

Hi-Fi WORLD SUPPLEMENT

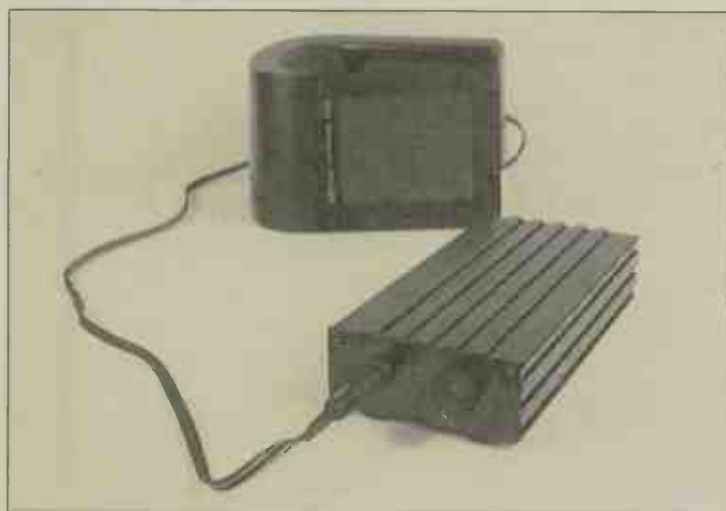
No. 9 AUGUST 1994

**BOOK REVIEWS -
THE WILLIAMSON AMPLIFIER
THE ART OF LINEAR ELECTRONICS**

LETTERS AND Q&A

SENSITIVE LOUDSPEAKER USING CARBON FIBRE DRIVE UNITS

SINGLE-ENDED CLASS A HEADPHONE AMPLIFIER



FREE D.I.Y. SUPPLEMENT No. 9



Chelmer Valve Company for Audio Valves

Audio valves with famous Brand Names of yesteryear such as MULLARD, MOV, GEC, RCA etc., are in very limited supply and their scarcity also makes them very expensive.

We at Chelmer Valve Company however provide high quality alternatives to these old makes. We have over 30 years experience in the supply of electronic valves of all types and during this time have established close ties with factories and sources worldwide.

For high fidelity use we further process valves from these sources using our specially developed facilities. After rigorous testing - including noise, hum, microphony, post burn-in selection and matching as needed - we offer this product as CVC PREMIUM valves.

A selection of the more popular types is listed here.

Price list & Order Form for CVC PREMIUM Audio Valves

	UNIT PRICE	QTY.	TOTAL PRICE		UNIT PRICE	QTY.	TOTAL PRICE
PRE-AMP VALVES				CARRIED FORWARD...			
ECC81/12AST7	5.00			RECTIFIERS			
ECC82/12AU7	4.00			GZ33	4.50		
ECC83/12AX7	5.00			GZ34/5AR4	4.50		
ECC85	4.00			5U4G	5.00		
ECC88	5.00			5Y3GT	3.20		
EF86	4.00			5Z4GT	3.50		
E81CC (GOLD PIN)	6.00			SOCKETS			
E82CC (GOLD PIN)	6.00			B9A (PCB)	1.60		
E83CC (GOLD PIN)	6.00			B9A (CHASSIS)	1.60		
E88CC (GOLD PIN)	7.00			OCTAL (CHASSIS)	1.75		
E80F	9.00			4 PIN (UX4)	3.00		
E83F	5.50			4 PIN (FOR 211 & 845)	11.00		
6SL7GT	4.00			MATCHING CHARGES * POST & PACKING 3.00 (UK) TOTAL EXC. VAT VAT @ 17 1/2% (ECC) TOTAL TO PAY £			
6SN7GT	4.20						
6922	5.00						
POWER VALVES				* MATCHING, if required; state valve types & if PAIRS, QUADS or OCTETS - Allow £1.00 per valve for this service.			
2A3 (4PIN)	14.00			Make CHEQUES payable to:			
2A3 (OCTAL)	14.00			'CHELMER VALVE COMPANY or pay by			
211	22.00			ACCESS/MASTERCARD/VISA, give details:			
300B	50.50			<input type="text"/>			
811A	9.50			Signature			
845	29.90			..... Expiry			
EL34/6CA7	7.50			Name			
EL84/6BQ5	4.00			Address			
E84L/7189A	5.10			.....		
KT66	9.20			.....		
KT88	12.50			.....		
KT88 (GOLDQ)	18.50			.....		
6L6GC	6.50			.....		
6L6WGC/5881	8.00			.....		
6V6GT	5.00			.....		
6146B	10.20			.....		
6336A	30.00			.....		
6550A	11.00			.....		
6550-A	13.50			.....		
7581A	11.00			.....		
TOTAL CARRIED FORWARD.....				..... Post Code			

Valves amplifiers sound better still with CVC PREMIUM valves!

130 New London Road. Chelmsford. Essex CM2 0RG, England. Telephone: (0245) 355296/265865 Fax: (0245) 490064

D.I.Y. Supplement

Contents

KIT NEWS

All that's new on the DIY hi-fi scene this month.

5

KLS3 THREE-WAY LOUDSPEAKER

Using high technology carbon fibre cone drive units we've designed a super clean sounding three-way floorstanding loudspeaker. With high sensitivity and even impedance, it is ideal for low power, high quality solid state or valve amplifiers.

6

AUDAX DRIVE UNITS

Want to get your hands on the latest drive unit technology? Well here's your chance. There are ten super drive units to choose from including Carbon Fibre, High Definition Aerogel (HDA), and doped paper, as well as three soft cone tweeters.

17

BOOK REVIEWS

This month we take a look at a reprint of an original classic, and a new book on solid state electronics.

19

THE WILLIAMSON AMPLIFIER

Reprinted from articles in Wireless World

22

THE ART OF LINEAR ELECTRONICS

By John Linsley-Hood

23

CLASS A HEADPHONE AMPLIFIER

Following numerous letters from readers about the circuit for a single-ended, Class A headphone amplifier, published with Richard Brice's April column, we've decided to give you full construction details.

27

DIY LETTERS

This month we tackle a range of letters including some practical advice from a reader who's built our KLS1 loudspeaker.

HALCYON ELECTRONICS

Test equipment, video monitors, amateur radio gear, printers, power supplies, communications, disk drives, multimeters, oscilloscopes, scientific instruments, connectors, component bridges, frequency counters, signal generators, computers.

QUAD 303 STEREO POWER AMPLIFIERS	£95	PENNY & GILES FADERS 11100 & 021903/1	£6
DAWE 1405D SOUND LEVEL METER 1300B(A)	£95	AVO MULTI-MINOR MK5 (1 ONLY)	£49
"ANTIQUE" WOODEN BOX TEST EQUIPMENT FOR CALLERS		CONSTANT VOLTAGE TRANSFORMERS .15-2KW	POA
CITOH CK6000 A4 PLOTTER 6 PEN CENT/RS232	£135	COMARC 2303 MV SOURCES, DUAL RANGE	£49
TETRONIX 4662 A3 PLOTTER 1-PEN GPIB/RS232	£175	MARCONI TF1370A LF OSC 10Hz - MHz SIN/SO	£49
130VA TOROIDAL TRANSFORMERS, UNIVERSAL		MARCONI TF2331 DISTORTION FACTOR METER	£175
PRIMARYES, 2x 18V SECONDARIES	£11.75	MARCONI TF2337A AUTO OISTORTION METER	£195
50VA TOROIDAL TRANSFORMERS, UNIVERSAL		MARCONI TF2343 QUANTIZATION DISTORTION METER	£49
PRIMARYES, 2x 20V SECONDARIES	£9.75	MICRO/MILLIVOLT METERS	FROM £17.50
PAPER BLOCK CAPACITORS, VARIOUS		SIGNAL GENERATORS, VARIOUS, 1Hz - 1GHz,	FROM £19
HI-VOLTAGE ELECTROLYTICS		SINE/SQUARE/TRIANGLE, etc	FROM £19
RESISTORS, CONNECTORS LEADS, SWITCHES, RELAYS etc.		TRANSISTOR TESTERS	FROM £49
C&R OCEADIE BOXES	FROM £15	FREQUENCY COUNTERS	FROM £49
S&F BLOCES	£11.50	AVO 8MK5 MULTIMETERS	£85
INSTRUMENT CASES/RACKS, VARIOUS	POA	AVO 8MK6 MULTIMETERS	£99
LEADER L80-9C ALIGNMENT SCOPE 2mV/10kHz	£249	GOERZ 3N MULTIMETERS	£79
DYNAMMCO 07100 SINGLE TRACE 10MHz SCOP		INSULATION TESTERS	FROM £44
WITH LINE FINDING & PICTURE MONITOR FACILITIES	£99	BENCH DIGITAL MULTIMETERS	FROM £129
SCOPEX 456 6MHz SINGLE TRACE	£95	600 & 75 OHM ATTENUATORS	FROM £15
TEKTRONIX 2215 60MHz 2 TRACE DEL T/B	£450	BEAT FREQUENCY OSCILLATORS	POA
TEKTRONIX 453A 50MHz 2 TRACE DEL T/B	£249	PM6456 FM STEREO GENERATOR	£175
H.P. 8405A VECTOR V/METER 1GHZ	£595	CARDIAC RECORDERS LTD MINIGRAPH	
TELEQUIPMENT D67A 10MHz OUAL TRACE	FROM £99	TYPE 123	POA
SELABS SM111 18MHz OUAL TRACE	£129	GOULD 2400 4-PEN CHART RECORDER	£195
TELEQUIPMENT D67A 25MHz 2T. DEL T/B	£215	X-Y-RECORDERS A3 & A4 FROM	£35 - £139
H.P. 1700A 35MHz OUAL TRACE	£249	7SEG 12" 89" DISPLAYS DIGITEK/SIGNALX	£15 & £10
HITACHI VC 8015 10MHz DIGITAL STORAGE	£345	MARCONI TF2300 FMAM MODULATION METER	£195
H.P. 1340 X.Y DISPLAY E1490ERTLING V20 SINGLE PAN		MCKENZIE 7 DAY TEMP/HUMIDITY RECORDER	£95
BALANCES IMG - 200G	£69	FEEDBACK S50603 1MHz SINE/SO OSC	£125
ANALYTICAL BALANCES WITH WEIGHTS 250GM	£69	COMMUNICATIONS RECEIVERS VARIOUS	POA
VACUUM PUMPS 1.5 & 28Cu INCH	£125 & £149	WAYNE KERR CT492 LCR BRIDGE	£79
KINGSHILL NS 1540 15V PSU'S CASED AS NEW	£195	AVO B151 LCR & 0 BRIDGE	£195
ACRON 402P SYNCHROISING PULSE GEN & 605P		MARCONI TF2701 LCR BRIDGE	£125
ENCODER	£375ea £595/ea	MARCONI TF2700 LCR BRIDGE	£195
RADIOMETER BK66 OIST. METER 20Hz - 20KHz	POA	MARCONI TF1313 LCR BRIDGE 0.25%	£95
MARCONI TF2330 WAVE ANALYSER 20Hz - 50KHz	£149	AVO C2457/S COMPONENT COMPARATOR LCR	£95
H.P. 5315A 1GHz F/CTR, OPTS 1.2&3	£595	LEVEL TM68 MICRO V-METER 450MHz	£95
LYONS 010 OISTORTION METER	£95	LEVEL TM38 MICRO V-METER 3MHz	£85

LIST AVAILABLE 1000'S OF UNLISTED BARGAINS FOR CALLERS. ALL PRICES EXC. OF P&P AND VAT. QUALITY ELECTRONICS EQUIPMENT ALWAYS WANTED

HALCYON ELECTRONICS

423, KINGSTON ROAD, WIMBLEDON CHASE, LONDON SW20 8JR
SHOP HOURS 9 - 5.30 MON-SAT. TEL 081-542 6383. FAX 081-542 0340

DESIGN SUPER-FI

With our book of ready-made tables covering high-end hi-fi design, including: horn loaded loudspeakers, ported speakers and closed speakers (from matchbox sized to bigger than a bus) and single ended valve amplifier design such as gain, 3dB points, distortion, output power & PSUs. 200 page A4 handbook only £10 inc P&P from

NUMERICAL DATA SUPPLIES

44 NORGATE RD, NORWICH NR4 7BT

SOWTER TRANSFORMERS

Sowter Transformers have been used by the Professional Audio Market throughout the world for at least the last twenty - five years.

Using modern technology and Computer Aided Design we are now able to offer a complete design and manufacture service.

Our current lists show a range of over 50 output, 70 power transformers and nearly 30 chokes.

E. A. SOWTER LTD

P.O. BOX 36, Ipswich IP1 2EL
Tel: 0473 252794. Fax: 0473 236188 SEND S. A. E. FOR DETAILS.



BANDOR

Miniature Loudspeakers
The sound of excellence

*BANDOLINE 20
and
BANDOLINE 30*



Transmission line kits designed to exploit the unique acoustical performance of BANDOR musical loudspeakers which are the product of 35 years experience humidity proof.

Anodised, curvilinear aluminium cones are assembled by hand into robust chassis fitted with powerful magnets. Long-throw, low distortion bass drivers for clean deep bass. THE ULTRA LINEAR DRIVER (see brochure for xmas). Complementary treble section with fast transient response and wide bandwidth, covers 2/3rd of spectrum frequency allowing low crossover point - below 200Hz.

Free technical details and prices from

Bandor
Design and Development Studio
11 Penfold Cottages
Penfold Lane
Holmer Green
Bucks HP15 6XR
Tel. & Fax (0494) 714058

Assembled
Bandoline 30
30Hz - 20KHz
size
48 x 13 x 8.5 in
122 x 33 x 21.16 cm

TOP QUALITY AUDIO TUBES from West Europe/USA.

We have 1 million valves/tubes in stock including vintage and high quality audio types. Please enquire for any type not listed below.

2A3 Chinese	£15.16	ECC82 Mullard UK	£4.65
5AR4, refer to G234/G237		ECC83 Russian	£2.75
5C-45DA	£295.00	ECC85 Tungstram	£2.66
5R4GY, RCA	£4.98	ECC88 Russian	£3.32
5U4G W Europman	£7.99	ECC88 Mullard UK	£5.51
5Y3WGTA Sylvania	£3.99	ECJ82	£2.59
6AS7G Russian	£4.58	ECJ86 Mullard	£4.38
6B4G American	£33.25	EF86 GE UK CV4085	£14.63
BH6 RCA	£2.19	EF86 Russian	£3.45
6C33CB Russian	£23.70	EF8045 AEG	£25.00
6C07 Mazda	£4.32	EL34 Chinese Billington	£7.86
60J8 refer to ECC88		EL34 Mullard	£9.30
6L6CC GE USA	£14.63	EL84 Tungstram	£3.05
6L6GC Russian 5881	£4.65	EL84 GE USA	£3.92
6L6GC EOG Philips	£18.62	EL519 Russian	£9.24
6SL7GT STC UK	£5.98	G232 Mullard UK	£8.37
6SN7GT STC UK	£3.58	G234 Mullard UK	£12.00
6V6GT STC UK	£3.45	G234 Genuine Russian	£5.98
6X4 UK MDD	£2.39	G237/CV378 Mullard	£4.39
12AT7, refer to CV4024/ECC81		KT66/7581A GE	£15.89
12AT7WC Sylvania	£3.92	KT88 Chinese Billington	£13.96
12AU7 refer to ECC82		KT88, refer to 6550A GE	
12AX7WA Russian	£2.75	M8136, refer to CV4003/ECC82	
12AX7WA ECG Phillip	£9.99	M8137, refer to CV4004/ECC83	
12BH7A Sylvania/RCA	£10.97	M8162, refer to CV4024/ECC81	
12E1 STC ITT UK	£13.30	ECC83 China	£1.75
1303 CV 4086	£5.99	Mu14 Bomar UK	£3.99
13E1 STC UK	£133.00	PL519 Sylvania USA	£7.91
85A2 Mullard	£5.98	VT40 GE	£42.56
211GE	£42.56	SOCKETS	
300B Chinese	£53.13	UX4, used for types 2A3/300B etc	£2.32
805 United USA	£33.25	VT4C/211 ceramic	£14.36
807 RCA	9.29	B5	£3.99
811A Russian	£10.40	UX5 McMurdo	£1.85
845 Chinese	£36.00	B7A Teflon, used for types 6C33CB etc	£1.80
4212A STC UK	£120.00	B7G McMurdo UK, chassis mounted and skirted	£0.63
5687 USA	£5.99	Octal McMurdo Chassis	£0.86
5751 USA	£6.50	Octal PCB	£2.99
5881/6L6WGB Russian	£4.25	9BA chassis unskirted	£0.69
6189 Mazda	£5.99	9BA chassis skirted	£0.79
6201, refer to CV4024		95B gold pins	£1.73
6922 Sovtek	£4.30	Topcap for 807	£2.66
6550 Sovtek	£12.00	Topcap for 5B-254-234M, 12E1, PL519 etc	£2.66
6550 Chinese	£12.36		
6550A GE USA1991	£29.00		
CV4003 Mullard	£7.31		
CV4004 Mullard	£15.53		
CV4024 Mullard UK	£7.85		
CV4085, refer to EF86			
DG7-32 Tungstram	£28.80		
E82CC, refer to CV4003			
E83CC, refer to 12AX7WA			
ECC91 Brimar UK	£3.12		

We can supply sockets for any valve listed in this advertisement

For matched pairs please pay add £2.00 per valve
All items tested prior to dispatch, very good quality and guarantee for 60 days
Postage and packing £3.00 per order to UK. Please allow 7 days plus postal time for delivery
Payment with order please (cheque, Visa, Mastercard, American Express accepted)

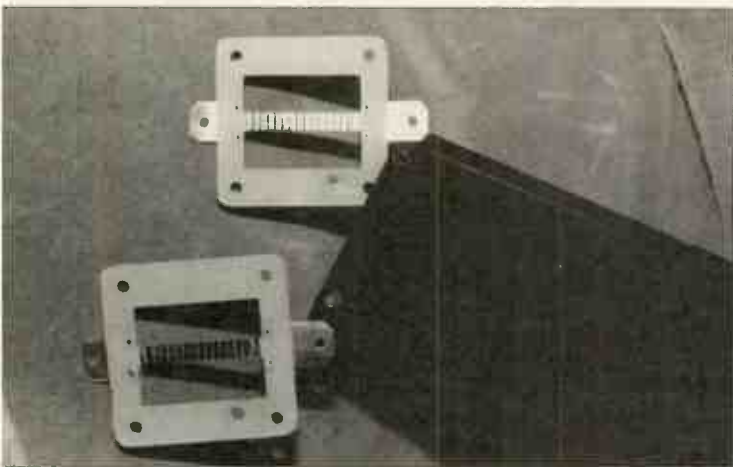
BILLINGTON EXPORT LIMITED

1E Gillmans Trading Estate, Billingham, W. Sussex RH14 9EJ UK Telephone: (0403) 784961 Fax: (0403) 783519

MINIMUM ORDER UK £50 00-17.5% V.A.T. EXPORT £100 00 Callers strictly by appointment only

Orders over £400 (MIX OF TYPES IS OK) qualify for 25% discount
After 31st March 1994 these prices are subject to review. Please confirm before ordering.

