sonically superior to any of the plastic or other paper types we have come across. If you have written and experienced the difference that a really good paper/oil capacitor can make in a valve amplifier, then you really should try. Our specially made paper/oil caps have a life, colour, lack of harshness and evenness of dynamic behaviour across the frequency range, which is guaranteed to brighten up your day! Recommended as replacements in old and new valve amplifiers alike (and even in the odd transistor amplifier), and essential for DIY projects.

Value	DC Voltage	Size	Price ex. UK Vat
0.015mF	400volt	21x9mm	2.85
0.022mF	400volt	35x10mm	3.70
0.082mF	400 volt	33x14mm	4.25
0.12mF	400 volt	33x14 mm	4.75
0.18mF	400volt	32x16 mm	5.15
0.22mF	400 volt	35x18 mm	5.85
0.33mF	400 volt	43x18 mm	6.75
1.4mF	400 volt	70x24 mm	14.95
0.0015mF	630 volt	17x9 mm	2.85
0.022mF	630 volt	20x10 mm	3.25
0.082mF	630 volt	33x16 mm	3.75
0.18mF	630 volt	43x18 mm	4.75
0.22mF	630 volt	52x19 mm	5.75
0.33mF	630 volt	52x22 mm	7.25
0.39mF	630 volt	52x26 mm	7.95
0.22mF	1000 volt	56x26 mm	6.95
0.39mF	1000 volt	61x26 mm	11.65
1.2mF	1000 volt	72x40 mm	16.75
0.22mF	1600 volt	60x26 mm	9.85
0.22mF	2000 volt	70x29 mm	11.55

All Audio Note paper in oil signal capacitors are axial type. We are preparing a range of very small picofarad value paper in oil capacitors at the moment in addition to the above.

PAPER IN OIL COPPER FOIL SIGNAL CAPACITORS.

We are currently developing a range of paper in oil capacitors where instead of using aluminium foil as in the above paper caps, we use an oxygen free copper foil with 99.99% pure solid silver lead out wires, to "bridge" the price-quality gap between the more standard paper/oil caps and the Japanese handmade Silver foil signal capacitors. For the time being we will only have two values available.

Value	DC Voltage	Size	Price ex. UK Vat.
0.15mF	630 volt	32x16 mm	16.45
0.22mF	630 volt	56x20 mm	19.75

AUDIO NOTE SILVER FOIL SIGNAL CAPACITORS.

Best signal capacitors available, quality really speaks for itself, used in amplifiers like ONGAKU, KEGON, GAKU-ON and M7TUBE Silver, handmade in very limited quantities at Audio Notes facility in Tokyo, Japan.

Value	DC Voltage	Price ex. UK Vat.
0.02mF	500 volt	211.75
0.05mF	500 volt	346.75
0.1mF	500 volt	645.75
0.2mF	500 volt	995.75

AUDIO NOTE PAPER IN OIL RESERVOIR CAPACITORS.

Mainly for use in inductor power supplies, but have other uses.

Value	DC Voltage	Size	Price Ex. UK Vat.
2mF	400 volt	30x40x55 mm	26.75
2mF	630 volt	35x45x72 mm	33.65
2mF	1000 volt	45x45x72 mm	41.75
2mF	1600 volt	50x70x72 mm	45.95
4mF	1000 volt	45x45x120 mm	49.95
4mF	2500 volt	70x70x120 mm	265.75
10mF	1000 volt	70x100x100 mm	96.75
12mF	1000 volt	70x100x120 mm	109.95
12mF	1600 volt	100x100x120 mm	136.75
12mF	2000 volt	100x100x220 mm	159.75

AUDIO NOTE ACID & FLORIDE FREE SILVER SOLDER.

The best solder we have been able to find, does not contaminate the junction, which over time increases junction resistance. Used in all our amplifiers from OT0 to the GAKU-ON.

Weight/Measure Price Ex. UK Vat.
50. grammes or about 8 meter 1 mm diameter 19.95
1 kilo roll of 1 mm diameter 299.95

AUDIO NOTE CABLES & WIRES.

We are proud to offer the AUDIO NOTE range of high quality copper and silver coax, speaker and wiring cables, which, depending on the overall price of the project will do justice to any hi-fi system, regardless of price.

Solid 99.99% Pure Audio Note Silver Wire.

Gauge	Insulation Material	Price per Meter Ex. UK Vat.
0.05mm	Polyurethane	16.75
0.2mm	Polyurethane	22.75
1 mm	MIL	36.75

The above solid silver wires are suitable for inductors for speaker crossovers, both active and passive or for internal wiring in tonearms, amplifiers etc.

AUDIO NOTE HIGH QUALITY STEPPED ATTENUATORS & SWITCHES.

These handmade attenuators and switches are manufactured by a friend of Mr. Kondo of AUDIO NOTE, and represent the best available volume controls and switches you can use in your pre-amplifier, the attenuator is 48 steps and with silver/iridium plated contacts/brushes made with an array of tantalum film resistors. The switches feature silver plated contacts and self cleaning action.

Type	Value	Price Ex. UK Vat.
Stereo Potentiometer		
/Attenuator	50K Ohms	198.75
Stereo Potentiometer		
/Attenuator	100K Ohms	207.75
2 Channel switch	6 - way adjustable	78.75
4 Channel switch	6 - way adjustable	101.75

AUDIO NOTE HIGH QUALITY CERAMIC VALVE BASES

All of our valve bases are of the highest possible quality, made from steatite and using the best metal parts from alloys which retain their spring tension around the valve pin for longer. They are recommended as upgrades to most old valve amplifiers and should be an essential part of any DIY project.

Type	Mounting	Plating	Price Ex. UK Vat
4-pin UK4 for 300B		Gold	8.25
2A3/801A Chassis			
4-pin UK4 for 300B		Nickel	7.25
2A3/801A Chassis			
4-pin UK4 WE-type for 300B/2A3/801A Chassis	Silver		14.75
4-pin Jumbo 4 for 211V14C/845 Chassis			
with bypass	Silver/chrome		159.95
5-pin UY5 for 807	ChassisGold		9.75
7-pin B7 for 6X4, OA2	PCB		
7-pin B7 for 6X4, OA2	PCB		
7-pin B7 for 6X4, OA2	Gold		7.85
Chassis from above			
7-pin B7 for 6X4, OA2	Silver		6.75
Chassis from above			
8-pin UBX for EL34, 6550, 5U4G, GZ34, 6L6G, etc	Gold		7.95
Chassis			
8-pin UBX for EL34, 6550, 5U4G, GZ34, 6L6G, etc	Silver		5.65
Chassis			
9-pin B9 for ECC83, ECC88, 5687, 6350, etc PCB	Gold		3.85
9-pin B9 for ECC83, ECC88, 5687, 6350, etc PCB	Silver		5.75
9-pin B9A for ECC83, ECC88, 5687, 6350, etc etc	Gold		4.45
Chassis from above	Silver		
9-pin B9A for ECC83, ECC88, 5687, 6350, etc etc	Gold		6.75
Chassis from above			
9-pin B9A for ECC83, ECC88, 5687, 6350, etc etc	Silver		4.95
Chassis from below			
9-pin B9A for ECC83, ECC88, 5687, 6350, etc etc	Gold		7.15
Chassis from below			
Topcap For 807 pentode	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.

Type	Mounting	Price Ex. UK Vat.
8-pin for EL34, 6550, KT66, 6L6G Chassis with bracket		1.45
9-pin for ECC83, ECC88, 5687,		
6350 Chassis with shroud		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 on request, beware the valves on this list are NOT cheap.

Type No.	Type	Price Ex. UK Vat.
ECC835/12AX7WA/7025	double triode	2.95
E88CC/6922/6DJ8WA/7308	double triode	3.95
EF86/6267/7Z79	pentode	2.45
ECC82/1 2AU7/61 89W	double triode, mil spec	5.75
6SN7	double triode, UBX base	1.75
6SL7GT	double triode, UBX base	2.85
65J7	pentode	1.75
5687WA	double triode	4.55
6350WA	very powerful double triode	4.75
EL84/6B05	small power pentode	1.55
EL84M/6B05WA	small power pentode, mil spec version	4.75
6V6GT	small power pentode	2.45
6L6G	medium power pentode	2.75
5881/KT66/6L6WG	medium power tetrode	4.95
6550/KT88	large power tetrode	12.45
6C33	powerful regulator, indirectly heated	

6A57/6080	triode strong regulator, indirectly heated	24.65
2A3 4pin	triode	6.45
300B	directly heated small power triode	17.95
	directly heated power triode	57.95
5U4G	HT-rectifier	3.25
5Y3GT	HT-rectifier	2.25
5V4GT	HT-rectifier	2.25
GZ34/5AR4	HT-rectifier	8.75
6X4	HT-rectifier, very good for pre-amplifiers	2.65

RESISTORS

Beyschlag

We offer three quality levels of resistor quality, all are 1%, starting with the Beyschlag metal film, which are slightly magnetic (as are the vast majority of other makes of metal film resistors), but nonetheless very good sounding as used in all our UK-made amplifiers, up to quality level 3 (the MEISHU/P3) no-feedback triode amplifiers.

Beyschlag 1 watt, 1% resistors up to 500K Ohm, E 0 11, above 500K Ohm E0 13 each.

HOLCO

Better sound quality can be achieved with the H2, 1 watt, 1% non-magnetic resistors, which we regard as the best "industrial grade" metal film 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, they may become noisy.

HOLCO resistors type H2 50PPM cost £0.36 each from 1000 Ohm to 500K Ohm, higher and lower values are all £0.63 each.

SHINKOH Tantalum Film Resistors.

This is definitely the best sounding resistors available, forget the VISHAY which may be ok in high feedback transistor amplifiers, but in our opinion quite uncomplimentary to the qualities of real Audio Amplification (i.e. directly heated triode amplifiers running feedback free in single-ended Class A), it is where you will need the tantalum film resistor for the best results.

Unfortunately, the manufacturers have decided to withdraw the 1 & 2 watt values off the market for the time being, leaving only the 1/2 watt version available, which does rather complicate matters. However, as with most handmade specialist items, which covers most on this list if demand is sufficient, supply will rectify itself.

Anyway, the 1/2 watt, 1% tantalum resistors are non-magnetic and cost £2.06 each for all available values. There is long delivery on all values, so be prepared to wait if a value is not stock.

POTENTIOMETERS.

Best available from sound quality - price viewpoint, made by Ncble in Japan, high quality carbon film.

Impedance	Construction	Price Ex. UK Vat
100K Ohm	Frame type, PCB mounted	3.45
1 00K Ohm	Encapsulated type, PCB mounted	12.65

Balance Controls.

1 00K Ohm Frame type, PCB mounted 3.95
100K Ohm Encapsulated type PCB mounted 14.15

STANDARD TYPE SWITCHES.

This switch is adjustable 2 - 6 - way, it has gold plated contacts and a stainless steel ball for best possible corrosion protection and contact, price ex. UK Vat £3.30.

STANDARD ELECTROLYTIC CAPACITORS. Good quality standard industrial types.

Value	Voltage	Size	Price Ex. UK Vat.
100mF	10volt	18x6mm axial, 11x7mm radial	0.23
100mF	16volt	15x6 mm axial	0.29
220mF	16volt	11x6 mm radial	0.31
220mF	40volt	13x10 mm radial	0.42
100mF	63volt	13x10 mm radial	0.42
4700mF	16volt	38x18 mm radial	0.87
2200mF	50volt	35x18 mm radial, 41x16 mm axial	0.87
10mF	160volt	15x10 mm radial	0.56

22mF	350volt	25x12 mm radial	1.25
22mF	450volt	41x16 mm axial	1.89
47mF	385volt	25x21 mm radial	2.16
56mF	400volt	30x21 mm radial	2.37
68mF	400volt	30x22 mm radial	2.68
100mF	400volt	30x25 mm radial	3.26
220mF	385volt	52x30 mm radial	
		can	4.45
220mF	450volt	40x30 mm radial	
		can	5.85
220mF	550volt	112x35 mm radial	
		screw terminals	27.65

RCA, BNC, BANANA, PLUGS, RCA SOCKETS, SPEAKER & GROUND TERMINALS & LOUSPEAKER SPADES.

RCA	Plugs Standard Gold plug	1.55
AN-C	Gold plug	3.65
AN-GP	AUD10 NOTE gold plug	8.51
AN-P	AUD10 NOTE Silver plug, teflon insulated non-magnetic	25.53

Type	Mounting	Price Ex. UK Vat.
RCA socket nickel plated	Chassis mounted	0.41
RCA socket gold plated	Chassis mounted	0.65
AN-CS AUD10 NOTE non-magnetic, teflon insulated	Chassis mounted	3.65

Type	Mounting	Price Ex. UK Vat.
RCA socket nickel plated	Chassis mounted	0.41
RCA socket gold plated	Chassis mounted	0.65
AN-CS AUD10 NOTE non-magnetic, teflon insulated	Chassis mounted	3.65

Type	Mounting	Price Ex. UK Vat.
Standard BNC plug		3.45
BNC Silver plated socket chassis mounted		2.05

Banana Plugs, Loudspeaker Cable Spades, Chassis Loudspeaker Terminals.

