Hi-Fi WORLD

NO. 22 JUNE 1996

SUPPLEMENT

BOOK REVIEWS:

AUDIO VALVE AMPLIFIERS by Rainer zur Linde

BUILD YOUR OWN HIGH END AUDIO EQUIPMENT, Elektor Electronics

WE BUILD AND TEST HART'S CHIARA SINGLE-ENDED HEADPHONE AMPLIFIER

ELECTRONICS WORKBENCH:

SIMULATE YOUR DESIGNS ON A PC BEFORE YOU BUILD

FREE D.I.Y. SUPPLEMENT No. 22

CHELMER VALVE COMPANY

for

High Quality Audio Valves

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

Price list and Order Form for CVC PREMIUM Audio Valves

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

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

RECTIFIERS	Unit Price	Qty	Total Price
EZ80	4.00		
EZ81	4.25		
GZ32	7.00		
GZ33	7.00		
GZ34	6.00		
GZ37	6.00		
5U4G	5.00		
5V4GT	4.00		
5Y3GT	3.50		
5Z4GT	3.50		

SOCKETS ETC	Unit Price	Qty	Total Price
B9A (Chassis or PCB)	1.60		
B9A (Ch or PCB) Gold	3.00		
Octal (Ch or PCB)	1.80		
Octal (Ch or PCB) Gold	4.20		
4 Pin (For 2A3, 300B)	3.30		
4 Pin Jumbo (For 211 Etc.)	11.00		
4 Pin Jumbo Gold (For 211 Etc.)	15.00		
5 Pin (For 807)	3.00		
7 Pin (For6C33C-B)	4.50		
Screening Can (For ECC83 Etc.)	2.00		
Anode Connecter (For 807 Etc.)	1.50		
Anode Connecter (For PL519 Etc)	1.60		
Retainer (For 6L6WGC Etc.)	2.00		

MATCHING CHARGES	£	
POST & PACKING (UK)	£3.00	
TOTAL EXC VAT	£	
VAT @ 17.5% (UK/EEC ONLY)	£	
TOTAL TO PAY	£	

Please make cheques payable to:
'CHELMER VALVE COMPANY' or pay by
ACCESS/MASTERCARD/VISA Please give details:

SIGNATURE: ..... EXP. DATE: .....

NAME: .....

ADDRESS: .....

.....

.....

..... Post Code: .....

VALVE AMPLIFIERS SOUND BETTER STILL WITH CVC PREMIUM VALVES!

130 New London Road, Chelmsford, Essex. CM2 0RG. Tel: 01245 355296/265865 Fax: 01245 490064

D.I.Y. Supplement

Contents

Billington Gold

Long known as specialists in rare tube brands, Billington Export provides a line of premium-grade valves to fill the increasing demand for hard-to-find tubes! BILLINGTON GOLD features specially tested valves selected for long life, low microphony and low noise. Versions with gold plated pins are available. BILLINGTON GOLD brand comes from a variety of countries around the world. We have carefully chosen the best manufacturer for each type, with an emphasis on the highest audio quality and product reliability. We stock one million valves including: BRIMAR, GE USA, GEC UK, MAZDA, MULLARD, RCA, RUSSIAN/SOVTEK/SVETLANA, SYLVANIA, TESLA, THERMIONIC, TUNGSRAM and other rare brands, as well as sockets and CRTs.

BILLINGTON GOLD

2A3	£15.00
6L6GC	£9.50
12AX7	£5.25
300B	£60.00
811A	£12.00
845	£33.00
6550B	£18.00
E81CC	£5.25
E81CC-01	£9.50
E82CC	£4.50
E82CC-01	£8.50
E83CC-01	£8.50
E88CC	£7.50
ECC81	£5.25
ECC82	£4.50
ECC83	£5.25
ECC88	£6.90
EL34	£9.95
EL84	£3.60
KT66	£9.50
KT88	£18.50

RARE BRANDS

3AMP1A Tungsram Hungary	24.00	6550A GE USA	42.00
5C-450A STC UK	180.00	CV4003 Mullard UK	POA
5R4GY RCA	POA	CV4004 Brimar UK	POA
5Y3GT RCA	3.00	CV4024 Mullard UK	7.50
68H6 RCA	2.48	DG7-32 Tungsram Hungary	24.00
6L6WGB Sylvania	15.00	ECC81 Mullard UK (CV4024)	7.50
6V6GT STC UK	5.93	ECC82 Mullard UK (CV4003)	POA
12BH7A GE	15.00	ECC83/ECC803S Tesla	13.13
12E1 STC/ITT UK	15.00	EF86 GEC UK (CV4085)	19.50
13E1 STC UK	135.00	GZ32 Mazda	9.00
85A2 Mullard	5.93	GZ37/CV378 Mullard UK	POA
807 USA	8.20	KT90 Yugoslavian	41.50
5687 Sylvania	6.45	PL519 Tungsram	9.30

YUGOSLAVIAN/ETC

5CG7 Yugoslavian	6.75	ECC83 Yugoslavian	3.09
6X4W Raytheon USA	3.60	ECC85 Tungsram	3.45
5751 (USE ECC83)		ECL86 Tungsram	3.45
6366A	72.00	KT90 Yugoslavian	45.00

RUSSIAN/SVETLANA

6AS7G	3.60
6B4G	19.50
6SN7GT	3.30
SV811-3	22.75
SV811-10	22.75

Try us for ALL Russian/Svetlana valves

SOVTEK

5U4G	3.60	ECC83/12AX7WB	3.50
6L6WGC	6.00	ECL82	2.25
6SL7GT	2.50	EF86	POA
12AX7WA	3.50	EL34G	6.20
12AX7WB	3.50	EL84	1.99
5881/6L6WGC	6.00	GZ34	5.40
		GZ34/5Y3GT	2.90

SOCKETS

Jumbo 4-pin for 211, 845, etc.	£11.50
Jumbo 4-pin, Gold Plated, for 211	£19.50
UX4 for 2A3, 300B, 811A, etc.	£1.95
UX4 Large Locking Type for 300B	£6.60
B5 UK	POA
UX5 McMurdo UK for 807	£3.60
B7A for 6C33CB	£3.23
B7G McMurdo UK, chassis, skirted	£0.72
813 Ceramic	£7.50
Octal McMurdo UK	£1.20
Octal PCB, nylon	£2.70
Octal PCB, foreign	£1.20
B9A for ECC83, EL34, EF86, suitable for pre-amps	
- Ceramic, skirted, chassis, screening can;	
Chinese	£1.20
Russian	£0.90
-PCB, gold pins	£2.40
B9D Magnoval, chassis, for PL519	£1.88

We supply sockets for all valves listed in this advertisement

CHINESE

300B Silverstone	60.00
ECC88	3.90
EL34	5.95

TOPCAPS

For 2C34 807 etc	£1.20
For 12E1, 5B-254M, PL519	£2.93

MATCHED TESTING

£2.00 Per Valve
(£4.00 per pair)

All items in stock at time of going to press. Prices in GB pounds and subject to fluctuation: please check before placing your order. We stock over 3000 valve types and 400 types of CRT. Please ask for our free 50 page catalogue of valves and/or our CRT catalogue.

Payment is accepted by:
ACCESS, AMERICAN EXPRESS, DEBIT CARD, JCB, MASTERCARD, VISA, Bankers Draft, Bank Telex, Eurocheque and Cheque (UK only).
MINIMUM ORDER: UK £50.00 + VAT & Carriage. Export £100.00 (US $150.00) + Carriage.

BILLINGTON
EXPORT LIMITED

1E GILLMANS TRADING ESTATE
BILLINGSHURST
WEST SUSSEX RH14 9EZ UK
TEL: (0)1403 784961 FAX: (0)1403 783519

VISITORS STRICTLY BY APPOINTMENT PLEASE

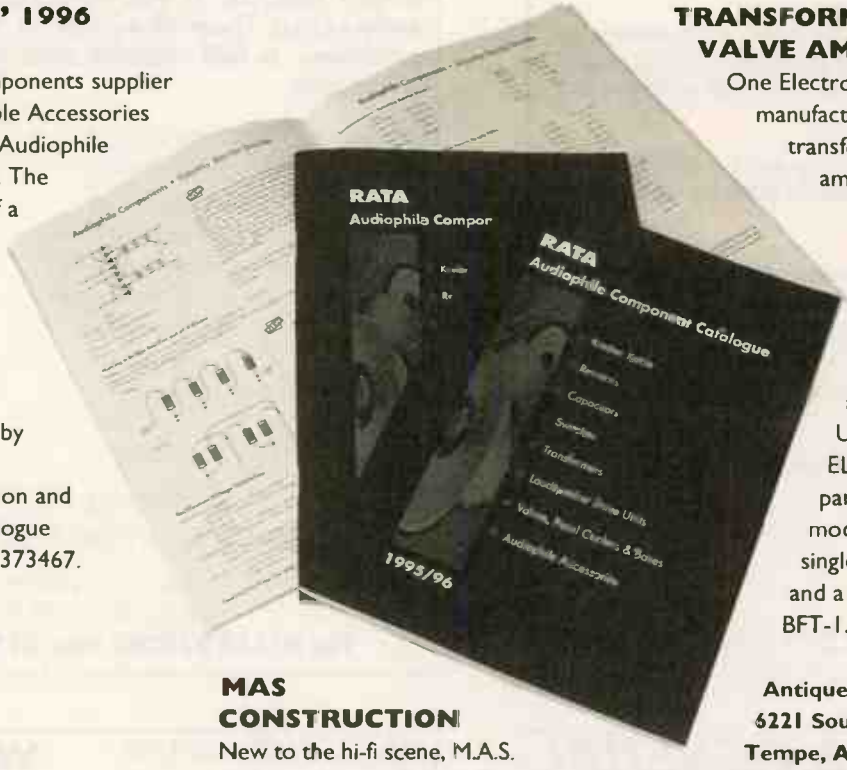
KIT NEWS

RUSS ANDREWS' 1996 CATALOGUE

High quality audio components supplier Russ Andrews Turntable Accessories has published its 1996 Audiophile components catalogue. The catalogue comprises of a mixture of in-depth articles, product descriptions and application notes.

All of the products described in the catalogue are available by mail order.

For more information and a free copy of the catalogue contact them on 0800 373467.



RATA
Edge Bank House,
Skelmergh,
Kendal,
Cumbria LA8 9AS

TRANSFORMERS FOR VALVE AMPLIFIERS

One Electron, designers and manufacturers of audio transformers for valve amplifiers, have appointed Antique Electronic Supply as their exclusive distributor. There are three transformers available at the moment, the PT-UBT-1 suitable for 2A3s, EL34s, 300Bs etc in parallel single-ended mode, the PT-UBT2 for single 300B, SV811-3s etc and a power transformer PT-BFT-1.

Antique Electronic Supply
6221 South Maple Avenue,
Tempe, AZ 85283
☎ 602 820 5411

MAS CONSTRUCTION

New to the hi-fi scene, M.A.S. Construction and Building Service are offering a range of DIY services from 'speaker upgrade notes to cabinet construction. Included in the notes is information on spiking systems and details of a silver plated copper cable you can build for £1.28/metre.

The charge for cabinet construction starts at £148, but the notes cost a mere £4.95.

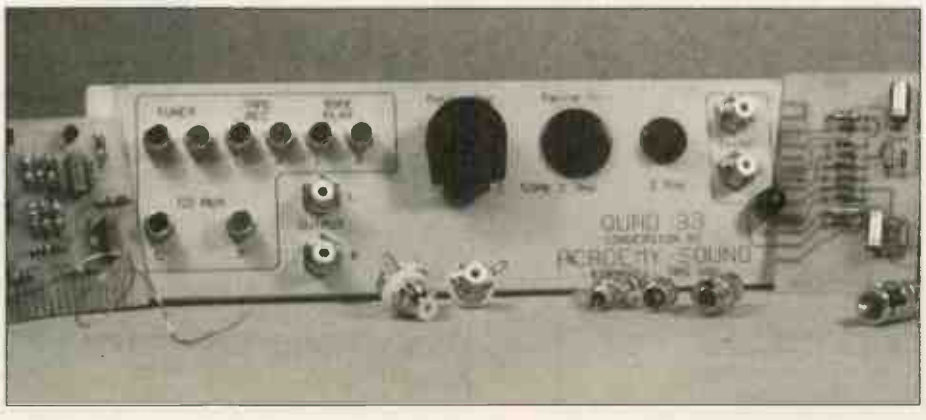
M.A.S. Construction & Build Service
45 Lapwing Close,
Parklands,
Blyth,
Northumberland NE24 3SE
☎ 01670 354726

QUAD'S BACK IN KIT FORM

Academy Sound's back panel upgrade for the Quad 33 is now available in kit form. This comprises a completely new back panel fitted with high quality gold plated phono sockets, instead of the original DIN sockets.

The upgrade kit comes with full fitting instructions and should be suitable for anyone with good soldering skills and presumably a Quad 33 handy. The price will be £138 which includes complementary Ixos interconnect leads and carriage. This is a saving of £47 over the fitted version and of course there's the added pleasure of doing it yourself!

Academy Sound
Bank House,
St Agnes,
Cornwall
TR5 0QW
☎ 01872 553317



PICO YOUR RESULTS

So you spent all your money on a PC and you've only a few hundred pounds left for test equipment, what do you do? Well one option would be to buy one of Pico Technology's Virtual Instruments. Via a choice of analogue to digital conversion units (depending on requirements) the PicoScope and PicoLog software provide a range of instruments controlled by your PC. These include a, digital storage oscilloscope, spectrum analyser, voltmeter, chart meter and frequency meter amongst others. The ADC's plug directly into a PC's parallel or serial ports.

Pico Technology
Broadway House,
149-151 St. Neots Rd,
Hardwick,
Cambridge
CB3 7QJ
☎ 01954 211716

definitive audio

*** BORDER PATROL 300B Power Amplifiers.**

10 Watt single-ended power amplifiers using 300B output valves and choke input filter power supplies.

The traditional single-ended qualities of sweetness, fluidity and integration are combined with wide bandwidth and strong bass performane. Unlike many single-ended designs, which have a tendency to lose resolution and shape when the music becomes complex, these amplifiers remain composed and controlled with firm extended bass and uniform dynamic consistency across the whole frequency range. They are highly recommended to anyone with an efficient (loudspeakers of 89dB / watt + sensitivity) and revealing system and ar equally suited to all types of program material. Price: £2499.00

*** HORNING AGATHON Loudspeakers.**

Two way Lowther bosed horn speakers with huge dynamics and fine resolution. High efficiency (96 dB / watt), wide bandwidth designs with low coloration and excellent timbre reproduction. An ideal compliment to low powered valve amplification. Price £3555.00.