KIT NEWS



GOOD NEWS FOR USERS OF DECCA RIBBON TWEETERS

Dismayed to learn about the demise of replacement ribbons for Decca DK30 and London ribbon tweeters, electronics engineer H. Dawson has taken the matter into his own hands. Mr Dawson has produced tooling to enable hand manufacture of these spares to the original mechanical and electrical criteria. A service is offered to readers who would like to keep their Decca ribbons in service, prices as follows: London/Kelly Ribbon Insert £15.00 each inc. P&P (outright) (£2-50 discount for old insert returned with outer frames re-usable.) Will fit F.O.C. if owner stands postage both ways or brings the drive units in (by prior arrangement). All spares come with printed instruction sheet/care tips. C.W.O., cheque or P.O. Delivery 10 to 14 days (small numbers only).

Write to:
Mr H. Dawson
16 Copeman Rd,
Aylsham,
Norwich.
NR11 6JL

RETURN OF THE CONSTRUCTOR SERIES

KEF are making available three plans for new 'speakers to be built by the DIYer, based on the commercial Q60, Q80 and Q90. All three use KEF's 8inch uni-Q driver which will be available separately, along with their 8inch bass driver and 8inch passive radiator (ABR).

KEF Audio
Tovil,
Maidstone,
Kent.
ME15 6QP
Tel: 0622 672261

THE SPEAKER CO.

The Speaker Co. now have prices for the Audax range of HDA units, which they will have available shortly. The 5inch midrange unit will be £46, the 6.5inch bass/mid £51, and the 8inch bass/mid £61. Other new units include the hi-fi range from professional

manufacturer Precision Devices. The Speaker Co. will be stocking one 10inch, one 12inch and two 15inches including the 600watt power handling 95dB efficient PD157. They will also be stocking a massive £620 21inch driver, telling us that most people buy them to use in cars!

Following the review of the Boxcalc package in our April Supplement, a demo version is now available for interested parties. Send an SAE to:

The Speaker Co.
Unit 9,
Waterside Mill,
Waterside,
Macclesfield,
Cheshire.
SK11 7HG
Tel: 0625 500507

HART ELECTRONICS

Hart Electronics, keen to entice more and more people into the DIY hi-fi scene, have put together a soldering practice kit for beginners. The kit includes a practice circuit board, solder and full instructions explaining the techniques behind soldering. Suitable for the absolute beginner, the kit costs £4.99 + £1.50 p&p.

Also from Hart, reprints of the original articles describing the Simple Class A amplifier designed by J. Linsley Hood in 1969 are now available. The eight page A4 reprint costs £2.50 + 50p postage.

Hart Electronic Kits
Penylan Mill,
Oswestry,
Shropshire.
SY10 9AF
Tel: 0691 652694

TABULA RASA ON DEMO

Ever expanding, Tabula Rasa have now appointed two dealers where their range of equipment can be auditioned. Covering the South East is Crawley Audio (Tel:

0293 531190) and the South West by Bugle Brand of Exeter (Tel: 0392 79217).

Richard Dawson of Crawley Audio is responsible for the design of Tabula Rasa's new loudspeaker stands. There are a range of standard size stands to suit Tabula Rasa's range of kit loudspeakers, along with a custom design service. Just complete a simple form and drawing and a quote for a custom built stand will be returned. Prices for custom stands are said to be no more than that you would pay for a similar 'production' stand.

Also in the pipeline are tripod style equipment racks with 10mm glass shelves, and a grille re-covering service.

Tabula Rasa
136 Kilnwood,
High Wycombe,
HP14 4UR
Tel: 0494 565116



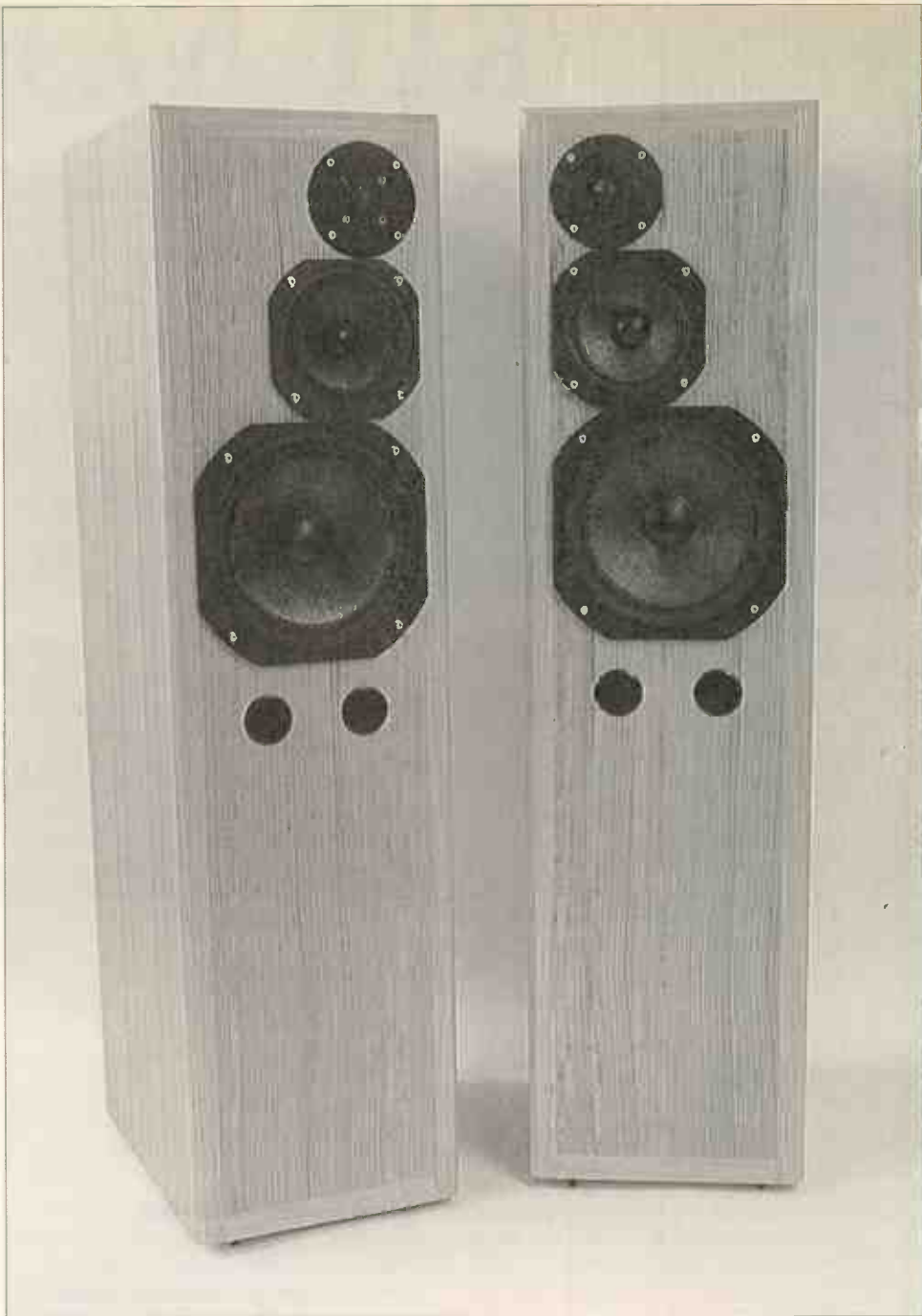
SOFT START FOR PROJECTS

A variable transformer may not instantly appeal to the DIYer, but for those who build their own valve amplifiers and other electronic projects they are extremely useful. Maplin have just introduced two, variable from 0-270volts and with either 2A or 8A current capability. They are especially useful when switching on your electronic project for the first time, as the mains can be smoothly increased up to 240V, highlighting problems before full power is reached (we use one, 'cos it beats going into the Anderson shelter before switching on). Prices are £29.95 for the 2A and £49.95 for the 8A version.

Also new from Maplin is a 70W power handling titanium composite tweeter. Priced at just £13.95 it is idea for budget kit loudspeakers.

Maplin Electronics
P.O. Box 3,
Rayleigh,
Essex.
SS6 8LR
Tel: 0702 554161

Three -Way Carbon Fibre Drive Unit Loudspeaker



Dominic Baker uses a computer, spectrum analyser, saw and his grey matter to build a superb floorstanding loudspeaker.

Our third loudspeaker design, KLS3, was partly prompted by our 300B zero feedback valve amplifier. Whilst this amplifier gives terrific stage depth and detail, because of the higher than normal output impedance it is affected by variations in the load the loudspeaker presents.

Most loudspeakers do not have a steady 8Ω impedance over the audio band. Instead, the load they present an amplifier varies with frequency. If, for example a loudspeaker with a high

impedance in the bass and low impedance in the treble was used with a zero feedback amplifier, it would sound unusually dull. So an important aim for this loudspeaker, as with the High Definition 'speaker (KLS2), was a reasonably flat impedance curve.

But KLS3 needed more than just a flat impedance curve. 300B has a power output of just 28watts, so these speakers had to be sensitive too. We wanted a minimum of 90dB for a nominal watt (2.8V) input at 1m. It also had to use modern, low colouration, super quality drive units, to be able to bring out the very best of 300B. Finally, the speaker had to have a flat frequency response, especially across the critical midband.

A 'speaker with high sensitivity and a flat impedance curve is an extremely easy load for any amplifier. This has several benefits, even for solid state amplifiers. The harder you work an amplifier, the more distortion it will produce. This loudspeaker will actually reduce the amount of distortion your amplifier produces for the same sound level. This is one of the many advantages of a high sensitivity loudspeaker.

These design criteria would have been very hard to meet even a few years ago, but the advent of high technology cone materials has allowed us to actually improve on the targets we set ourselves at the beginning of this project.

THE DRIVE UNITS

Audax have been researching and producing new materials at a rate of knots over the last few years, now offering drivers with paper, TPX, Kevlar, glass fibre, carbon fibre, HDA and HDI cones. For this reason we looked to them for the drivers for our latest kit design. We do plan to design a 'speaker using the HDA units within the next year, but for this project the carbon fibre units were best suited.

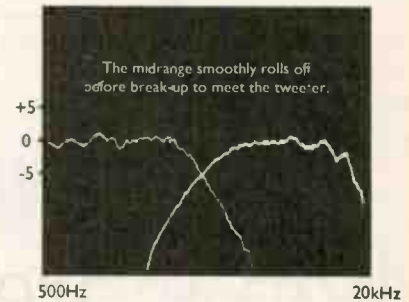
These have a high impedance, making it easier to design the overall loudspeaker for a flat impedance curve. They are also extremely light and stiff, giving them the high sensitivity needed. This modern material has improved break up characteristics over a paper cone, giving a smoother sound.

As with KLS1, we felt it important to keep the cone materials of each driver as similar as possible, to avoid obvious character changes, keeping tonal quality as even as possible. So a dedicated 4inch mid-range carbon fibre unit was teamed with an 8inch carbon fibre bass cone. A three way design was preferred for its superior mid-range clarity and projection, together with good bass drive and kick. A soft dome tweeter was considered to be the best tonal match to carbon fibre. Good soft dome tweeters also have the detailed and natural sound which we wanted.

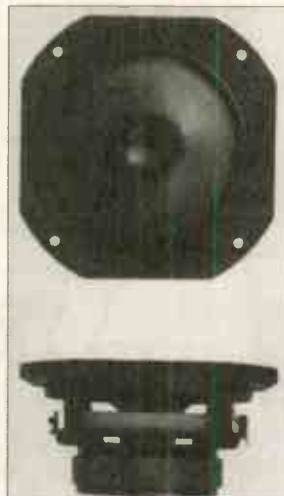
The tweeter we picked again came from Audax. It was featured in the December '93 supplement, having a smooth response, high impedance and high sensitivity. It is a very nicely

built unit, having a replaceable diaphragm and voice coil assembly should you do any damage. Being from the same manufacturer as the bass and mid-range units also makes it easier for the home constructor to obtain them.

Midrange and Tweeter Drive Unit Frequency Response



Audax HM210CO 8inch bass unit.



Audax HM130CO 4inch midrange unit



Audax TW025MI 25mm fabric dome tweeter

CABINET DESIGN

The Bass Enclosure

The cabinet was designed to give good, powerful low bass, hence its generous proportions. The bass cabinet is around 55 litres internal volume and is tuned to 40Hz using two 38mm diameter, 85mm long ports. I used a computer aided design package to come up with the initial dimensions and port size, which gave a good, but rather sterile bass quality. Using a combination of listening tests, and observing the changes altering the port size made on our Hewlett Packard HP3561A Spectrum Analyser, we were able to tune the bass to give exactly the character and bass quality we wanted.

You can see from the plot below how the ports extend the response from the front of the cone down to an impressive 17Hz at -3dB. Of course a close eye on the impedance curve was also important.

Port Output/Low Bass Response



The Midrange Enclosure

The midrange driver sits in a sealed chamber, the walls lined with felt carpet underlay. The cavity is lightly stuffed with long hair wool which, in combination with the carpet felt, absorbs most of the sound reflected off the internal walls. I made the midrange chamber volume 3.5 litres, which rolls off the midrange unit acoustically at low frequencies. The rising

impedance of the midrange unit towards low frequencies prevents it drawing power in the bass, so power handling is not affected. This makes the crossover simpler and more efficient.

It is important to seal this enclosure very well, using plenty of PVA glue in the joints and to block the hole the internal 'speaker cable passes through.

Midrange and Bass Drive Unit Frequency Response



VACUUM TUBES are BACK... and they sound better than ever!

Glass Audio is a quarterly journal designed for dedicated music lovers who've always known tube equipment sounds better than solid state.

The articles have special emphasis on construction with projects ranging from simple modifications of existing equipment, to restorations, to construction of the most sophisticated designs available today. The projects include schematics, parts lists and instructions. An annual feature is a world directory of international tube dealers and manufacturers.

Here's a sampling of recent articles: ST-70 with Solid-State Regulation, Rebuilding Tube Amps, An Electrostatic Headphone Amp, Greening the ReVox G36, Restore your Scott Tuner, Soft Start for Tubes, 70 Watts of McIntosh Power, Output Transformerless Amp, Vacuum Tube Voltage Regulator plus Vacuum Tube AC Feedback Amps.

*We don't expect everyone to subscribe--
just those who savor a taste for warm, satisfying tube sound.*

Please enter my airmailed subscription for:

Two years (8 issues) at \$60

One year (4 issues) at \$35

Charge to my VISA Mastercard Bill me

Remit in US \$, drawn on US bank. Allow up to 6 weeks for delivery.



CARD NO. _____ EXP. _____

NAME _____

STREET _____

CITY _____ COUNTRY _____ POSTAL CODE _____

PO BOX 176, DEPT. HFWS Peterborough, NH 03458-0176 USA
FAX (603) 924-9467

W O L L A T O N A • U • D • I • O

XLO FOR THE HOME CONSTRUCTOR

Whether you are building equipment from scratch, or upgrading existing equipment then XLO wiring will improve the performance. Also available are the XLO chassis mount phono and the XLR connectors, and the speaker binding posts.

Cables and wires.

PRO 100 interconnect	£5.50 per foot
PRO 150 interconnect	£3.00 per foot
PRO 625 speaker cable	£1.25 per foot
PRO PL1000 mains cable	£12.00 per foot
REF PL10 main cable	£25.00 per foot
PRO 16P* Chassis hook up wire	£1.00 per foot
REF 16T* Chassis hook up wire	£10.00 per foot

Connectors

Neutrik gold plated XLR male	£6.00
Neutrik gold plated XLR female	£7.00
XLO pro phono plugs (4 pack)	£25.00
XLO ref phono plugs (4 pack)	£44.00
XLO spade plugs (4 pack)	£13.00
XLO Signature XLR chassis mount (2 pack)	£28.00
XLO Signature XLR chassis mount	£28.00
XLO BNC connectors (2 pack)	£16.00

* Note that the chassis wire is excellent for loudspeakers internal wiring or to replace the jumper connectors used when Bi-wire speakers are used in single wire mode. When using the wire to carry signals of less than 100hz a double run should be used. High quality preamps should be wired with 16T.

WOLLATON AUDIO - TEL/FAX: 0602 284147

LANGREX SUPPLIES LTD

DISTRIBUTORS OF ELECTRONIC VALVES, TUBES AND SEMI-CONDUCTORS AND I.C.S.