Type	Price Ex. UK Vat.
Banana plug, gold plated, spring loaded lension	2.45
AUD10 NOTE Loudspeaker Cable spade, silver plated, non-magnetic	4.65
AUD10 NOTE AN-ST Speaker Terminal, chassis mounts, nickel plated, red or black	1.85
AUD10 NOTE AN-ST/G Speaker Terminal, chassis mounts, gold plated, red or black	2.75
AUD10 NOTE AN-STR Speaker Terminal, chassis mounts, fully gold plated, non-magnetic, red or black	4.75
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-hi News

BLACK GATE ELECTRON TRANSFER, High Performance, Graphite Electrolytic capacitors.

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 as to 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 leaflet. It is very important to note that all BLACK GATE capacitors take time to charge-up or stabilize, when first put in circuit, depending on type and application this "maturing" time can be between 100 and 300 hours.

Value	Voltage	BG-Type	Suggested Use	Price Ex. UK Vat.
0.47mF	50volt	PK	Anywhere	1.05
1 mF	50volt	PK	Anywhere	1.25
2.2mF	50volt	PK	Anywhere	1.55
4.7mF	50volt	PK	Anywhere	2.15
22mF	50volt	PK	Anywhere	3.35
100mF	100volt	Standard	Anywhere	7.75
1.000mF	50volt	Standard	Anywhere	24.55
220mF	1.6volt	Standard	Anywhere	4.35
470mF	1.6volt	Standard	Anywhere	6.35
10,000mF	80volt	Standard	Anywhere	234.65
4700mF	1.6volt	Standard	Anywhere	14.25
47mF + 47mF	500volt - 550v surge	SK-Type	PSU filter capacitor	85.95
100mF + 100mF	500volt - 550v surge	SK-Type	PSU filter capacitor	101.95
100mF	500volt - 550v surge	SK-Type	PSU filter capacitor	72.75
220mF + 220mF	350volt - 400v surge	SK-Type	PSU filter capacitor	92.65
100mF + 100mF	350volt - 400v surge	SK-Type	PSU filter capacitor	75.35
22mF	350volt	VK-Type	Decoupling or filter capacitor	18.95
220mF	1.6volt	F-Type	Low ESR version	6.75
220mF	1.6volt	Fk-Type	Ultra low ESR version, comparable to film caps	9.95
1000mF	50volt	FK-Type	As above use anywhere	43.95
2200mF	50volt	FK-Type	As above use anywhere	98.85
4.7mF	50volt	C-Type	For circuits with DC potential difference	3.35
1 mF	50volt	N-Series	Bipolar for use in negative feedback circuits etc	4.95
4.7mF	50volt	N-Series	as above	5.75
10mF	50volt	N-Series	as above	6.95
47mF	50volt	N-Series	as above	13.75
100mF	50volt	N-Series	as above	18.95
6.8mF	50volt	Bipolar	For loudspeaker crossover networks	8.95
1.0mF	50volt	Bipolar	as above	10.85
22mF	50volt	Bipolar	as above	17.45
47mF	50volt	Bipolar	as above	27.95
100mF	16volt	BG-N Type	For super low noise PSU's	24.65
470mF	16volt	BG-N Type	as above	28.95
1000mF	50volt	BG-N Type	as above	99.95
220mF	100volt	BG-N Type	as above	423.35

On the next page is a list of all BLACK GATE capacitors available, together their sizes, best usage etc. Lastly, we can supply a range of more modestly priced components, still good quality, but more industrial grade, if you like

AUD10 QUALITY OUTPUT TRANSFORMERS.

Single-ended Circuits. Suggested Valve VAT	Max Cl. A Power	Prim-Sec. Impedance	Size/Weight Max.	Current	Price ex. UK
EL84/ECL86/6V6	20 watts	2K6 - 4/8 Ohms	117x98x90 mm	110mA PSE	87.00
300B/2A3/6B4G	25 watts	2K5 - 4/8 Ohms	117x98x90mm	90mA SE	91.00
EL34/6550/KT88	30 watts	1K5 - 4/8 Ohms	115x98x95mm	180mA PSE	113.00
2A3/6B4G	30 watts	1K25 - 4/8 Ohms	98x82x95mm	130mA PSE	97.00
5881/KT66	30 watts	2K1 - 4/8 Ohms	115x98x95mm	140mA PSE	106.00
211/AT4C	30watts	10K - 4/8Ohms	117x98x100mm	150mA SE	114.00
211/AT4C/845	50 watts	10K - 4/8 Ohms	112x134x150mm	150mA SE	124.00
300B	50 watts	1K25 - 4/8 Ohms	135x115x125mm	180mA PSE	151.00
845	50watts	2K5 -4/8 Ohms	137x114x130mm	180mA PSE	172.00
211/AT4C	75 watts	5K-4/8 Ohms	137x115x145 mm	240mA PSE	237.00
New SE Product					
EL34/6550/KT88	20 watts	3K - 4/8 Ohms	117x98x92 mm	130mA SE	104.00
6L6G	30 watts	3K - 4/8 Ohms	115x98x95 mm	140mA PSE	107.00
Push-Pull Circuits					
EL84/ECL86/6V6	15 watts	8K - 4/8 Ohms	80x67x68 mm	PP	42.00
EL34/6L6G/5881	25 watts	6K - 4/8 Ohms	88x73x80 mm	PP	59.00
2A3/6B4G/300B	30 watts	5K - 4/8 Ohms	88x75x80 mm	PP	63.00
KT88/6550	50 watts	6K6 - 4/8 Ohms	108x91x90 mm	PP	73.00
EL34/KT66/5881	50 watts	3K - 4/8 Ohms	98x82x83 mm	PPP	74.00
845	50 watts	6K8 - 4/8 Ohms	108x91x90 mm	PP	114.00
Pure Silver Wired Outputs.					
300B/2A3/ 6B4G 25 watts	2K5 - 4/8 Ohms	11 7x98x90 mm	90mA	SE	1.645.00
211/AT4-C/845 50watts	10K - 4/8Ohms	112x134x150mm	150mA	SE	1.975.00

The AUD10 NOTE silver wired outputs listed here are designed and made in the UK, we can supply the AUD10 NOTE Japan manufactured outputs for the ONGAKU or the KEGON, but they are exceptionally expensive, as you would expect from items that take upwards from 100 hours each to make, for example an output transformer for an ONGAKU costs £16,500.00

AUD10 NOTE CERAMIC STAND-OFFS.

In most handwired valve power amplifiers it is frequently difficult to get the HT and heater rails properly suspended and separated, safely and neatly from the chassis, this especially applies when building amplifiers using the really high voltage directly heated triodes like 211, VT4-C, 845, 849, 304TL, DA100 etc. When planning design like this, it is important to incorporate suitable layout from the start, and the AUD10 NOTE stand-offs should be more or less mandatory in that context. They are screw-in type with steatite insulator and either a wrap-round turned "head" on the single way version or separated solder slots on the multi-way versions.

Type No.	Number of Tags	Height/Length	Solder Connection	Chassis Fixing	Price Ex. UK Vat.
AN-421	1	25.5 mm	Wrap-round	Screw-in bolt	1.41
AN-422	1	17.4 mm	Wrap-round	Screw-in bolt	1.41
AN-423	1	22.6 mm	Solder slot	Screw-in	1.41
AN-452	2	Adjustable, 17mm	Solder slots	Dual bolt screw-in	2.42
AN-453	3	Adjustable, 24mm	Solder slots	Dual bolt screw-in	3.05
AN-455	5	Adjustable, 32mm	Solder slots	Dual bolt screw-in	4.04
AN-458	8	Adjustable, 58mm	Solder slots	Dual bolt screw-in	5.79
AN-460	10	Adjustable, 72mm	Solder slots	Dual bolt screw-in	7.31
AN-476	6	25mm/45mm	Solder slots	Screw-in bolts	5.35
AN-479	9	25mm/66mm	Solder slots	Screw-in bolts	7.53

AUD10 NOTE Coax Interconnect Cables.

Type/Colour code	Construction	Price per Stereo Meter Ex. UK Vat.
AN-A yellow	symmetrical 6N copper litz coax	15.32
AN-C red	symmetrical OFHC copper litz coax	29.79
AN-S dark grey with yellow stripe	symmetrical 99.99% silver litz coax	84.25
AN-V silver grey with yellow stripe	symmetrical 99.99% silver litz coax	152.35
AN-Vx silver grey	symmetrical 99.99% silver litz coax	382.98

It is recommended to use the internal twin silver wires in the AUD10 NOTE coax cables as internal wiring cable, this is what we do in amplifiers like the ONGAKU, M7TUBE etc.

AUDIO NOTE COMPLETE KITS.

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. In order 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.

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 volts with 75mA current giving 9/10 watts of the cleanest power you will ever hear, the input stage consists of a 6SN7GT with a 6E7 double triode driver stage running in SRPP.

The powersupply is a capacitor-choke capacitor with a 5U4G HT rectifier, the heaters are AC heated.

Component quality is similar to our Level 2 finished products, AUD10 NOTE paper in oil signal capacitors, Beyschlag watt 1% metallfilm resistors, good quality electrolytics (sorry NO Black Gates!) and a simple, attractive stereo chassis in grey paintwork. Protecting cover is extra.

Price £750.00 incl. Vat, which includes all valves (yes, also the 2 x 300B needed) but not postage/packing which to UK customers is £12.00, topcover is £99.00 extra. The Kit One is available now.

Kit Two.

Kit Two features 2 x 5881 pentodes running in parallel Single-Ended mode, yielding some 20 watts of pure Class A, valve rectified HT for the output stage, stereo chassis, and 6SL7GT input and 6SH7GT SRPP driver stage componentry and chassis as Kit One.

Price £600.00 incl. Vat, includes valves, but not postage/packing, cover is extra at £99.00. Available in December 93. Write to, AUD10 NOTE (UK) Ltd, Unit 1, Block C, Hove Business Centre, Fonthill Road, Hove, East Sussex, BN3 6HA, England. Telephone +44 0273 220511, fax +44 0273 731498. Direct Line to sales +44 0273 885511

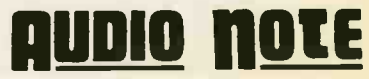
MAINS TRANSFORMERS

This range relates to our finished products, mains transformers are notoriously difficult items to offer as the number of permutations of HT and Heater voltages are almost endless. We shall be offering a more comprehensive range as opportunities arise.

Primary Voltages	Secondary HT Windings	Secondary Heater Windings	Price Ex. UK Vat.
0v/100v/110v/120v	0v-230v at 350mA	0v-12.6v at 1 Amp	34.00
0v/220v/230v/240v	3.1 5v-0v-3.1 5v at 4 Amp		
120v/1 10v/100v/0v	0v - 230v at 0.4 Amp	0v-12.6v at 1 A	41.00
0v/1 00v/11 0v/1 20v	3.1 5v - 3.1 5v at 4 Amp		
0v/1 00v/11 0v/1 20v	0v - 290v at 40mA	1.2 6v-0v at 1.5 A	26.00
0v/100v/110v/120v	0v - 6.3v at 300mA		
0v/100v/110v/120v	310v-244v-0v-244v-310v at 320mA	3.15v -0v-3.15v at 4.5 Amp	72.50
0v/100v/110v/120v	0v-920v at 160mA	12.6v at 1.5 Amp	
0v/100v/110v/120v	150v-150v at 50 mA 1.5A	0 -10v at 4 Amp, 0v-6.3v at	98.00
120v/1 10v/1 10v/0v	390v-0v-390v at 200 mA	0v - 5v at 2.5A	
0v/1 00v/11 0v/1 20v		3.15v-0v-3.15v at 1.2Amp, 7v	86.70
0v/1	20v/1 70v at 50mA at 3A	7v at 3A, 5v at 2A	

AUD10 NOTE Speaker & Wiring Cables.

Type/Colour code	Construction	Price per Mono Meter Ex. UK Vat.
AN-D green	single core 6N copper speaker wiring	6.85
AN-B blue white writing	double strand, screened 6N speaker	12.34
AN-L blue black writing	wire double strand, screened 6N litz copper	25.11
AN-SP silver	speaker wire single core 15 strand 99.99% litz	106.38
AN-SPx silver	silver speaker wire single core 20 strand 99.99% litz	382.98
PTFE Insulated Silver Plated Copper Wires		
We can also provide less expensive wiring wires for hard wiring circuits, these PTFE insulated silver plated copper wires are 19 strand of 0.15 mm wire and come in brown, black, blue, pink, red, green, orange, violet, white and red/white, they cost £1.60 per meter in any colour		





A Single-Ended Valve Amplifier

Designed by Tim de Paravicini, written by Noel Keywood.

Here's one of the simplest amplifiers you'll ever see. It's Single-Ended: just one valve, all on its own, drives the loudspeaker. It follows the wisdom of pursuing elegant simplicity to yield an amplifier that is right at heart. You can't get purer than single-ended working and it is gathering a strong following.

I'll describe what single-ended working is all about later - and why the world's two most expensive amplifiers - Ongaku (£34,000) and Yoshino (£25,000) - use it. As well as why nobody wants to use it (money comes into it here!).