*** BRAVURA Loudpeakers.**

Single way Lowther based harns- the classic configuration. Enormously dynamic and efficient with extended bass and fine resolution. Two models: Brio and Accelerando. Price £5950 and £6600.

*** DEFINITIVE AUDIO.**

Off board valve rectified, choke input power-supply upgrade for Audio Innovations EL34 and 2A3 based amplifiers. Developed in conjunction with Border Patrol Power Amplifiers this upgrade reduces distortion, increases resolution and dynamic range and strengthens bass performance. Price £550.00

***SECOND HAND EQUIPMENT FOR SALE**

Audio Innovations S200 pre-amp	£250	(£350).
Audio Innovations S200 power-amp	£225	(£500).
Gale 402A loudspeakers Chrome End Caps and stands		offers
Kenwood KA7050R Integrated Mosfet with-		
Full remote control	£200	(£450).
Audio Innovations S500 integrated	£495	(£1199)
Impulse H5 Oak	£799	(£1750)
Impulse H6 Grey / Black	£650	(£1250)
Impulse H7 Walnut	£400	(£750)

Tel/Fax: Brighton 01273 276716/208649

nva

BLACK BOX RANGE KITS

A range of easy to assemble solid state kit amps, with fully tested and fitted printed circuit boards. If you are competent with a soldering iron these kits should be no problem. A full rebuild and sort out service available.

AP30	Integrated Amplifier	£230.00
AP50	Integrated Amplifier	£320.00
	Phono Stage Fitted	£70.00
A60	Stereo Power Amplifier	£300.00
A70	Mono Power Amplifier	£570.00 Pair
A80	Mono Power Amplifier	£880.00 Pair
P50	4 Input Pre Amp	£180.00
P90	6 Input Pre Amp	£240.00
Phono 1 MM or MC Phono Unit		£170.00
Phono 2 MM or MC Phono Unit		£240.00
P.S.U. Power Supply for Phono 2		£180.00

EX REVIEW/DEMONSTRATION STOCK BARGAINS, The Emotive Statement (TES) CD Player £1000.00 RRP £2000.00

***NVA**, 6 Watermill Ind. Est., Aspenden Road, Buntingford, Hertfordshire SG9 9JS*

Tel: 01763 272707 Fax: 01763 271594

TECHNICAL & GENERAL

Some Necessities - From the Original Classic Turntable Specialists

			P&P
Connoisseur			
	BD1/2 Drive Belt	10.25	1.85
	BD1/2 Motor Suspension kit	13.95	2.45
	SAU.2 Headshell	16.75	2.55
	SAU.2 Connecting lead	15.95	3.55
Garrard	Standard Models		
	Wired arm tubes	from 12.75	2.55
	Cartridge carriers (sliders)	10.25	1.85
	Idler Wheels	9.85	2.25
	301/401 Transcription Models		
	Original Thrust pad assembly	10.25	2.25
	Original Idler tension spring	2.95	1.85
	Original Speed control disc - 401	13.75	2.20
	Xeroxcopy Owners Manual 301 Incl. full size mounting template	7.85	1.85
	Xeroxcopy Owners Manual 401 incl. full size mounting template	5.70	1.85
	Replacement Intermediate drive wheel	19.95	2.85
	Replacement 301 control knobs		
	On-Off/Speed select	pair 20.25	2.55
	Replacement 301 suppressor unit	5.65	2.25
	Replacement 301 motor pulley (-2%), (-1%),(Std), (+1%)	each 12.65	2.25
	Replacement 301 Chrome plated mounting bolts	set 4.70	2.25
	Recommended Lubrication set - early 301/standard 301/401 - please specify	5.60	1.85
Goldring/Lenco			
	Idler wheel (lock-nut or clip fixing)	19.95	2.85
	Arm Pivot bearings with Instructions	8.25	1.85
	Spindle/Main bearing assembly complete	24.85	3.85
	Headshells	from 21.95	2.55
	Instruction books	from 4.20	1.85
Thorens			
	TD.124 series		
	Idler wheel - original	27.50	2.85
	Idler wheel - our redesigned replacement	15.35	2.55
	Drive belt	15.25	1.85
	Chassis spring suspension (replaces 'mushrooms')	13.85	2.55
	150/160 series		
	Drive belt	10.25	1.85
	Suspension springs (-1%), (Std),(+1%)	set 11.85	2.55
	Suspension bushes	set 12.50	2.25
	Armboards for most models	from 16.90	2.55

Cecil Watts Dustbugs/Parastats/ (spares incl. Preener wicks)
Cartridges and styli for 78s & Mono LPs in addition to current Stereo LP

TECHNICAL & GENERAL PO Box 53. Crowborough, E.Sussex. TN6 2BY Tel:- 01892 654534

KEF CONSTRUCTOR SERIES

Wilmslow Audio

KEF Uni-Q Technology, the unique KEF driver design that delivers a sharply focused sound stage throughout a room, is now available to the home constructer.

KEF's Constructer Series of loudspeaker drive units and dividing networks, may be used in systems of your own design, or by following the KEF kit plans below:

KEF Kit 60 - A two-way bookshelf/stand-mounted loudspeaker using a single 8" Uni-Q drive unit in a compact 18 litre reflex loaded enclosure. The DN60 dividing network allows bi-wiring/bi-amping.

KEF Kit 80 - An 8" Auxiliary Bass Radiator augments the output of the main 8" Uni-Q driver used with a DN80 bi-wireable dividing network. This is a floorstanding loudspeaker with exceptional bass response.

KEF Kit 90 -An 8" dedicated bass unit, 8" Uni-Q and DN90 bi-wireable dividing network give this three way floorstander extended bass output down to 35 Hz (-6dB).

KEF have designed a range of drive units and dividing networks which, with simple D.I.Y skills, can be transformed into State-of-the-Art loudspeakers capable of giving years of truly high-fidelity performanc.

Kit	60	70	80
Boxed	£215	280	370
Total	£290	370	460

Free DIY speaker catalogue
export £3.50

KEF Kit 60
2-way bookshelf/ stand-mounted

KEF Kit 80
2-way floorstanding

Dept. HFW
Wellington Close, Parkgate Industrial Estate,
Knutsford, Cheshire WA16 8XL
Tel: 01565 650605
Fax: 01565 650080

Open Tuesdays to Saturdays
4 demonstration rooms

ACCESS VISA AMEX

KEF Kit 90
3-way floorstanding

KIT NEWS

TO RUSSIA WITH MONEY

The Defence Enterprise Fund, a U.S. government private venture capital fund to finance joint ventures that promote defence conversion in Russia, has decided to pour $3 million into Svetlana Electron Devices. Svetlana is an American corporation which owns a major share of the privatised Svetlana electron tube complex in St. Petersburg, Russia.

In its pre-privatisation days Svetlana was busy producing a line of military products that included components used in military radar and ocean deployed offensive and defensive equipment. Now, with funding from the old enemy, they produce power tubes and glass vacuum tubes for civilian uses worldwide.

Svetlana Electron Devices
3000 Alpine Road,
Portola Valley, CA 94028 USA
☎ 415 233 0429

POLYSWITCHES FROM FALCON

Polyswitches are conductive polymer PTC devices which have a very low resistance when cold, but when an overload occurs and their temperature increases they rise suddenly to a much higher resistance. A range of Polyswitches are now stocked by Falcon Acoustics of Mulbarton. These components can be useful for minimising the complexity of protection circuitry for loudspeaker crossover units or power amplifier output stages.

Falcon Acoustics
Tabor House,
Norwich Road,
Mulbarton, Norwich,
Norfolk NR14 8JT
☎ 01508 578272

NVA'S LOW POWER AMPLIFIER

A new low power amplifier suitable for driving headphones and high efficiency loudspeakers is available from NVA. The AP10 is a 15watt per channel machine built to the same dimensions as the P50, Phono 1/2, DACon and PSU units in their range. The AP10 is available with black Perspex or chrome front panels. It is priced as a kit at £130, whilst a fully built and tested version can be bought for £160. A variation, the AP10x, is also available which has four line inputs and a selector switch, intended to be used as an integrated amplifier. Kit price for the '10x is £150 and built price £200.

NVA
6 Watermill Ind. Est.,
Aspenden Road,
Buntingford,
Hertfordshire SG9 9JS
☎ 01763 272707

BELDEN AUDIO CABLES FROM ELECTROMAIL

Electromail are steadily increasing the number of items in their audio range, with Belden audio cables the latest to be added. The new range includes screened audio cables and 'speaker cables.

The analogue audio cables use a tinned copper conductor with polypropylene insulation and a paper tape separator to facilitate jacket stripping. The cable also has a bonded Beldfold shield and a drain wire for grounding purposes.

Belden's loudspeaker cable is intended for amplifier to speaker connection and for the internal wiring of loudspeakers themselves.

The cable is a four conductor, 14-gauge high flex cable for bi-amp or tri-amp 'speaker connections and, we are informed, is compatible with Neutrik Speakon connectors.

Also included in the range are high flex multi-pair snake cables and microphone cables.

Electromail
PO Box 33,
Corby,
Northants NN17 9EL
☎ 01536 204555

OS-CON AUDIO OFFER

Audio-Links are running a promotional offer until the 30th June to introduce constructors to their range of Os-Con SG audio grade electrolytic capacitors. They believe, due to the unique technology implemented, they are the best electrolytic capacitors available. The offer entitles you to a discount of 20% off the catalogue price.

Audio Links
7 Fairmont Crescent,
Scunthorpe,
North Lincolnshire DN16 1EL
☎ 01724 870432

A High Quality Headphone Amplifier

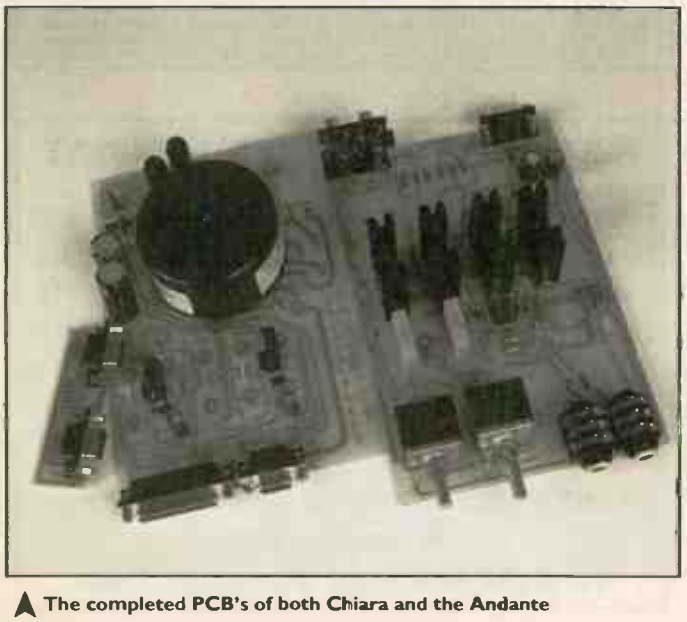
Haider Bahrani builds and tests Hart's Chiara headphone amplifier and Andante power supply.

This one came courtesy of Hart Electronic Kits of Oswestry in Shropshire and it's a 'Chiara' class A headphone amplifier, as designed by John Linsley Hood. Well, actually I was sent two kits, the headphone amplifier itself along with the 3565 'Andante' power supply.

The original brief for this amplifier was published in Gramophone in October 1992 with Mr Linsley Hood clearly defining his intention as putting forward a design that can be easily built by the DIY enthusiast with little or no adjustment (or tweaking) necessary afterwards. Hence the reason for using an emitter follower in a 'single-ended' class A configuration at the output stage as opposed to a push-pull one. The latter requires quiescent current and bias adjustment and possible thermal coupling while the former has it fixed in the design.

The Chiara kit unassembled

The power supply module prior to assembly



The completed PCB's of both Chiara and the Andante

BUILDING THE CIRCUIT BOARDS

Hart truly do make every effort to accommodate their kits to the absolute beginner. Provided is a hearty wad of paper introducing the wannabe constructor to the world of PCB construction and DIY electronics. The kit instructions too are a step-by-step guide - I followed them to the letter.

The order of assembly seems to have been well thought through. Mounting the PCB components is done in ascending size and height, making soldering a lot neater and easier. The only other tools necessary, other than the obligatory soldering iron, are a pair of wire cutters, screw drivers (crossed head and flat-blade) and a multimeter - one with basic voltage and resistance measurement will do. Everything else, including 'super audio grade silver solder', is provided.

FINAL ASSEMBLY

Once the PCBs were complete the front and rear plates of the headphone amplifier and the rear plate of the power supply were mounted. The end plates attach first to the PCB-mounted sockets, and are then screwed to the case. This too was a very neatly set out procedure, particularly the use of plastic bushes for the volume and balance control shafts which ensured they were wobble-free.

The power supply front plate wasn't mounted in the same way, and this was cause for my first criticism, though a minor one at that. Because there's only a power switch and LED on this panel, it isn't held to the PCB. This made it awkward to solder the LED in place and care was needed not to stress its mounting legs while the panel was attached to the bottom plate. My only other moan while I'm on a roll is that I struggled a bit getting the transformer to fit in the holes provided. This is probably just due to a combination of tolerance errors and nothing that a little bit of effort, a pair of pliers and some gentle persuasion couldn't sort out.

There's no wiring in the headphone amplifier - everything's neatly PCB-mounted, but construction of the power supply did require a little. These were primarily for the mains supply/switch connections plus the routing to the extra dc supply outputs (small PCB shown). The casing in both cases tidily slides together giving two elegant pieces of equipment.

SOUND QUALITY

Using Beyerdynamic DT 531 headphones with my Ziggy Stardust CD playing in our Audiolab 8000CDM transport and a Pink Triangle Da Capo CD convertor, I plugged myself into the 'Chiara'.

'Starman' was a stop on the way through I certainly couldn't miss, and I wasn't disappointed. The sound was clear and pacey with plenty of life.

Riverside Audio

18, Riverside, Cambridge CB5 8HL. Telephone/FAX: (01223) 512253

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

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

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

Stereo amplifier circuit board : board only £49.50; component pack (including valve bases), add £63; populated board £125; full valve set, add £45. Power supply board : board only £20.50; component pack, add £44; populated board £66. Input board : board only £15.50; component pack, add £16; populated board £33.

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

The chassis, comprising main chassis and transformer cover, is hand polished, welded 1/16" stainless steel - NC machine tooled for a perfect fit and clean finish. Each kit also includes a mesh valve cover and baseplate, finished in semi matt black. Price £310. Also available in mild steel finished in black, £195. For those who wish to use one of these high quality chassis for their own projects, details of the chassis are given in the 4040 reference manual, £6.50.