1 MAYO ROAD • CROYDON • SURREY CR0 2QP

PHONE
081 684 1166

24 HOURS EXPRESS MAIL ORDER SERVICE ON STOCK ITEMS

FAX
081 684 3056

A selection of our stocks of New Original Mullard - Brimar audio types made in UK.

STANDARD TYPES			SPECIAL QUALITY TYPES			
ECC88	MULLARD	6.00	E88CC - GOLD PIN MULLARD		8.50	
ECH81	MULLARD	3.00	ECC81 - M8162 / CV4024 MULLARD		6.00	
ECL86	MULLARD	3.50	ECC81 - 6201 / GOLD PIN MULLARD		8.50	
EF86	MULLARD	7.50	ECC82 - M8136 / CV4003 MULLARD		6.50	
EL84	MULLARD	6.00	ECC83 - M8137 / CV4004 BRIMAR		6.50	
GZ32	MULLARD	8.50	EF86 - M8195 / CV4085 G.E.C		10.00	
GZ34	MULLARD	12.50	AMERICAN TYPES GE.			
6SL7GT	BRIMAR	4.50	6146B.G.E	15.00	6L6GC G.E	12.50
6SN7GT	BRIMAR	4.50	6550A.G.E	17.50	12AX7A G.E	7.00
6V6GT	BRIMAR	4.25	7581A.G.E	12.00	12BH7A G.E	6.50
					12BY7A G.E	7.00

OPEN TO CALLERS MON.-FRI. 9AM - 4PM. CLOSED SATURDAY

QUOTATIONS FOR ANY TYPES NOT LISTED.

OVER 6000 TYPES AVAILABLE FROM STOCK

OBSOLETE ITEMS A SPECIALITY

TERMS C W O/VISA/ACCESS ETC...

P&P 1-3 VALVES £1.00, 4-6 VALVES £2.00 ADD 17.5% VAT TO TOTAL INC P+P



THE CROSSOVER

The crossover for this 'speaker had to be simple. More complex crossovers take power from the drive units, reducing sensitivity. Second order filters (6dB/octave) use few components (just two) and give a usable rate of roll off that,

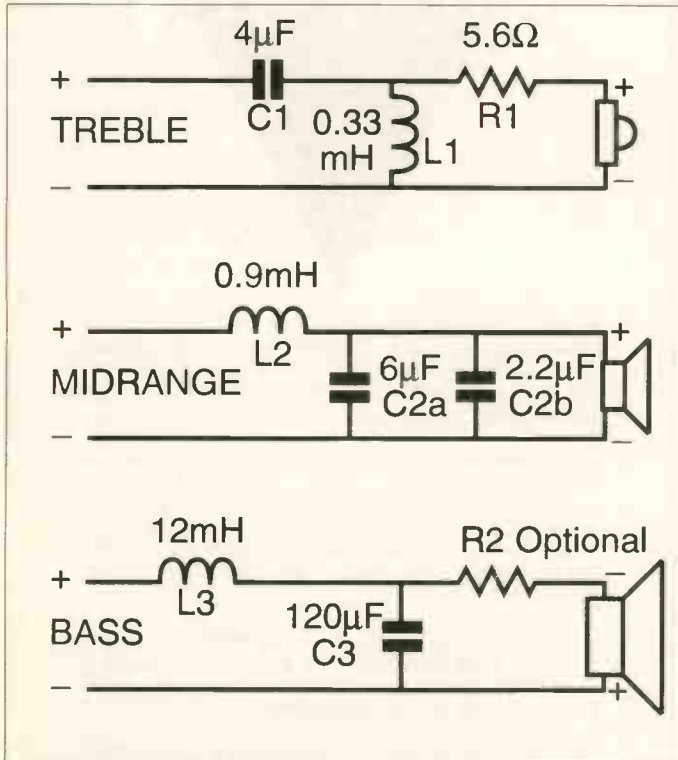
with careful alignment, is sufficient for good quality drive units.

The tweeter is fed from a second order high pass filter as shown in the circuit diagram below. The capacitor should be a high quality polypropylene, and the inductor air cored for cleanest and smoothest sound. A 5.6Ω resistor is used to attenuate the treble level down to match that of the midrange and bass, and it also helps to give a smooth impedance characteristic through the treble. This resistor gives a flat response to the loudspeaker, but it can be varied between 4.7Ω and 6.8Ω to suit personal tastes. The lower the value the brighter the treble will be.

Because the midrange cabinet was designed to mechanically roll off bass, no series capacitor is needed to filter any remaining bass from it. At the top end, a second-order low pass filter is used to roll off the upper midrange to match the tweeter. Use a high quality 2.2μF polypropylene capacitor in parallel with a 6μF Alcap for best results, along with an air cored inductor.

The bass driver is fed from a second order low pass filter. Both components have high values, so a reversible (bipolar) electrolytic capacitor has to be used, along with a high power ferrite cored inductor. If you find the bass too heavy in your listening room, a low value series resistor can be used to reduce the bass level, say between 1-3Ω.

Midrange-To-Treble Integration Frequency Response



TWEAKING KLS3

Apart from the crossover tweaks already discussed, there are several other things that will affect the overall sound.

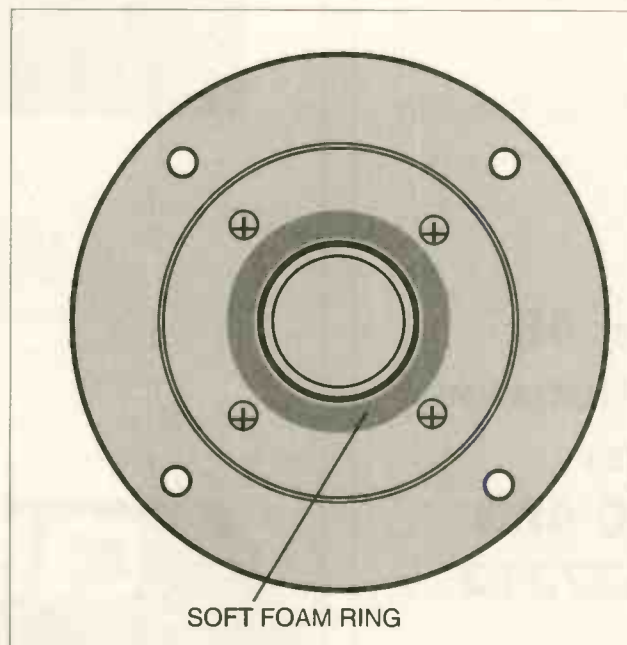
Firstly, the reflex ports can be made either longer or shorter to change the box tuning. Making the ports longer moves the tuning frequency downwards, giving a flatter and deeper bass response. But this will tend to excite small rooms, resulting in a boomy or overblown sound. In smaller rooms the ports should be shortened, which reduces bass depth and peaks bass higher up, giving more subjective speed and punch.

Spiking the cabinets to the floor with a suitable spike kit will improve bass definition too. Spike kits are available from most kit loudspeaker suppliers and from stand manufacturers such as Apollo and Target.

The tweeter used has a very wide dispersion characteristic.

This gives them a spacious sound, but cleaner, more precise treble can be had

by glueing a thin piece of soft foam around the dome of the tweeter to restrict its dispersion and lessen reflection of walls and ceiling. Images will also come into better focus too.



Being a three way speaker, KLS3 can be either single, bi or tri-wired. We'd recommend bi-wiring, connecting the tweeter and midrange together and driving the bass with a separate cable run. But for those with plenty of spare cable around, tri-wiring will bring a subtle improvement.

Good quality internal cable should be used to connect the crossover to the drive units, and because of the small quantity used it makes sense to use silver solder. We do not advise you to solder the wires to the tweeter however, as a touch to much heat will damage it.

**** DIY MOTIONAL FEEDBACK
SUBWOOFER KIT:- AVAILABLE
NOW!!****

Our unique circuitry samples the velocity of the speaker cone and the internal circuitry uses this signal to correct for speaker box errors, the result is extremely accurate and extended bass, unobtainable by other means. Feel the difference!! Our kit features,

- * Genuine - 3DB at 20HZ
- * Internal Power amp and filters, one board construction
- * Simple connection to existing systems, including variable top filter
- * Small 42L enclosure with no internal resonances
- * Dedicated to Audio, not an A/V compromise
- * 2, 200mm Diam Long Throw Drivers, 100DB output at 30HZ

Only £395.00 + £8.50 post and packing. Overseas add £30.00 Airmail, Cheques and PO's in £sterling only to:-

**Eurosonics, 48
Orchardside, Hunston,
Chichester,
Sussex PO20 6PQ
Tel:- 0243 537312**

**WHY BUY A NEW
C.D. PLAYER ?**

When you can transform the performance of your existing C.D. player, with the award winning DIGIT the D.A.C. at a truly incredible price of only £139.00 + £19.00 for the DIGIFLEX interconnect cable.

To quote Audiophile magazine, " its effect is remarkable. Add the Digit and the performance of the MARANTZ CD 52 SE which is already excellent for its price, leaps one stage further towards the magically true to life transparency, of two box players costing £1000.00 or more.

In recent What Hi Fi ?, Audiophile and HI-Fi Choice awards, Digit beat products costing 2 or 3 times the price - so don't be fooled in to paying more, it's not necessary.

To obtain DIGIT, with a money back guarantee, please telephone (0276) 451166 or complete the coupon below:



Please send more information on DIGIT including the POSITRON Power supply upgrade and dealer list.

I enclose a 1st class stamp

NAME _____

ADDRESS _____

POSTCODE _____

QED

QED Ltd, 45, High Street, Chichester, Sussex PO13 5QJ England

CONSTRUCTION

The cabinets are constructed from 25mm MDF, which results in a very solid and inert enclosure. It is easier and far quicker to cut all holes for drive units, ports, terminal dish etc before you start to glue the cabinet together. It also reduces the amount of dust inside the cabinets which can find its way into the open voice coils of the drive units. I glued all panels to produce a permanently sealed enclosure, subsequently inserting all items through the drive unit holes.

The plans below show the general construction. The speakers can conveniently be built up on one side panel, laid flat. After the front, rear, internal top and bottom panels are glued into position, I put on the other side panel and held it down with weights until

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

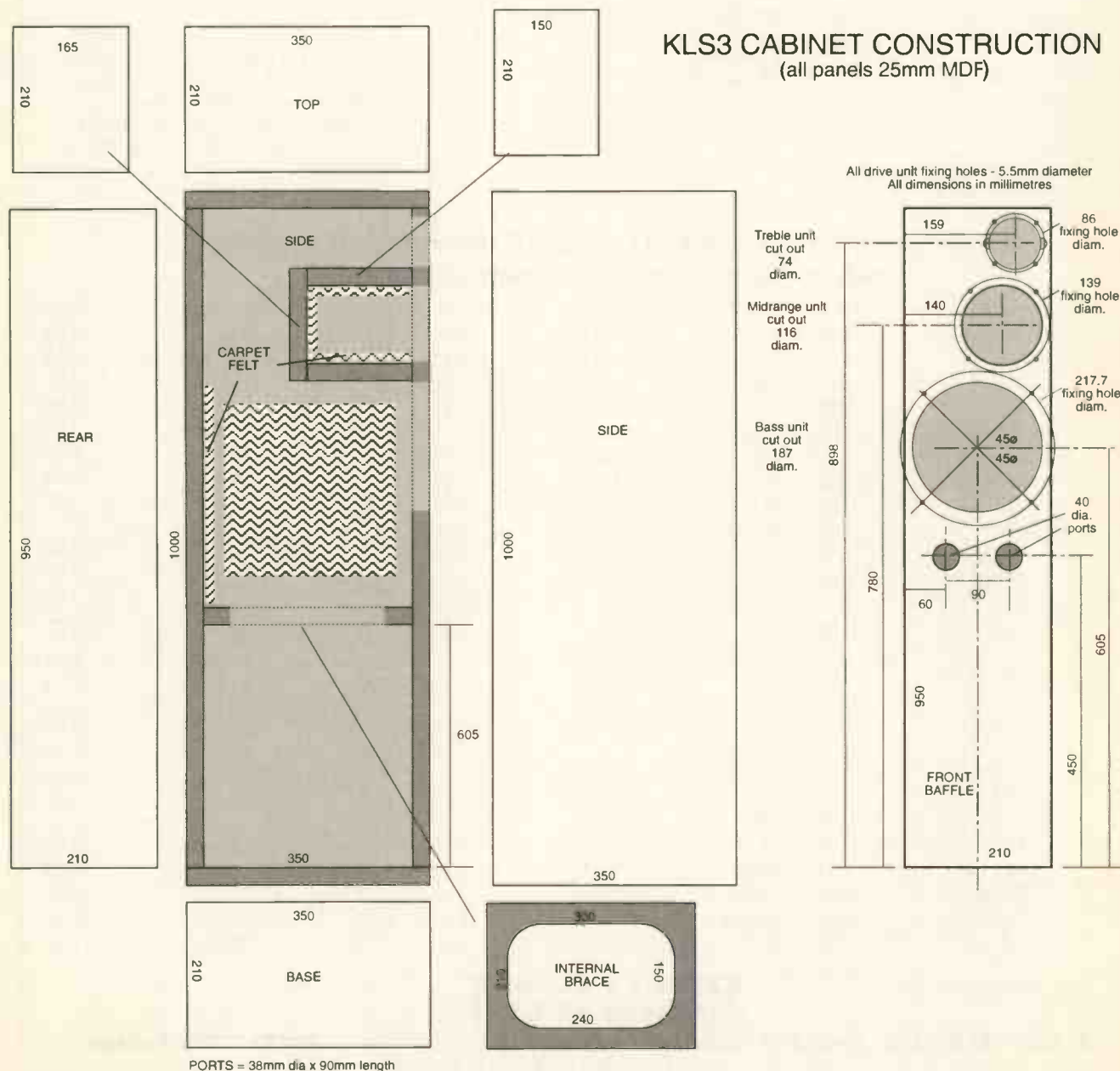
Using Evostick Resin-WV, apply the glue to the edges of the panels. They can then be slid into place, their 25mm thickness being enough to stand steady without panel pins. Any excess glue that oozes from the joins can be wiped away lightly with a damp cloth.

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

wet enough to allow the panels to be gently pushed into line.

Once the cabinets are dry - overnight is normally enough for the glue to reach full strength - they are ready for the internal damping to be fixed into place. Small squares of carpet felt should be glued to each of the surfaces in the midrange chamber, and onto the sides and back of the main bass enclosure. This helps to absorb the majority of the sound wave that would otherwise be reflected off the rear wall of the cabinet and back out through the drive unit.

The whole cabinet, including the midrange enclosure, is then lightly stuffed with long hair wool, to further absorb reflections and reduce the effects of standing waves. Of course, you are free to experiment with other forms of panel treatment: BAF and Deflex pads for





Golden Dragon

Precision Audio Tubes

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

RETAIL PRICE LIST

Golden Dragon Pre-Amplifier Tubes	Singles
6AQ8/ECC85	£6.50
12AT7A/E81CC/ECC81	£6.95
12AU7A/E82CC/ECC82	£6.95
12AX7A/E88CC/ECC83	£6.95
6DJ8/E88CC/ECC88	£10.95
6SL7GT/ECC35	£7.50
6SN7GT/ECC33	£8.95

Special Quality Golden Dragon Pre-Amplifier Tubes

Special Quality Golden Dragon Pre-Amplifier Tubes	Singles
E81CC-01 Gold Pins Low Microphony Low Noise	£10.50
E82CC-01 Gold Pins Low Microphony Low Noise	£10.50
E83CC-01 Gold Pins Low Microphony Low Noise	£9.50
E88CC-01 Gold Pins Low Microphony Low Noise	£14.50

Golden Dragon Triodes

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

Golden Dragon 300B Range

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

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

Golden Dragon Power Tubes

	Pairs	Quads	Octets
EL34/6CA7	£25.00	£50.00	£100.00
EL34L (Laminated EL34)	£29.95	£60.00	£120.00
EL84 (Special Quality EL84)	£12.50	£25.00	£50.00
6L6WGB	£25.00	£50.00	£100.00
KT66	£25.00	£52.00	£104.00
KT88 (New Design)	£57.95	£116.00	£232.00
KT88 Super (Laminated)	£67.95	£136.00	£272.00
*KT88 Special (Gold Plated)	£64.95	£136.00	£272.00
6L6GC	£19.95	£40.00	£80.00
6550A	£42.95	£86.00	£172.00
6550A Special (Gold Plated)	£64.95	£130.00	£260.00
50CA10	£84.95	£170.00	£340.00
807	£25.00	£50.00	£100.00

Ceramic Sockets and Hardware

	Standard	Gold Plated
Locking 4 Pin (300B etc.)	£6.95	£15.00
4 Pin UX4 (300B etc.)	£2.5	£3.50
Jumbo (211 etc.)	£14.50	£25.00
Octal Chassis (EL34 etc.)	£1.25	£3.50
Octal PCB (EL34 etc.)	£1.25	£3.50
B9A Chassis (pre amp)	£0.95	£2.50
B9A PCB (pre amp)	£0.95	£2.50
Screening Can & Skirt (pre amp)		£8.50
Damping Can (pre amp)		£4.50
Power Valve Retainer (EL34 etc.)		£5.50

High Quality Plastic Sockets and Hardware

B9A Chassis (pre amp)	£1.15
B9A PCB (pre amp)	£0.95
Octal Chassis (EL34 etc.)	£1.25
B7G Chassis (85A2 etc.)	£0.95
B9A Skirted Chassis	
Socket & Can (pre amp)	£1.75
Power Valve Retainer (EL34 EC.)	£1.95

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

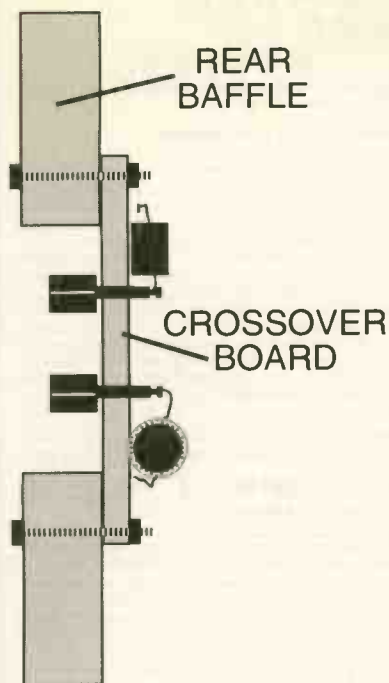
We have a vast range of tubes available from manufacturers all over the world including rare and vintage types. A 50 page booklet of valves available is updated monthly and can be provided at a cost of £2.50 per copy including U.K postage or you may telephone our Sales Desk for prompt a quotation.