Money? Don't worry about that. Tim de Paravicini, errant genius and valve designer extraordinaire, was very enthusiastic about our desire to produce a real hi-fi, single-ended amplifier at absolutely the lowest price. Since Ongaku, and Yoshino (designed by Tim), turn out around 25watts, yet take two men to lift them because of the huge transformers they need, our little baby had to be limited to low output if it was to be practicable. Small transformers are not only easy to lift - but they don't cost insane amounts of money.

So here's a 4watt stereo integrated, line-level amplifier. It's small enough to go on a shelf, it can be built by anyone who can wield a soldering iron and it should cost no

more than a few hundred pounds if built from the transformer set, which will be made available. As always, there'll be a full kit too and, provisionally, its price is set at around £350, which includes a professional welded steel chassis, with a baked-on 'powder coat' smooth black finish, proper screen-printed legends and components of

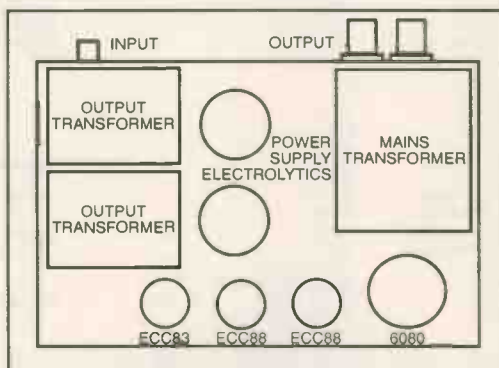
tested this month (see speaker group test in the main issue) can be used with this design, and they don't cost a king's ransom. However, our own KLS2 kit loudspeaker is considerably more sensitive and will go very loud with 4watts. It was specially designed by us for amplifiers like this, also having a flatter load impedance characteristic than is

usual, which improves amplifier matching. Another suitable loudspeaker is the Heybrook Quartet, but it is expensive in comparison to the amplifier, even if the amplifier does deserve such quality.

Old hands may well be remembering that a 4watt single-ended is the sort of thing that used to grace Dansette record players. Those amplifiers used a miniature output transformer and often a combined triode/pentode valve, like the UCL82. They were exercises in cost cutting.

This design is different. It has a full hi-fi specification and it sounds superb,

having all the easy sweetness single-ended working can provide, without any of the soft and vague sound of older designs. It easily out-performs solid state amplifiers, having the dimensionality valve amplifiers bring to the sound stage, but lacking their hardness or edginess. Just a look at the neat, but substantial, output transformers shows how much has gone into this modern design.

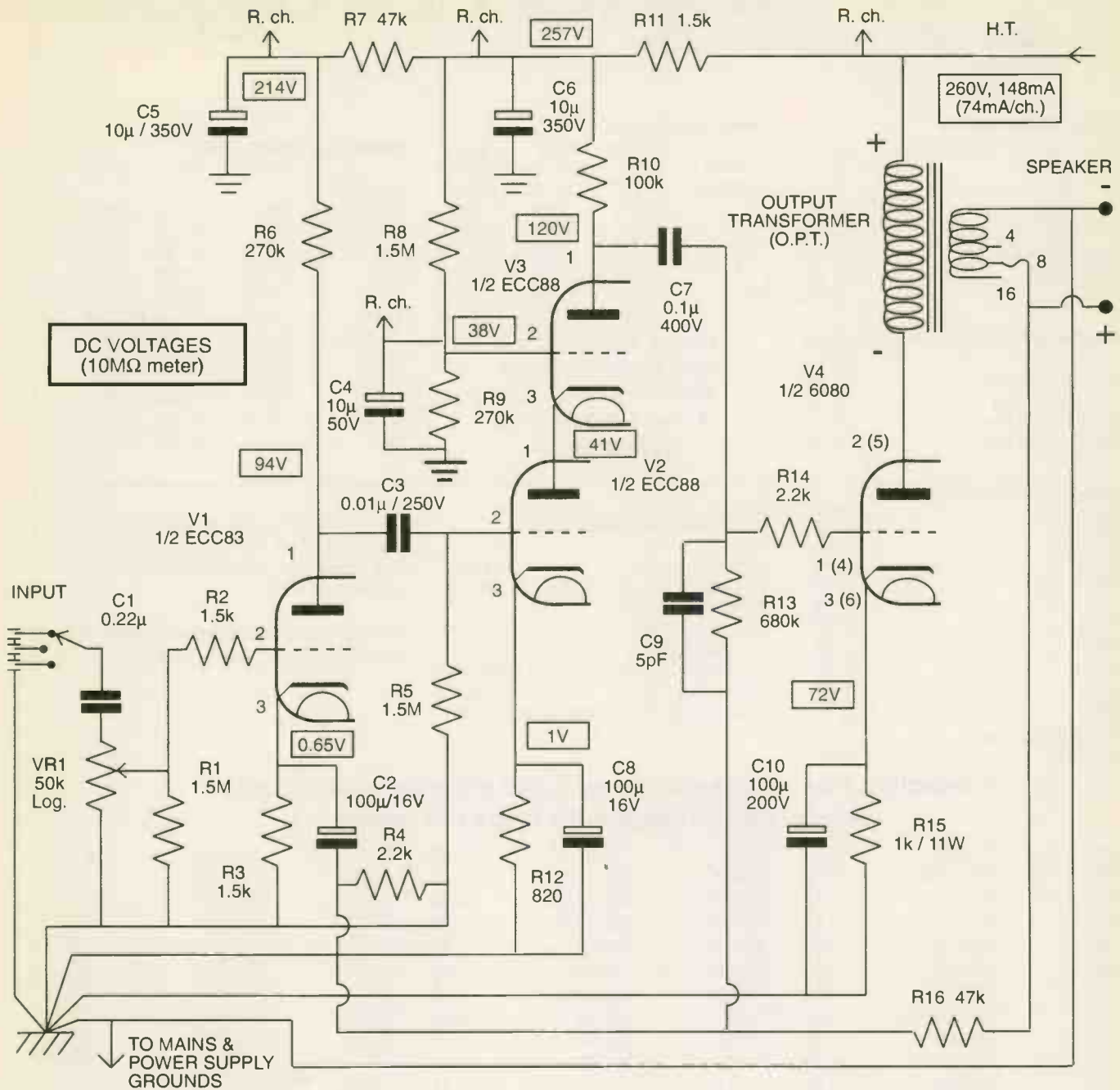


Suggested chassis layout for the home constructor.

higher quality than those found in commercial amplifiers (of course - this is real hi-fi!).

Don't poo-poo 4watts; I know it doesn't sound much, but it will give good volume in a normal room, providing sensitive speakers are used. Curiously, such speakers are beginning to appear on the market. Both Goodmans' Mezzos and Celestion's 7s

SINGLE ENDED VALVE AMPLIFIER



Theory of Operation

This amplifier is based around the 6080 double triode power valve, which is a rugged beast that'll last for years. The trick to using it in single-ended mode, Tim told us, is to swing around 200volts peak-to-peak into it to get enough drive. To do this requires high gain and a driver stage capable of swinging the necessary volts. This task is carried out by an ECC88 (V2), a low-volts, low impedance RF triode which, in this circuit is connected in a cascode arrangement to provide high gain (approx x200). In cascode, a second

ECC88 (V3) acts as a dynamic load in the anode of the basic amplifier V2.

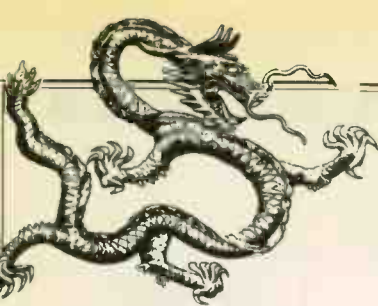
Local feedback is used to get enough bandwidth from the driver stage and to keep it linear over its wide operating range, R13 being the feedback determining resistor. The small, low value (5pF) compensation capacitor across it is only necessary if overall feedback via R16 is used too.

It is best to apply a limited amount of overall feedback to keep output impedance down, so that the varying

impedance of a typical loudspeaker does not significantly affect amplifier frequency response. Bandwidth measures 9Hz-64kHz (-1dB).

An ECC83 input triode acts to provide sufficient gain to achieve a sensitivity of around 200mV, so the amplifier can be used as a line-level integrated that will accept the output from a tuner, tape or CD direct, through a selector switch.

Because single-endeds don't hum-cancel in their output stage, they must have a very quiet power supply. Consequently, although this is an inexpensive design, the power supply still uses a smoothing choke and large smoothing and reservoir capacitors (C11,12), and the H.T. line is well smoothed too by R11/C6 and R7/C5.



Golden Dragon

Precision Audio Tubes

RETAIL PRICE LIST

Golden Dragon Pre-Amplifier Tubes	Singles
*6A08/ECC85	£6.50
12AT71/E81CC/ECC81	£6.50
12AU7A/E82CC/ECC82	£6.50
12AX7A/E83CC/ECC83	£6.50
6DJ8/E88CC/ECC88	£10.95
6SL7GT/ECC35	£7.50
6SN7GT/ECC33	£8.50

Special Quality Golden Dragon Pre-Amplifier Tubes

	Singles
*E81CC-01 Gold Pins	£9.50
E82CC-01 Gold Pins	£9.50
*E83CC-01 Gold Pins	£9.50
*E88CC-01 Gold Pins	£14.50

Golden Dragon Triodes

	Singles	Pairs	Quads
2A3 4PIN	£22.50	£47.50	£95.00
2A3 OCTA1	£22.50	£47.50	£95.00
211	£28.50	£59.00	£118.00
*300B	£69.00	£140.00	£280.00
*300C	£79.00	£160.00	£320.00
811A	£11.50	£25.00	£50.00
845	£36.50	£75.00	£150.00
805	£36.50	£75.00	£150.00

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

Golden Dragon Power Tubes

	Pairs	Quads	Octets
EL34/6CA7			
NEW DESIGN	£25.00	£50.00	£100.00
EL84/6BQ5	£8.50	£17.00	£34.00
E841/7189a	£12.50	£25.00	£50.00
KT66	£25.00	£50.00	£100.00
KT77	£39.00	£79.00	£158.00
KT88	£49.50	£99.00	£198.00
*KT88 SUPER	£59.00	£118.00	£236.00
6L6GC	£18.50	£37.00	£74.00
6550A	£39.50	£79.00	£158.00
50CA10	£75.00	£150.00	£300.00
6L6WGB	£25.00	£50.00	£100.00
807	£25.00	£50.00	£100.00

Golden Dragon Select Tubes

5AR4	£9.50
5U4G	£8.50
85A2	£6.50
ECL82	£4.50
ECL88	£4.50
EL509	£7.50
G234	£8.50
PL509	£7.50
12E1	£25.00
13E1	£125.00
310A	£60.00
572B	£45.00
5687	£8.50
6550 Special, per pair	£75.00
6072A	£7.50

Gold Plated Ceramic Valve Bases

4 PIN UX4	£3.50
4 PIN JUMBO GOLD PLATED	£25.00
7 PIN B7G CHASSIS	£3.50
8 PIN OCTAL PCB	£3.50
9 PIN B9A CHASSIS	£2.50
GOLD PLATED ECC83 SCREENING CAN & SKIRT	£8.50
GOLD PLATED ECC83 DAMPING CAN	£4.50

Carriage charge £2.50 on any order. All prices plus VAT @ 17.5%. Payment: Cash with order or Visa - Mastercard - American Express 24 Hour Answerphone Services

PM Components are the recommended valve supplier for World Audio Kits.

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

ECC81	BRIMAR	4.50	LS9B	COSSOR	6.95	6SL7GT	BRIMAR	4.50
ECH81	MULLARD	3.50	M8136	MULLARD	8.50	6SN7GT	BRIMAR	4.50
EC82	GE	4.50	M8162	MULLARD	8.50	6SN7GT	TEONEX	3.50
ECC82	RFT	4.50	M8137	MULLARD	15.00	6SQ7GT	TONEX	4.50
ECL82	TEONEX	3.50	MHLD6	MAZDA	5.50	6V6G	RCA	5.50
ECC83	TEONEX	3.50	OA2WA	TEONEX	3.50	6V6GT	TEONEX	4.50
ECC85	TEONEX	3.50	PCC88	SIEMENS	3.50	6X4	TEONEX	2.50
ECL86	TEONEX	3.50	PL36	MAZDA	3.50	6550A	TEONEX	12.50
ECC88	BRIMAR	4.50	PL504	MAZDA	2.50	12AT6	BRIMAR	2.50
ECC88	GE	5.50	PL509	MAZDA	5.50	12AV6	RCA	2.50
ECC88	TEONEX	4.50	PL519	THORN	5.95	12BA6	WESTINGHOUSE	3.50
EF86	TEONEX	4.50	PY32	MULLARD	2.50	12J5GT	RCA	3.95
EF804S	TELEFUNKEN	25.00	TT100	GEC	65.00	12E1	RCA	3.95
EL32	MULLARD	4.50	U19	GEC	8.50	12E1	STC	15.00
EL85	MULLARD	4.50	UCC85	MULLARD	3.50	13E1	STC	140.00
EL86	MULLARD	4.50	UU5	MAZDA	5.50	13D3	BRIMAR	6.50
EL504	TEONEX	3.50	UU6	MAZDA	6.50	85A2	MULLARD	6.50
EL509	TEONEX	5.50	2X2A	RCA	5.00	1625	RCA	6.50
EL519	TEONEX	5.50	3A/167M	ITT	10.00	5687WA	RCA	6.50
EM84	TEONEX	3.50	5Y3WGT	SYLVANIA	4.50	5751	RCA	6.50
GZ32	MULLARD	8.50	5V4G	BRIMAR	3.50	5814A	GE	5.50
GZ33	MULLARD	5.50	6AG7	RCA	3.50	5881	USSR	4.95
GZ34	MULLARD	12.50	6A7G	RCA	8.50	6146B	TEONEX	8.50
GZ37	MULLARD	4.50	6BH6	BRIMAR	3.50	6158	BRIMAR	6.50
GZ34	TEONEX	5.50	6C8G	RCA	3.50	6189	SYLVANIA	6.50
KT66	TEONEX	6.00	6DQ6B	PHILIPS	3.50	6201	GE	6.50
KT66	GE	16.50	6K7G	RCA	3.50	6463	UNITED	7.50
						6870	BRIMAR	11.50

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SINGLE ENDED VALVE AMPLIFIER

CIRCUIT DETAILS

With a high sensitivity of 200mV, the amplifier will directly accept outputs from CD (2V), tuner (300mV up), tape (300mV up), disc preamp stages and other modem sources. After the input selector switch, C1 blocks any d.c., preventing its appearance on the grid of V1, which would upset the biasing. VR1 should be a high quality (we recommend Alps) 50k logarithmic-law potentiometer, which then gives a high and constant-with-volume-position input impedance of 50k. This is high enough not to load or affect sources.