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

The Riverside P2 phono preamplifier is designed to partner the Riverside 4040 for those who enjoy the vinyl sound. Equalization is provided for moving magnet output to line level. The P2 features a high accuracy feedback RIAA equalization circuit, ensuring a natural tonality, a regulated high voltage supply per channel and cathode follower outputs. 3xECC83, 1xECC81, 2xECF80. Full details and circuit diagram in the P2 reference manual, £6.50. Kit £225, fully assembled £275.

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

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

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

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

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

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

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Faster tracks like 'Sexy MF' of Mr Symbol's (now apparently called Prince again!) Symbol CD presented a harder sound than some might appreciate, but otherwise it was full and dynamic with fairly good separation. Reggae fans though may be a bit disappointed, but then these aren't 20 inch cones stacked to the ceiling.

The DT 531s, being closed headphones, do give, as is typical of their kind, a more confined sound than open counterparts. I tried several other 'phones and the results were always pleasing, with a detailed, spacious and open sound.

Tori Amos' 'Blood Roses' gave a wonderful sensation of her fingers tinkling the Harpsichord keys, between my ears. As with Jimi Hendrix's 'Highway Chile', my Stratocaster wasn't handy so an air guitar was necessary.

Comparing the Chiara with the headphone stage on the Audiolab 8000Q preamplifier did make it seem like a hill in the shadow of a mountain. The Audiolab had a clearer and fuller sound filling in the gaps in the lower registers, sweetening the treble and opening the image. Mind you, to get your hands on this headphone amp you would have to pay a great deal more, and it'd be without the added bonus of building it yourself. Well Ziggy played guitar and so did I at some points. Jolly pleasant stuff indeed.

CONCLUSION

Overall, particularly for the DIY newcomer, this is a very well presented and easy to build kit with a good sonic performance to match. Excellent for accelerating a beginner's learning curve ●

Hart Chiara	**£109.50**
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SINGLE-ENDED OR PUSH-PULL?

In his design, Linsley Hood opted for a single-ended configuration. This is not to dismiss push-pull circuits out of hand. Considering the properties of each, one can be left to choose the appropriate topology for the given circumstances.

Single-Ended

With a typical bipolar transistor single-ended output stage, the output device swings the full audio signal, positive and negative half cycles. The output terminal (emitter) is held at half supply volts and passes half the peak output current when idling, meaning that in a powerful output stage it must dissipate a lot of heat. However, it does not have to "crossover" to another device, so device thermal matching and crossover distortion are eliminated. This configuration, by its very nature, is Class A only.

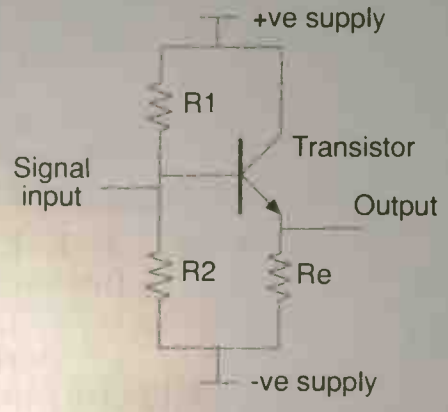
Push-Pull

Push-pull circuits use two output devices biased just into conduction (Class AB case). When complementary transistors (i.e. NPN/PNP) are used, one will turn on during the negative half cycle and the other during the positive half cycle. One pushes whilst the other pulls, as it were.

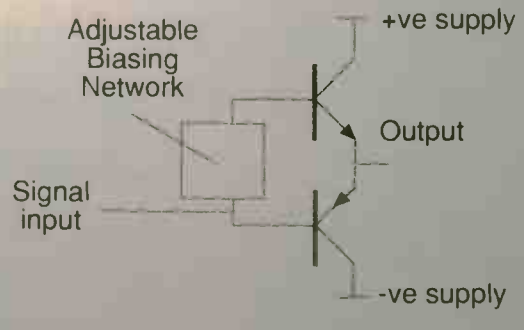
When there's strict division of labour between the output devices, the method of operation is known as Class B. When there's some overlap, to make a smooth change betwen them and minimise crossover distortion, Class AB, and when both share fully, Class A.

As the quiesent current required for each transistor is zero in Class B and low in Class AB, compared to the single-ended case, thermal disipation is a lot less and efficiency much higher.

SINGLE ENDED CONFIGURATION



BASIC PUSH PULL TOPOLOGY



ELECTRONICS WORKBENCH

Version 4

An electronics simulator for the masses? Interactive Image Technology of Canada have had a go at producing one. Their latest version is reviewed by Haider Bahrani.

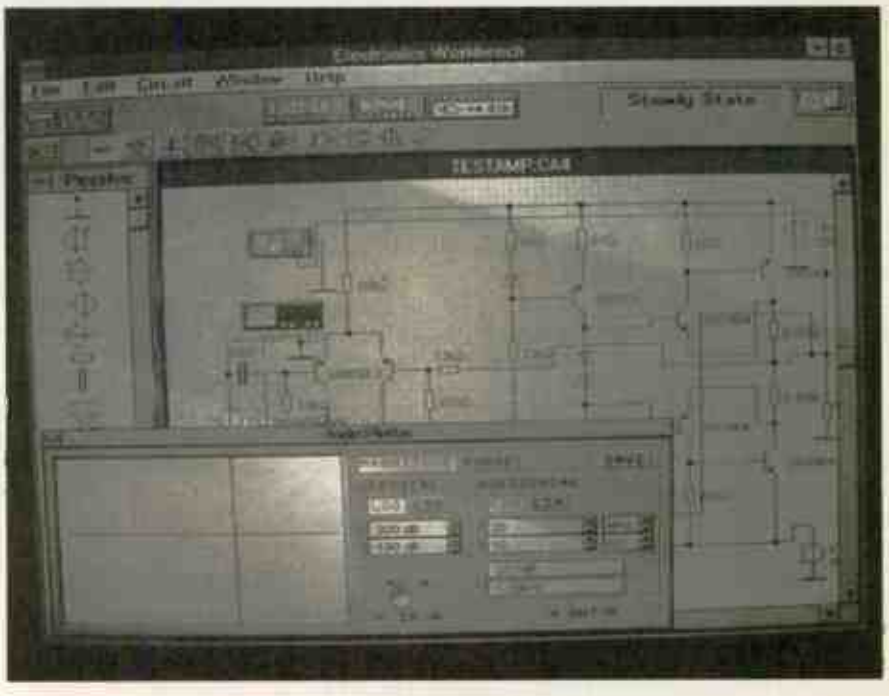
The first time I came across an Electronics Workbench package was a number of years back now whilst doing my degree. These were the days when Intel 386 based PCs were the state of the art and DOS was the predominant user interface. Having laboured away on programs like Spice and Analyser where inputting a circuit required a full blown programming session, the idea of a package that allowed you to build the circuit schematically and simulate it was very attractive.

It was this early version that invited me into a world where at the click of a mouse button I could have virtually any standard laboratory instrument. There was also the bonus of one or two which weren't typically found on a student's workstation, including a Bode plotter. OK, it was slow and the device models lacked the sophistication of its programmable counterparts, but it was user friendly and encouraged experiment.

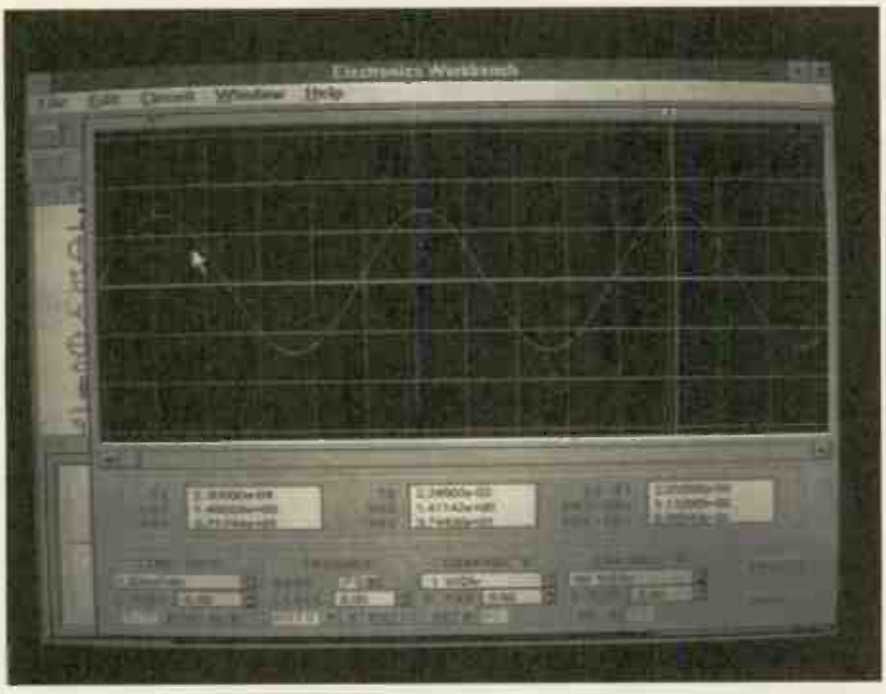
With Version 4 in my grasp I took little time rushing to my PC to install it. The one sent to me runs under Windows, but it is also available for DOS and the Apple Macintosh. Having spent some time growing in educational establishments, the new version now seems intent on tackling the professional design field. As far as ease of use is concerned, Workbench is certainly first class. The much more expensive Microcap and workstation based Hspice are not as user friendly in my opinion, making Workbench look even better value at £199.

WORKBENCH INSTRUMENTS

So what has Workbench got going for itself? Well instead of having a breadboard, components and test



An analogue amplifier circuit with the Bode plotter in action.



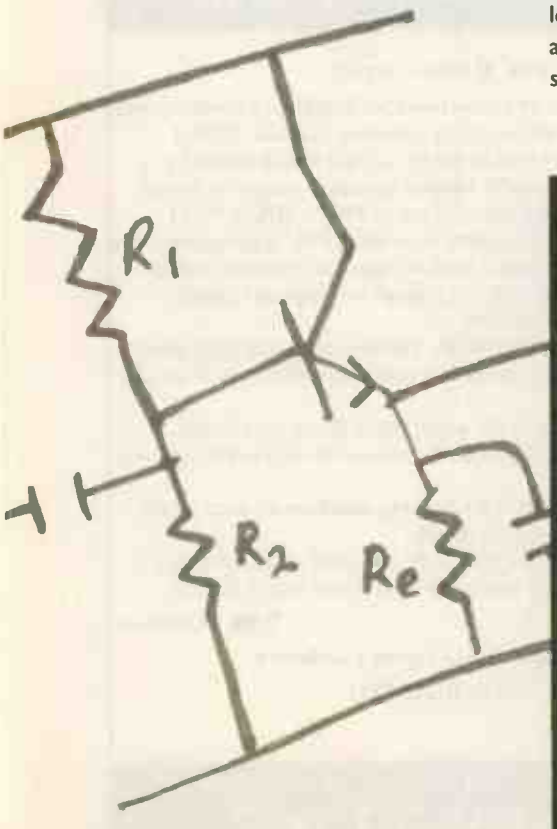
Workbench's oscilloscope showing the amplifier's output.

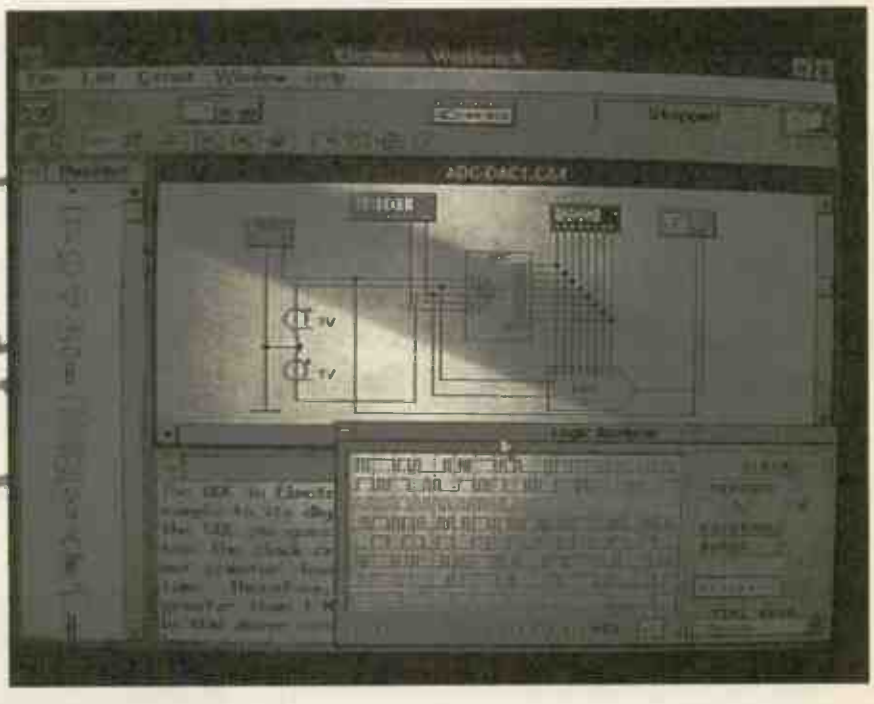
instruments in front of you, Workbench places them on the computer screen. The standard test instruments available include a multimeter, oscilloscope, function generator, logic analyser and logic word generator. These can be accessed via icons at the top of the screen in typical Windows fashion.

The not so typical items such as the Bode plotter and logic converter, which presents logic in gate, truth table and Boolean formats, can be pulled down onto the work area and plugged into the circuit. If we haven't been spoilt enough already, an endless number of voltmeters and ammeters can be pulled out of the indicator parts bin and plugged into desired points on our circuit.