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
ECC82	GE	4.50	M8162	MULLARD	8.50	6SN7GT	TEONEX	3.50
EC82	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	5Y3WGTA	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

EXPORT WELCOME CARRIAGE AT COST

P.M. COMPONENTS LTD., Springfield Enterprise Park, Springfield Road, Gravesend, Kent DA11 8HD, England
Sales Desk Tel: 0474 560521. Fax: 0474 333762



example. But we find that the combination of soft carpet felt glued to the panels together with long hair wool stuffing to be extremely good, as well as being cost effective.

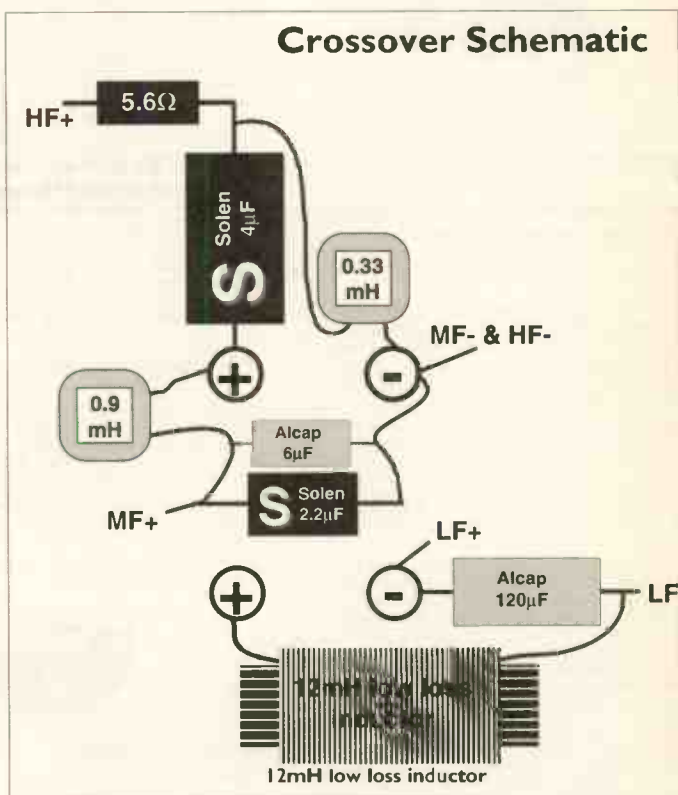
Mount the crossover as shown in the diagram above. Because inductors, being magnetic components, have a field around them, they need to be spaced well apart and at right angles to each other to minimise inductive coupling. Again, a recommended layout is shown below.

The components can be fixed to the crossover board with PVA glue, but I find a hot-melt glue gun holds them in place just as well, but the glue is more easily removable.

The wires for the midrange unit have to pass through a small hole in the midrange chamber. It is very important to seal this hole either with hot-melt glue or PVA. The drive unit can now be soldered to these wires and screwed into the front baffle. The tweeter should have wires attached using slide-on terminals to prevent heat damage from a soldering iron. The tweeter can then be fitted in, the wires passing down over the back of the midrange enclosure to reach the crossover positioned against the input terminals. A foam gasket made from draft excluder (you can get it in any hardware shop) should be stuck to the rear of the drive unit frames where they mate with the cabinet, to give a good airtight seal.

TESTING

A simple test to reduce the risk of any damage to your amplifier when you first plug in, is to check that the impedance of the loudspeaker with a simple multimeter. Using the resistance setting they should measure around 4Ω (their DC resistance) across the terminals. If there is a short anywhere, this simple test will show it with a reading below 1Ω .



SOUND QUALITY

An independent view by David Harris

On seeing the impressively large speakers which Dominic recently designed my initial feelings were that they would sound pretty dramatic, especially using high quality drive carbon fibre drive units. The lowest bass was reproduced with remarkable ease, possessing a nice, warm, rounded sound yet controlling the huge orchestral bass drum resonances heard on Stravinsky's Fire Bird suite extremely well. The bass remained both tuneful and rhythmic all of the time.

Vocals were handled very naturally, coming across as life-size with a nice crisp, dry edge to them. Seal could be visualised within the room when

performing Whirlpool from his debut album, the KLS3s putting almost no strain on his vocal talent. Choral work also had a wonderful openness about it; Mozart's Mass in C carried such atmosphere that the listening room expanded towards concert hall size with the '3s keeping a tight focus on soloists throughout the piece. The sheer breeziness of their overall character was excellent.

Listening to a Ronnie Cuber Live at the Blue Note (CD) highlighted another of these speakers strong points - rhythm. They kept a tight, foot-tapping pace going relentlessly, cymbals crashed with quartz-locked accuracy leaving you to play 'air drums' from your armchair!

The KLS3s have a sweet, open sounding treble which gives a high

definition to the midrange, painting a clear picture of the music. It could however be a little lightweight at times, cymbals occasionally lacking in body and depth, but all-in-all a welcomingly inoffensive, delicate sound was produced.

Imagery was particularly good. Vocalists and instruments had pin-point focus, generating a believable soundstage of excellent depth. On Seal's hit Killer the keyboards drifted their way in from about ten yards behind the speakers, as did his backing vocals, the sound filling the entire room.

To sum up, the KLS3s can best be described as a very open sounding speaker possessing excellent qualities of imagery and rhythm and give the listener a good deal of insight into the scale of the music being played.

HART

Hart Audio Kits - Your Value for Money Route to Ultimate Hi-Fi

2 Penylan Mill, Oswestry, Shropshire, England SY 10 9AF
phone Oswestry (0691) 652894

Hart Audio Kits and factory assembled units use the very best audiophile components in circuit designs by the renowned John Unslley Hood to give you unbeatable performance and unbelievable value for money. We have always led the field for easy home construction to professional standards, even in the sixties we were using easily assembled printed circuits when Heathkit in America were still using tagboards! Many years of experience and innovation, going back to the early Dinsdale and Bailey classics gives us incomparable design expertise in the needs of the home constructor. The current range of Hart kits is designed to give you the important core components of a system as a matching ensemble of audio excellence

1100 Series. LH80W "Audio Design" Mosfet Power Amplifier.



Another masterpiece from the drawing board of John Unslley Hood and another opportunity to give a system mega sound performance for only a few hundred pounds cost. A host of advanced features, in the hands of the skilled designer, give this amplifier a performance that really is only equalled, not exceeded, by the 4 or 5 figure price tagged exotica.

As always with a HART kit you have the pleasure of building selected, state of the art equipment, allied to the knowledge that your money has all been spent on quality components, you save all the costs of building and testing, plus the dealers margin on top of these by doing it yourself.

To give an idea of the measures taken to achieve ultimate quality and linearity in this amplifier each of the four output devices is only called upon to work at one NINETY-SIXTH part of its ultimate power rating.

We are proud to offer this latest John Unslley Hood masterpiece, the flagship of our range, which we believe is truly the ultimate design for the perfectionist, combining as it does the best circuit design, the best engineering and the best components, surely the only recipe for REAL sound fidelity. The HART KIT concept also makes it possible to build an amplifier with the facilities YOU want and we offer no less than three variations with options on the basic theme to suit your needs. One of these versions will, we feel sure, cater for your requirements. Should your requirements change at a later date then upgrades or alteration to a different version are no problem, try doing that to your High St store amplifier.

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 'Monobloc' 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 monobloc versions enable very sophisticated bi-amping and active crossover systems to be constructed.

K1100 Complete STANDARD Amplifier Kit, two power amplifier channels and one power supply module, direct input passive signal selector stage, Construction Manual and RLH11 Reprint.
SPECIAL DISCOUNT PRICE FOR COMPLETE KIT IS ONLY £395.21
A1100 Factory Assembled **£499.21**

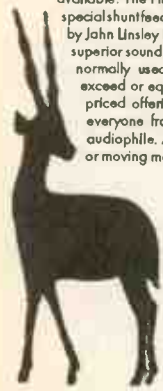
K1100S Complete SLAVE Amplifier Kit, as above but without passive input stage.
SPECIAL DISCOUNT PRICE FOR COMPLETE KIT IS ONLY £333.62
A1100SC Factory Assembled **£422.62**

K1100M Complete MONOBLOC Amplifier Kit, consists of all parts for one power amplifier channel and one power supply module and all chassis parts.
SPECIAL DISCOUNT PRICE FOR COMPLETE KIT IS ONLY £261.20
A1100M Factory Assembled **£329.20**

All HART kits are designed for easy home construction to the very highest standards, and can be built by anyone of average manual ability. If you are still not convinced how easy it is to build it yourself with a HART kit you can order the Instruction Manual to read for yourself and we will refund the cost when you buy your kit!

PROBABLY THE LAST VINYL PREAMP YOU EVER BUY.

For those who love the vinyl medium the listening pleasure can only be enhanced by using the very best phono preamplifier available. The Hart range of phono preamps feature a special shunt feedback circuit topology and are designed by John Unslley Hood. This circuit format gives audibly superior sound to the standard series feedback system normally used and gives a performance that will exceed or equal that given by the best of the mega priced offerings. Our range includes units to suit everyone from the occasional user to the serious audiophile. All can be changed to suit moving coil or moving magnet cartridges at the flick of a switch.



K1500 Series. This is an integrated circuit version of the shunt feedback concept, using so little power that it may be run from



batteries. An ideal "first kit" project as it is very simple to put together and no mains voltages are involved.

K1500 Complete Kit With Full Instructions (Battery Powered) **£73.76**
A1500 Factory Assembled **£118.76**

K1450 Features a totally discrete component implementation of the Shunt Feedback concept. Audiophile grade components fitting to an advanced double sided printed circuit board make this a product at the leading edge of technology that you will be proud to own. Nevertheless with our step by step instructions it is very easy and satisfying to assemble. Due to the higher current consumption this unit is powered by our mains driven K1565 Audio Power Supply. Itself an advanced piece of technology in a matching case. This supplies the superbly smoothed and stabilised supply lines needed by the preamplifier and features a fully potted Hi-grade toroidal transformer along with a special limited shift earth for hum free operation. Suitable for all moving coil and moving magnet transducers this unit is especially recommended for, and will extract the very best from the modern generation of low output high quality transducers.

K1450/1565X. Complete RIAA Phono preamplifier, Power Supply and power connect cable Kit form **£196.29.**

1450/1565X Factory assembled & tested. **£285.29.**

ALPS PRECISION LOW-NOISE STEREO POTS

Now you can throw out those noisy ill-matched carbon pots and replace with the real hi-fi components only used selectively in the very top flight of World class amplifiers. The improvement in track accuracy and matching really is incredible giving better tonal balance between channels and rock solid image stability.

On the motorised versions the 5v DC drive motor is coupled to the normal control shaft with a friction clutch so that the control can be operated manually or electrically.

Our prices represent such super value for pots of this quality due to large purchases for our own kits.



MANUAL POTENTIOMETERS

2-Gang 100K Lin **£15.67**
2-Gang 10K, 50K or 100K Log **£16.40**
2-Gang 10K Special Balance, zero crosstalk and zero centre loss **£17.48**

MOTORISED POTENTIOMETERS

2-Gang 20K Log Volume Control **£26.20**
2-Gang 10K RD Special Balance, zero crosstalk and less than 10% loss in centre position **£26.98**

PRECISION Triple Purpose TEST CASSETTE TC1DD.

Are you sure your tape recorder is set up to give its best? Our latest triple purpose test cassette checks the three most important tape parameters without test equipment. Ideal when fitting new heads a professional quality, digitally mastered test tape at a price anyone can afford.

Test Cassette TC1DD Our price only **£10.99.**

DISK-COUNT Classical CD's.

Top quality, Full Digital (DDD) Compact Disks of the great classical favourites. Like everyone else we didn't like the idea of paying silly prices for CD's. After a long search we have now located a source of top quality classical recordings at prices that make you suspect the quality - until you try them! Send for our list of titles.

TECHNICAL BOOKSHELF

Modern Books. Selected to represent the state of the art today.

"THE ART OF LINEAR ELECTRONICS."

J.L. Unslley Hood.
Just Out! Hot Off the Press, the definitive electronics and audio book by the renowned John Unslley Hood. This 300+ page book will give you an unparalleled insight into the workings of all types of valve and solid state audio circuits. Learn how to read circuit diagrams and understand amplifiers and how they are designed to give the best sound. The virtues and vices of passive and active components are examined and there are separate sections covering power supplies and the sources of noise and hum. As one would expect from this writer the history and derivation of audio amplifier circuitry have an entire chapter, as does test and measurement equipment. Copiously illustrated this book is incredible value for the amount of information it contains on the much neglected field of linear, as opposed to digital, electronics. Indeed it must be destined to become the standard reference for all who work, or are interested in, this field.

SPECIAL OFFER. With each book purchased you may request a FREE extended index, written by the Author, exclusively from HART. 0-7806-0868-4 **£16.95**

Don't forget most of our kits have reprints of articles by John Unslley Hood that you can purchase separately.

"DIGITAL AUDIO AND COMPACT DISC TECHNOLOGY"

2nd Edition. Boett, Theunissen and Vergult. (SONY Europe)
A thoroughly well written book covering the field of recording media starting with the Phonograph right through to modern professional PCM digital recording systems with particular and extensive coverage on the compact disc. All aspects of the recording and reproduction processes are explained with separate chapters on such things as compact disc encoding and the use of cross interleave Reed-Solomon error correction code (CIRC). This book is of course essential reading for engineers and students involved in the field but its very low prices makes it ideal for the enthusiast of recorded music who wants to know more about the hidden processes going on in his CD player.
1992/94 248 Pages. 247 x 190.
0-7506-0614-2 **£17.95**

"THE LOUDSPEAKER DESIGN COOKBOOK" Vance Dickason. (4th Edn.)

All the information you need to build the loudspeaker system you always wanted but could not afford. Easy ways to pick the exact box size, the ideal drivers, and the correct way to feed the music to your new super loudspeaker system. Over 140 pages packed with important design data.

1991. 152 Pages.
0-9624-191-7-6 **£22.95**

"THE ART OF SOLDERING"

R. Brewster.
Absolutely essential reading for anyone who ever picks up a soldering iron. Written from knowledge gained in a lifetime in the field, this is the first book ever solely devoted to this essential and neglected skill for all electronic enthusiasts. Covers everything from the correct choice of soldering iron and solder to the correct procedures to follow with many illustrations and practical exercises.
0-85935-324-3 **£3.95**

Postage on Single Books is £1.50 except for The Art Linear Electronics, Digital Audio and Compact Disc Technology and The Loudspeaker Design Cookbook which are £3.50. Two, or more books are only £4.50, any size, any quantity.

Classics from the "Golden Age"

"THE WILLIAMSON AMPLIFIER."

D.T.N. Williamson.
In April 1947, Williamson's power amplifier, using excellent quality push/pull output valves, a special output transformer, and a highly filtered power supply, became an overnight success. The author takes the reader deep into his design considerations, offering practical advice on how to build the units plus concise instructions on setting up the new amp. A cult classic.

1947, Reprinted 1990. 40 Pages.
0-9624-1918-4 **£6.95**

LOUDSPEAKERS; THE WHY AND HOW OF GOOD REPRODUCTION. G.A. Briggs This easy-to-read classic, last revised in 1949, introduces the reader to concepts such as impedance, phons and decibels, frequency response, response curves, volume and watts, resonance and vibration, cabinets and baffles, horns, room acoustics, transients, crossovers, negative feedback, Doppler and phase effects, and much more. A provocative survey of the right questions about sound reproduction.

1949 Reprinted 1990. 88 Pages.
0-9624-1913-3 **£8.95**

Send or phone for your copy of our FREE list of these and many other Kits & Components. Enquires from Overseas customers are equally welcome, but PLEASE send 2 IRCs if you want a list sent surface post, or 5 for Airmail. Ordering is easy. Just write or telephone your requirements to sample the friendly and efficient HART services. Payment by cheque, cash or credit card. A telephoned order with your credit card number will get your order on its way to you THAT DAY. Please add part cost of carriage and Insurance as follows: **INLAND Orders** up to **£20 - £1.50, Order over £20 - £3.50. Express Courier, next working day £10. OVERSEAS - Please see the ordering information with our lists.**

QUALITY
AUDIO KITS

24hrs. SALES LINE
(0691) 652894

ALL PRICES
INCLUDE
UK/EC VAT

HART

PARTS LIST

WARNING

Be extremely careful when screwing drive units in and out of the cabinets. One slip with a screw driver and they're useless. We recommend using cross head screws which reduce the chance of this happening.

Do not try and solder wires to the terminals on the tweeter. They are mounted on plastic which will melt if too much heat is applied, and the fine wires connecting the voice coil will vaporise, rendering the unit useless. Use small push-on receptacle clips.