Resistor R1 is a safety tie-down (grid leak) in case VR1 should ever go O.C. (open circuit) with age, and R2 is a stopper resistor to prevent parasitic oscillations.

Roughly 0.5mA is drawn by V1, biasing the cathode (pin 3) 0.65V positive, effectively making the input grid, which is tied down to earth by R2/R1, equivalently negative, as it needs to be. A feedback voltage is applied across R4 and is 'seen' through C2.

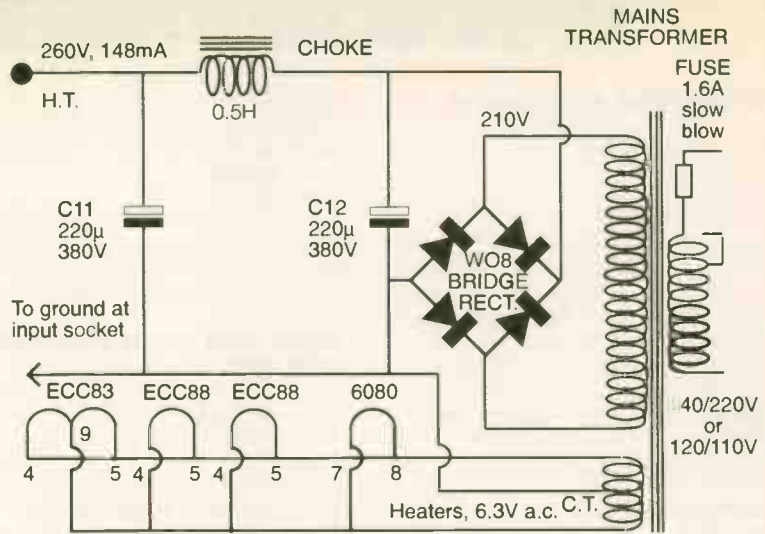
The first stage gives approximately x50 gain, developing its output across anode resistor R6. This signal is applied to the input grid of V2 through d.c. blocking (and coupling) capacitor C3. The grid is tied to ground with respect to d.c. by grid leak R5. A current of 1mA drawn by the valve produces +1V of bias across cathode resistor R12, effectively making the input grid negative by this amount, which is the operating condition for the valve. Decoupling capacitor C8 bypasses the a.c. signal current to earth to prevent degenerative negative feedback and loss of gain.

V3 acts as an anode load for V2 in what is known as a cascode arrangement. This gives high gain, acting much like a pentode, but with lower noise. The grid of anode load V3 is held at a constant d.c. potential by R8/9, with C4 providing decoupling.

The signal voltage of the second stage is developed across R10 and applied to the input grid of the output valve (V4) through d.c. blocking/coupling capacitor C7. The resistor R14 is a grid stopper, to prevent parasitic oscillations. A negative feedback signal can be taken from this point, being applied by R13, which is used to set feedback level. This also acts as a grid leak in conjunction with R4. Capacitor C9 provides a small amount of phase compensation, needed only to correct for the affect of using overall feedback from the output transformer as well.

Cathode resistor R15 acts to self-bias the 6080 output valve, raising the cathode to 72V; current through the valve is 72mA. Capacitor C10 decouples R15; the transformer primary acts as anode load. Power dissipation of R15 is 5W but a 10W rated unit is recommended for longevity.

Single-ended amps must have a hum free voltage supply, so full wave rectification is used, plus a section L/C smoothing filter comprising a 0.5H choke, C11,12. The choke must be rated at 150mA minimum. Additional smoothing is provided by R/C filters R11/C6 and R7/C5, which feed the earlier stages. The 6080 output valve draws a large 2.5A of heater current.



Sound Quality

This amplifier sounds smooth and rich, almost creamy-textured, without being warm and cloying. It demonstrates all the musicality of a good valve amplifier, without going too far.

There was a slight lack of speed due to its low power rating, which was more than compensated for by its detail and staging ability, which brought the musicians out into the room. No matter how reticent and boxy the 'speakers normally are, this amplifier levered the stage out of the boxes to give a solid, three-dimensional performance, literally brim-full of the tiniest details.

Bass was a little light, but is one area of the performance which depends heavily on the 'speakers used, since this amp made the differences between 'speakers quite distinct.

The midband was very good, clean and open all the way up, without displaying a preference for any particular instrument or kind of music.

The treble continued the smooth and easy performance. All in all, it seemed superbly smooth and unaggressive, and suited to any kind of music. Careful loudspeaker matching is necessary to make the most of it, as it really does show up the differences between models. Oh, don't be put off by the power rating. You'd be surprised at how loud four watts can sound with a good, sensitive loudspeaker! **Simon Cooke**

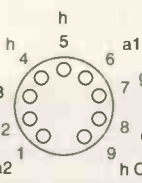
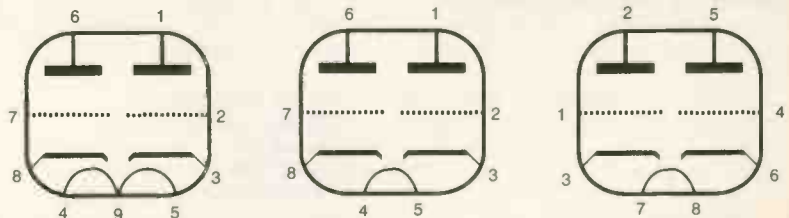
MEASURED PERFORMANCE

Power output measures 4W per channel. A feature of single-ended working is a progressive increase in distortion towards full output, but conversely a progressive decrease with reducing level. At 4W distortion measured 3%, at 1W 1.2%. However, this was mostly innocuous sounding second harmonic; third harmonic, which is more audible and has a sharpening effect, measured less than 0.1% at 1W.

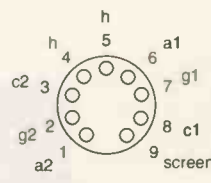
This balance of harmonics is important in understanding why valve amplifiers that, superficially, don't measure well, in fact can and do perform well. This amplifier is, at ordinary music levels, very linear. Music peaks will have some second harmonic content, but it will not be discernible. The advantages of great circuit simplicity are, however, real.

Otherwise, the amplifier is quiet, hum free (less than 1mV on the output), very sensitive and of wide bandwidth.

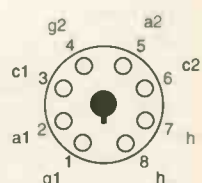
Power	4W
Frequency response	9Hz-64kHz
Distortion (1kHz/1W)	1.3%
(10kHz/1W)	1.4%
Separation	74dB
Sensitivity	180mV
Noise (hiss)	-100dB
(hum)	0.7mV



ECC83 high gain Double Triode (B9A base)



ECC88 R.F. Double Triode (B9A base)



6080 Double Power Triode (International Octal base)

Views are from underneath valve or valve holder
h = heater c = cathode a = anode g = grid NC = no connection CT = centre tap

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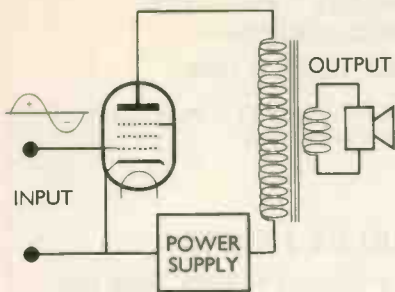
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SINGLE-ENDED

Single ended working is the simple way of doing things, so the first amplifiers used it. One valve controls the flow of current from the power supply through the output transformer, modulating it in response to the input signal applied to the grid such that the output is a replica of the input, but stronger. Single-ended working, by its nature, is pure Class A. Half the total required signal current passes through the transformer even when there's no signal to be amplified (i.e. under quiescent conditions).

It is this standing or quiescent current that is a problem. It magnetises the transformer core, taking it up closer to saturation (magnetic overload), reducing the strength of signal that can be accommodated. That's why to get a strong signal through a single-ended valve amplifier demands a massive output transformer if core saturation and distortion are to be avoided.

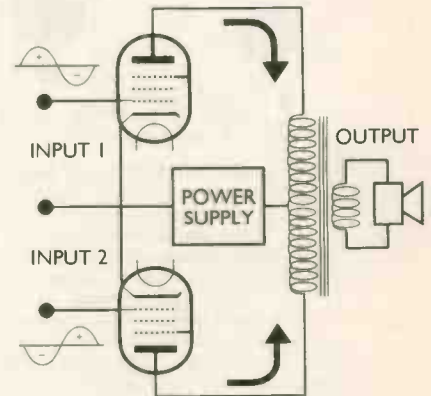
Push-pull - like negative feedback - appeared to be an almost magic problem-solving idea. It offered a solution to these difficulties. It demanded the use of two

Single Ended V Push Pull

valves, and a phase splitter to drive them, but in spite of this extra complexity, the benefits were - and still are - enormous. Firstly, by passing the d.c. supply current two different ways through the tapped transformer primary, the resultant field cancels and the problem of d.c. magnetisation is largely eliminated. When Class B or A/B working is used the power dissipation through each valve is lowered, increasing

efficiency and maximum power output. So high power push-pull amplifiers need smaller output transformers than single-endeds and they can easily deliver much more power.

Why go back to single-ended? They possess the benefit of great simplicity, as well as high inherent linearity at low levels, both important factors in hi-fidelity. I personally suspect that phase-splitters are responsible for a small degree of signal cancelling too, since good single-ended amps have much more low level detail and atmosphere in their sound than push-pulls.



PUSH-PULL

What once would have been beyond consideration in cost terms is now - if not cheap - at least affordable. Properly specified output transformers can be used - as they must be if building a single-ended amplifier is to be worthwhile.

Tim de Paravicini designed Yoshino to demonstrate what single-ended working had to offer when uncompromised. It's true to say that anyone who heard this amplifier, or Ongaku, came away stunned. But whilst we've all got more disposable income, not so many of us have that much! Tim was more than happy to design this amplifier, so anyone could get their hands on a good, modern single-ended amplifier.

Parts List

RESISTORS (all 0.25W, except R15))

R1	1.5M
R2	1.5k
R3	1.5k
R4	2.2k
R5	1.5M
R6	270k
R7	47k
R8	1.5M
R9	270k
R10	100k
R11	1.5k
R12	820
R13	680k
R14	2.2k
R15	1k/10W
R16	47k
VR1	50k log. Alps volume control

CAPACITORS

C1	0.22/100V
C2	100µ/16V elect.
C3	0.01µ/250V
C4	10µ/50V elect.

C5,6	10µ/350V elect.
C7	0.1/400V
C8	10µ/16V elect.
C9	5pF
C10	100µ/200V elect.
C11,12	220µ/380V elect.
RECTIFIER	WO8 bridge

VALVES

- 1 x ECC83 input double triode (B9A base)
- 2 x ECC88 gain/driver double triode (B9A base)
- 1 x 6080 output power double triode (I.O. base)

TRANSFORMERS

Mains: 210V a.c., 150mA continuous + 6.3V, 3.5A
 Choke: 0.5H, 150mA
 Output: 4/8/16 secondary. Multi-section
 NOTE: Output transformer is custom designed by Tim de Paravicini to give performance quoted. These are available from Hi-Fi World - see World Audio Design pages.

SAFETY WARNING

Lethal voltages exist in this amplifier. We do not suggest you attempt to build it unless you are conversant with valve circuits and safety precautions.