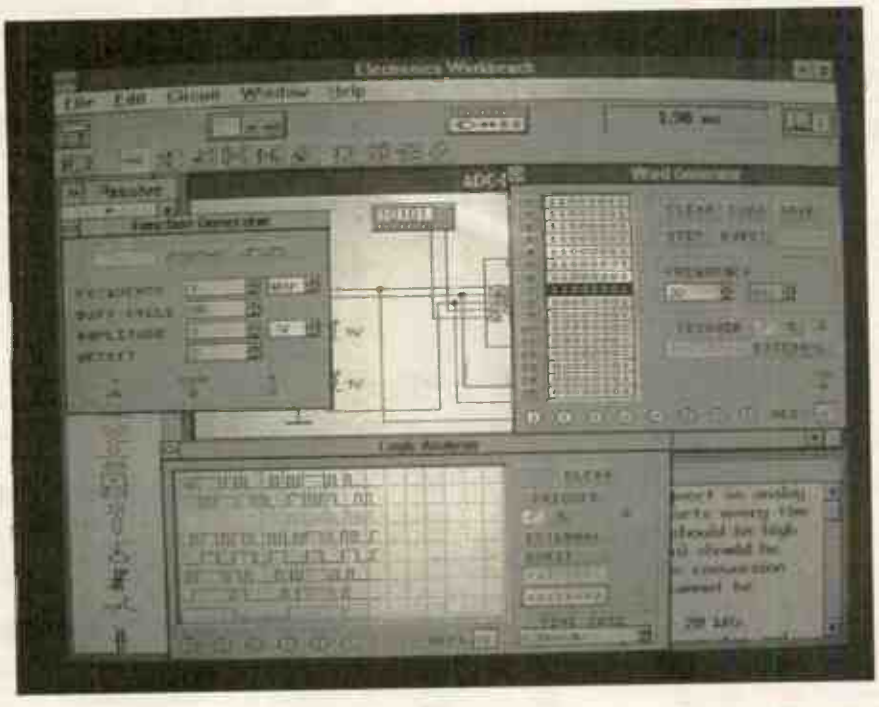
The multimeter allows the measurement of both DC or AC voltage and current as well as resistance at DC and dB loss between two points. The decibel values are set at a default reference of 1volt, but as with nearly everything else in this package, can be customised to suit your requirements. The oscilloscope has similar characteristics to those of a standard dual-channel, real world device with basic triggering facilities and markers allowing point reference measurement along the horizontal axis.

The Bode plotter, having the least sophisticated of representations, in a not so standard fashion, can only display phase or magnitude responses at any one time. This does make it less straight forward to read off gain and phase margins (which is really one of the powers of the facility), but at least it is there.





An ADC-DAC circuit showing off the logic analyser.



Function Generator, Word generator and Logic Analyser in action.

CIRCUIT SIMULATION

For circuit stimulation the function generator provides the standard triangular, sine and square waves with variable frequencies and offsets. The logic analyser provides graphical and hexadecimal displays of digital circuits' outputs. The logic word generator is for driving these digital circuits by producing 16 8-bit words which can be pumped through one word at a time, all together or in cycles if desired.

The core of the Electronics Workbench package is based on Berkeley Spice 2G6. The device models can be customised. A Spice I/O module can be added to the standard package which allows you to export the netlists for analysis using a Spice package. You can also import device models from Spice versions 2 and 3. Another add on also allows the export of schematics to PCB design packages such as QuickRoute, a review of which we hope to bring you in the not too distant future.

Analogue Simulation

One of the frills of this most recent update of the Workbench package is the combination of both analogue and digital simulation onto one virtual breadboard. I had quite a bit of fun with the analogue simulation which is probably the most powerful aspect, managing to put together circuits and simulate them very easily.

Double clicking on active devices allows you to easily modify their parameters. Clear, concise details are given in the technical reference manual. If the devices aren't specified the program defaults to the ideal. As it is a Spice based simulator both transient and steady state analysis is possible, with an option to revert to linear operation if it can be assumed that all active devices will operate in their linear regions.

Digital Simulation

Much the same as with the analogue components, the digital and hybrid (including 555 timers, DACs and ADCs) component circuits can be put together using the ideal form. The components can then be replaced with TTL, CMOS or 74 series blocks etc. from the vast libraries, either provided or obtainable as extras from the 2100 or so Model Libraries available for the package.

The logic converter was probably the most interesting aspect for me as I used to hate doing Boolean algebra and Karnaugh mapping in my student days. Once I had supplied all of the input and output data, Workbench did the rest for me, building the circuit on screen. What more could you ask for?

CONCLUSION

Educationally Workbench is superb, with everything mouse handy on the screen. A budding designer can experiment by simulating device faults, forcing them to short or open circuit and even add current leakage into the circuit. As a designer's package it is a perfect tool for pre-evaluation work; the speed you can put together a circuit and get a response out of it is phenomenal. It doesn't, for now, provide the detail and low level programmability that a Spice package would have, but then we are playing a different game here. For this money we should be queuing for it. PC not included!

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4mf	1000 volt	45x45x120 mm	48.95
4mf	2500 volt	70x70x120 mm	[illegible]
10mf	1000 volt	[illegible]x100x100 mm	[illegible]
12mf	1000 volt	70x100x120 mm	[illegible]
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AN-421	1	25.5 mm	Wrap-round	Screw-in bolt	1.41
AN-422	1	17.4 mm	Wrap-round	Screw-in bolt	1.41
AN-423	1	22.6 mm	Solder slot	Screw-in	1.41
AN-452	2	Adjustable, 17mm	Solder slots	Dualbolt screw-in	2.42
AN-453	3	Adjustable, 24mm	Solder slots	Dual bolt screw-in	3.05
AN-455	5	Adjustable, 32mm	Solder slots	Dual bolt screw-in	4.0[illegible]
AN-458	8	Adjustable, 50mm	Solder slots	Dual bolt screw-in	5.7[illegible]

AR-469	10	Adjustable, 72mm	Solder slots	Dual ball screw-in	7.31
AR-476	6	25mm*45mm	Solder slots	Screw-in bolts	5.35
AR-478	9	25mm*65mm	Solder slots	Screw-in bolts	7.53

AUDIO NOTE SELECTED AUDIO VALVES.

Our valves are selected from the best available sources and are tested to the same stringent standards that we apply in the production of our own amplifiers, they be into two categories, standard production items and rare, usually NOS (New Old Stock) valves which are no longer in production. We have compiled a special list of the NOS items, which is available against a stamped self addressed envelope, if you live outside the UK, send US$ 2.00. You should be aware that the valves on the list are NOT cheap, but we have stock of original GE, RCA and United Electronics 211, both standard versions and reinforced airborne type, 845 Westing house, VT25/10/10Y, VT62/40/A, WE300B, STC-4300A, Mullard G234/CV1377, Tungsol 5U4G (best sounding 5U4G I have ever heard), Chatham SR-WE5Y and many others.

Standard Stock Items.

Type No.	Type	Price Ex. UK Vat
EB80CC7/ 2AX7/6N7/7025	double triode	2.95
E80CC Sylvani 2AX7/W	high gain super low noise	3.95
E80CC01/ 2AX7/W3T	superlow noise, low microphony audio version of W6	3.45
6072W/1 2AY7	double triode, low gain ECC83 type, exceptional sounding used in CHAKALI, MOTdate Silver. KESON probably best sounding ECC83	3.45
E88CC/6922/6DJ8/M/W/7308	double triode	3.95
EF86/CV2127/Z729	pentode	2.45
ECC82/1 2AU7/5814 4a	double triode, mil spec	5.95
6SN7GT Russian	double triode, UBX base	2.75
6SN7WGTA Sylvania	double triode original UK-made, low microphony, super sounding	5.95
6SL7GT	double triode, UBX base	3.25
6350WA	small power pentode	6.75
5687WB Sylvania USA	double triode, powerful driver used in CHAKALI, KESON etc.	6.75
E1 82CC/7044 General Electric USA	double triode very powerful driver, pin-equivalent of 5687WB	14.75
ECL82/6BM8	triode-pentode	2.85
EL34/6CD6	small power pentode	1.55
EL84/6BQ5/6W4	small power pentode, mil spec version	4.51
6V6GT	small power tetrode	2.45
EL86	medium power pentode	2.75
5881/6L6WGC	medium power tetrode, standard base	4.51
5881WXT	medium power tetrode, standard base	5.35
KT-77/EL34 Fat Bottle	power tetrode	8.85
EL34S	power pentode	8.45
5881	power tetrode, Audio Note branded and tested to our specification	56.45
KT-77	power tetrode, Audio Note branded and tested to our specification	29.45
AN-845	power triode, Audio Note tested and tried	33.45
6C33	powerful regulator, indirectly heated triode	24.85
6AS7/6080	strong regulator, indirectly heated triode	8.45
2A3 4-pin or 8-pin for Audio	directly heated small power triode	14.95
	transitions Second Audio Amplifiers	17.95
5U4G Russian	MT-rectifier	2.25
5Y3GT Russian	MT-rectifier	2.25
5Y3GT Sylvani	MT-rectifier	3.95
GZ34/5T	MT-rectifier	2.25
GZ34/5AR4 Russian	MT-rectifier	6.75
GZ34/CV1377 Mullard	MT-rectifier	44.85
GZ37/CV378, UK-made	MT-rectifier, equivalent to GZ32/04 but better sounding	9.55
SM4W/GB Cohnes USA	Very powerful MT-rectifier, 2,500volt at 100mA	24.35
GX4	MT-rectifier, very good for pre-amplifiers, 7-pin base	2.85
GX5	MT-rectifier for pre-amplifiers & power amplifier front-ends, UBX base	2.85

Please note, our 300B's are manufactured in China by Gold Dragon/Shuguang, but are tested in-house under and working conditions to parameters somewhat more stringent than is otherwise done. We, they do not sound quite as good as original WE 300B's or STC 4300A's, nor do they carry the same premium price, please consider the following, unless you have absolutely tons of money or you happen to have them in your attic, do not consider original 300B's, it is a must cause for better to invest the money in more permanent features of the amplifier project, the better output transformers, better signal caps or resistors or the like, valves wise and, better quality passive components but. A pair of original WE 300B's cost at least £ 1,200.00, on a good day, think in terms of an overall price compromise, you can get some fabulous sounding passives for the difference in cost between a pair of Chinese 300B's and the original WE's, and a more than the improvement in sound-quality is greater than the WE 300B's will contribute. AND the contribution to sound is permanent, consider that when you plan your project.
We have made some very considerable purchases of valves at the US-government auctions and types like the 6SN7WGTA, 6072A, 5687 and 7044 are probably the best sounding small signal - driver valves made, the prices are not unduly high at the moment, so now is the time to try.

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

Bypassing.
We offer three quality levels of resistor quality: all are 1%, starting with the Bypassing metal film, which are slightly magnetic (as are the well majority of other values of metal film resistors), but nonetheless very good sounding, as used in all our UK-made amplifiers, up to and including quality Level 3, the MEGHAVPP/P4, 300B no-feedback triode amplifiers.
Bypassing 1 watt, 1% resistors up to 500KOhm. £ 0.11, above 500KOhm £ 0.13 each.

HOLCO.
Better sound quality can be achieved with the H2, 1 watt, 1% non-magnetic resistors, which we regard as the best "industrial grade" metal film resistors available. They have one small drawback, as they are quite fragile, and require careful handling, do not bend the legs too close to the body, they may become noisy.
HOLCO resistors type H2 50PPM cost £ 3.05 each from 1R0 to 5R0, £ 0.80 each from 5R1 to 10R0, £ 0.36 each from 200hm to 2300hm, £ 0.41 each from 2310hm to 1400hm, £ 1.02 each from 1501 to 2MΩ, £ 1.24 each from 2M1 to 4MΩ, and £ 2.21 each from 4M1 to 5MΩ

SWIRLOM Tantalum Film Resistors.
This is definitely the best sounding resistors available, forget the VISHAY, which may be ok in high feedback transistor amplifiers, but in our opinion quite uncomplimentary to the qualities of real Audio Amplification (i.e. directly heated triode amplifiers running feedback free in single-ended Class A), this is where you will need the tantalum film resistor for the best results.
The 1/2 watt Shinkoh tantalum resistors are non-magnetic and cost £ 2.25 each.
Some values are available in 1 watt from Shinkoh at £ 4.00 each. List of stock available.

AUDIO NOTE 1/2 WATT TANTALUM RESISTORS.

With our in-house range of tantalum resistors increasing all the time, and Shinkoh becoming less and less able to supply, we have found it necessary to second-source the 1/2 watt value in addition to the 1 watt already offered, the AN-Tant are non-magnetic and share all other aspects of the Shinkoh, except the colour, they will be available by the time you read this in the following values, 10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 91R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 910R, 1K0, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 9K1, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K 68K, 75K, 82K, 91K, 100K, 120K, 150K, 180K, 180K, 180K, 220K, 250K, 270K, 330K, 390K, 470K, 5 MR, 560K, 620K, 680K, 820K.
The 1/2 watt Audio Note tantalum resistors cost £ 1.50 each.

AUDIO NOTE 1 WATT TANTALUM RESISTORS.

Up to now the tantalum film resistors have been extremely difficult to get, however, after much persuasion and against a minimum quantity guarantee from Audio Note UK, the manufacturers have agreed to make the range of 1/2 watt and reintroduce the 1 watt range which becomes an exclusive range for AUDIO NOTE, we consider this to be major breakthrough, since without a reasonable range of values at the 1 watt rating it is pretty difficult to get the very best out of the best circuits. The 1 watt Audio Note tantalum film resistors are available in the same values as the 1/2 watt, with the addition of the 1 MΩ.
The AUDIO NOTE 1 watt 1% tantalum resistor values are £ 3.70 each.
We shall now be working on getting 2 and 3 Watt tantalum resistors made available as well, and who knows perhaps we will be able to build amplifiers in a year's time that have all tantalum resistors in all parts of the circuit.

AUDIO NOTE PRECISION CARBON FILM RESISTORS.

In addition to the non-magnetic tantalum resistors, we are going to stock a range of precision gold plated carbon film resistors, in many cases the carbon film resistor is preferable if you are building an amplifier based on an old circuit, like for example the WE91 or another circuit of similar vintage. We shall be stocking values suitable for projects like the WE91 in 1/2 and 1 watt values, these resistors are made especially for us by a major manufacturer.
They cost for the 1/2 watt £ 3.30 each; 1 watt £ 4.65 each; 2 watt £ 6.80 each

ALLEN BRADLEY 1 Watt 5% Carbon film Resistors.
Due to popular demand, and a general lack of other sources, we have started stocking a range of Allen Bradley carbon film resistors, many experienced DIYers, like my friend Hein Reichert, consider these the very best sounding for many applications.

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

HIGH WATTAGE WIRE WOUND RESISTORS.