Drive Units

Tweeter	Audax TW025M1
Midrange	Audax HM130C0
Bass	Audax HM210C0

Crossover

R1	5.6Ω*/5W, non-inductive
R2	1-3Ω*/10W
C1	4μF polypropylene/50V min.
C2a	6μF Alcap/50V
C2b	2.2μF polypropylene/50V min.
C3	120μF Alcap/100V
L1	0.33mH air core (0.71mm wire)
L2	0.9mH air core (0.71mm wire)
L3	12mH ferrite core (0.5Ω)

*R1 can be raised or lowered to set treble level to individual taste. R2 is optional and can be used to attenuate bass in rooms where it may become overblown.

Reflex Ports

38mm diameter x 85mm length.

MEASURED PERFORMANCE

Using our standard third-octave analysis with a pink noise test signal the frequency response shown below is very flat and smooth. There is a small dip around 1kHz which can be seen more clearly on the high resolution near-field plot on page 9. It is not a crossover dip, more likely a cancellation caused by the rubber cone surround of the midrange unit.

This kind of smooth and flat frequency response was obtained by first using computer crossover and cabinet analysis packages, and then fine tuning with our FFT spectrum analyser. Of course, tuning was combined with listening tests to ensure that the result was subjectively an improvement.

The second frequency response plot shows the effect that driving KLS3 with a high output impedance (6Ω) amplifier would have, such as our own 300B zero-feedback valve amplifier. The midrange is pushed forwards slightly because of the impedance hump at this point, but still remains essentially flat.

The impedance curve is again very smooth, part of the aim of the design. This ensures that response variations due to high amplifier output impedance is kept to a minimum. The overall impedance figure of 9Ω and high 90dB sensitivity show what an easy load KLS3 is to drive.

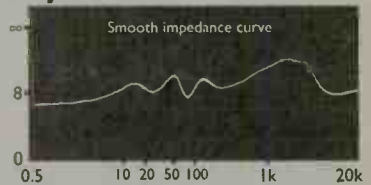
KLS3 is suitable for a wide range of amplifiers including specialised designs with

zero feedback. I'd suggest a minimum of 20watts for good sound level in a normal sized listening room. **DB**

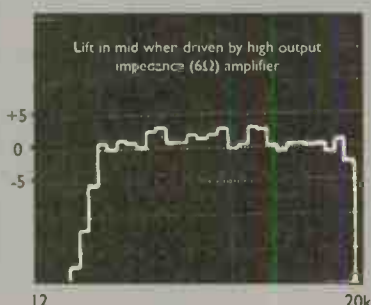
Frequency Response with Low Output Z Amplifier



Impedance



Frequency Response with High Output Z Amplifier



A pack of KLS3 drive units is available for £220. See page 17 for details.

SPEAKER KITS FROM IPL ACOUSTICS

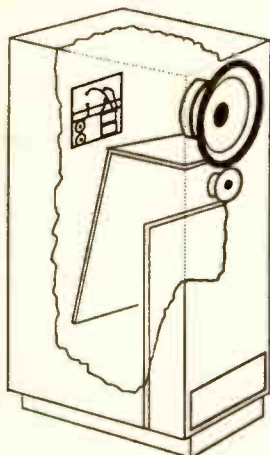
Over a 5 year period I.P.L. Acoustics have developed a range of high quality speaker kits, using the best units from SEAS, MOREL, AUDAX, VISATON and I.P.L. and have produced a comprehensive range of speakers which will compete with the most expensive of commercial designs. All speakers have BIWIRED crossover kits containing high quality components and terminals.

AS6 PANEL KIT



PLUS KIT.....£262.77
PANEL KIT.....£302.77

FOUR TRANSMISSION LINE KITS



TRANSMISSION LINE
PLUS KIT
£167.00 - £280.00

M3TL



PLUS KITS.....£167.00
TOTAL KIT.....£226.00

A2 RIBBON KIT



PLUS KIT.....£222.00
TOTAL KIT.....£291.00

M2 MINI-MONITOR



PLUS KIT.....£166.00

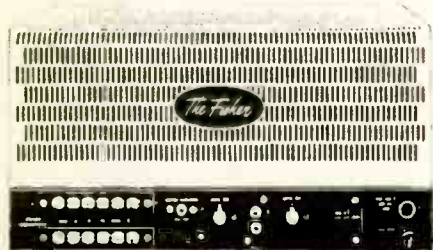
PRE-VENEERED CABINET NOW AVAILABLE. Cargaage charge extra on all kits.

If you would like further details please send £1.50 for 36 PAGE SPEAKER BUILDING CATALOGUE, comprising VALUABLE ADVICE on DESIGNING, BUILDING and TESTING speakers and full technical specifications including response curves of eight kits, drive units, and details of SPECIALIST CABLES and ACCESSORIES

I.P.L. Acoustics, 2 Laverton Road, Westbury, Wiltshire, BA13 3RS. Tel: 0373 823333



FISHER SA-100



This very attractive stereo amp provides 17 1/2 watts per channel, a centre channel output for connection to a new amp, input level adjustments, easy to use bias adjustments, as well as AC and DC adjustments. This is all under a lovely brass cage on a solid copper chassis. With an efficient speaker this is a marvelous amplifier.

Dynaco, Sherwood, Scott, The Fisher, McIntosh, Eico, Harman-Kardon, Heath, Altec, Stromberg-Carlson

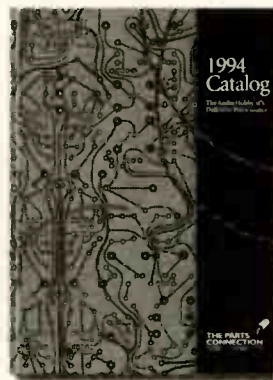
Prompt Insured Delivery. Vintage Parts Available on Request

Looking for a particular piece of vintage equipment?
Send Us Your Requests.

FAX: (604) 876-5876

P.O. BOX 147, STATION A, VANCOUVER, B.C.
CANADA V6C 2M3

To make the most of your projects,
start with the right tool.



Get connected with the widest selection of audiophile grade parts. Send £3* along with your mailing address and you will receive our 1994 parts catalogue and a \$10 discount** coupon good on your first order over \$100.

THE PARTS CONNECTION

A DIVISION OF SONIC FRONTIERS INC

2790 Brighton Road, Oakville, Ontario, Canada L6H 5T4 Tel: (905) 829-5858
Toll Free Order Line 1-800-769-0747 (U.S. & Canada only) Fax: (905) 829-5388

MIT MultiCap • Wonder Cap • Kimber Kap • Solo • Solen • Siemens
Hovland MusiCap • Wima • Holco • Rel-Cap • Draloric • Vishay • Caddock • Mills
Matsushita • TKD • Noble • Cardas • Kimber Kable • Discovery • Audioquest • MIT
ClearAudio • Alps • Bourns • Shalco Attenuators • Elma • Electros witch • Nichicon
Gold Aero • RAM • Mallory • Ruby Tubes • Edison Price • Linear Technology
Motorola • Analog Devices/PMI • International Rectifier • MagneQuest • Pearl
Sonic Frontiers • Tube Sockets • WBT • Neutrik • Curcio Audio Engineering • Kits

*or \$5.00 US, or credit card information
**catalogue pricing and discounts are in US Dollars



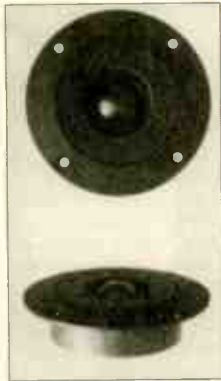
High Technology Drive Units From Audax

At last, a chance to get your hands on the latest drive unit technology and materials. We'll be stocking a small range of quality drive units from specialist manufacturer AUDAX, including the carbon fibre units and fabric dome tweeter used in the kit KLS3 design in this supplement. All of the units selected below have been picked for high performance in domestic hi-fi loudspeakers. The cone drivers have solid cast chassis and gold plated terminals.

All of the units are supplied with full specification sheets complete with suggested bass alignment. Most units are held in stock for fast delivery. (Please phone to check).

TWEETERS

TW025M0 (25mm) £15
Sensitivity 92dB
Power 55watts
Recommended range 1kHz-20kHz
Comments: Good for two-way systems with 8inch bass units.



TW025M1 (25mm) £16
Sensitivity 92dB
Power 70watts
Recommended range 2.5kHz-20kHz
Comments: Suitable for three-way systems or with 6.5inch bass units.

TW034X0 (35mm) £25
Sensitivity 93dB
Power 70watts
Recommended range 700Hz-20kHz
Comments: Use in sensitive two-way systems with 8-10inch bass units.

CARBON FIBRE UNITS

HM130C0 (4inch) £40
Sensitivity 90dB
Power 50watts
Recommended range 100Hz-5kHz



Comments: Excellent mid-range unit in three-way systems.

HM170C0 (6.5inch) £45
Sensitivity 91dB
Power 60watts
Recommended range Bass-3kHz
Comments: Modern driver for high quality two-way systems.



HM210C0 (8inch) £55
Sensitivity 91dB
Power 70watts
Recommended range Bass-1.5kHz
Comments: Light and fast driver suitable for two-way or as dedicated bass in three-way systems.

HIGH DEFINITION AEROGEL UNITS

HM130Z0 (4inch) £45
Sensitivity 93dB
Power 50watts
Recommended range 200-5kHz
Comments: Ultra stiff and light mid-range unit for three-way systems.

HM170Z0 (6.5inch) £50
Sensitivity 92dB
Power 60watts
Recommended range Bass-3kHz
Comments: Modern light and fast unit for two-way systems.

HM210Z0 (8inch) £60
Sensitivity 91dB
Power 70watts
Recommended range Bass-2kHz
Comments: Crisp and dynamic bass for two- or three-way systems.

DOPED PAPER UNIT

HM170G0 (6.5inch) £35
Sensitivity 91dB
Power 60watts
Recommended range Bass-3.5kHz
Comments: Cast chassis doped paper unit with smooth response.

AUDAX DRIVE UNITS

PRICE LIST AND ORDER FORM

Qty	
<input type="checkbox"/>	TW025M0 (25mm) .....£15.00
<input type="checkbox"/>	TW025M1 (25mm) .....£16.00
<input type="checkbox"/>	TW034X0 (34mm) .....£25.00
<input type="checkbox"/>	HM130C0 (4inch) .....£40.00
<input type="checkbox"/>	HM170C0 (6.5inch) .....£45.00
<input type="checkbox"/>	HM210C0 (8inch) .....£55.00
<input type="checkbox"/>	HM130Z0 (4inch) .....£45.00
<input type="checkbox"/>	HM170Z0 (6.5inch) .....£50.00
<input type="checkbox"/>	HM210Z0 (8inch) .....£60.00
<input type="checkbox"/>	HM170G0 (6.5inch) .....£35.00
<input type="checkbox"/>	KLS3 Driver Pack .....£220.00

All prices are exclusive of postage & packing. For U.K. please add £5.75 for a pair of tweeters or one chassis unit, and £10 for anything above. Overseas please contact us for rates.

I enclose cheque/PO for £ made payable to
World Audio Design Ltd.

I wish to pay by Visa/Access, please debit my account no:

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Expiry date:

--	--	--	--	--

Name.....

Delivery Address.....

N.B. If delivery address is different to the credit card holder's, please supply both.

Tel:.....

Please send completed order form together with your cheque/PO to:

WORLD AUDIO DESIGN,
64 Castellain Road,
Malda Vale,
London W9 1EX.

Please allow 28 days for delivery





JORDAN JX Series

Congratulations to the rest of the world - you're finally waking up.

E.J. Jordan Designs has been working with metal cone loudspeakers for over 40 years. We've tried and rejected avenues other manufacturers are still exploring today and our JX Series of drive units represent the cutting edge of loudspeaker technology.

Our design services, supported by in-house R & D facilities and unmatched experience have been commissioned by a number of major high end clients at home and abroad.

Our JX Series of foil cone drivers are now available world wide, from ourselves or our appointed agents.

Please contact us for colour brochure.

E.J. JORDAN DESIGNS

The Dak, Manorbier, Tenby, South Pembrokeshire, SA70 8QR. Tel: 0834 871209 Fax: 0834 871770

Seas Loudspeakers



Seas 11F-M

At SEAS, we take pride in working according to the highest standard. We put a lot of effort into speaker design, using materials and techniques which give the best audible results even if this means time consuming and painstaking production processes. Many critical parts are produced in-house some of which made by special purpose machinery designed and built by Seas. Quality is a key word in every aspect of our activity. We monitor the quality of the parts and materials which we purchase, and of the parts and operations made in-house. We use sophisticated equipment and highly trained and experienced personnel to check that our finished products meet their specifications.

U.K. Trade Distribution:

Radio Components Ltd., 428 Whippendell Road, Watford, Herts.

Tel: 0923 - 250665 Fax: 0923 - 250188

TABULA RASA LOUDSPEAKERS



"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."

(Hi-Fi World - Dec '93 on CT77 loudspeaker kit)

With the increased popularity of "do it yourself" hi-fi, Tabula Rasa are offering an extensive range of quality loudspeaker kits and car audio kits from top German manufacturer Mainhattan Akustik.

All loudspeakers kits are simple, fun to build, and at prices to suit

all pockets. Each kit comprises drivers, filters, connections, terminals, and all the necessary fittings needed to complete your chosen loudspeaker, and every kit is available with or without cabinets. Furthermore, each kit comes with a 10 year warranty as standard and will be delivered within 14 days of confirmation of your order. For a catalogue (including price lists and a brief guide to speaker construction) please send £2.00 (refunded after first kit purchased) and a self addressed A4 envelope to:

Tabula Rasa, 136 Kilnwood, Walters Ash, High Wycombe, Buckinghamshire, HP14 4UR, Tel 0494 565116

Cheques and postal orders should be made payable to Tabula Rasa.

Trade prices available on request.

30 days money back guarantee offered on all drivers & kits.

Wilmslow Audio



As any discerning sound engineer will tell you, the ATC SCM50 and 100 are the ultimate in accurate low distortion professional monitoring. But what they may not know is that self assembly versions based on these classic monitors are now available from the UK's leading speaker kit supplier, Wilmslow Audio, at a fraction of the ready built price. ATC and Wilmslow Audio have worked very closely on the cabinet and crossover design to ensure that the completed kit lives up to the very high standards associated with the ATC name. As with all Wilmslow products, the ATCK50 and K100 kits come complete with precision machined cabinet panels, crossovers, and all necessary hardware, including

factory matched ATC drivers. Cabinet parts are machined from high grade MDF for easy assembly and consistent acoustic performance. ATC's MK I Tri-Amp Pack systems are available as an option if required.

- The Result . . .**
- Stunning accuracy and clarity
 - Clean well damped bass
 - Smooth detailed treble
 - Totally transparent mid range
 - No overdraft!!!

If you aspire to the unrivalled quality of ATC monitoring, but are working to a tight budget, contact Stephen Leigh who will be pleased to tell you exactly how economical these kits are. ATCK50s and 100s are on demonstration by appointment.

Wilmslow Audio Limited, Wellington Close, Parkgate Trading Estate, Knutsford, Cheshire, WA16 8DX, England. Tel: (0565) 650605 Fax: (0565) 650080

THE WILLIAMSON AMPLIFIER

A compilation of original articles describing a classic valve amplifier, reviewed by Noel Keywood.

Theo Williamson worked for M.O. Valve Co after the war. He designed his renowned amplifier in 1947 and modified it in 1949, its claim to fame being very low distortion - a magical 0.1% figure - for what was, then, high power output (15watts). The output tubes are KT66s, Kinkless Tetrodes from

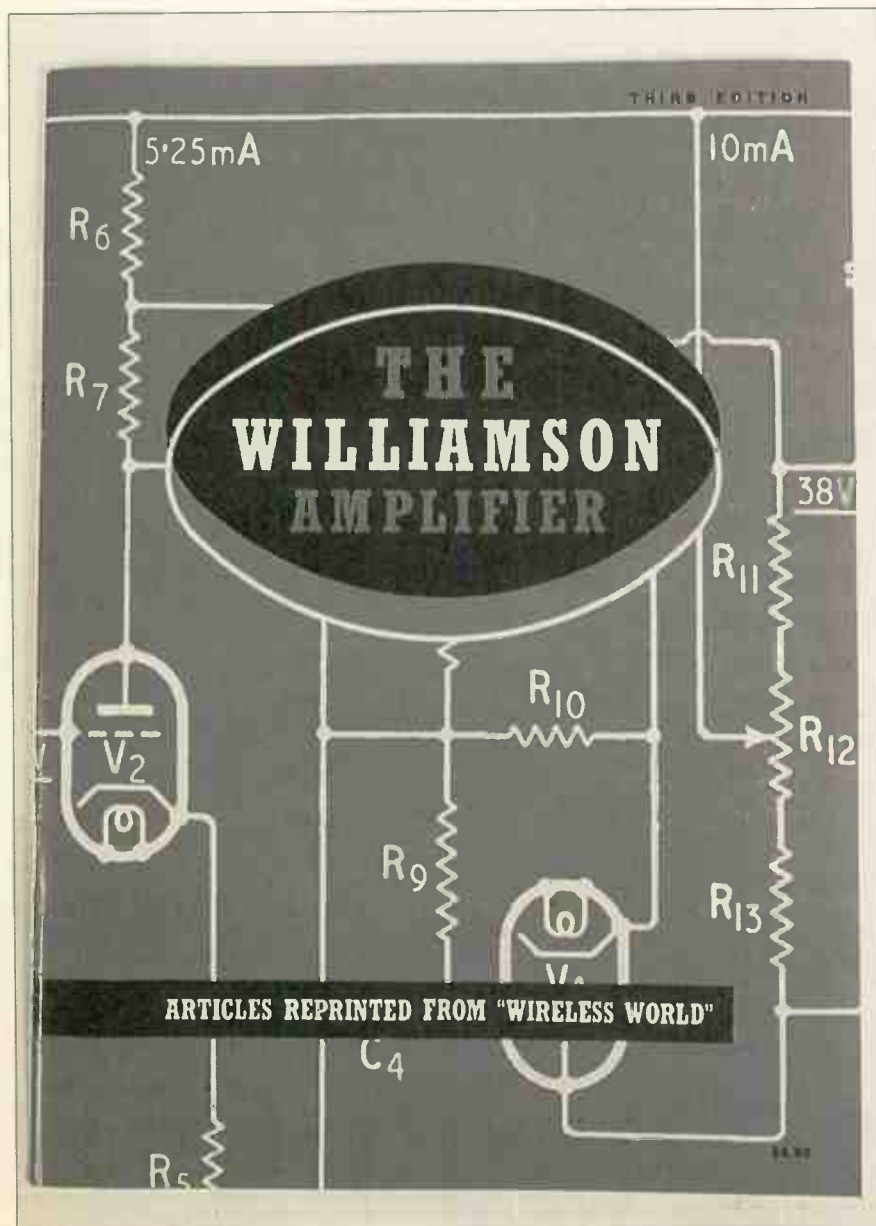
GEC now made in China and available from P.M. Components. The design was published in *Wireless World* and became well known in both America and Britain. It relied on the use of negative feedback globally applied, being one of the first amplifiers to do so. As such, it was something of a pioneering design,

discussing concepts such as open-loop gain and stability criteria, doubtless helping a lot of design engineers reach an understanding of such matters in the process.