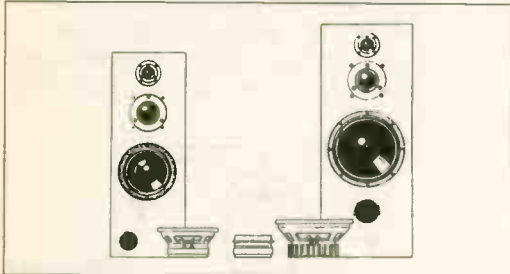
You should possess a voltmeter capable of reading up to 1000volts. The final unit should be fitted with a protective underplate to protect against accidental shock and a wire mesh top cover, since valves run very hot and can burn.

An approved BUILT version is available for those without electronic knowledge or experience.

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HEWLETT PACKARD	1707B	35MHZ 2CHANNEL	£300	HEWLETT PACKARD	3400A	RMS VOLTMETER	£150
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RIAA Head-Amp

... for our line level preamplifier. In Part 1 of this two part article Dominic Baker describes the theory behind the RIAA curve and our choice of input device.

Demand for a phono input on our pre-amplifier has forced us to design one sooner rather than later. Knowing we are - er - shall we say 'keen' on valves, you may be surprised to see an apparent heresy being committed in this project: there isn't a valve in sight (at least until part 2). We've used a silicon chip.

Electric shock therapy hasn't yet turned our brains into quivering jellies, making us as happy with a TL072 (that's a swear word) as an EF86. Silicon chips are only bad news for audio because the industry insists on using the very cheapest capable of an acceptable measured performance, to wit: TL072 & NE5534. Slaves to simple audio theory love these things, as do those who equate penny pinching with making a profit. Opening up £600 amplifiers to find them populated with 50p chips makes us groan.

So why did we go and use a chip? Because there's no underlying reason for their apparent sonic mediocrity and, indeed, making the perfect audio chip seems to be something of a challenge for the major chip manufacturers; they do try hard to offer something special, but their efforts seem largely ignored because for many manufacturers price takes precedence over sound quality. Numerous well specified audio chips are available, but all of them cost

much more than an NE5534 or TL072. We chose to use the Analogue Devices AD797, because it has a good reputation, but it costs £7.40. That's roughly seven times more than the norm.

Of course, after manufacturer and dealer margins have been added, the £1 chip accounts for around £2.25 of the retail price, whilst our choice represents

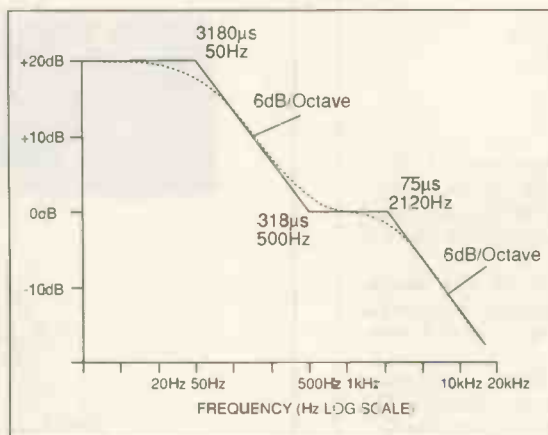
the big difference. So there's evidence to show that a good audio chip is more than acceptable for hi-fi and that all chips cannot be condemned equally.

There's one last but not inconsequential reason for using a chip: lack of noise. The quietest valves are very quiet but sadly, modern low noise chips can be quieter. For a moving coil stage they are essential; for a moving magnet stage they are still appreciably quieter than a valve.

WHY EQUALISATION

The difference between any line level source and a record deck is that the latter does not have a flat frequency response. This is not a fault. LPs are equalised before being cut. On playback they need to be corrected, to sound right, and this is done by what is known as 'RIAA correction' in the disc stage.

Equalisation is in effect an engineered frequency response, designed to overcome innate difficulties met when cutting grooves with a 'constant velocity' cutter. The record is given treble boost and bass cut. The bass is cut on the record because if it was recorded at full level, the grooves would be so large that playing time would be reduced and cartridges would struggle to track. The treble is boosted to increase the signal to noise ratio. At high frequencies the grooves in the record would be



The RIAA equalisation curve.

£16. That's how the bean counters see it, but to the DIYer, this sort of cost inflation is avoided.

The two best sounding disc preamplifiers we know are the Michell Iso and the Deltec (now DPA) disc preamp - and both use silicon chips. However, both also use specialised, high quality chips - not standard industry fodder. And that is

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(Alvin Gold, Hi-Fi News, March 1992)

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so small that the signal would be affected greatly by dust, scratches and surface roughness, or noise. Boosting the treble decreases these effects by increasing the size of the grooves, improving the signal to noise ratio and reducing noise. In addition, this means that the size of the grooves stays within sensible limits, rather than ranging from very large to very small. This allows cartridges, arms and record decks to be optimised more closely.

The disc preamplifier must correct the equalised characteristic of an LP, by cutting treble and boosting bass by precisely the same, but inverse amount to the boosts applied during recording. It must

amplify the weak signal provided by a pickup cartridge, so both equalisation and gain are needed. This is the special role of the phono stage and why it is so different from any other input.

STAGES

Only a record cut with an equalised (flat) frequency response, and some cartridges that read them have a very low signal output. In the case of a low output Moving Coil cartridge, output is around 17,000 times less signal than a CD player. We have chosen to apply gain in two stages for this design. A very special, ultra low noise, ultra low distortion op-amp is used for the first gain stage and the RIAA correction curve equalisation. This is the first part of the design, the second gain stage and the power supply will be in Part II.

At the stage of writing this I have built a solid state second gain stage and am about to do a valve alternative so that we can listen to the difference and see which is best. A solid state op-amp was chosen for the front end because it has low noise and distortion. Additionally, I have never been impressed by the sound of valves used as gain stages in pre-amplifiers, they seem to have a closed in sound, rather than the openness found in the better solid state phono amps, but perhaps this was more a reflection of the way they were designed than of valves themselves.

THE CIRCUIT

The RIAA equalisation and the first gain stage are both handled by one device. This is a super high quality precision 'op-amp' (operational amplifier) made by Analogue Devices. The AD797 is available in two grades, A and B, and three different package varieties. The easily available version, the AD797AN, comes in the standard 8-pin dip (dual in-line

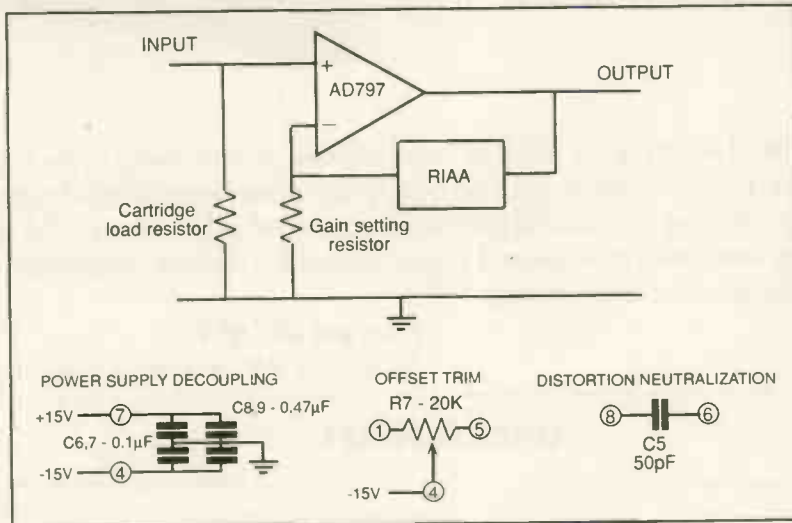
package) package (I hope this means something to some of the keener enthusiasts) and is the lower grade of the two.

For lowest noise, shortest signal paths,

have both 10Ω and 100Ω loads to match low and high output moving coils respectively. Resistors in the feedback loop give the necessary time constants, as specified by RIAA, and harmonised in all national

standards. Note that the equalisation curve was derived by the Recording Industry Association of America and all other standards merely echo it. The curves are defined by R/C time constants: 3180μs gives the bass characteristic, 318μs the midband characteristic and 75μs the treble characteristic.

The gain of the circuit is set to give enough input signal headroom to avoid overload when the circuit is driven to deliver its full output of around 10V-



and highest quality, we have chosen to use the surface mount AD797BR version. Surface mount components are miniature; resistors and capacitors are a few millimetres long, have no component leads and are soldered directly to copper cladding of a circuit board. The short component

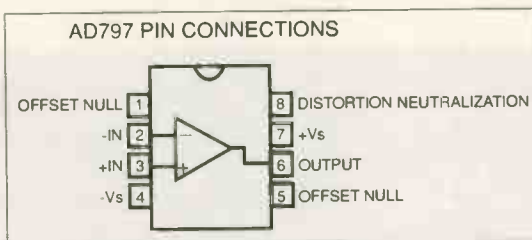
12V rms. The required input overload headroom value for moving magnet is 50mV minimum at 1kHz, 80-100mV being common enough in commercial amplifiers.

USING THE AD797

The AD797 is a very high quality device with noise figures considerably lower than most normal precision audio devices. It requires special care to get the best results. The power supply must be bypassed by two small capacitors that must be mounted within 5mm of the chip. Surface mount is ideal for this as the 0.1μF and 0.47μF bypass capacitors on each supply line can be jammed right up against the AD797.

For lowest noise the feedback components have to be made as low as possible, but consideration to load drive and power consumption must also be given. As gain is increased distortion at high frequencies increases with most op-amps. The AD797 however, provides an effective method of cancelling this distortion. For the circuit and values we are using, this is simply done by connecting a 50pF capacitor between pin 8 and the output.

Part II follows next month with the full circuit diagram and details of a kit of parts available from Hi-Fi World



leads on normal resistors etc. act like little aerials standing up on the circuit board, receiving RF noise. For lowest noise they should be avoided - a benefit of surface (SMD or Surface Mount Device) mount.

The signal from the cartridge must first be correctly loaded. For Moving Magnet (MM) cartridges, the correct load is around 220pF total capacitance, including around 100pF for arm signal leads, in parallel with a 47kΩ resistor. For Moving Coil (MC) capacitance isn't needed and resistance of around 100Ω is favoured by many manufacturers, but it is useful to

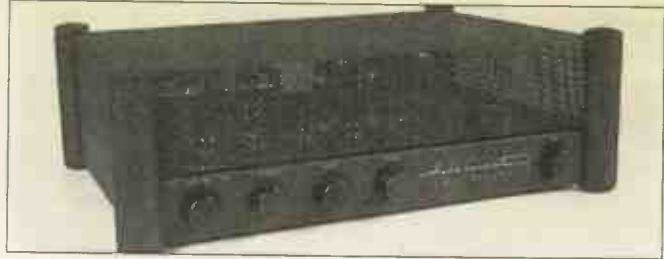
Low Noise Op-Amps

Device	Manufacturer	eN (equivalent input noise)	Type	Price
AD797AN	Analog Devices	0.9nV/√Hz	Single	£7.41
OPA620KP	Burr-Brown	2.5nV/√Hz	Single	£10.23
NE5534	Various	3.5nV/√Hz	Single	£1.04
LM833N	Motorola	4.5nV/√Hz	Dual	£1.30
MC33078	Motorola	4.5nV/√Hz	Dual	£1.50
OPA2111KP	Burr-Brown	6nV/√Hz	Dual	£10.75
OP275GP	Analog Devices	6.5nV/√Hz	Dual	£2.10
TL071	Texas	18nV/√Hz	Single	£0.51

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Book Review

by Noel Keywood

MAPLIN CATALOGUE

Don't laugh, but this is a review of a catalogue. Some people read them in preference to *Wind in the Willows*, *War and Peace*, or *Riders*. Dominic takes the RS catalogue to bed, and is currently ploughing his way through Part 3, fetchingly entitled 'Mechanical'!

I've been 'reading' the 1994 Maplin Colour Guide to Electronic components, a break-your-foot tome that runs to 800 pages. It warrants special coverage by us for its vast range of components and special, difficult to obtain items. It is priced at £2.95, an amount that would hardly cover its production cost. All the same, sensitive to the view that catalogues should be 'free', Maplin include discount vouchers inside.

This catalogue runs from specialist period-style radios through home security systems to radio controlled gadgets and similar paraphernalia, on to huge ranges of specialist components. It is the latter that interest us. Here's a look at some of the rarer, but incredibly useful, DIY parts.

They have a wide range of steel and aluminium cases, including modular assembly types, for chassis and amplifier cases. There are extension spindles and, something I've not seen since my radio building youth, epicyclic ball drives, etc. There are lots of nuts, bolts, spacers and thingumyjigs that you cannot find in the most jumbled of hardware stores, all for electronics.

There's a wide range of test equipment, multimeters from £8 up, including ones that'll read capacitance, inductance and frequency, topped out by expensive Flukes and Avos. We even noticed a simple audio spectrum analyser (acoustic) and a pink noise generator.

The semiconductor section is huge and has plenty of specialised audio items, from the ubiquitous 5534, through to super-quiet specialised preamp chips like the SSM2016/7. There are inductors of all sorts, but curiously not separate loudspeaker crossover components. However, Maplin have a large range of drive units, including Audax glass fibre and Kevlar cones, plus wadding and other useful materials. There's even a modest range of valves and bases, unobtainable in other catalogues. And there's a valve amplifier, but it's expensive.