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

Wattage	Value	Tolerance	Price excel. Vat
5 watt	47R	5%	0.85
5 watt	100Ω	5%	0.85
5 watt	470R	5%	0.85
5 watt	1KΩ	5%	0.85
5 watt	2K2	5%	0.85
5 watt	15K	5%	1.32
5 watt	33K	5%	1.32
5 watt	100Ω	5%	1.32
5 watt	1K5	5%	1.24
5 watt	1KΩ	5%	1.24

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

BLACK GATE ELECTRON TRANSFER. High Performance. Graphite foil capacitors.
Firstly, I would like to categorically state that any rumours about Black Gate capacitors being unavailable or discontinued are totally misguided, malicious and incorrect, AUDIO NOTE is currently the sole source in Europe that holds any significant range of values in stock, we are literally 10007's in production, as we were the first company to realise the tremendous benefits that Black Gate capacitors offer, and we are to date the only high-end audio company in the world to incorporate Black Gate capacitors consistently in our finished products. There are very few audio parts that promise a guaranteed improvement when replacing practically any other part, but this is what the BLACK GATE capacitors actually do. Exchanging any electrolytic capacitor anywhere in the circuit of an amplifier or in the crossover of a speaker will greatly improve sound quality. We are working on some guidelines and values, bias and which types of Black Gates to use in different circuits, the first such technical guideline is available now and is called "improving your CD-Player" and can be obtained by sending a stamped addressed envelope to us requesting this leaflet. All AUDIO NOTE Level 2 Signature products use Black Gate Electron Transfer in critical signal/power supply positions.
It is very important to note that of BLACK GATE capacitors take time to charge-up or stabilise, when first put in circuit, depending on type and application this "maturing" time can be between 100 and 300 hours. Black Gate call this the "tiling process", we endorse! but of available values. We feel, however, that this process takes longer, be heard
We are about to stock the entire range of values on the enclosed list, as a separate price list is attached to the list of Black Gate program available. Ask us to send you this list as it is too long for an advertisement or to incorporate in our standard component list, wherefore it is not included in full. Again, as always, we appreciate a stamped self addressed envelope, it greatly influences the expediency the cost.

IMPORTANT NOTICE!

PLEASE NOTE, THE PRICE LIST FOR BLACK GATE CAPACITORS IS A GUIDELINE ONLY. DUE TO THE CONTINUOUS STRENGTHENING OF THE JAPANESE YEN, IT IS IMPOSSIBLE TO PRINT UP-TO-DATE PRICES MONTHLY. SO ASK FOR PRICE WHEN YOU ORDER.

Value	Voltage	BG-Type	Suggested Use	Price Ex. UK Vat.
1.7mF	25volt	FK	Anywhere	1.85
33mF	35volt	FK	Anywhere	1.75
0.47mF	50volt	FK	Anywhere	1.65
1mF	50volt	FK	Anywhere	1.12
2.2mF	50volt	FK	Anywhere	1.23
3.3mF	50volt	FK	Anywhere	1.36
4.7mF	50volt	FK	Anywhere	1.89
10mF	50volt	FK	Anywhere	1.87
22mF	50volt	FK	Anywhere	2.85
22mF	1 0volt	Standard	Anywhere	2.82
33mF	1 0volt	Standard	Anywhere	3.42
47mF	1 0volt	Standard	Anywhere	4.11
330mF	1 0volt	Standard	Anywhere	6.89
10mF	50volt	Standard	Anywhere	2.97
47mF	50volt	Standard	Anywhere	4.41
100mF	50volt	Standard	Anywhere	4.73
100mF	50volt	Standard	Anywhere	5.47
220mF	50volt	Standard	Anywhere	10.41
10mF	100volt	Standard	Anywhere	3.71
22mF	100volt	Standard	Anywhere	6.31
47mF	100volt	Standard	Anywhere	8.54
100mF	100volt	Standard	Anywhere	7.75
220mF	1 00volt	Standard	Anywhere	22.15
1000mF	16volt	Standard	Anywhere	8.22
1000mF	50volt	Standard	Anywhere	24.35
220mF	1 0volt	Standard	Anywhere	4.35
470mF	1 0volt	Standard	Anywhere	6.35
2200mF	1 0volt	Standard	Anywhere	13.45
13,000mF	8volt	Standard	PSU smoothing	234.65
4700mF	1 0volt	Standard	Anywhere	14.25
47mF + 47mF	530volt - 550v surge	SKp-Type	PSU filter capacitor	85.95
100mF + 100mF	500volt - 550v surge	SKp-Type	PSU filter capacitor	101.95
100mF	500volt - 550v surge	SKp-Type	PSU filter capacitor	72.75
220mF + 220mF	350volt - 400v surge	SKp-Type	PSU filter capacitor	68.65
1000mF + 1000mF	350volt - 400v surge	SKp-Type	PSU filter capacitor	75.35
22mF	350volt	VK-Type	Decoupling or filter capacitor	10.95
1 50mF	350volt	VK-Type	PSU filter capacitor	41.23
0.47mF	50volt	F-Type/Low ESR, Low impedance use anywhere		1.11
22mF	6.3volt	F-Type	As above	1.22
100mF	6.3volt	F-Type	As above	1.56
220mF	6.3volt	F-Type	As above	2.11
2200mF	6.3volt	F-Type	As above	4.75
47mF	16volt	FK-Type/Ultra low ESR version, comparable to film caps		7.15
1 00mF	1 0volt	FK-Type/Ultra low ESR version, comparable to film caps		13.71
220mF	1 0volt	FK-Type/Ultra low ESR version, comparable to film caps		9.95
100mF	25volt	FK-Type	As above	14.29
220mF	25volt	FK-Type	As above	21.43
100mF	50volt	FK-Type	As above	15.71
1000mF	50volt	FK-Type	As above see anywhere	58.71
2200mF	35volt	FK-Type	As above see anywhere	56.71
2200mF	63volt	FK-Type	As above see anywhere	109.43
100mF	100 volt	FK-Type	As above see anywhere	32.85
2.2mF	50volt	C-Type	For circuits with DC potential difference	2.87
4.7mF	50volt	C-Type	For circuits with DC potential difference	3.35
6.8mF	50volt	Bipolar	For loudspeaker crossover networks	12.85
10mF	50volt	Bipolar	as above	16.85
22mF	50volt	Bipolar	as above	23.85
47mF	50volt	Bipolar	as above	36.95
0.47mF	50volt	BG-Hi Type	For PSU decoupling	12.35
220mF	6.3volt	BG-Hi Type	For super low noise PSUs	11.85
100mF	1 0volt	BG-Hi Type	For super low noise PSU's	24.85
470mF	12volt	BG-Hi Type	as above	28.95
4700mF	35volt	BG-Hi Type	as above	212.45
1mF	50volt	BG-Hi Type	as above	5.45
4.7mF	50volt	BG-Hi Type	as above	8.65
10mF	50volt	BG-Hi Type	as above	7.55
47mF	50v3b	BG-Hi Type	as above	13.75
100mF	50volt	BG-Hi Type	as above	20.35
1000mF	50volt	BG-Hi Type	as above	98.95
2200mF	100volt	BG-Hi Type	as above	423.35

In our component list you will find a listing of all available Black Gate values, together their sizes, heat usage etc.
Lastly, we can supply a range of more modestly priced components, still good quality, but more industrial grade, if you like

POTENTIOMETERS.

Best available from sound quality - price viewpoint, made by Noble in Japan, high quality conductive plastic film.

Volume Controls Impedance	Construction	Price Ex. UK Vat.
100KOhm Stereo	Frame type, PCB mounted	3.95
100KOhm Stereo	Encapsulated type, PCB mounted	15.85

A better alternative is the KO-OR volume controls which are used in pre-amplifiers like the M77 etc. M7Lite, and in a more version on the input on the MEHRO, KISSIM, KESON and GAKU-ON, these are very good sounding pots by any standard.

Impedance	Construction	
100KOhm Stereo	Encapsulated	32.25
100KOhm Stereo	Large Encapsulated	70.65
100KOhm Stereo	Large Encapsulated, high quality	£107.45
Balanced Controls		
100KOhm	Frame type, PCB mounted	4.45
100KOhm	Encapsulated type, PCB mounted	17.25

KO-OR ratio makes a very good quality 100KOhm balance control, similar to the encapsulated 100K pot, this costs £32.25

STANDARD TYPE SWITCHES

This switches is adjustable 2 - 6 - ways, if has gold plated contacts and a stainless steel ball for the best possible corrosion protection and contact, price ex. UK Vat £5.80
Again KO-OR offers a very nice sealed switches, 6 way 2 channel at £50.85 each.

STANDARD ELECTROLYTIC CAPACITORS

Good quality standard industrial types

Value	Voltage	Size	Price Ex. UK Vat.
100mF	10volt	13*20mm axial	0.23
100mF	16volt	13*20mm axial	0.29
220mF	16volt	17*40mm axial	0.31
200mF	40volt	13*40mm radial	0.42
100mF	63volt	13*40mm radial	0.47
4700mF	16volt	30*40mm radial	0.82
2220mF	50volt	35*1 0mm radial, 41*40mm axial	0.87
10mF	160volt	15*40mm axial	0.98
22mF	350volt	25*12mm axial	1.25
22mF	450volt	41*40mm axial	1.89
47mF	385 volt	25*21mm axial	2.16
56mF	400volt	30*21mm axial	2.37
68mF	400volt	30*22 mm axial	2.89
100mF	400volt	30*25 mm axial	3.39
220mF	385volt	52*30 mm radial can	4.45
220mF	450volt	40*30 mm radial can	5.85
220mF	550volt	112*35 mm radial screw terminals	27.85
470mF	325volt	50*35 mm radial can	4.95

RCA BNC BANANA PLUGS. RCA SOCKETS. SPEAKER & GROUND TERMINALS & LOUDSPEAKER SPADES.

RCA PLUGS

Standard Gold plug	1.55
AN-C Gold plug	3.85
AN-SP AUDIO NOTE gold plug	8.51
AN-P AUDIO NOTE Silver plug, teflon insulated, non-magnetic	25.53

RCA SOCKETS

Type	Mounting	Price Ex. UK Vat.
RCA socket nickel plated	Chassis mounted	0.41
RCA socket gold plated	Chassis mounted	0.85
AN-CS AUDIO NOTE non-magnetic, teflon insulated socket, gold plated	Chassis mounted	3.85

BNC PLUGS & SOCKET

Type	Price ex. UK Vat.
Standard BNC plug	3.45
BNC Silver plated nickel chassis mounted	2.89

Banana Plugs, Loudspeaker Cable Spades, Chassis Loudspeaker Terminals.

Type	Price Ex. UK Vat.
AUDIO NOTE Banana plug, gold plated spring loaded bronze	2.45
AUDIO NOTE Loudspeaker Cable spade, silver plated, non-magnetic	4.85
AUDIO NOTE AN-ST Speaker Terminal, chassis mounts, nickel plated, red or black	1.85
AUDIO NOTE AN-STJG Speaker Terminal, chassis mounts, gold plated, red or black	2.75
AUDIO NOTE AN-STR Speaker Terminal, chassis mounts, fully gold plated non-magnetic, red or black	4.75
Ground Terminal, chassis mounted and nickel plated	1.45

Our range of components is constantly expanding, as we find new or better suppliers so stay in touch by reading our inserts in HiFi World and Hifi News.

FERRITE RINGS

In many systems, especially ones using transistor based amplification there is often a problem of incoming RF crossing into the feedback loop, especially from connected CD-players, clamping a ferrite rings around the cable between the CD-transport and the DAC or the output of the DAC or CD-player and the pre-amplifier input yields surprising results.
A set of two Ferrite rings costs £ 6.50

AUDIO NOTE Moving Coil, CD Line & Input Matching Transformers.
I have received many requests for moving coil, CD and input matching transformers, and since we already make and use these, it might be a good idea to offer them for general sale. Common to all of these small signal transformers is that they come in a shielded screaming can with a threaded spindle with a nut for mounting.

Type	Colour Code	Primary/Secondary Impedance - Ratio Use	Price Excel. UK Vat
TT7087	Brown	3 & 120ohm - 100KOhm, copper wired MC matching	£ 51.50
TT7088	Red	15 & 600ohm - 100KOhm, copper wired, MC matching	51.50
TT7089	Orange	150 &4000hm - 25K & 100Ohm, copper wired, hum matching	£ 51.50
TT7090	Yellow	3 & 12 Ohm - 100KOhm, copper wired High Quality .E MC matching	78.20
TT7091	Green	15 & 600hm - 100KOhm, centre tapped copper wired High Quality .E/C-matching	78.20
TT7092	Blue	150 & 4000hm - 25S & 100Ohm, copper wired High Quality, hum matching	78.20
TT7093	Violet	25 & 1000hm - 20S, copper wired High Quality line matching	78.20
TT7094	White	150-1500hm copper wired High Quality/acoustic	101.50
TT7095	Silver	150 - 150 Ohm silver wired High Quality line matching	378.00
TT7096	Black	3 & 120hm - 100KOhm silver wired MC matching	378.00
TT7097	Gold	15 & 600hm - 100KOhm silver wired, MC matching	378.00

The moving coil matching transformers are suitable for all moving coil cartridges, the low impedance versions are suitable for cartridges like the Audio Note Ivie, most better Ortofons, the Goldring, Koetsi's and some Kontour's. the High versions are meant for Ionizing Exotics, most Ossons, Clearaudios, Van Den Hul cartridges, the Linds and a few Zeigler output devices.
The line matching transformers can be used in a number of applications, inter-component isolation and matching (as we recommend between CD-Player and pre-amplifier, to separate earth planes and RF transfer), as pre-amplifier input or output transformers or whatever else you can think of.
We shall expand this range to include more types as we go.

AUDIO NOTE CHASSIS SETS

We have decided to offer for sale the two standard chassis' that we use for production of the OTO/BRODAC range of UK-made AUDIO NOTE products. Chassis's are extremely difficult to get in a one-off basis, so here you are. We will only sell the chassis that we have rejected for production, due to minor failures in the finish, they still look alright, but are not strictly of a flawless, finished product quality.

Type	Size	Price Excel. UK Vat
Chassis 1 Aluminium	width*depth*height 432*300*125mm	94.50
Chassis 2 Aluminium	394*300*125mm	88.50
Chassis 1 Copper	432*300*125mm	198.50
Chassis 2 Copper	394*300*125mm	185.00
KIT CHEAT THREE Chassis, solid steel, grey paint	400*300*50 mm	78.50
KIT CHEAT THREE Chassis solid steel, polished chromed	400*300*50 mm	116.70

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

AUDIO NOTE COMPLETE KITS

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

KIT ONE.
Based around the justly famous 300B directly heated triode, we see this kit as the introduction to real Audio Amplification, as it covers all the important aspects of design necessary. Single-Ended, No-Feedback, Class A, Directly Heated Triode, to become a member of this exclusive club of amplifiers
Kit One has one 300B per channel running at 42B volts with 75mA current giving 8+3 watts of the cleanest power you will ever hear, the input stage consists of a 6SN7GT with a 5687 double triode driver stage running in SRPP. The power supply is a capacitor-choke-capacitor with a 5U4G/W rectifier, the heaters are AC heated. Component quality is similar to our Level 2 finished products, AUDIO NOTE paper or oil signal capacitors, Bypassing Vcast 1% metal film resistors, good quality 41 actrolytics (sorry NO Black Gates!) and a simple, attractive stereo chassis in grey paint work. Protecting cover is extra. We have several upgrade kits available for Kit One, ask for details.
Price £ 799.00 excl. Vat, which includes all valves (yes, also the 2 x 300B needed) but not postage/packing which to UK customers is £ 12.00. Imp cover is £ 99.00 extra. Kit One is also available with a polished chrome chassis and chromed transformer bell-ends, this makes the Kit One a real "stunner" Add £ 200.00 to total £ 999.00. The Kit One is available now

KIT TWO
Kit Two features a single 6550 triode running in Single-Ended mode, yielding some 17 watts of pure Class A, valve rectified HT for the output stage, stereo chassis, and 6SN7GT input and 5R1 4eECC82 SRPP driver stage, componentry and chassis as Kit One. KIT Two is currently only available without valves for £ 570.00 incl. UK Vat. If used with Chinese 6550's no claims for faults in power supply or output transformers will be accepted!!!
Price £ 599.00 excl. Vat, includes valves, but not postage/packing, cover is extra at £ 99.00. With polished chrome chassis and chromed bell-ends on the transformers, £ 799.00.