This 40 page book reprints his original design and a later modified version, plus answers to readers queries, circuits for tone controls, a radio feeder unit and even a cartridge pre-amp. It's the discussions of theory gathered together in one compact source that makes this book valuable and absorbing. Williamson also includes some transformer design equations, as well as winding data and section connection details - rare but valuable information that I've otherwise seen only in the increasingly costly and rare *Radio Designers Handbook* (long out of print). Since the real secrets of a good audio transformer lie in the way its sections are arranged, something we pore over for hours here to ensure our in-house designs reach high standards, especially in the notoriously difficult inter-stage driver transformer for example (300B), this book carries some real nuggets.

However, many people will also want to know what sort of amplifier they will end up with, should they build Williamson's design. In my view, it isn't ideal for beginners; Mullard came up with a simpler equivalent in the later 5-20 and we've produced an even simpler and more robust design in K5881 that also delivers 20watts at 0.1% distortion from kinkless tetrodes with global feedback. However, whether you do or do not intend to build the actual amplifier - and I know many people who've enjoyed doing so, even if one did gripe about latent instability and the difficulty of optimising phase compensation to avoid oscillation - the book itself is a delight from the period. It contains quantities of valuable information not now available anywhere, except in treasured hoards. So in reprinting this information, Old Colony Sound Lab of the States have made available the wherewithal for audio enthusiasts to once again get really involved in their pastime - and that's why we've chosen to sell this book in Britain ●

**Available from Hi-Fi World,
see page 101.**



THE ART OF LINEAR ELECTRONICS

BY JOHN LINSLEY HOOD

At last! A book devoted to hi-fi design.

Noel Keyword gets reading.

As good books on audio gradually become scarcer, new ones of merit grow commensurately more valuable. The Art of Linear Electronics has many unusual attributes that mark it out as unusual and, nowadays, peculiarly valuable.

The author, John Linsley Hood, has been involved in audio design all his life, starting off with valves, he told me. Since much of this was within industry, the book is studded with valuable insights into

apparently obscure practical concerns such as 'properties of switch and connector contact metals', in chart and discussion form. Not interested? Well, hold on. He builds on this by discussing capacitor and resistor construction, which is of growing importance in real hi-fi as we find that this factor, in conjunction with the materials used, has quite a significant affect upon sound quality in any circuit that is otherwise working well. Future engineers also need to be aware of such

practical concerns as switch contact oxidation, which can blight a production run by warranty claims just a few years after purchase as products become unuseable.

Pondering on the way mass produced Oriental amplifiers seem almost by magic to go wrong after two or three years, whether this is deliberate in order to stimulate sales and what sort of long term damage may result in terms of perceived reliability, I value Linsley Hood's coverage of this topic. It's one important way in which his book differs from others, especially the otherwise superb Foundations of Wireless and Electronics by M.G. Scroggie.

Few modern electronics books bother to cover valves, yet this one penetrates quite deeply even into valve construction, coating materials, etc

which was another surprise. And it includes valve amplifier theory and circuits, discussing with circuit diagrams the Quad II, McIntosh and Williamson circuits, for example.

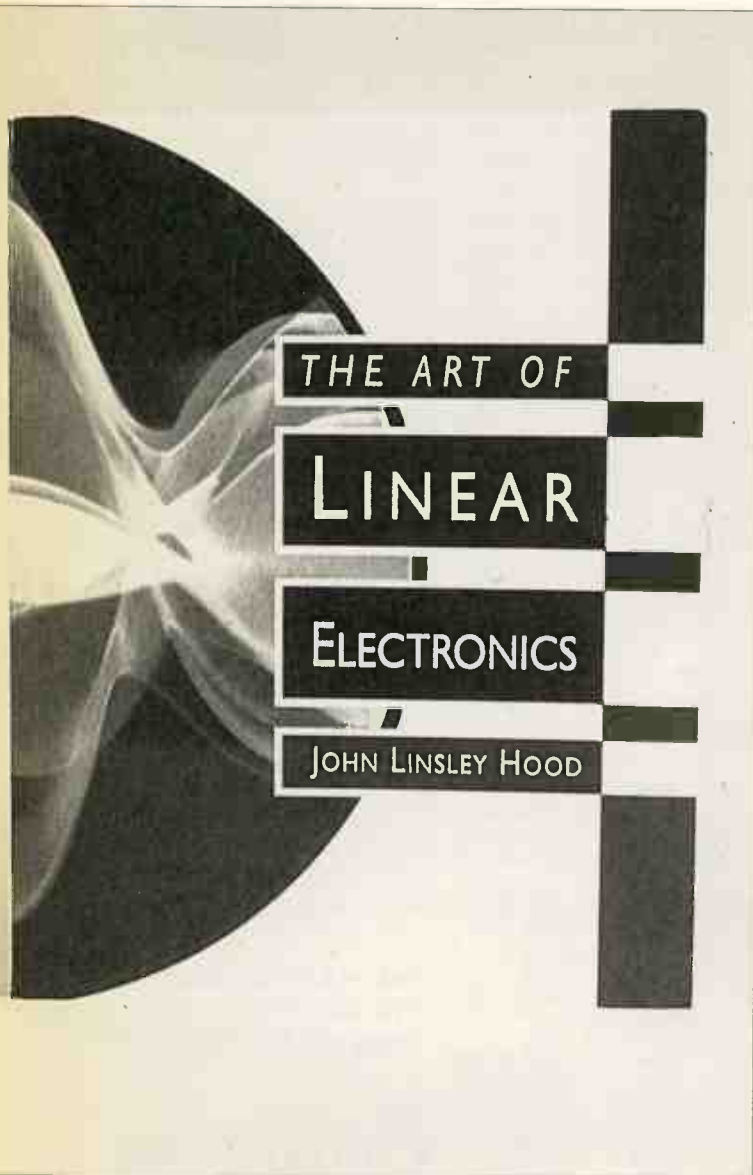
However, Linsley Hood understandably and correctly in my view dedicates most of the book to modern solid state engineering techniques in audio, devoting an entire chapter to 'Feedback, negative and positive', for example. It is in this way that the book reveals its strictly audio perspective, hi-fidelity being very much to the fore, rather than just functional Consumer Electronics.

And that's another way in which the book is unusual - there are many books of a tutorial nature that discuss audio amplifier design, but with no special emphasis on designing for optimum sound quality. With his background in designing audio circuits for Wireless World magazine, John Linsley Hood is well acquainted with audio angst and argument, although the book keeps its feet on the ground in sheer engineering terms; silver foil capacitors and cables don't enter the picture.

MOSFETs are discussed, although I see a comment to the effect that they possess "relatively high linearity", whereas audio designers of considerable experience - notably Tim de Paravicini (EAR) and Stan Curtis (Cambridge, Wharfedale, et al) - tell me otherwise. MOSFETs, I am told, have to be swamped by negative feedback, to which they are amenable due to their excellent gain/bandwidth product, before looking at all decent in audio terms. The book doesn't quite reach this level of detailed analysis and argument, but then that was doubtless not in its remit. It does cover an immense amount, including test equipment, noise and hum, tuned circuits and radio receivers, power supplies, component marking conventions and circuit impedance and phase angle calculations using the J operator.

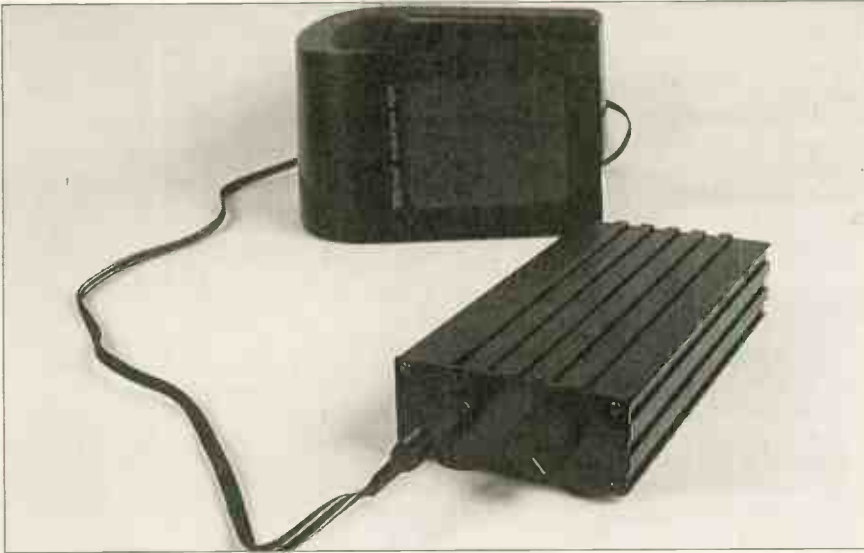
Because of its rare, almost unique nature - I know of no other dedicated hi-fi design book - The Art of Linear Electronics is, for engineers or budding engineers, invaluable. At £16.95 (soft cover), when nearest equivalents lie in the £30-£80 range these days, it's also an extreme bargain in my view ●

Available from bookshops or Hi-Fi World, see page 101.



HIGH QUALITY HEADPHONE AMPLIFIER

**A high-quality, single-ended Class A headphone amplifier
designed and explained by Richard Brice.**



High-quality loudspeakers deserve a high-quality amplifier to drive them. In just the same way, high-quality headphones deserve their own dedicated amplifier designed to furnish them with the cleanest signal that it is practically possible to supply. Sadly, headphone amplifier stages in hi-fi separates, where they exist at all, are often engineered with an eye to simplicity and low cost, rather than with a view to providing an exemplary mini-power-amplifier. Because that's what a headphone amplifier really should be and it ought, therefore, to have as much care and attention-to-detail lavished upon it as a designer would when developing a state-of-the-art loudspeaker power amplifier. In fact, arguably more so, because the signals which headphones require are smaller in relation to the amount of distortion products certain amplifiers produce. This article describes my own design for a stand-alone, single-ended, Class-A transistor headphone amplifier.

CLASS ACT

I must confess to a personal liking for valves. This isn't so much based upon sound quality judgements as more general aesthetic considerations - bluntly, they look great! You'd have to have a

heart of cold steel to not admire serried ranks of glowing tubes. They look - and feel - hot as if they are really doing something. By comparison a solid-state circuit looks lifeless and a bit dull. But looks can be deceptive and a number of my own circuits, which have particularly delighted me in sound-quality terms, have been Class A, solid-state designs. With care, I've discovered you can combine many of the virtues of both valve and transistor circuitry. (Incidentally, this was a discovery which led me to re-design my own recording studio with an entirely Class A, solid-state signal path!)

Unfortunately, the great penalty in the choice of Class A semiconductor circuitry is the necessity of removing heat fast enough from the transistor junctions to prevent them from destroying themselves. Sadly, all transistors are potential suicide cases: push them too far and they'll crumple beneath their deep quantum urges and revert back to the sand from which they sprang. The transistors in low-level signal stages have an easy enough life and are rarely brought to a "time of hard testing". Not so the poor power transistor in a Class A loudspeaker power amplifier. These highly-strung personalities demand the services of the electronics, mechanical

and heating engineer to keep them stable! A fact which, no doubt, accounts for the relatively few Class A, solid-state power amplifiers on the market.

A headphone amplifier lies somewhere between the two extremes of a signal-level stage and a true power-output stage. Happily, for the enthusiast, it is quite possible to employ Class A circuitry at this level which, although requiring power transistors, does not require unwieldy heat sinks to ensure the equipment remains thermally stable.

Having made the decision to employ a low-efficiency topology for the headphone circuit, I decided to "go the whole hog" and opt for a single ended circuit of lower efficiency still! This choice confers two important advantages: it is simpler to build, and single-ended is widely regarded as the ultimate circuit configuration for audio signal handling.

I first suggested a Class A headphone amplifier circuit in my Recorded Message column a few months ago. The circuit shown in Fig. 1 incorporates a number of improvements and embellishments over the original circuit and is sensitive enough to be fed from most sources, including cassette decks. Firstly, the output transistors are buffered by an extra PNP emitter follower which raises the input impedance seen by the op-amp driver and removes the need to fiddle with the bias resistors to achieve an optimum quiescent point, which was an awkward job required in the original circuit.

Secondly, and much more unusually, I have introduced an optional, secondary signal path through op-amps U2a and U2b. In order to understand the effect of this extra circuit, it's necessary to take a sideways look at some obscure psycho-acoustics. In a nutshell, the extra circuit inverts the phase of the signal fed to one ear and the brain interprets this as a frequency-dependent delay effect.

The result is that the stereo image, normally centred in the middle of the head, seems to spread out to fill the whole head with sound. Also, due to an effect known as binaural masking level difference, it is possible to detect

KIT & COMPONENT SUPPLIERS

LOUDSPEAKER KIT SUPPLIERS

Bandor Design & Development Studios
11 Penfold Cottages, Penfold Lane, Holmer
Green, Bucks HP15 6XR
Tel. (0494) 714058

Bandor Musical Drive Units cover the entire audio spectrum with one 50mm (100Hz - 35K) and one 150mm (20Hz - 8K). One driver covers 2/3 RD of the frequency. Crossovers 150 Hz/8K. Anodised aluminium spun cones. 1.3 grams moving mass gives cnsr transients. Good power handling. Robust. 35 YEARS EXPERIENCE.

Tabula Rasa

136 Kilnwood, High Wycombe, HP14 4UR
Tel. (0494) 565116

A young company specialising in the distribution of loudspeaker kits, components, accessories, and design measuring equipment from Germany, where the DIY loudspeaker has been well established and very successful for many years.

We handle speaker kits (with or without cabinets), a wide range of drivers, filters, filter components and accessories. Very low cable prices. Loudspeaker designs, measurement systems and high quality filter components also available. 30 day money back guarantee on all speaker kits. Send £2.00 (returnable on purchase of any speaker kit) for our catalogue. Trade enquiries welcome.

Faraday Sound

248 Hall Road, Norwich, NR1 2PW.
Tel. 0603 762967

Loudspeakers in Concrete

Now you can build your own low density concrete cabinet enclosure Faraday FS1, Siren, FSS, FS10 or a design of your own choice. Stunning sound. Simple DIY skills only. Full instructions including cabinet construction for only £10.00. Includes reviews, photo's etc. and at least £10.00 discount off any further products purchased from us e.g. ready made cabinets. Also £25 - £150 off any complete loudspeakers!!

Hart Electronic Kits Ltd

Penylan Mill, Oswestry, Shropshire SY10 9AF
24 Hr sales / enquiries Tel. 0691 652892

A range of Audiophile kits for 80 watt Power Amplifiers, Tuners, Pre-Amps and Moving Coil / Moving Magnet RIAA Pickup Preamps. All kits are fully engineered, with our thirty years design experience, for easy constructions from circuits by John Lindsey Hood, the most respected designer in the field. Send for lists.

The Speaker Company

Unit 9, Waterside Mill, Waterside, Macclesfield, Cheshire SK11 7HG
tel. 0625 500507

The Speaker Company are a new company offering a wide range of loudspeaker drive units from Audax, Celestion, KEF, Morel SEAS, Volt and a new ribbon tweeter. Also a wide range of associated accessories for the speaker builder.

Falcon DIY Speakers

Falcon Electronics, Tabor House, Mulbarton, Norfolk NR14 8JT
Tel. 0508 78272

Falcon sell kits, drive units and crossover components and have a large range of books and back issues of kit magazines. Please send large SAE (34p) for free price list.

Wilmslow Audio

Wellington Close, Parkgate Trading Estate, Knutsford, Cheshire WA16 8DX
Tel. 0565 650605 Fax. 0565 650080

Extensive range of drive units and over 30 different designs of self-assembly kit. Two 'ATC' kits now available. Drive units

include those from KEF, Dynaudio, Audax, SEAS, Peerless, Scanspeak and Morel. Everything required for the loudspeaker builder and four dem rooms to listen to the kits in built-up form. Two new kits from Morel - one 3 litre, magnetically shielded, one 11 litre book shelf.

IPL Acoustics

2 Laverton Road, Westbury, Wilts BA13 BRS
Tel. 0373 823333

IPL supply a range of eight speaker kits using drive units from SEAS, Morel, Audax, Visaton etc. including four transmission lines to suit all room sizes. We also supply a full range of drive units, capacitors, and cabinet accessories as well as silver plated P.T.F.E. insulated cables.