But this isn't important. Maplin's stocking policy doesn't concentrate only on popular items; it's a cornucopia of the popular, mixed in with the rare and the unobtainable. I'd rate this catalogue very highly as one of the best publications of its kind. Maplin's huge stocks and low prices are pretty impressive. This catalogue throws the doors of DIY wide open.

Available from WH Smith and other main Newsagents.

AUDIO AND HI-FI HANDBOOK

At heart, I like giant reference works like the Audio & Hi-Fi Handbook, but they are difficult to compile and poor ones seem to disappoint in direct proportion to their size; I suppose big flops are just more obvious than small ones.

The Audio & Hi-Fi Handbook (£40) starts off well - and badly - and that's how it goes on. Dedicated to Langford-Smith, author of the *Radio Designer's Handbook*, its editor obviously has an eye on this, the best example of the breed. However, he then personally states in the introduction that "the most remarkable contribution of the Compact Disc was to show how much the record deck and pickup had contributed to the degradation of music". This is a remarkably contentious observation, and it's not the only one. *Radio Designers Handbook* assiduously sticks to its subject matter and avoids personal political comment of this sort.

However, gaffs, axe-grinding and ill considered opinion apart, the Audio Handbook does have much to offer. For example, it has a knowledgeably written section on tape recording, a subject which, surprisingly, is little understood in Britain. There's a good chapter on the subject here, even if its author, John Linsley Hood,

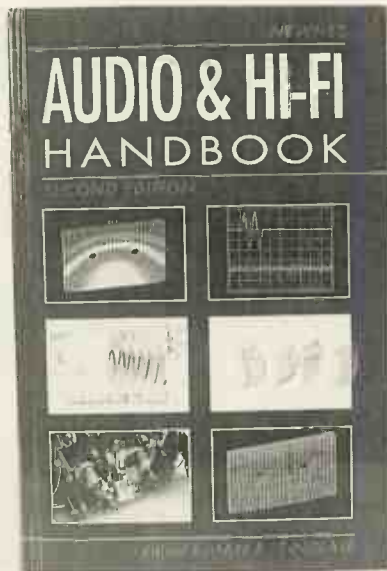
Hood's contributions always contain irritating criticism about anyone harbouring different views to his own, set in a rigidly conservative engineering mould, he does nevertheless come up with some good, solid factual material and, at times, even some glimmering realisation that we might not know everything there is to know about human cognition and the way it interfaces with electromechanical transmission systems.

Let's go on to loudspeakers. Stan Kelly wrote this one and it's very good as far as it goes. Do it Yourselfers are not really addressed here, nor are modern enclosures discussed individually, as reviewer Martin Colloms is prepared to do, for example. There are basic theoretical explanations of how closed and ported enclosures are modelled, using a familiar enough approach, a limited coverage of crossover design, basic transmission line and horn theory.

I was happy to see a chapter on Interconnections, if a little bemused to see it written by Allen Mornington-West of Quad, for Quad have always strenuously denied that cables affect the sound. Now the party line is that it can all be explained by conventional measurement: still no acknowledgement of our limited understanding of the human cognitive process, its sensitivity, its variability and our inability to come up with any certain rules for correlation between the engineering domain and human cognition. This incomprehension is summarised by the statement that "The audible performance of the cable can be calculated and verified by measurement" - calculation and measurement can do nothing of the sort. All the same, as an engineer, I found this chapter comprehensive and interesting in its discussion, even if ultimately it was unable to throw light on, for example, the disconcerting difference in sound between copper cable and solid silver cable, past the fact that silver has lower resistivity - something we all know in any case.

The final chapter on "The Future" was, for me, unbearably opinionated and of dubious value. The constant axe grinding of the editor and many of his authors stains this book. Perhaps as an insider, I'm more aware of this than most potential readers though. Standing back, I'd say there's enough in the Audio & Hi-Fi Handbook to make it useful and consequently a worthy addition to the bookshelf, I'd buy it for Linsley Hood's contributions alone. But I'd would like to see something closer to the stature of *Radio Designers Handbook*, which this is not.

Available from technical bookshops or by mail order from Butterworth-Heinemann, contact Sam Hill on, Tel: 0865 314556.



unfortunately claims that equalisation is "the subject of much misunderstanding" and, two pages on, prints a graph with 120µS and 70µS record characteristics wrongly identified. Whose misunderstanding? In general, the book could do with a little less carping and a little more diligence directed towards the subject matter in hand.

Variability makes itself known in a disappointingly light chapter on Disc Reproduction. However, this is balanced by Linsley Hood's comprehensive coverage not only of Tape Recording, but also of transistor amplifier circuitry, a speciality of his. Whilst

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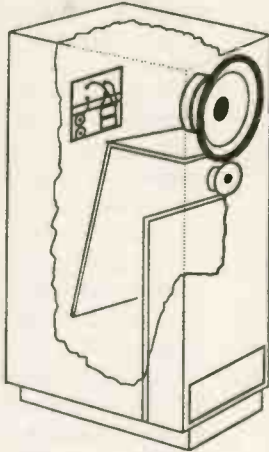
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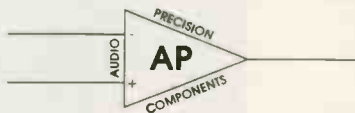
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Tweeters Group Test

Dominic Baker takes the bird seed.

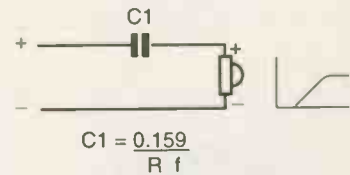
Bad tweeters give sharp, almost painful treble; good ones give a delightfully smooth and sweet sound. Choosing the right one for your speaker project is important, but the curves manufacturers publish understandably don't convey nasties in big, bold fashion.

Our group review uses high resolution tests to sort the peaky from the perky. The tweeters are all available from either Wilmslow Audio or The Speaker Co. Prices range from £12 to £44, but money spent doesn't always relate to the quality of the drive unit. On the whole it is best to choose a tweeter with a similar character to that of the bass/mid or midrange unit you are using, as this draws less attention to the change-over between the two units and gives a smoother transition. Fabric domes generally give the smoothest sound; metal domes a bright one; plastic domes lie in-between.

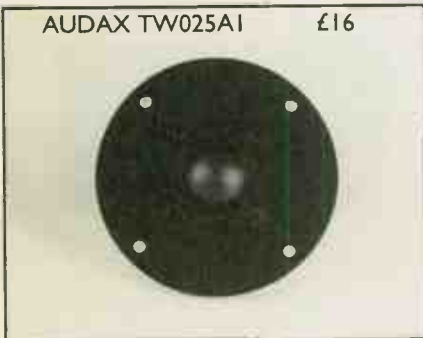
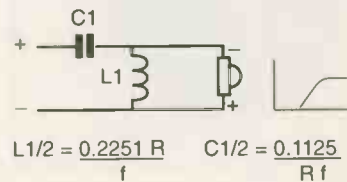
I experimented with simple, first order (series capacitor) filters at first to find which were the easiest tweeters to use. Six of the twelve gave satisfactory results with this simple arrangement (see lower traces), making them very easy to use, but the others needed higher order filters. In practice, a 2nd order high pass filter is steep enough (12dB/octave) for most tweeters.

Higher order filters require more components and so are more complex. Where a 2nd order filter is required, pick the crossover frequency, -3dB point, and find the value for R, which varies with frequency, from the impedance plot. I have done this for the most obvious and sensible crossover points of each driver. The equations for both first and second order filters are given below.

1st Order high pass filter



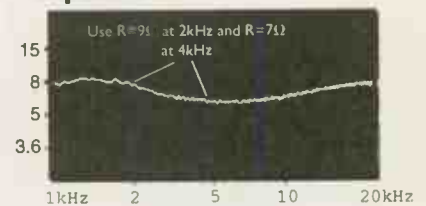
2nd Order high pass filter



Frequency Response



Impedance



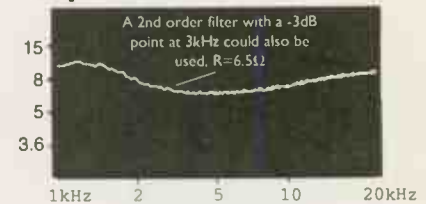
The Audax TW025A1 is a 25mm textile dome tweeter with a sensitivity of 90.5dB. A few dBs are lost with the addition of a crossover, so this tweeter should be matched with drivers of around 88dB.



Frequency Response



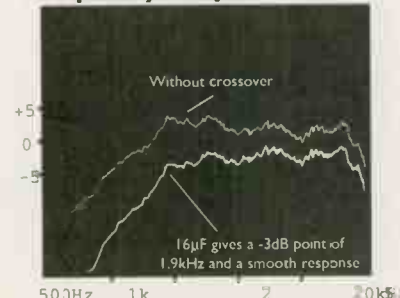
Impedance



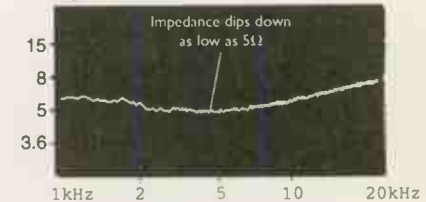
The TW025M1 is a nice looking fabric dome unit with a sensitivity of 92dB. If the first order filter is used match with drivers having a sensitivity of 90dB, if 2nd order is preferred, 88dB.



Frequency Response



Impedance



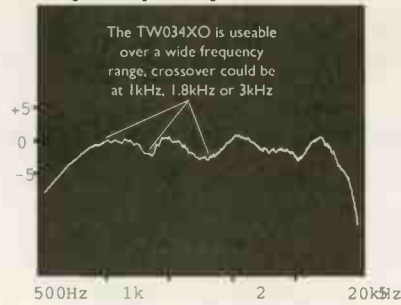
This shielded aluminium alloy dome is suitable for A/V applications. It has a sensitivity of 92dB making it suitable for matching with drivers of up to 90dB with a first order filter.

TWEETERS TEST

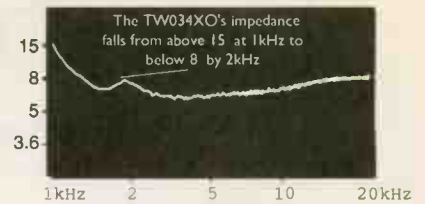
AUDAX TW034XO £26



Frequency Response



Impedance

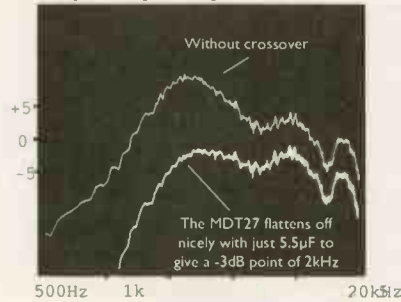


This large, 34mm, soft dome tweeter has a wide useable response. High sensitivity, 93dB, is also a plus point making it suitable for use with drivers of up to 91dB.

MOREL MDT27 £21



Frequency Response



Impedance

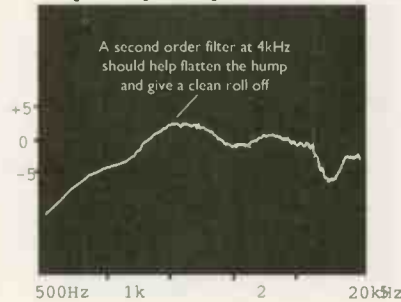


This fabric dome tweeter is horn loaded for greater efficiency. Sensitivity is 94dB, so with a simple first order filter it will be suitable for matching to drivers of up to 92dB.

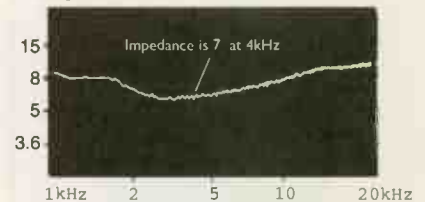
MOREL MDT30 £25



Frequency Response



Impedance

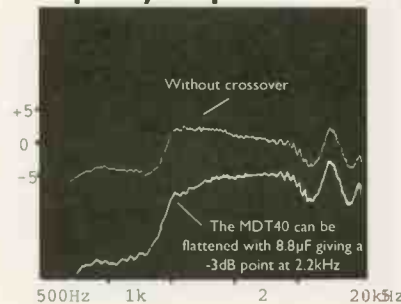


A treated soft dome tweeter with a smooth response and reasonable sensitivity, 90dB. When used with a second order filter match with drivers of up to 87dB.

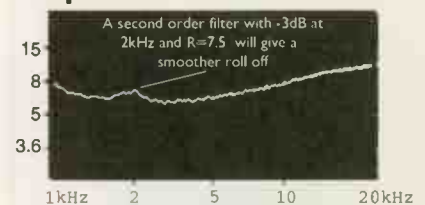
MOREL MDT40 £28



Frequency Response



Impedance

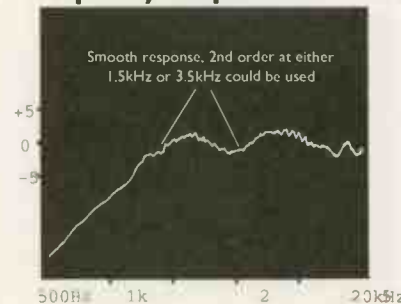


The MDT40 is ideal for small satellite 'speakers, it is lightweight and small. For best results use a second order filter and match with drive units of no more than 87dB.