KIT THREE.
Kit Three features 2 x 300B per channel running in single-ended parallel yielding 16/17 watts in pure Class A, this kit is on the same chassis* with valve rectified HT supplies, no signal feedback, it uses a 6SN7GT double triode as input valve and a pair of 5687 double triodes running in SRPP as drivers.
The KIT THREE is essentially a mono version of the KIT ONE with double the power, the same component choices and on two chassis* instead of one.
The KIT THREE costs £ 1,599.00 and is available now. Cover is £ 99.00 extra per chassis (£ 199.00 for two). Polished chrome chassis and bell-ends is also available at £ 400.00 extra. Several upgrade kits are available for Kit Three as well, ask for details.

KIT FOUR
The KIT FOUR is really our introduction to valve amplifier kit building, circuit and power supply mounted on one single printed circuit board, with low DTO - type push-pull output transformers, all mounted in a small PISE type chassis covering everything, we naturally will be able to see that you have success in the form of the valve amplifier, which is sweeping the world. The circuit consists of two 6V6GT tetrodes running in Push-Pull class A, yielding about 10 watts, driven by a 6SN7GT and a ECC83 input stage. Easy to build, even for the beginner
The KIT FOUR costs £ 199.00, and is available now

PRE-AMPLIFIER KIT

A kit based on the AUDIO NOTE M77 valve pre-amplifier circuit is under development, it will be offered in three/four versions, with the basic version using cheaper valves, expected cost £ 299.00 incl. Vat, etc. More details available bme. Write to,
AUDIO NOTE (UK) Ltd. Unit C, Foxcomb Industrial Estate, Lyne Close, 125-127, Woolgate Road, Hove BN3 1RB. East Sussex, England Telephone 01273 220511(8 lines), fax 01273 731498.
RUSSIAN Federation, contact EROTERICA Ltd. Tel: 095 917 4305, Fax. 095 917 6782
HUNGARY please contact, Gorilla Audio, H4, H. Nadap Ist, 2, H-1082 Budapest, HUNGARY, Tel/Fax. 01 210-3912.
GERMANY please contact, de Jong Components. 2, Guggenhof, DE-67304 WT Hallmund, Tel 06359 14091 Fax 14773
USA please contact, Angela Instruments, 10830, Guilford Road, Suite 300, Annapolis Junction, MD 20701, Tel 301 725 0491, Fax. 301 725 0823.
FRANCE please contact, MEXICO. Paris, Tel/Fax. 1 4888 4867, PB.01 10.1 185.

We accept VISA, Mastercard Access, Diners and Amex to pay this way, we will send your address, card no. with shot and expiry dates, you can also pay by bankers draft. Even cheque or cheques drawn on a UK bank account.
Delivery is normally about 14 days from receipt of cleared funds, but please allow up to 60 days for some items, if not stock at the time or order
If any of you reading this have possessions of any books which contain information relevant to the subject of Audio Design and which would be useful to share with others, please let us know either by fax or telephone, there is an award of £ 20.00 (payable in valves or other bits, positive) to anybody who sends us a book which contains useful information about valve amplifier design or theory.
Likewise, I am looking for a number of old valves to experiment with, so if you have any PX4's PX25's, DA30's, AD1's, or any of the old triodes, I will be happy to buy or swap at a good price. Likewise anyone of you know where to find old studio tape recorders, STUDER, TELEFUNKEN or AMPEREX or the like, record cutting, plating, processing or processing equipment, or have books or information about building valve/gramo recording technology, LP-manufacture, then it will all be gratefully received. AUDIO NOTE likes the attention over the next 2 - 3 years to set up recording and record manufacture and whilst we already have quite a lot of information, much more is needed.

Circuits, Valvedata & Basic Technical Information.
If you would like some suggestions which in turn a future project around, then we shall be happy to provide you with a circuit pack containing good circuits like CHIKAKU, KESON/KABUSA, NEIRO, GAKU-ON plus several other power amplifier circuits and the M77 also pre-amplifier, which is the best pre-amplifier circuit we have come across. Just send a stamped self addressed A4 size envelope, together with £ 5.00 pounds in small denomination UK stamps, or if you live outside the UK US$ 15.00 or $ bills will do, please do not send Bankers Drafts or US$, International Response Coupons or international money orders, as they cost more to cash than their value.
We have a large number of requests for the circuits of the AUDIO NOTE UK-made amplifiers, the OTO Phase 3E, 3H Phase, MEGHAU, SORO etc., and since we (unlike the majority of our talented competitors) do not have any secrets in this department, and are only too pleased to help extend the envelope of knowledge in this much maligned field, we shall be happy to send you or any existing or prospective competitor, one or more circuit diagrams, they cost £ 5.00 each, or you can buy for example all phase-integrated amplifiers, for £ 30.00 (§ 50.00), or all Low-integrated amplifiers for £ 25.00, all pre-amplifiers for £ 20.00 (§ 35.00), or simply a complete circuit pack for £ 50.00, (§ 80.00), All can be paid either by credit card, cash, bankers draft or cheque drawn on a UK bank, the cost includes postage.
We can also supply 8 out of date sheets for the most commonly used valves, ECC82, ECC88/6922, 12AY7/6072A 7025/12AU7/WA/ECC83, 6SN7, 300B, 211/4/VT4C, 845, EL34/KT-A, 2A3, 6SA, 5U4G, GZ34/5AR4, EL84/6BQ5, 6V6GT, 6L6G, 5881/6L6WGC/KT88. Again send a stamped self addressed A4 envelope together with £ 4.00 in small denomination stamps or if outside the UK another US$ 15.00 will suffice.
Since nothing really exists which gives a reasonable background to the subject of valve amplifier circuit design, Guy Adams and I have written and assembled a number of articles and extracts from old books which give some background to the subject, do not expect to become an output expert, but it will serve as a useful reference, for the beginner as well as the more advanced, we have expanded this into-pack to include even more useful information, so if you have already bought the old pack, just send £ 2.00 or US$ 5.00. For the full pack a small charge is required, this is now £ 7.00, in small denomination stamps with a stamped self addressed envelope, or outside the UK, please send US$ 25.00
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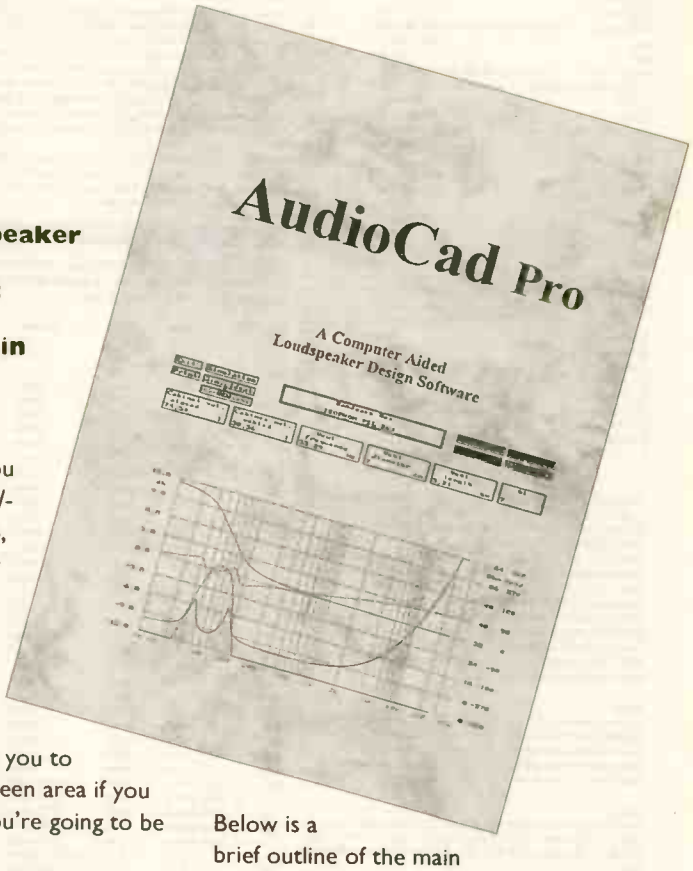
AUDIO CAD PRO

AudioCad Pro is one of the most advanced loudspeaker simulation packages available for the PC. Dominic Baker outlines its basic features - more to follow in the next Supplement.



AudioCad Pro is quite different to the majority of loudspeaker modelling packages. Whereas most rely on Thiele-Small parameters alone to predict a result, AudioCad Pro is aimed more at the professional and enthusiast with access to PC based measurement equipment. It can interface with just about any PC measurement package like Liberty's IMP, MLSSA, etc. If you have a package not already catered for, the author offers to write the necessary interface software for you. The 'real' measured data for the driver you are using can be imported into the package, making it more accurate in its calculations.

So, for example, if you input the measured impedance curve for a driver, AudioCad Pro will use this to perform calculations such as driver inductance (Le), resonance frequency (fs), and total electrical and mechanical quality factors (Qts, Qes, Qms).

AudioCad Pro requires an IBM PC compatible, 286 or higher with at least 640kB of memory, a VGA graphics card and DOS 3.0 or later. It takes up 2MB of hard disc space once installed, but during the installation process it needs 5MB of free hard disc space. It is copyright protected, and once installed, the copyright code is moved from the floppy to your hard disc; it can be installed up to three times though in case of error, like insufficient hard disc space.

Aimed primarily at professionals, AudioCad Pro allows you to set the configuration in a number of different forms. For example, you can choose between +/- 24 or 48dB range, 0-16, 32, 64, or 256ohms for impedance, and the frequency over which the simulation will be performed. This is not such an important point, but it does allow you to make full use of the screen area if you have an idea of what you're going to be looking for.

For the crossover optimisation section, the number of points AudioCad uses to calculate the data over can be set to 64, 128, 256, or 512. In most cases this can be set to the lowest value, where it will work fastest; it is only a simulation package, so don't be fooled into thinking that just because you've selected the highest resolution it will be more accurate.

In its basic form, AudioCad Pro is very similar to the majority of loudspeaker modelling packages. If you don't have access to PC based measurement equipment, the Thiele-Small parameters for the driver can be entered from manufacturers' data and then the box volume and tuning frequency can be entered and optimised on screen. One useful feature of AudioCad Pro though, is its 'Calculate Parameters' section, which determines whether the data you have entered is feasible - a useful check, as it's common to find typographic errors in manufacturers' data sheets.

Below is a brief outline of the main sections of AudioCad Pro. It is such an involved package, with so many features and options, that it is impossible to cover everything in one article. In the next Supplement we'll take a deeper look, using Liberty's Audiosuite to calculate the Thiele-Small parameters, response, impedance and phase curves, and then import this data into AudioCad Pro for simulation.

Closed Boxes

As you'd expect, this section is similar to most other packages. There is provision for entering the serial resistance of the system, which includes your amplifier's internal resistance, the cable's resistance and that of the crossover, as there is for all simulations. The effects of the damping material can also be entered, which can effect cabinet volume by up to 30% for a heavily stuffed box.

Vented Boxes

Here again AudioCad Pro is similar to most modelling packages. Like BoxModel

it takes into account the loss factor caused by a leaky box, vent and damping materials. But usefully, the program adjusts this depending on the volume of the box, larger boxes having higher losses than small ones. And you can model both circular and rectangular ports, which is a useful feature.

Band Pass

The band pass enclosure, a driver mounted in a chamber driving a second chamber loaded by a reflex port, can also be modelled, as can a band pass two, where the driver sees a reflex loaded volume either side of the cone. These configurations are most useful for designing subwoofers, and a reasonable amount of practical advice is given. For example, for the band pass two case the author advises that you keep the volume of each chamber and their tuning frequencies identical, and that the ports terminate on opposite sides because their outputs are 180° out of phase.

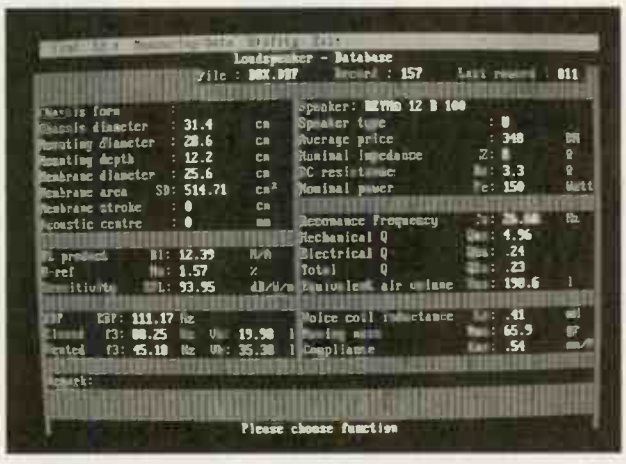
In fact, there is useful practical advice littered everywhere throughout the manual, which will be a great help to many enthusiasts attempting a new type of design for the first time.

Transmission Lines

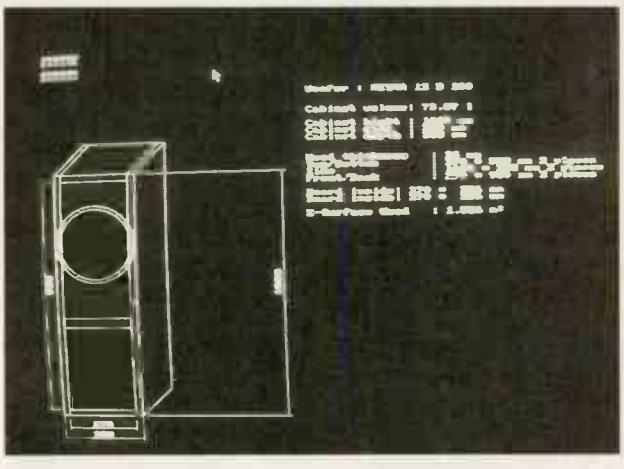
Where AudioCad Pro starts to become interesting is in its ability to model transmission line enclosures and horns. For TLs, the cabinet width, opening cross section, exit cross section, volume and length of the line can all be adjusted and optimised. It is a fairly basic simulation, but then there are so few packages that model TLs that it is still extremely valuable.