DBS Audio

PO Box 91, Bury St Edmunds, Suffolk IP30 0NF
Tel. 0284 828926

Sole authorised supplier of DBS loudspeaker kits designed by Dave Beniman. The acclaimed DBS6 kit includes Morel tweeters and custom built woofers, plus top quality pre-assembled crossover and components.

VALVE AND OUTPUT TRANSFORMER SUPPLIERS

Vintage Valves,

PO Box 147,
Station A, Vancouver B.C.
Canada, U6C 2M3. Fax (604) 876 5876.

Dynaco, Sherwood, Scott, The Fisher, McIntosh, Eico, Harmon Kardon, Heath, Altec, Stromberg- Carbon. Many vintage parts and equipment available on request.

Langrex Supplies Ltd

1 Mayo Road, Croydon, Surrey CRO 2QP
Tel. 081 684 1166 or fax. 081 684 3056

One of the largest distributors of electronic valves, tubes and semi-conductors in the UK by original UK and USA manufacturers. Obsolete types are a speciality. Telephone or fax for an immediate quotation.

Billington Export Ltd.

1E Gillmans Trading Est., Billingham, Sussex RH14 9E3
Tel. 0403 784961 or fax. 0403 783 519.

Billington Export Ltd. are one of only two or three suppliers of obsolete cathode ray tubes in England. DG7-32, DG7-36, and 3WP1. Data can be sent on request with any valve or cathode ray tube order. (minimum order £50.00)

PM Components

Springhead Enterprise Park
Springhead Road, Gravesend., Kent DA11 3HD
Tel. 0474 560521

Suppliers of Shuguang Golden Dragon valves amongst others.

Sowter Transformers

EA Sowter Ltd
PO Box 36, Ipswich IPI 2EL
Tel. 0473 219390/252794

Output and mains transformers for GEC KT88 circuits. Can also make any other transformer to order. Send SAE for lists and data.

Chelmer Valve Company

130 New London Road, Chelmsford, Essex CM20RG
Tel 0245 265865 Fax. 0245 490064.

Supplier of premium range of audio valves, other valves and components also available. (Please see our ad on inside back cover of this supplement).

RESTORATION

GT Audio

5 Upper Road, Higher Denham, Bucks UB9 5EJ
Tel. 0895 833099

Professional repair/restoration of all hi-fi including classic and vintage equipment. Supplier of very high quality electronic components, in particular types which are difficult to source. Original valves available, i.e. Mullard, Brimar, GEC, GE, RCA, Sylvania etc.

COMPONENT SUPPLIERS

Audio Components Ltd

Albany Court, Albany Road, Granby Industrial Estate, Weymouth, Dorset, DT4 9TH
Tel. 0305 761017 Fax. 0305 761492

Audio Components supply the Audio Innovations Classic 25 Kit Amplifier. This valve Line Intergrated design offers 4 line inputs, a tape loop and 25 watts of Class A power in an elegant, domestically friendly casework. It comes with a comprehensive 40 page instruction manual and a guaranteed fixed price competition service should any difficulties be encountered. Price is £699.

SJS Acoustics

Ben-Dor, Lumb Carr Road, Holcombe, Bury, BL8 4NN.

Suppliers of difficult to find high quality components for valve amplifiers: including Single Ended Output Transformers, Signal and Power Supply Capacitors, PTFE Board and Silver Wire. For full information and a catalogue send an SSAE to the above address.

AP Electronics

20 Derwent Centre, Clarke Street, Derby, DE1 2BU

Check out the AP electronics 1993 catalogue. It's free with every order over £30.00. AP - for pre-amp kits, power amp kits, integrated amp kits plus everything else from resistors to mains cables.

Chelmer Valve Company (pls look under valves)

Electromail

PO Box 33, Corby, Northants NN17 9EL
Tel. 0536 204555

The branch of the well known RS Components trade mail order business that deals with the public. They have a huge range of components and catalogues to match.

Norwood Electronics

Unit 8 Pinbush Road, South Lowestoft Ind Est, Lowestoft, Suffolk NR33 7NL

Components suppliers- DACs, digital filters, Digital interface ICs, Optical transceivers/Cables, OP-Amps. Kits- DACs and Power Amps.

Omni Electronics

174 Dalkeith Road, Edinburgh EH16 5DX
Tel. 031 667 2611

A wide range of components aimed at the hobbyist, competitive VAT incl. prices, mail order and a friendly service. Open Mon-Thurs 9.15-6.00, Friday 9.15-5.00 and Sat's 9.30-5.00.

RATA Ltd

Edge Bank House, Skelsmergh, Kendal, Cumbria LA8 9AS

Tel. 0539 823247

RATA specialise in supplying high grade audiophile components and cables. They also have a small range of drive units and kit amplifiers.

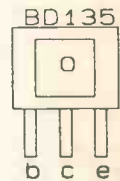
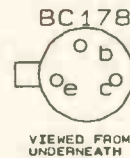
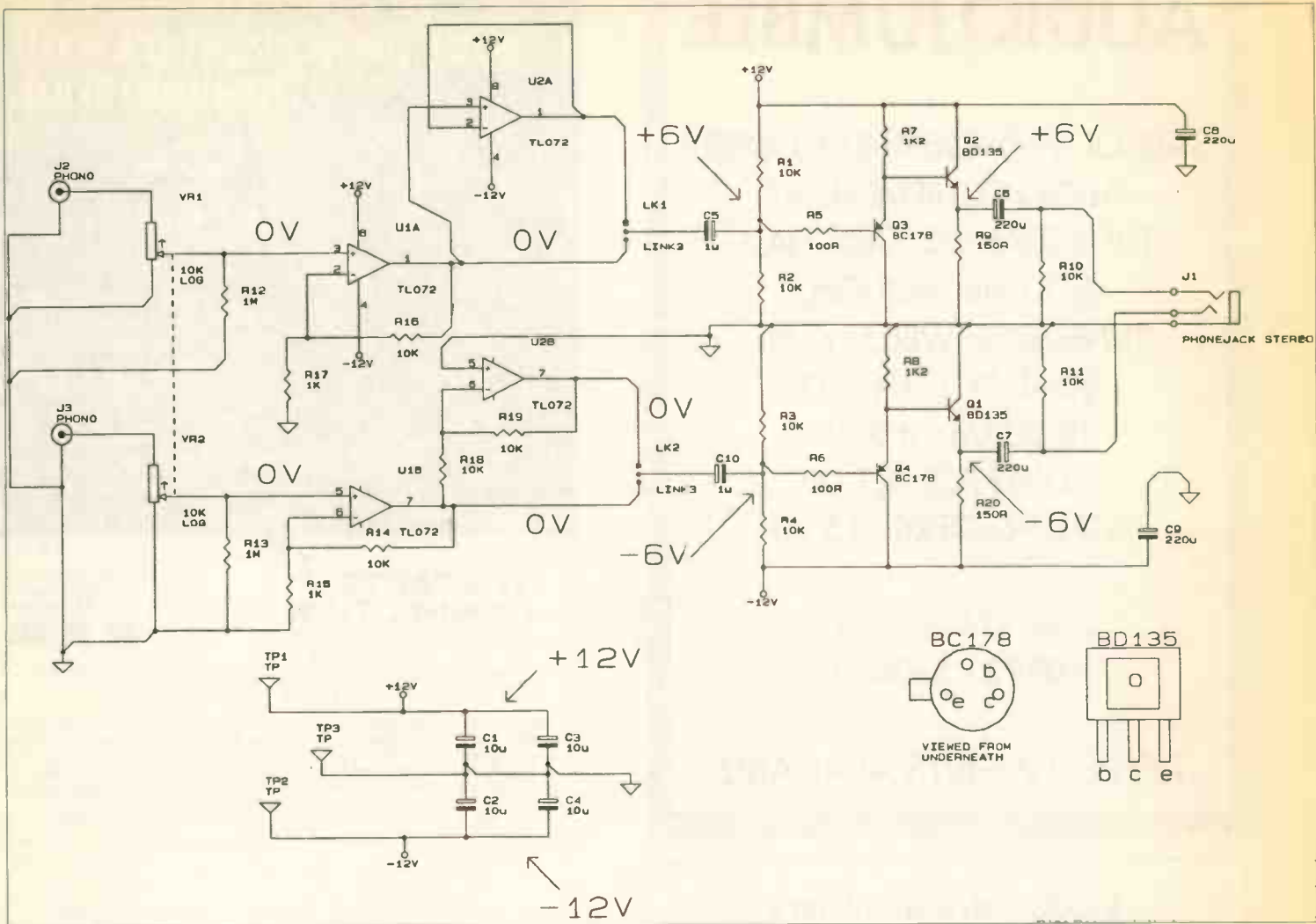
VINTAGE DIY

Loricraft Audio

4 Big Lane, Goose Green, Lambourn, Berks RG16 7SQ
Tel. 0488 72267

Specialist restoration of 301's and 401's using genuine spares and re-manufactured parts to original pristine standards in our newly built workshops designed primarily for these purposes.

**YOU CAN ADVERTISE IN THIS SECTION FOR ONLY £20.
CONTACT CAROLINE KNOTT ON:
071 - 266 0969.**



instrumental lines at very low levels within the mix that would be inaudible if the signals arrived at the ears in-phase. The circuit may be used (and/or built) ignoring this phase-shifting circuit by ensuring LK1 and LK2 are fitted in the lower positions on the diagram. If LK1 and LK2 are fitted in the upper position, the phase-shift is introduced. The inclusion of this link arrangement means constructors can be perceptual psychologists too and experiment for themselves!

A high-quality, glass fibre, printed-circuit board will be available from the Hi-Fi World offices for this circuit. The circuit requires a well-smoothed power supply of +/-12V d.c. at about 200mA per rail. A convenient and technically excellent solution would be to buy a complete, encapsulated power supply from Electromail (Tel: 0536 204555 Order No. 591-102, price approx £60).

WARNING

A final word of warning. When you have built the circuit, don't be tempted to get those headphones on and start to boogie before you have checked the voltages shown on the diagram above. Above all, don't fiddle with the circuit board, the

components or power supply when you are wearing headphones which are plugged in. Accidentally moving or unseating a component might cause

plops, bangs, cracks and thumps in the headphones which would subject your ears to high acoustic intensities and possibly damage your hearing ●

HEADPHONE AMPLIFIER PARTS LIST

Item	Quantity	Reference	Part
1	2	U1,U2	TL072
2	1	J1	PHONEJACK STEREO
3	2	LK1,LK2	LINK3
4	3	TP1,TP2,TP3	TP
5	4	C1,C2,C3,C4	10µ
6	2	C5,C10	1µ
7	12	R1,VR1,R2,VR2, R3,R4,R10,R11, R14,R16,R18,R19	10k
8	2	R5, R6	100R
9	2	R7,R8	1K2
10	2	R9,R20	150R
11	4	C6,C7,C8,C9	220µ
12	2	Q1,Q2	BD135
13	2	R12,R13	1M
14	2	R15,R17	1K
15	2	J2,J3	PHONO
16	2	Q3,Q4	BC178

AUDIOJUMBLE

SALE OF VINTAGE AND MODERN
AUDIO EQUIPMENT AT
THE ROYAL VICTORIA HALL
SOUTHBOROUGH,
TUNBRIDGE WELLS, KENT.
SUNDAY 17TH JULY
10.30AM - 4.30PM
ADMISSION £1.00
STALLHOLDERS £15.00

ALL ENQUIRIES:
0892 - 540022

REFRESHMENTS AVAILABLE

triode valve amplifiers

preamplifiers, single ended power
amplifiers

designs, components,
transformers

For further information and a
catalogue send an SSAE to:

sjs electroacoustics

Ben-Dor, Lumb Carr Rd, Holcombe, Bury, BL8 4NN

To make the most of
your projects, start with
the right tool.

1994
Catalogue
The Audio Hobbyist's
Definitive Parts Source

Get connected with
the widest selection
of audiophile grade parts.
Send £2.85* along with
your mailing address
and you will receive our
1994 parts catalogue
and a \$10 discount coupon good
on your first order over \$100.

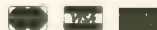
**THE PARTS
CONNECTION**

A DIVISION OF SONIC FRONTIERS INC

2790 Brighton Road, Oakville, Ontario, Canada L6H 5T4
Telephone (905) 829-5858 Facsimile (905) 829-5388

MIT MultiCap • Wonder Cap • Kimber Kap • Solo • Solen • Siemens • Hovland MusiCap
Wima • Holco • Rel-Cap • Draloric • Vishay • Caddock • Mills • Matsushita • TKD • Nobie
Cardas • Kimber Kable • Discovery • Audioquest • MIT • ClearAudio • Alps • Bourms • Elma
Shalco Attenuators • Electroschwitch • Elna • Nichicon • Gold Aero • RAM • Mallory
Ruby Tubes • Linear Technology • Analog Devices/PMI • Motorola • Edison Price
International Rectifier • MagneQuest • Sonic Frontiers
Pearl • Tube Sockets • WBT • Neutrk • Curcio Audio Engineering • Kits

*or \$5.00 US, or credit card information
**catalogue pricing and discounts
are in US Dollars



S Standens

92A HIGH STREET
TONBRIDGE 0732-353540

We stock:-

**NAD 304,
CREEK 4240,
MARANTZ CD63**
(see reviews this issue)

ALL QUAD PRODUCTS STOCKED

**WE'VE BEEN GIVING
SOUND ADVICE FOR
OVER 50 YEARS**



D.I.Y. Letters

LOOKING FOR A SYSTEM

Earlier this year I built a pair of IPL M3 speakers. They not only look good, but knock my old Mordaunt-Short MS20s for six! I've since built speaker stands to suit the IPLs, but unfortunately my 21 month old son does not allow me to leave the IPLs permanently set-up.

Secondly, I'm after your advice. Not concerning my son's desire to damage speaker drive units, but on the harder subject of CD players. The rest of my system comprises Pink Triangle LPT, Roksan Tabriz, Sumiko Blue Point, Audiolab 8000A.

I am pleased with the current performance from vinyl using the IPLs. The music is more often detailed and tuneful, with the individual instruments being more clearly defined when compared to the MS20s. The sound is not

forceful in presentation - I like to 'relax' when listening to music.

I would ideally like a CD player capable of complementing my turntable. Am I asking too much? I have previously borrowed sub-£200 players and found them lacking. Unfortunately, my budget for this purchase is only £400 maximum. You have previously reviewed players like the Yamaha CDX-870 and Aura CD50 (black). Are these possibilities and do you have any other suggestions?

**Andrew J. Dean
Milverton,
Somerset.**

Unfortunately you are asking the impossible if you want a CD player for £400 to match the performance of your £600+ turntable. I'd suggest that your best bet would be to go for a budget CD player for the time being and then

add an external high quality D/A convertor at a later date as your CD collection increases. The Yamaha has a very smooth and neutral sound, and is possibly the closest in terms of tonal balance to the Pink Triangle turntable.

When the time comes

DPA's Little Bit II convertor would make a good choice, or maybe Pink Triangle will have a £300 DAC available by then. But as you've already taken an interest in DIY hi-fi, you could have a go at one of Audio Synthesis' superb kit DACs. These are tricky to build, and you'll need to have plenty of experience, but they do sound superb. **DB**

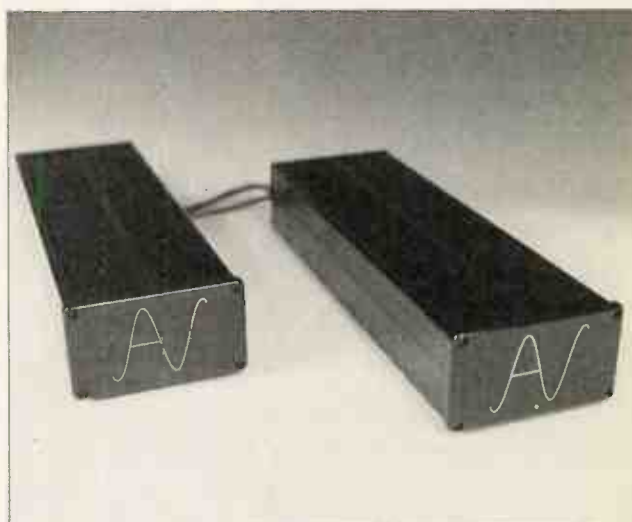
AFFORDABLE DIY HI-FI

I have been a regular reader of your Magazine since the issue with DIY Supplement No.2, which I must admit is the reason I began buying it. I have been following with some interest the development of your amps and loudspeakers. Being, at the time of writing, unemployed, I sympathise with a recent correspondent who enquired if the (cheaper) amplifier kits from Maplin are worth considering. I thought that he and maybe others in a similar position might be interested in my experiences.

My system is as follows.

Main source is a Thorens TD160 turntable fitted with an SME 3009 arm and Ortofon VMS 20E (which is due to be replaced by a Goldring 1012GX when funds permit). This was bought second hand around 4 years ago. I also use an elderly Pioneer CT-200 cassette deck, but as yet no CD player.

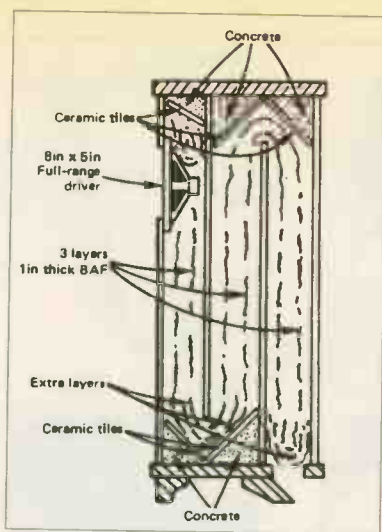
All the rest of the system is



The Audio Synthesis DAC - available in kit form.

home built. The pre-amp is a three-stage Class A design with shunt feedback on the RIAA stage. This is based on a project in E.T.I. in 1982, the 'System A' modular amplifier by Stan Curtis. The power amp is built around a Maplin Project board using the LM 1875 op-amp. Both are supplied by an external power supply that provides 15-0-15 volts for the pre-amp and 17-0-17 volts for the power amp and is built around a large toroidal transformer with a regulated output.