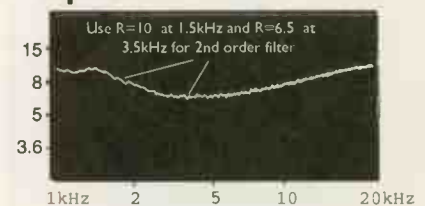
SCANSPEAK D2010B £33



Frequency Response



Impedance



This is a lovely unit and can sound very sweet. Its sensitivity of 90dB will drop to around 87dB with a second order filter making it suitable for all but the most sensitive mid range units.

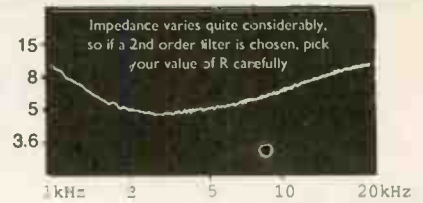
SCANSPEAK D2905 £44



Frequency Response



Impedance

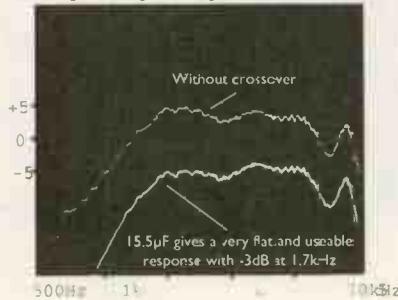


The new Scanspeak D2905 is a beautifully made unit. Sensitivity is 90dB, but match with driver of around 88dB due to loss in the crossover.

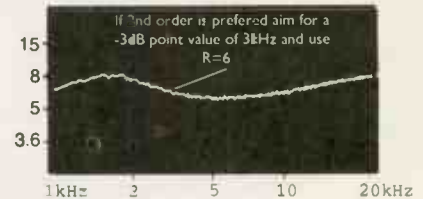
SEAS H398 £20



Frequency Response



Impedance

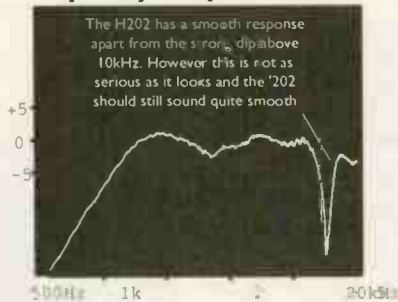


The H398 is a good metal dome tweeter with a smooth response and sensitivity of 90dB. With a first order filter match with drivers of up to 88dB.

SEAS H202 £12



Frequency Response



Impedance

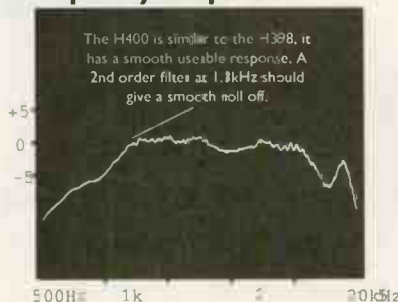


The H202 is popular amongst many manufacturers due to its low price and smooth response. Sensitivity is 90dB so with a second order filter it will suit drivers of up to 87dB.

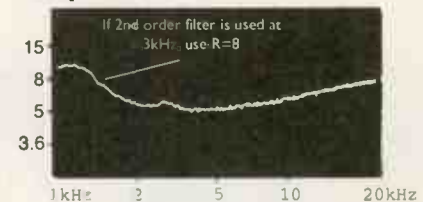
SEAS H400 £24



Frequency Response



Impedance



The H400 has a higher sensitivity, 91dB, than the H398, but needs a second order filter for best results. So again match with drivers of up to 88dB.

Conclusion

The easiest tweeters to use are tamed by a simple series capacitor. Of these, the Audax TW025M1, Scanspeak D2905 and SEAS H398 give the smoothest and most useable responses. The Audax and SEAS are very similar in price and performance, both having a -3dB point around 2kHz, but the H398 is a metal dome with 2dB less sensitivity. If you like metal domes the H398 is one of the smoothest and a bargain at £20. The Audax is a sensitive soft dome so

should sound smooth and detailed and being £3 cheaper than the H398 also makes it excellent value for money.

If high sensitivity is not needed, and you are designing a very high quality loud-speaker, the new Scanspeak D2905 is excellent. It is beautifully made and can be flattened easily with 14µF of capacitance. Its smaller brother the D2010B also has a smooth response, but a second order filter works best with this one.

The Morels are a bit of a mixed bag. At £21 the MDT27 offers good value for its high sensitivity and ease of use. The

MDT30 and '40 both need second order filters, more difficult to calculate, to obtain the best from them, the '30 being the best bet.

The SEAS H202 is a popular tweeter, and at £12 with a smooth response it isn't hard to understand why. The sharp notch above 10kHz will not be that noticeable, so it's well worth using in high quality systems with limited budget.

Last, but not least, the impressive Audax TW034XO. This is a huge tweeter with a wide response and high sensitivity. At £26 it's a steal and can sound very good.

WORLD DESIGNS

by Mail Order

K5881 KIT

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Here's a superb, Class A, 20watt stereo power amplifier that uses the inexpensive Russian 5881 output valve, a military version of the obsolete American 6L6, intended for low distortion audio work. It has super-quality output transformers (4/8/16 selected internally) to minimise distortion and the input stage uses triode working. A rugged, sixteen-gauge, all-

welded steel chassis is provided, together with protective bottom plate for safety; a protective top cover is an optional extra.

Designed for long life, low running costs and excellent sound quality, K5881 is sensitive enough to be used with a simple passive pre-amp. or our own line-drive pre-amp, and it matches modern loudspeakers well. There is a choke-regulated power supply, plus heavy 4mm 'speaker terminals that accept bi-wiring.

K5881 costs just £395 as a kit of parts, £495 for an easy-build version with made-up tag board and wired mains supply, and £595 fully built from an approved build service. The U.K./ Europe version has a 240/220V transformer but 120/110V can be supplied as an alternative - see Overseas details on Order Form, page 28.

SPECIFICATION

Power	20watts/ch.
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Distortion	0.02%
Separation	60dB
Noise (CCIR)	-103dB
Sensitivity	240mV
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Supply	110/120V or 220/240V, 220W
Weight	16kgs(34lbs)

VALVE LINE LEVEL PRE-AMPLIFIER £295 ►

We now have finished the design of a super high quality chassis for the line level pre-amplifier. It is constructed from heavy gauge steel with an aluminium anodised and polished front panel. This new chassis comes with the complete kit of parts necessary to build the valve line level pre-amp.

The components are all high quality and include a special screened toroidal transformer, Military Spec. Russian valves, Alps potentiometer, metal film resistors, polypropylene signal capacitors, silver plated copper wire etc.



►HIGH DEFINITION LOUDSPEAKER £295

The High Definition loudspeaker is ideal for low power, high quality amplifiers, transistor or valve. It goes very loud with just 1-5watts, having an enormous sensitivity of 94dB - that's 8dB more than most other speakers. It is also a very easy load for valve amps (8ohms) and it gives a terrifically dynamic and fast sound.

As well as being just about unmatched as a partner for esoteric amps, this speaker is also unusually suited to low powered vintage amplifiers, such as Quad IIs, Radfords, Pye Mozarts and such like.

The High Definition DIY loudspeaker is available as a complete kit, including flat pack cabinet, drivers modified and tested by us, all crossover components and hardware. The flatpack cabinet is finished in an attractive satin black and requires no further finish, but for those who prefer something a little more traditional a mahogany veneer is an option.

If you would like to build your own cabinets we are also offering a drive unit pack that comprises two tweeters and two woofers, modified and tested.

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D.I.Y. Letters

DIY ADDICT

I have found your recent series of articles on DIY hi-fi most interesting.

Having built my own DAC (based on T. Giesberts design published in 'Elektron Electronics' last year), I can testify to the enhanced pride of ownership you feel for a component which has been laboriously, and lovingly pieced together by your own hands.

The process also gives you a far deeper insight into the problems of faithful sound reproduction than may be gained by taking a unit out of its box and turning it on. My next project will be the valve amplifier kit you featured in your April issue, although unfortunately I must wait a while for my finances to recover.

On looking through recent back issues, I noticed the February article on the British Vintage Wireless Society. I wonder whether you could publish a contact address for

this society, as it would appear to be an ideal source for one who wishes to learn the mysteries of valve amplifier design.

**Charles King
Walthamstow,
London.**

The British Vintage Wireless Society can be contacted at the following address:

**Robert Hawes
63 Manor Road,
Tottenham,
London.
N17 0JH.**

The BVWS hold regular meetings where you can spend your Sunday mornings swapping and buying vintage valves and books. Thoroughly recommended. DB

REVIVING THE QUAD 33/303

The letter from David Marshall in the June '93 issue, mentioning his Quad 33/303, prompts me

to write to you again.

In response to a letter to you last year you suggested I try replacing my older speakers with Epos ES11's on my similar Quad system. This I eventually did and the result was beyond expectations, showing how much loudspeaker technology had moved on in the last decade. This improvement prompted me to look at modifying the Quad 33/303 as, like NK, I was reluctant to part with it.

Prior to the ES11s I had already replaced the pre-amp boards with some produced by "Soundbox", (now part of Harbeth) and perhaps still available. These had cleaned up the sound somewhat, but I felt more was achievable. Incidentally, with the ES11s the changes these made were much more evident and thoroughly worthwhile.

I then continued work on the 33, replacing all the resistors with modern low noise metal film types, although not going to the expense of Holco H8s. I also replaced the PSU electrolytics with modern high frequency types, now readily available for switched mode PSUs. Further subtle improvements were evident. At the same time I changed the "Radio 2" input to a CD input, permanently wiring in a 10dB attenuator.



Epos ES11s: Good for the Quad 33/303

The most significant improvement however came when I turned my attention to the power amplifier. Investigation showed that the main PSU electrolytics had "popped" their vents. Replacing these and the amplifier coupling electrolytics with modern SMPS types made the most noticeable improvement thus far. (I was

In case you hadn't noticed they already are. The response to our DIY articles has surpassed even our expectations, which is brilliant because it means that Noel and I have a chance to break away from the reviewing machines that we were rapidly becoming.

DIY is a real breath of fresh air to us and I'm glad that you

and 12in deep, cost £25) and although the dimensions were selected for their proportional relationship, they were not scientifically calculated in relation to the performance of the drive units and crossover. The enclosures were built to accommodate KEF drive units (T27 h.f., B110 mid., B139 bass), crossover and reflex port

distantly too, with solo performers in the middle distance. Individual instruments may be pin-pointed and the whole audio spectrum, from sparkling triangle to extended bass, is reproduced with smooth gradations without enclosure colouration, for untiring listening. Vocals are free from sibilants and the atmosphere of live performances is realistically reproduced.

The bass definitely is not 'one-note'; it is vibrant. In 1977 they were admired by two visiting loudspeaker engineers for their 'exceptionally smooth transients'; and were valued by a dealer for insurance at £800, being the approximate cost of comparable commercial products for replacement, though I have yet to hear any which would prompt me to replace them. Commercial speakers may be technically more 'correct' for point-source reproduction (if that is what one seeks), though to my perception few are capable of reproducing instrumental tonal colour or making 'music'.

That transformation, from 'sow's ear' to 'silk purse' was accomplished solely by numerous trial and error experiments, ad nauseam, to determine the correct internal damping for those enclosures, i.e. the precisely correct combination of quantity and positioning of material, since quite small variations caused a perceptible change in sound quality. Therefore, enthusiasts who are inclined to design their own enclosures should not be intimidated by theory.

Obviously, constructors should select matching drivers and crossovers; they must not economise or skimp on enclosure materials and they must determine reflex port dimensions. The rest is mainly trial and error, perseverance and common sense. However, I strongly recommend the following basic components for all large, multi-unit speakers, whether own-design or kit.

The internal cavity should preferably be divided into airtight treble and bass chambers, which should be separately damped to obtain an acceptable tonal balance. Begin with minimum damping and gradually increase or re-position and note the changes caused. The minimum may be best for the treble chamber. ▶



variants of the NAD 3020 are cheap to buy second-hand and easy to tweak

able to find slit foil types of the required working voltage). The bass tightened up and deepened, and the mid range was cleaner, as though a veil had been removed. In addition, a nagging low level hum which I had been unable to trace also vanished. Whether these new capacitors have merely restored the amplifier to its original performance or made some further improvement I can't say, but the result is certainly most worthwhile.

My recommendation then, as was yours to David Marshall, is to replace these four electrolytics, and make this the last change, so that any others can be assessed more readily. It is something that can be done by the owner, providing he can handle a soldering iron and wire cutters. The new electrolytics are almost certainly going to need new mounting clips, as modern types are generally smaller, and this should be borne in mind.

I intend to look further at the power amplifier, possibly by rewiring it, but these experiments will have to wait until darker nights are with us again.

Perhaps other readers might like to share their thoughts in our DIY pages?

**John Haynes
Address Withheld.**

too have seen its value - i.e. saving on an expensive upgrade. DB

ARE DIY LOUSPEAKERS DIFFICULT?