Horns

Even more valuable is the section on horn loudspeakers. AudioCad Pro is the first program I have come across that covers this topic. Again, a lot of practical advice is given to aid the designer in making the right decisions for driver choice and so on. The simulation itself concentrates on exponential and Tractrix horn profiles, giving the user the ability to vary chamber volume, fore chamber volume, throat area, horn length and mouth area. I hope to have a model of a small Tractrix horn driven by a 34mm dome tweeter up and running in time for the next Supplement, fingers crossed.



Driver parameters can be entered from manufacturers' data sheets or imported from a PC measurement package.



Audio Cad Pro can produce 3-D cabinet diagrams to make construction easier.

Cabinet Draw

AudioCad Pro will produce either 2-D or 3-D drawings of your cabinet for you. Here the thickness of the material you intend to use can be entered and AudioCad Pro will calculate the dimensions of the box, showing a representation of the loudspeaker complete with driver and port cut-outs. The positions of these can be moved, distances between drivers and proportions entered. If you have a printer, these make a very useful plan to hand to your local woodworker, and should ensure that no mistakes are made during construction.

Crossover Design

AudioCad Pro also comes with a crossover designer. Using the driver data entered, it will predict values for crossover components for 1st-4th order designs. If you have the driver Re, fs, Qms, Qes and Le, it will also calculate a suitable network for impedance equalisation. This corrects for the rise in impedance towards high frequencies caused by a voice coil inductance, and is only really of use for midrange and bass drivers. It will also calculate values for an L-pad attenuator, given the attenuation you need in dBs to match the other drivers in your system.

When using the crossover optimisation section, the author recommends finding Le at the crossover point you are aiming for, if you don't have the impedance curve data. This is good advice; it is important to know how the driver is behaving at the crossover point so that the data is relevant to where you are working.

Acoustical Centres

More often than not, the acoustical centres of the drivers you are using will not be aligned. The distance between the acoustic centres of the two drivers causes a phase shift that will effect your crossover design. AudioCad Pro can be informed of the distance between the acoustical centres of the drivers you are using, and then take this into account when optimising the crossover.

In the next Supplement we'll bring you a more in-depth look at some of AudioCad Pro's features ●

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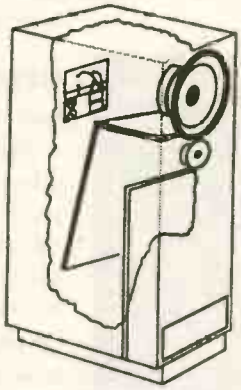

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Build your own Audio Valve Amplifiers

by Rainer zur Linde, reviewed by Noel Keywood.

This book was written by a German, Rainer zur Linde, for Elektor, a Dutch magazine. But that doesn't make it half-Dutch; for the most part "Build Your Own Audio Valve Amplifiers" is quite easy to understand if you have a grounding in electronics. All the same, its history in particular did remind me that culturally the English channel has always been a lot wider than the Atlantic.

Although Philips, a Dutch company, bought its way into Britain and its Empire when it purchased Mullard from Captain W.O. Mullard in 1925, valves like Philips' AD1 power triode are rarely mentioned in the U.K., but it gets star billing in this book: "the legendary AD1 was both the pinnacle and final development of output triodes". British and American readers who've never heard of the AD1 might be a bit baffled by this and its apparent superiority to the DA100 and the 212E, for example.

None of this impinges on the main strengths of the book though, which is to present a wide variety of circuits, many or all of which have been built and tested. There are more than ten power amplifiers, for example, with output powers up to 20watts. However, although at one level the book is very much a hands-on publication, it is not aimed at the beginner. There are enough graphs of transfer curves and formulae to keep a design engineer happy, but an absence of basics.

I was puzzled by some of the book's curiosities. On p128 the author talks of "the KT88 used as a pentode in the prototype", when in fact it is a Beam Tetrode. The beam deflector plates I presume Linde treats as a suppressor grid. Since, it is said, RCA developed the beam tetrode to get around Philips' 1926 patents for the pentode, it may well be that Europeans (other than Brits) treat the RCA 6L6, GEC KT (Kinkless Tetrode) series valves and all other beam tetrodes as pentodes-in-kind. This is confusing for Brits and Americans, who make a clear distinction between the two.

Also, although there are long discussions on why and how distortion harmonics affect sound quality, delivered with a confidence that I find disturbing in its simplicity, there is no mention at all of the role and importance of transformers. Of all things - especially in modern day valve amps - it is the output transformer that most affects performance.

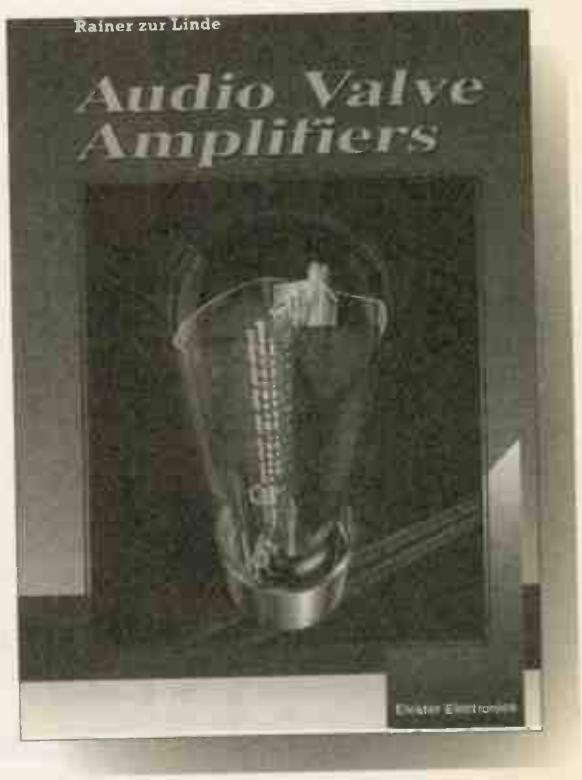
Trouble is, transformers are so complex to model theoretically and build practically, their design is a black art about which little has been written. I can sympathise with Rainer zur Linde; I know of only one book that discusses audio transformer design in useful detail.

At times Rainer zur Linde had me baffled. I presumed that a 2xKT88 design, upon which Chapter 8 is based, would deliver good power. My presumption seemed to be confirmed by opening observations about push-pull being "a must", "for higher audio powers". A pair of KT88s can swing up to 40W or so, or 100W in fixed bias, GEC tell us. Rainer zur Linde triode connected this high power Tetrode and used it in single-ended configuration to deliver just 6W. In my view, this is a bizarre way to use a KT88!

I have talked about the curiosities of the book, but it has strengths. In particular I liked its cookbook of solid-state power supplies and backup circuits - they're scattered far and wide throughout the book. Purists may groan, but I believe there's a lot to be said for "modern" valve amplifiers relying on the flexibility and cheapness of solid-state circuits in certain non-critical areas.

In true German manner, Rainer unashamedly includes arrays of relay switching circuits for an input busbar, with lines of ICs, albeit not in the signal path. He also includes a small but interesting final chapter on valve output stages, including filtering, for CD players using Philips' TDA1541 convertor chip and there is, earlier on, a sizeable chapter on musical instrument amplifiers.

On balance I found Build Your Own Audio Valve Amplifiers a rather curious book, possessing a medley of strengths and weaknesses. For those who already know a bit about valve load curves, biasing and what have you, it contains useful information. It is fine if you use its circuit ideas for, perhaps, your own design. In this sense it can make a valuable contribution ●



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All Manticore Audio Visual products come with a lifelong guarantee. This is qualified in the following way - electronic components, such as transistors, are guaranteed until the end of their reasonable working lifetime. Mechanical assemblies for the most part manufactured by us are guaranteed until the reasonable end of their specified design life. The first Mantra was produced 12 years ago and is still in fine shape.

BUILD YOUR OWN HIGH END AUDIO EQUIPMENT

Satisfy your high-end urges with this book from Elektor Electronics, reviewed by Haider Bahrani.

Build Your Own High-End Audio Equipment is, roughly, an anthology of articles and designs that have appeared in Elektor Electronics magazine. The book is presented in six parts laid out in a reasonably logical order with each one covering an aspect of the audio reproduction chain.

Part one is reserved for preamplifiers or as the heading describes them, voltage amplifiers. The first of these is a simple NE5534 (or similar) op-amp based line preamplifier circuit with input select, balance and volume controls only. A simple relay switch on delay circuit is added in for good measure.

The second circuit has a few more frills. For starters an RIAA circuit is included, usable/adaptable for both MM and MC cartridges. The phono stage circuitry is sophisticated, utilising a combination of operational amplifiers and matched pair transistors for the input differential stages. The final circuit shown in this section adds the not so typically high-end tone controls and a headphone amplifier for the budding builder who really wants them.

Descriptions and construction details for the all of the above circuits are kept to the point and reasonably clear. Ideas for enhancement and different component selections are also on offer, giving the average reader with even the most basic of electronics backgrounds plenty of room to experiment.

The following part, in much the same vein, concentrates on power amplification. Four circuits are shown in ascending order of power and complexity. The first two amplifiers shown use HEXFET and the not so commonly used IGBT (Insulated Gate Bipolar Transistor) devices respectively in their output stages whilst the final two rely on normal transistors.

Part three is dedicated to headphone amplifiers. Three circuits are given, presenting a variety of different ideas. The first of these is IC based (again NE5534) with a digitally switched volume control. The second is a fully discrete circuit with bipolar transistors in push-pull configuration throughout. The last of the bunch jumps back into IC mode with a miniaturised circuit taking advantage of the Philips TDA1308T surface mount headphone driver.

The fourth part of the book ponders the ethos of surround sound. It delves into some basic principles leading into the latter half of the section which presents a domestically usable design. Construction, calibration and circuit description are all well detailed, as are response characteristics and component lists.

Stepping somewhat back into line, section five connects us to the final link in the hi-fi/human interface, the loudspeaker. First is a three-way loudspeaker set up with IC amplifiers driving the upper and mid frequencies and discrete bipolar transistors driving the low frequency end. Full calculations of filter component values are provided, with various options including more complex filter arrangements.

The following two loudspeaker projects are an active, phase linear, crossover network and a mini active sub-woofer. The former of these two utilises time delay circuitry for phase correction. Again all the calculations are clearly presented, including the Linkwitz low frequency correction network formulae.

And so the final part. This section has logically been reserved for testing. The first part of the section describes the circuitry, build and use of a phase check unit for audio systems. Finally there's a general overview of PC based test systems available, placed in vastly varying price brackets, for measuring your electronic masterpieces. Most (not all) of the PCB layouts for the circuits shown are presented in the appendix.

Hobbyists and professionals alike should find some stimulation within this neat little collection, which is as much one of ideas as it is of fun to build circuits. I will certainly be making some space on my bookshelf for it.

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D.I.Y. Letters

HOME BUILD K5881

I have built the 5881 amplifier, with all my own parts and it was hard work. The overall performance is not satisfactory. The sound is very clear, with deep bass, full bodied and detailed, but also it has a strident sound in the treble and sibilance with human voice.

The output transformers are McIntosh 230 replicas (by audio Classics, N.Y.), with 5.4kohms primary. I think your transformer is 6kohms. My question is - is it necessary to adjust any part values, such as grid resistors or feedback, for best sonic results?

The power transformer is custom built, but it is under powered, giving 360 volts, 250mA, and as a result, all the working voltages are 20% under your values.

As a solution I want to duplicate the power supply, with one transformer and choke per channel. Is this correct or is it necessary to have more parts or change any values?

Miguel Angel Alfonso Martinez
Elche,
Spain.

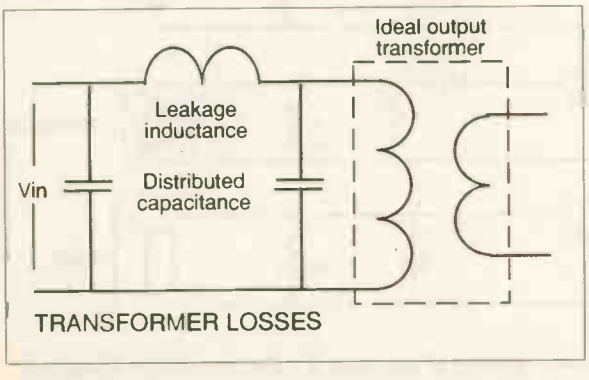
Oh dear! We can't usefully comment on an amplifier that uses unknown transformers and operates at too low an H.T. voltage. For low distortion the output transformers must match the output valves and too low an impedance reduces power and raises distortion.

The output transformers of our K5881 amplifier are carefully load matched for optimum power transfer with minimum distortion and broad load matching, using a high speed distortion analyser. They are of relatively high impedance. These transformers use multi-section windings to minimise distributed capacitance, in order to obtain flat high frequency response and relatively distortion free treble. Otherwise, the output valve ends up driving a capacitor whose impedance at high frequencies is so low, the output valve cannot supply enough current and serious slewing occurs at high output levels. The result is serious third harmonic distortion.

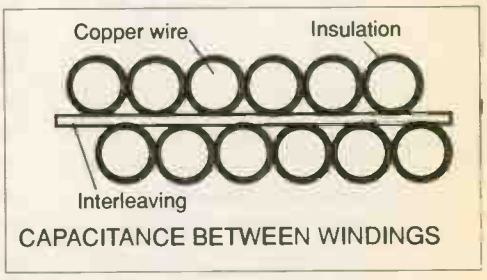
The gap between coil layers (see diagram) introduces distributed capacitance and is adjusted by the thickness of the insulant. This adjustment must be balanced against the leakage inductance, which increases as capacitance decreases. Transformers, as a science, are so complex theoretically, that their design and construction is a black art, one that demands both knowledge and experience for success.

Your transformers are of too low impedance, which will degrade treble quality. Furthermore, low H.T. will result in reduced power output. The best thing to try is parallel 5881s, which will utilise the low H.T. and match the transformers better. NK

I think that your main problem is that you have made a cheesecake using Gorgonzola cheese. Not that your transformers stink but the circuit and your transformers just



Leakage inductance and distributed capacitance need to be carefully controlled in a transformer.



Distributed capacitance in a transformer is determined by the gap between coil layers.

▶▶

aren't compatible. Your output transformer's H.F. parameter's and load impedance are not correct for this circuit.

The K5881 achieves excellent linearity by running the 5881 valves at a high voltage and by using a transformer with a very high 11k anode to anode impedance. They are specially wound to reduce self capacitance which is very important at such a high impedance as the loading effect of shunt capacitance causes distortion and phase shifts which lead to a humped frequency response or, even worse, HF instability.