The speakers are single driver transmission lines. See 'An Introduction to Loudspeakers and Enclosure Design' by V. Capel, Babani Books BP256. I modified the design published as follows. The front, sides, top and bottom are made from 18mm MDF, with the sides being in



The Kapellmeister speaker

one piece, not three as suggested. Internal partitions and the back are 12mm chipboard. The cabinet is glued and screwed together and is very solid. The internal partitions are held by a 12mm quadrant glued and pinned in

place. Wadding and speaker cable were obtained from Maplin. I estimate the cost of building these speakers at not more than £50 for the pair. All cables and interconnects are 'whatever I had around that was suitable' mostly rather lo-fi.

Is the result hi-fi? I don't know, but it sounds good to me. Everyone who has heard it has commented how clear and natural the sound is, one dedicated CD fan swearing that my

records sounded clearer than his CDs. The only criticism that's been offered is that the bass is perhaps a bit light. But I wonder if in fact what is missing is the 'one note' bass thump that some speakers seem to produce, and which is

taken as being 'bass' by some.

The point of this letter is that it is possible to put together a listenable system that is within the reach of almost anyone, if they are prepared to do the sawing and soldering. If anyone would like more information, i.e. circuit/board layouts for the pre-amp, they are available from the E.T.I. photocopy service. Some of the transistors are hard to find now, and I had to find substitutes.

**Anthony Maughan
Worthing,
Sussex.**

P.S. I think that my speakers pass the 'Tina Turner 'Break Every Rule' Test.

BUILDING KLS-1

I thought you may find it of interest to hear from a satisfied

Letter of

DISPLAY CABINETS?

I wrote to you and all the other hi-fi mags when I got my new EAR 834 amp, I was so pleased with it. I got no reply from any of them.

Well, as your magazine is the most interesting, because of the DIY Supplements with valves and DIY loudspeakers, I picked you to continue writing to.

If getting a new valve amp isn't interesting for you, what about a pair of home made transmission line speakers! Please at least read this one, or I will loose heart - I'm a very keen hi-fi nut.

Well, I've enclosed some photos for you - I hope they are O.K. Do you like the old collection of valves?

I had some old MC4s and wasn't happy with the sound. Changing the amp made a big difference, but the small speakers weren't letting all that wonderful

sound coming from my EAR 834 through, so I made my

new speakers from a display cabinet (black Ash). It was



hard work, but worth it. I am very pleased now with my new transmission line speakers. Internal wire is van den Hul D352 for midrange and bass, solid core for the tweeter.

Wire from the crossover, which is in a small box at the back of the speaker on the floor, to the amplifier is AQ Midnight 2. The separate black box stand is full of lead shot from work - very heavy. They are spiked of course.

I also got new phono leads made by Keswick Audio Research from my Hi-Fi Dealer in Doncaster, the Hi-Fi Studios. He is coming down to see my speakers and hear them for himself.

If you want any more detail on my speakers I am only too happy to help. Please let me know what you think!

How come you (Hi-Fi

customer (one of many, I'm sure). This is the story of how I became the proud owner of KLS-1 three way speakers.

After selling my much loved AEIs in early 1992, it was my intention to put this money towards a pair of somewhat larger boxes. My system comprised LP12, Ittok, Goldring Excel and Lentek integrated amplifier.

Then the plans decided to change without my permission. I just couldn't resist buying a pair of very reasonably priced Naim NAPI35 power amps. The Lentek was put into use as a pre amp and once again I started to save for my speakers.

After a painfully long time the bank balance reached almost usable proportions. Then (I'm still not sure why) I blew it all on a 29" Trinitron, Surround Sound inc decoder

and Panasonic stereo video.

More months of saving later, a Teac VRDS-10 caught my ear. I was quite impressed (lucky it didn't catch my eye first, whatever the yardstick may be, it's beauty can at best be described as more Margeret Thatcher than Naomi Campbell). I also heard it connected to a P.T. Da-Capo and bought the VRDS-10 on the basis of its upgradeability and fine performance as a stand alone player.

The following months were spent looking for a speaker that could match the mid-range of the AEIs, but go lower and not include anything that sounded remotely like a metal dome tweeter. Thanks to a very helpful local dealer, Bury Audio, I was able to hear and/or home dem the Shahanian Arc, Heybrook

Quartet, Heybrook Sextet and ProAc Response 1s. These were compared with previous experiences of Naim SBLs, Linn Isobariks and numerous others of varying shape, size, type, price etc. The nearest to meeting my criteria was either the ProAc (with REL sub woofer) or the Sextet. Unfortunately one was too expensive and the other a little bit reserved and laid back for my liking.

Well that's the background now down to the real business.

The Tonigen ribbon tweeter produced the most impressive treble of any speaker I'd heard. How was I going to find my ideal speaker with this sort of limitation? Time was running out - I had to do something before some other irresistible goodie forced me into parting with my hard earned cash.

Thank the Lord for Hi-fi World Supplement No 3 (I think). A high quality three-way with deep bass, lucid mid-range and Tonigen ribbon for the treble. All this coupled with the enjoyment and satisfaction of home construction sounded almost too good to be true.

After being a little bit disappointed with the sound at the Penta show, I was kindly offered a demonstration by DB at his abode. This proved most successful and I decided to part with my money without being given any of the usual "hard sell" tactics (thank you).

Although I was capable of cabinet construction. I could not face the possibility of compromising the finished article due to my impatience with the electric plane. So I decided to purchase the full kit and spend all my time on the surface preparation etc. The

The Month



World) are the only mag to be keen on valves and DIY speakers? Glad you are!

**Derek Walker
Hornsea,
Nr. Hull.**

It's certainly a novel idea, making your 'speakers from an old display cabinet. We are impressed by your ingenious use of materials. I'm glad you are happy with the 834, it's nice to see products that we have recommended being

enjoyed in the field, and better still when you've built part of your own hi-fi and are pleased with the results. The collection of valves is also interesting, but unfortunately the photo is a little out of focus, I hope that they will be recognisable in the magazine. Please keep up your enthusiasm; we try to answer most of the letters we receive, but there's is only room for so many each month. **DB**

Everyone on this magazine has tales to tell of youths mis-spent building valve amplifiers and loudspeakers and other contraptions. We are all, at heart, DIY enthusiasts and most of us decided to take up audio engineering for a living as a result. The projects in our Supplements are a great source of enjoyment to us, as well as being a challenge and - importantly - highly educational. Happily, they get easier to produce as we gain knowledge and experience. Two people, designer Andy Groves and his assistant Nick Lucas, work on the projects and the kits full time and both of them are complete valve heads. But Dominic and I don't let them have all the fun. **NK**



**WIN A MAPLIN
SOLDERING IRON KIT
COMPLETE WITH A
LENGTH OF SILVER
SOLDER**

The writer of the most interesting DIY letter each month will receive a superb Maplin soldering iron, stand, booklet on good soldering practice and a length of high quality silver solder. Write in to: **Hi-Fi World DIY letters, 64 Castellain Rd, Maida Vale, London W9 1EX.**

paint job was to be professionally done by a car restoration company. This would cost a further £200 so I felt a little extra effort on surface preparation was fully justified. As promised the machined panels all slotted together perfectly with minimal overhang. The process of assembling all 36 pieces and the crossover boxes was indeed a relatively painless process.

The paint job is wonderful. But the drive home (60 miles) was rather stressful.

All the staff at Hi-Fi World continued to be supportive and helpful at all times. My only complaint would be an over use of the phrase "I promise to call you back" (you never did!). Thankfully for us readers you are enthusiasts first and businessmen second. Although this may contribute to some frustration it is a mild criticism and surely not serious enough to jeopardise my possible success in the "Letter of the Month" prize.

Anyway, all bits were eventually received and the whole caboodle glued, screwed and soldered together. At this point may I offer other constructors the benefit of my experience (mistakes) with a few tips.

1) Work out how you are going to connect the mid/treble units to the crossover before gluing the boxes together. I used Ortofon

bi-wire cable and binding posts bolted through the MDF itself. With hindsight the binding posts should have been mounted on a metal plate screwed over a pre-cut hole in the back of the mid/treble enclosure before glueing took place.

2) If you intend to use spikes, reinforce the bottom of the bass enclosure in each corner with a triangle of MDF. If you don't, you may drill right through and unseal the sealed design!

3) Use decent mounting cones for the mid/treble enclosure. My dealer supplied some interesting brass/carbon fibre items which work well and look very good.

4) If you are having the cabinets painted I found that a decent radius on every edge improved the aesthetics no end.

5) Beware the dreaded test disc! Despite the numerous warnings on mine about the high frequency tones, I managed to turn both tweeters into a very short, but irreversible fireworks display. Remember just because you can't hear it doesn't mean it's not there.

The sound produced had potential but was far from balanced. The following few weeks were spent

experimenting with crossover values and enclosure stuffing density. A very prominent upper midband is now tamed and the bass frequencies enhanced at the crossover point. After all this experimentation I do feel satisfied that my speakers are better than anything that I've heard for £1000 and probably much more. What adds to my satisfaction is that the finish would normally cost up to £500 extra on your average floorstanders.

My remaining doubts are bass depth and slight mid-range coloration. However as DB's pair sounded far more expressive and weighty in the lower registers, I guess it must be the system or room, probably a bit of both. The room, which is eighteen foot square with a low ceiling seems to suck out low frequencies. Also the Lentek, although a wonderful piece of British design, is a bit out of its depth and possibly an electrical mismatch for the Naim amps. The mid-range colouration will probably improve with the modifications you describe, further experimentation with stuffing and maybe trying Deflex panels?

In summary, I believe the kit is a very capable design that can produce excellent results. If you're like me and can cope no longer with metal domes and long for a Sextet with balls, then the KLS-I may prove to be your saviour, but please

don't skimp on the finish. Even my cloth eared peasant friends can appreciate that. No matter what people may like to think, I believe the experience of owning and listening to hi-fi is enhanced if the equipment looks and feels quality.

I hope your magazine continues to provide its readers with more innovative kits and understandable technical information. I would like to dabble with active systems and long for the day when you design and build a high quality and user adjustable two or three way active crossover. This I am sure would enable the KLS-I to reach new levels of performance, if such an animal exists please let me know.

Meanwhile, who let that bloody baby put his grubby mitts on my speakers? I don't care if he likes looking at his reflection!

R. Cockman
Bury St Edmunds,
Suffolk.

Phew! It all sounds as much effort as designing the original - and pretty costly too when two Tonigens go up in smoke. The crossover point problems may be due to component variations, including driver frequency response, something we cannot be certain about without testing large batches, which is obviously impractical.

The bass cabinets go very low and have a good bass punch, so I think you may well be suffering some room imposed limitations here.

The problem of midrange colouration I cannot understand - it is difficult to find an explanation. Neither driver nor cabinet should be responsible. Be careful you have not over-stuffed the chambers, especially just behind the drive unit, because then too much energy will be reflected back out through the cone. Damping needs to be made progressive, loose to begin with, but becoming steadily more dense as distance behind the cone increases. The cabinet walls must be covered with dense carpet felt too. Then you should find the midrange seamless, highly detailed and just about characterless. Good luck - I'm glad you like them. **NK**



MAIL ORDER
Tel: 071 436 1053
Fax: 071 637 2690

KAMLA

Coming Soon:
Large range of
NTSC Laserdiscs
will be available
from November

Product List

- AIWA
- AKAI
- AR
- ALCHEMIST
- ALPHASON
- AUDIO ALCHEMY
- AUDIOSTATIC
- AURA
- B&W
- BEYER
- BOSTON
- CERWIN VEGA
- CONRAD JOHNSON
- GOLDRING
- INFINITY
- JAMO
- JVC
- KEF
- KENWOOD
- KINSHAW
- MIRCROMEGA
- MORDAUNT-SHORT
- MOTH
- NAKAMICHI
- ORIGIN LIVE
- PHILIPS
- PIONEER
- PROCEED
- PROJECT
- ROTEL
- RUARK
- SANSUI
- STAX
- SME
- SYSTEMDEK
- TEAC
- TECHNICS
- THORENS
- TOWNSHEND

TEAC
VRDS 7
D700/P700
NOW ON
DEMONSTRATION

We also stock a large
range of TV's/Video's
from
**AKAI, HITACHI, JVC
MITSUBISHI, PANASONIC
PHILIPS, SAMSUNG
SHARP, TOSHIBA**

MICROMEGA
T-DAC
T-DRIVE
*the first front loading
transport from Micromega*

**Townshend Rock III
Turntable Now On
Demonstration**
*See review in Oct '93
issue of Hi-Fi Choice*

**New Rotel AV
Products Now
In Stock**
*RSP 960 AX Prologic Processor
RB956 Six Channel Poweramp*

SALE ON NEW AND EX-DEM HI-FI

		RRP	NOW
Audio Alchemy DDE V1.0	new	420.00	295.00
Motif (Conrad Johnson) MS2001 200 Watt Power Amp	ex-dem	4000.00	2400.00
Motif (Conrad Johnson) MP111 Phono Stage	ex-dem	2250.00	1125.00
Conrad Johnson MF200 200 Watt Power Amp	ex-dem	2400.00	1800.00
Oracle Alexandria inc. SME345 arm	new	1890.00	945.00
Oracle Delphi III	ex-dem	1595.00	950.00
Alphason Sonata inc. HR100/Atlas	ex-dem	1785.00	1160.00
Teac D500 D/A Converter	ex-dem	330.00	265.00
SD Acoustics SD1	ex-dem	1650.00	825.00
SD Acoustics SD4	ex-dem	700.00	455.00
Nakamichi 1000mbi	new	4500.00	2295.00

UPTO 50% OFF

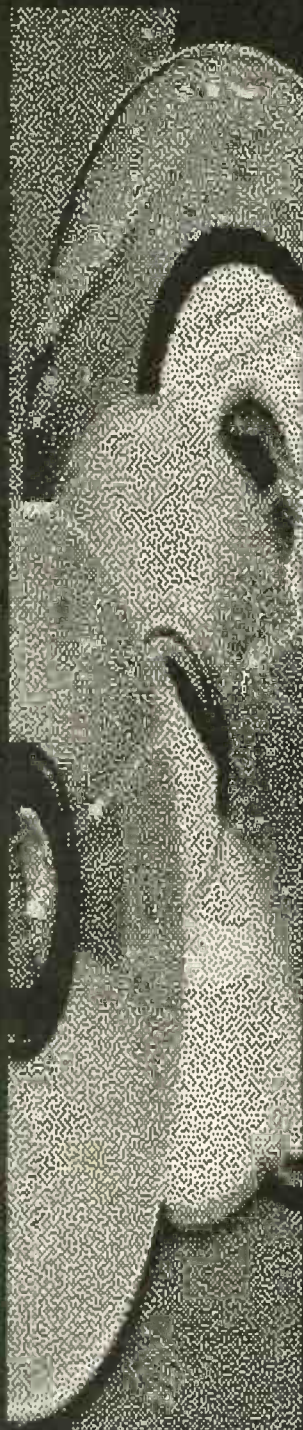
ACCESSORIES FROM:
AKG, ALPHASON, AUDIOQUEST, AUDIOTECHNICA, BEYER, CABLETALK,
FOUNDATION, FURUKAWA, GOLDRING, IXOS, KONTAK, LYRA, LYNWOOD,
MONSTER, ORTOFON, QED, SENNHEISER, SONIC LINK, SOUND STYLE,
STRAIGHTWIRE, STANDS UNIQUE, SUMIKO, SUPRA, TOWNSHEND, XLO,
VAN DEN HUL

ASK Electronics Ltd.
248-250 Tottenham Court Road
London
W1P 9AD
071 637 0353/0590

251 Tottenham Court Road
London W1P 9AD

071 323 2747

Harp Electronics Ltd
237 Tottenham Court Road
London
W1P 9AD
071 636 4611



THE HI-FI LAW OF DIMINISHING RETURNS

Ask a Hi-Fi dealer to upgrade your system, and he'll sell you ever more expensive bits of hardware, giving you a constantly changing sound, new solutions producing more problems which can only be solved with more expensive equipment. The harder you try, the more it costs and the less satisfying the results. This is the well known Hi-Fi law of diminishing returns. We have an alternative:

THE RATA LAW OF INCREASING RETURNS

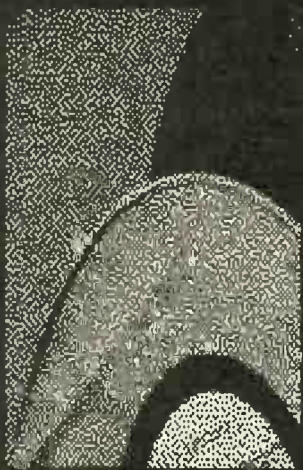
Why buy new equipment when it makes more sense to realise the full potential of your existing equipment. Don't replace it, upgrade it; it's cheaper. Most equipment can be transformed by us for the cost of a dozen CDs. Magic? No - logic! To find out how we do it, ask for our new free Catalogue; it provides discussion, analysis and a definitive resource of audiophile components and advice on the art of recreating music in the home.

Russ Andrews Audiophile Catalogue

Includes :-

- CD Players, Preamplifiers, Disc Preamplifiers, Power Amplifiers,
- Loudspeakers
- Kimber Kable
- Upgrading Services and Guides
- Audiophile Kits and Components
- Accessories
- Reviews

1993 Edition 2 Available Now



RATA

Edge Bank House,
Skelsmergh,
Kendal,
Westmorland, LA8 9AS

Tel: 0539 823247

Fax: 0539 823317

UK Post Free,
Europe 3 International Reply Coupons.
Overseas Send US \$3 bill or four IRC