With due respect for your professional eminence, I am prompted by practical experience to take issue with your reply to the letter from L. R. Hiatt (supplement to the April issue) on the necessity for precise enclosure volume in relation to drive units and crossovers to ensure loudspeaker success.

That theoretical dictum may apply to commercial manufacture, for particular reasons, but should not be interpreted by amateur constructors as a discouragement to attempt their own designs. My own practical experience in having built several large loudspeakers since 1950 leaves me in no doubt that, apart from the fundamental necessity for a rigid, heavy structure (rarely found in commercial products), precise internal damping is the most critical factor for enclosure success and I believe this is substantiated by the following experience.

In 1975 I designed and built a pair of reflex enclosures (externally 36in high, 18in wide

mounted on a simple chipboard baffle (cost £105 per pair) with the intention of utilising the maximum potential of the B139, and were substantially larger than the maximum volume recommended by KEF.

By your dictum, this combination should have been an abject failure, as indeed it was initially. KEF recommended that the enclosures be damped internally by hanging a curtain of BAF wadding (supplied) behind the drivers, but although that may have been appropriate for their recommended enclosure size, it certainly was not for mine.

Initially, the completed speakers were placed in the centre of a room 20ft x 12ft. The sound was congested and hopelessly unbalanced, with screeching treble, unbearable 'head-banging' bass boom and barely recognisable mid-range. However, twelve months later, they were in corners twenty feet apart and literally within an inch of walls, where they have remained. In addition to the sound stage being twenty feet wide, it extends beyond the base-line wall to create a natural perspective in which operatic performers move on the stage in the middle distance (not artificially thrust onto my carpet, as by many modern speakers).

Orchestras are ranged

Damping should be in two forms: a suitable material glued to all internal surfaces, except the baffle, to minimise resonances in the structure (discarded Axminster and Wilton carpet, glued by the pile surface is excellent) and BAF of required thickness attached to the carpet as necessary. The back panel in the bass chamber should be of double thickness; and a wooden brace, approximately 50x50mm inserted as a tight-fit between the rear of the bass driver and the back panel, to maximise the rigidity of the bass driver and minimise bass 'slur'.

**G. A. Jolly
Hockley,
Essex.**

We are not trying to dissuade our readers from building their own loudspeakers, quite the opposite (see our mid-range driver group test this month). But there are cases where DIYers could get the cabinet volume so far wrong that they would not be able to develop them into a respectable loudspeaker. Not everyone can afford to risk building a prototype that may not work. What we are trying to do is make people aware of the

size or reducing cabinet volume by putting bricks in!

But equally such ad-hoc experimentation may not work out. Obviously, we can't recommend things that may not work! Yet at the same time, I accept that hit-or-miss experimentation is part of the fun of DIY, and as in your case it can result in the 'perfect' cabinet - one that suits its owners tastes down to the ground.

I endorse your findings that thick carpet and underlay acts as an effective form of panel damping. We also find that BAF is not very effective though, compared to long haired wool. The latter is available from The Speaker Co. I hope this helps all you experimenters. **NK**

CHEAP KITS

Thank you for producing the most interesting and informative magazine to come out in the last decade. At last we DIY maniacs have something to get our minds, hands and ears into, as long as we respect those deadly voltages of course!

However, there is one area of DIY hi-fi that I feel would be of great interest to many of your readers.

numbers out there who would love to see you build and review some of these cheaper kits or even some of the not so cheap ones.

Many like me would never get to hear the difference between a Maplin Mosfet kit and a kit in the so called high end that costs hundreds of pounds.

I am sure that even some of the I.C. amps available today must rate pretty well, if only in measured performance, but how do they sound? That's surely a subject for you to help us evaluate before we send off those credit card details?

So how about it gents (and ladies): why not run a series for those of us who love to tinker with our transistors for hours in the shed, then sit for hours playing all our favourite albums and CDs, driving our wives mad as we insist they help us to decide if this latest piece of wizardry sounds as good as the Naim or - dare we say - even better!

**Bill Mortimer
Co. Tyrone,
Ireland.**

As you will see from this and the previous Supplement we are working towards

You could buy the components over a few months to help spread the cost, and pretty soon, without too much initial outlay, you could have a single-ended valve amplifier and a highly detailed pair of 'speakers.

The Maplin kits are general purpose audio amplifiers, that are cost effective, whilst not claiming to be top notch hi-fi. They do, however, provide a basis for experiment and give builders valuable experience. We would like to review Maplin kits, but they have been unwilling to supply for review, from which you draw your own conclusions.

Another approach, if you want to stick with transistors, would be to buy a second-hand budget hi-fi amp (the NAD3020 is an ideal candidate going for between £20 and £100 depending on age and condition) and tweak it. Circuit diagrams are easily available and it is a simple task to replace existing components with higher quality parts. Resistors can be replaced with precision metal films, capacitors with polyprops, tone controls wired out, internal wire replaced with silver plated copper etc etc. **DB**

BANISH BLACK BOXES

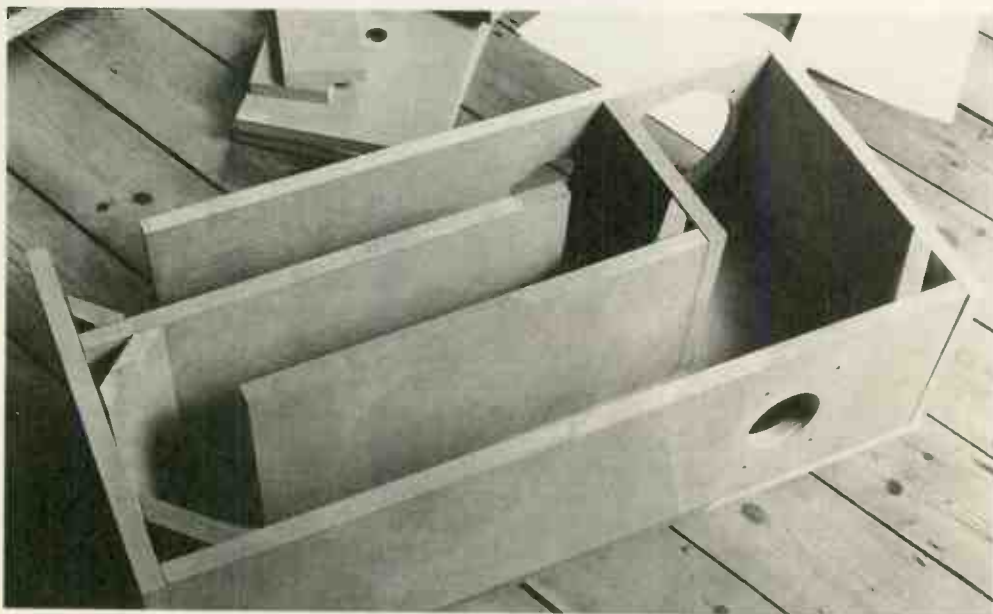
I can only applaud Hi-Fi World for having the sense and interest to realise that not all audiophiles (read enthusiasts) sport a bank balance of \$10,000 and can spend it all on equipment even if they did.

How long is it since I have entered the local paper shop and swooped on a mag as if it was a \$100 note? Or checked the shop every day until the mag arrived? Or almost ran out of the shop gleaming with the anticipation of building my first valve amp (pre or power)?

Your DIY Supplements are just what we "black boxes all look the same, too many choices, hard-to-match, product-bashed" enthusiasts need (and want). Any real enthusiast is a tinkerer - no question. Let's face it, building leads or adjusting speaker positions is still tinkering.

But to be able to build tried and tested designs, as well as understand and possibly customise (read modify) them is, well its a winner down here in the colonies.

It may be of interest to your



difficulties involved so that they can make informed design decisions which will result in a finished item of higher performance. **DB**

Trial and error is hit and miss, if you'll pardon the tautology. You may well be able to tune a cabinet this way, by gradually adding damping, changing port

I refer to those of us who can't really justify splashing out hundreds of pounds on valve amp kits even though we would like to. We are therefore stuck with transistor based equipment in kit form from firms like Maplin etc or, if we have the know-how, designing and building from scratch.

I think there may be huge

producing more affordable kits. The drive units for our high definition loudspeaker will cost you just £145, and building your own boxes will save some money. The single-ended valve amplifier could be built into a cheaper chassis of your choice and with budget components, again offering a saving on the whole kit price.

readers to know that I have modified many production speakers, by component upgrade mostly, and as yet have never failed to impress the friend who gets them back (as well as myself), and this is easy.

I have always enjoyed your magazine heaps and think that it correctly embraces all levels of hi-fi enthusiasm very well.

Finally, if I may be so bold as to put in my two pennies worth of suggestions, I would like to see more technical explanations and alike. I still don't fully understand balanced amp designs and what XLR connectors look like, a bit more on Class A biasing and other general stuff like that.

Anyway, three cheers for DIY and a magazine with obvious enthusiasm. As Oliver said: "Please Sir, can I have some more?" How about a 100w EL34 based monoblock? Come on, take pity on a poor colonist in need of valve amplification.

**Malcolm Bevege
Victoria,
Australia.**

PS The parts suppliers is a good idea too, as we have to import that stuff down here. Easy to get sheep - hard to get bulk-foils etc.

I'll be perfectly frank with you: technical stuff so turns a lot of readers off (we know from the complaints) that we fear to run much of it. However, there is always a need for the practical technical approach and we must shortly get around to providing such info.

Unfortunately, simplified technical explanations commonly draw criticism from experts, especially from University academics who don't really appreciate anything other than strings of equations. So we get flack from both sides on this subject and tend to steer clear!

An EL34 based 100w amplifier? Funny you should mention that because P.M. Components have just brought out a modified EL34 with graphite coated anode capable of 40watts anode dissipation, they tell us. This caught my eye at the Penta Show and we've all been muttering about it, but beware of high power valve amps - they commonly operate in Class A/B and can sound 'orrible. This new EL34 in

pure Class A could, however, be an interesting beast, but to get the power dissipation you desire, they would have to be operated in push-pull triples, which could be expensive.

Personally, from my experience of Oz, I think you colonists got the best of the deal! Give my regards to the sheep. We will have some more wicked valve amplifiers for you over the coming months. Enquiries about custom silver wound transformers and custom polypropylene power supply capacitors, built to our specifications, are looking promising. Bulk foil resistors are on the cards too, so there's much more to come.NK.

SPEAKER TWEAKER

After reading several of your articles on speaker tweaks I decided to try to tweak my speakers, Wharfedale 505.2s, in the following ways:

- 1) Replace tag connectors to speakers with soldered joints.
- 2) Remove crossover from 'speaker enclosure.
- 3) Upgrade crossover components.
- 4) Hardwire crossovers.
- 5) Replace internal speaker cable.
- 6) If possible make the speakers bi-wireable.

I was planning to do the above tweaks over a reasonable period of time so that I could evaluate the improvement, if any, of each of the changes. Before I undertake any of these tweaks I decided to write to Wharfedale to check two things: a) Whether these changes would invalidate the guarantee (I assumed it would) and b) How to remove the mid/bass driver from the cabinet to get access to the 'speaker's internals.

I enclose the letter I sent to Wharfedale. I have not yet had any reply from them, and as you can see from the date of the letter it was sent about four months ago. Please could you either answer my questions yourselves or prod Wharfedale to answer them.

As a general point on the subject of tweaking speakers, if a manufacturer marketed several DIY upgrades to their speaker I, and from the letters in your magazine, several other people, would be willing to buy such upgrades. This would not only create revenue for the

manufacturers but would also generate more brand loyalty.

Although I am planning to upgrade these 'speakers in the future, and not to other Wharfedale models, I would be much more likely to recommend a company's products to a friend if they showed interest in people getting the most out of their products and not the attitude of "soonest sold, soonest forgotten". I am sure that Wharfedale aren't alone in this, but I find it hard to feel any loyalty to a company that doesn't reply to simple questions within three months.

**S G Wigley
Congresbury,
Bristol.**

gained by removal of the bass unit. However as this is bayonet fixed to the baffle board a special tool is required to remove it. Dealers who sold the original 'S' Series have this tool so presumably you would be able to ask for your dealer's assistance. As this is not a specific service problem your dealer may make a labour charge for this, so we think it would be prudent to ask him first.

Removal of the treble unit, should this be necessary, is carried out by lifting off the black self-adhesive trim with the radiation sign on it. When the trim has been removed, three Pozzi - Drive screws around the outer edge of the



Well, why don't we have a 100w EL34 Monoblock?

Thank you for your letter regarding your 505.2 loudspeakers received via Hi Fi World. We apologise for our lack of response, but having looked into the matter carefully, no trace can be found of your letter dated 21 January 1993.

In response to your enquiry, any modifications to the components would invalidate the guarantee. However the speakers are yours, and if it is your wish to do this, then the decision is yours. If at a later stage our services were required, we would make a normal service charge for any work we carried out.

Access to the crossover is

mounting plate will be seen. These are removed, the unit lifted from the baffle board, and two wires from the crossover disconnected. Please note the smaller central screws adjacent to the aluminium dome should not be removed.

We trust this information is found satisfactory and again apologise for the delay that has been experienced. From our comments you may appreciate that it has not taken undue time to resolve, and therefore had your letter been received, it would have received the appropriate attention.

**P S Escott
Manager,
Service Department.**



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