Your mains transformer is not delivering the juice the circuit needs to kick into action, so it needs serious modification to get it working. You need to bite the bullet and either get a set of K5881 transformers or build another circuit which is more suited to your transformer set.

The 5881 valve can work at lower voltages and load impedances but you will need to redesign the output stage to account for this. You say you are getting a 360V H.T., try changing the cathode resistors to 270 ohms, this will increase the current through them putting the circuit back into Class A. Adjust the EF86 cathode resistor to give an anode voltage of 100V. Put a network of 220pF and 10K in series across the EF86 anode load resistor, use a 630V polystyrene capacitor, and try again.

If you can get hold of an oscilloscope and signal generator then monitor the output waveform and use a 10kHz square wave signal. If there is any strange blurring and ringing on the trace then try increasing the 220pF cap in 47pF steps until the oscillation stops. If you get stuck the best place to go for advice is probably a guitar shop with a repair technician, who will have experience of valve amp circuits and access to test gear. AG

SPLIT CROSSOVERS

I was interested to read Douglas Floyd-Douglass' report on the excellent QLN Signature speakers, a product I discovered at the Bristol show early last year and enjoyed tremendously. Being a bit of a DIY'er and having built a pair of Bailey Transmission Line speakers many years ago, and a very capable Crimson 100W/Ch amplifier which is still in constant use, I was pleased to speak at length to one of the QLN representatives on the philosophy of their external crossover units. My present system consists of: a Lingo'd LP12/Zeta and Audio Technica OC30 (more balls than a Klyde!), a Cyrus Discmaster-Dacmaster, Quad 34/606 and JBL SL120Ti 'speakers, a tremendous combination for my liking of loud rock music.

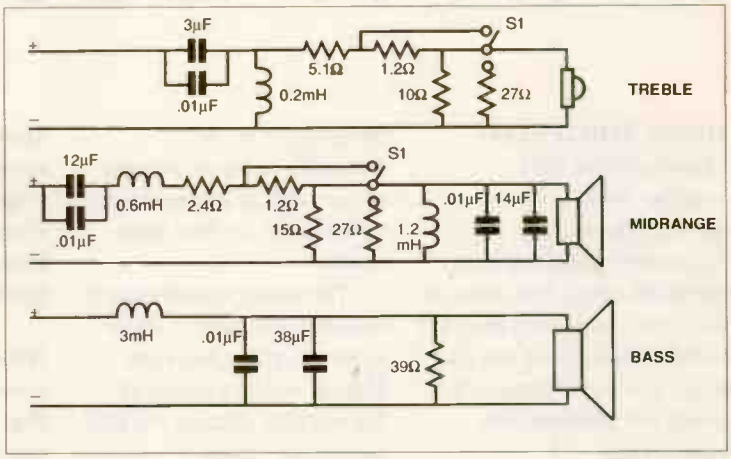
Looking towards future upgrades, my questions are two-fold: 1. Having delved inside the JBLs and found the crossovers to be manufactured in a relatively agricultural manner, can I re-manufacture them 'a-la' QLN, using high quality materials to re-assemble the current components, and using the option of a single input, or splitting the input/crossover stages completely? I predict this will give me the versatility of experimenting with different physical positioning of the crossovers and different cables and their configurations, but will it improve the performance of the, already satisfying, 120s?

2. I think I would like to build a high quality passive pre-amp, but am unaware of the pitfalls, complexities and problems created by this approach. Apart from requiring the obvious phono stage amplifier, I see a passive switching unit/volume control as being the answer to the 'single piece of wire' philosophy. I know that my other sources will drive the '606 without an intermediate pre-amp and also see this as being a way of saving money when the time comes to upgrade my amplification. I believe the Quad 34 to be my weakest link at the moment, but instead of spending funds on a new pre/power combination, I would like to take the passive pre-amp route and invest all available funds on a high quality power amp, possibly valve, such as the Tube Technology mono-blocs.

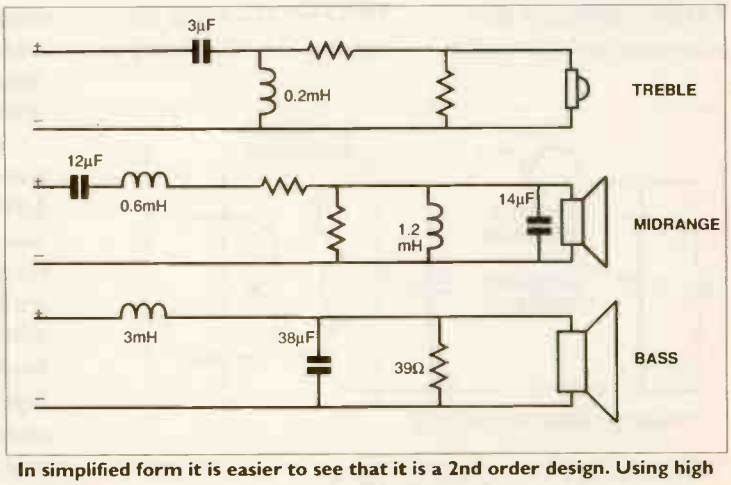
I would appreciate your views and advice on this approach and look forward to playing with my soldering iron once again in the near future.

WOMEA (H) G. Dunsmuir
HMS Illustrious.

There is certainly plenty of room for experimentation and tweakery with your JBLs, but a few things to be aware of first. Replacing the existing parts with better quality components, like polypropylene capacitors and higher grade inductors, may unbalance your loudspeakers. Even though we call a capacitor a capacitor it also has a resistance and some



JBL's SL 120Ti loudspeaker crossover has switches for setting midrange and treble level and all capacitors are bypassed by 0.01µF.



In simplified form it is easier to see that it is a 2nd order design. Using high quality components and 'fixing' midrange and treble level the crossover could be re-built to this circuit.

inductance and an inductor will have some resistance and capacitance.

The components in the existing crossover will have been carefully tuned to each other to give a predicted response. Changing a capacitor for a higher grade equivalent will normally add some brightness, due to its different characteristics, mainly lower impedance. A higher grade inductor will normally use thicker wire, so will have a lower resistance too, allowing more signal to pass.

The different characteristics can be enough to unbalance the crossover, causing a peak or a dip where before there was a smooth roll off. In most cases the effects are very mild though, so it is worth experimenting; better components will certainly improve the sound. You have a switch to set midrange and treble level on your JBLs too, so once you have found the balance you like with the new components, I'd recommend hard wiring the whole crossover without these. Use high quality speaker cable and silver loaded solder for best results.

I'd keep the original crossovers too; not only will they serve as a useful benchmark when you are building the upgraded version, but if you sell them, it will be easy to return them to their original form.

Although it looks quite complicated, the crossover in the 120Tis is a quite straight-forward 2nd order design. When you replace the capacitors, ignore the .01µF bypass capacitors. For example, in the treble arm there is a 3µF capacitor bypassed by 0.01µF; replace this with a single, high quality 3µF capacitor. I suspect that JBL have used cheap capacitors, then bypassed them with low value polypropylenes - a more economical approach than putting in a good polyprop in the first place. I'm only guessing though, as I can't see inside your 'speakers.

I have drawn the simplified circuit you should end up with. There are no values on some resistors because this will depend on which switch position you prefer. DB

Letter of the Month

DECODING FOR STEREO

Some years ago I was lucky enough to obtain a Leak Troughline 3 mono tuner for the grand sum of £8. Its erstwhile owner had 'upgraded' to a modern transistor device.

The Leak certainly sounded, and continues to sound, absolutely superb, but I must really get round to fitting a decent stereo decoder. Do you have any suggestions as to where I may be able to obtain such a thing, either in kit form or ready made? I should be most grateful for your advice.

Philip Thornton-Evison
Grove,
Oxon.

I've had some very pleasing results from Studio 12s decoder, which is available either in kit or ready built form. It is a very simple device to build, taking around 1hour to finish. The main circuit board comes built and tested, so all that's needed is to wire up the mains transformer and a few other components. We reviewed this decoder in our June '95 DIY Supplement and its performance was very good.

A couple of months later Studio 12 made a few small modifications to improve performance further. One of the coupling capacitors was removed altogether so that the decoder is direct coupled to the MPX output of the tuner, the sensitivity potentiometer was increased to 1MΩ and the two output coupling capacitors increased to 10µF. I listened to this decoder again after these modifications, which all of Studio 12s decoders now come with as standard, and I must say that the level of performance is now really first class.

In kit form it is available for £28.50 and built up it's £48.50. You can contact Studio 12 on Tel: 01736 798393. If you're keen to experiment, try using a higher quality potentiometer and Solen or other high quality polypropylene signal capacitors. Oh, and another useful thing is that it boosts the output level a little, making it compatible with a wider range of amplifiers. DB

A properly aligned and serviced Leak Troughline tuner will benefit from a good stereo decoder.

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SINGLE-ENDED MOSFET AMPLIFIER - UPDATE

Hi-FI World DIY Letters
64 Castellain Road,
Maida Vale,
London.
W9 1EX

Dear Hi-Fi World,

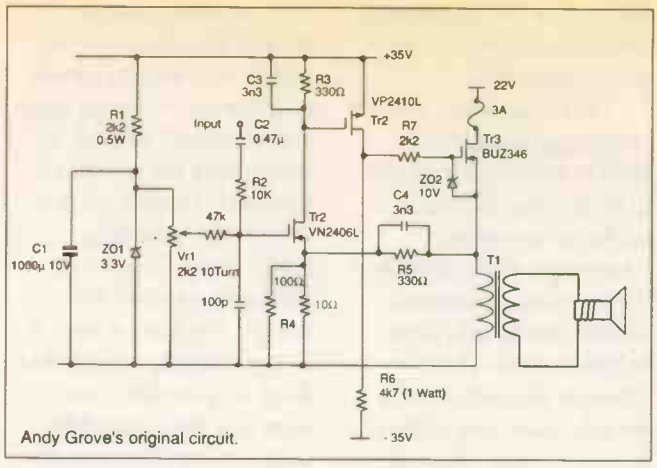
I read the article about the 15W single-ended MOSFET amplifier with great interest (DIY Supplement No 20, February 1996). Whenever I buy Hi-Fi World, I do so mostly for the circuits published. Usually they are carefully drawn but this time I was disappointed to find several problems. From Hi-Fi World I did not expect such a way of publishing a circuit diagram.

I would like to draw your attention to the following points:

1. Andy Grove, in his description of how his circuit works, refers to parts R1, C1, etc. but these are not shown on the circuit diagram.
2. What exactly does "10 turns" mean on the circuit diagram next to the 47kΩ resistor?
3. Are the 100Ω and 10Ω resistors meant to be connected in parallel in the source of the VN2406L MOSFET?
4. On Chris Found's alternative circuit diagram as many as four components are indicated without the values shown.
5. I can see no evidence that Chris Found's circuit uses considerably less feedback than Andy Grove's. The open-loop gains should be similar (the bias currents are similar and apart from a small amount of local feedback caused by the 100Ω resistor in the source of the P-channel FET in Chris Found's circuit, they are the same). The closed-loop gain is set to similar values (37 and 48). What accounts for the "considerably reduced feedback"?

Laszlo Gaspar

Laszlo Gaspar
Nottingham.



Andy Grove's original circuit.

Clearly the single-ended MOSFET amplifier circuits published in our February supplement have been causing some confusion. We have to be very careful here. Building an electronic device can be dangerous and many of the questions we have received have come from inexperienced builders who are simply not safe to construct such a device. Some of your points are valid though, so I hope the following will help clear up any confusion.

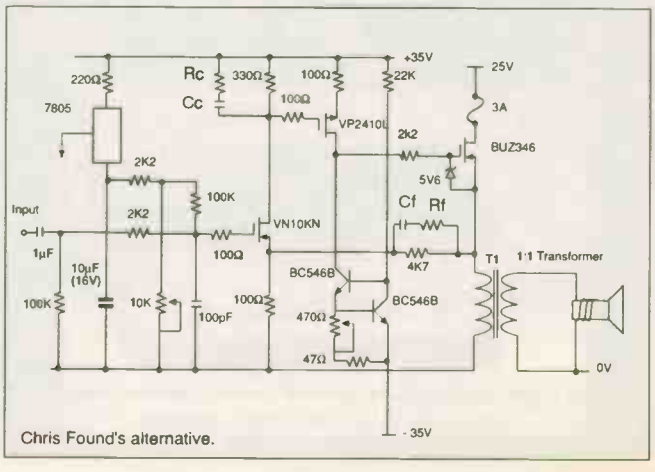
Below are the two corrected circuit diagrams. The labels R1, C1 etc. should refer directly to Andy Grove's original article.

Now to answer some of your questions. One of the clearly visible differences between Andy and Chris' circuits are the ways they've treated the feedback. There is actually an approximate 28% decrease in feedback between Andy's and Chris' set ups although at best (or worst), admittedly, it only constitutes a 0.06volt reduction in the amount of voltage feedback.

This, particularly as far as the first circuit is concerned, is only true in the midband frequencies as Andy has employed a fair bit of phase lag compensation. This in the form of C3 and C4 acts with the 330Ω resistors to form a phase lead network. These reduce gain at high frequencies (this one starts to operate at about 10kHz) taking it down to 0dB level before the 180 degree phase inversion which will occur, turning the -ve feedback in to +ve leading to oscillations at and above these frequencies.

Chris Found's circuit although shown unmarked in the original diagrams, didn't employ the same form of compensation. If anyone wishes to build this circuit they should omit Cf, Rf, Cc and Rc to start with and if any problems occur (ie. oscillations) try placing a 3.3nF capacitor in place of Cc and Rc as in the first circuit and as ball park values 47pF for Cf and 100Ω for Rf. I have to stress that these values are untested on this circuit, but are a reasonable starting point.

To answer your questions, two and three; firstly the 10 turns refer to a multi-turn preset resistor. These types are a lot easier to set accurately offering far better precision and tolerance. And yes, the 100Ω and 10Ω resistors are in parallel at the source of the VN2406L (R4 as shown) giving approximately 9Ω. This value isn't so critical and just a 10Ω or an 8.2Ω resistor in place would do, although it will vary sensitivity a little. Happy building. HB



Chris Found's alternative.

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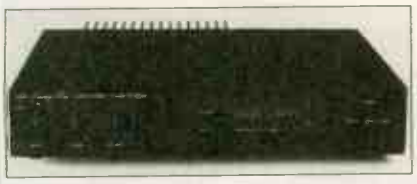

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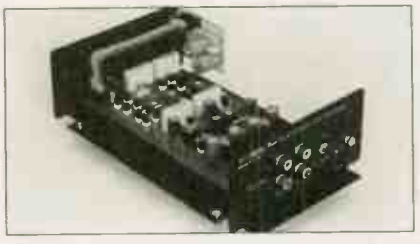

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