Hi-Fi WORLD

NO.36 APRIL 1998

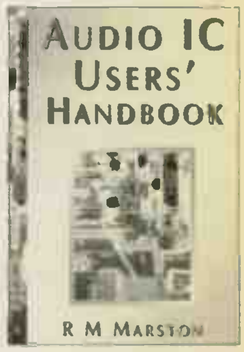
SUPPLEMENT

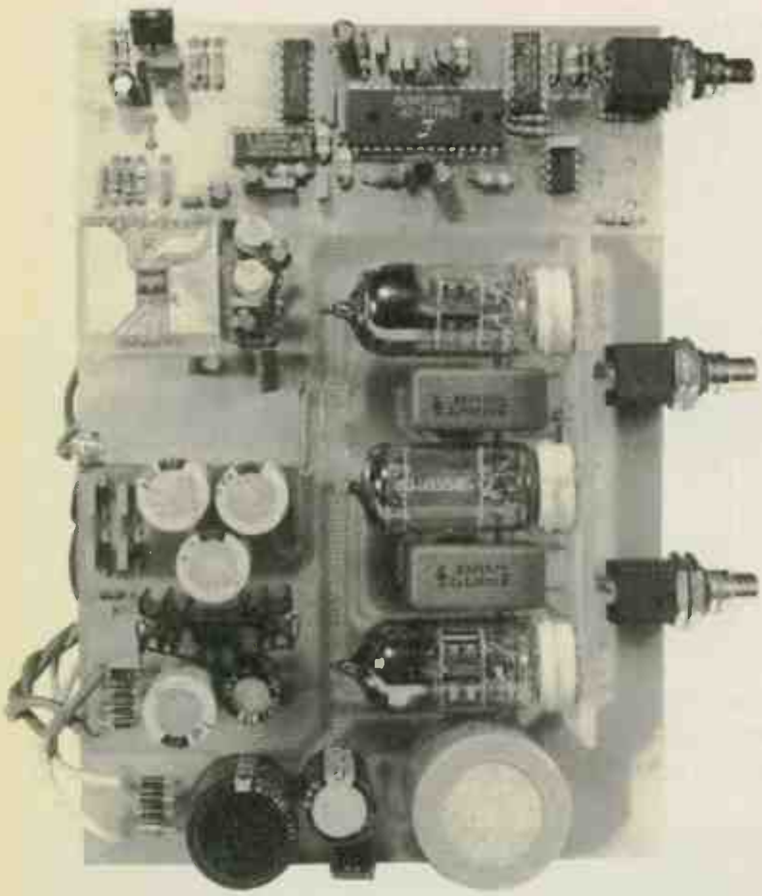
24-BIT DAC WITH VALVE OUTPUT

BOOK REVIEWS:

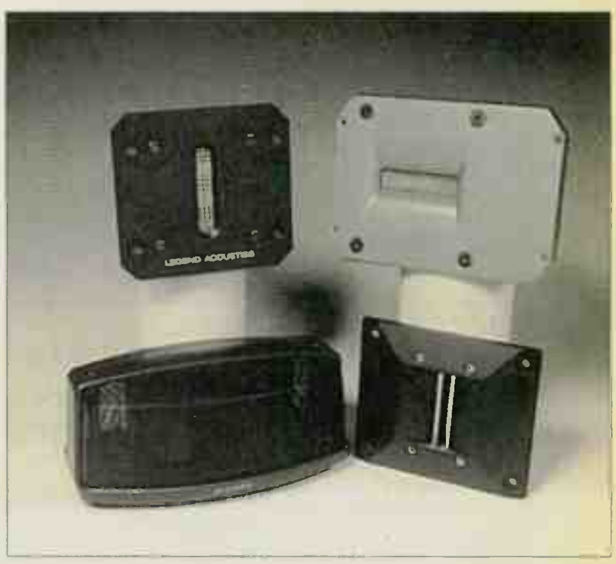
Audio IC Users' Handbook
by R.M. Marston

Valves For Audio Frequency Amplifiers
by E. Rodenhuis





RIBBON TWEETERS PUT TO THE TEST



FREE D.I.Y. SUPPLEMENT No.36

D.I.Y. Supplement

Contents

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KIT NEWS

EXCEL-LENT SEAS

DIYers impressed with the sound of Jamo's Concert 8 and Concert 11 loudspeakers will be happy to discover that the respective SEAS Excel drive units are available to buy separately.

The mid/bass unit, aka W14CY001, is a 5in. driver, its lightweight yet stiff magnesium cone supported by a natural rubber surround. The driver has an injection-moulded zinc chassis with a substantial 0.42kg magnet system and boasts a power handling of 70watts (long-term) and 200watts (short-term).

In the centre of the cone lies a large, solid copper phase-plug which, along with the heavy copper rings mounted above the T-shaped pole piece, improves heat dissipation. Nominal impedance is 8Ω and sensitivity is given as 87dB.

The T25001 is the matching 25mm fabric-dome tweeter. Surrounding a diaphragm made from Sonotex (where the fabric is pre-coated four times with a damping/sealing material), the front plate is constructed from 6mm thick injection-moulded zinc, gently shaped to give mild horn loading and a more linear frequency response.

Inside is a silver-wire voice coil leading to gold-plated output terminals. A double magnet system improves sensitivity and provides better control of the voice coil. Overall sensitivity of the T25001 is given as 90dB, with a nominal impedance of 6ohm and a steady-state power handling of 90watts (via the suggested second-order high-pass Butterworth filter at 2.5kHz).

Prices for the Seas Excels are about £134 for the W14CY001 mid/bass unit and about £80 for the T25001 treble unit. Also available is a 6.5in. bass driver for about £153.

Stockists:
IPL Acoustics, tel: 01373 823333
Falcon Acoustics, tel: 01508 578272
Wilmslow Audio, tel: 01455 286603
South Coast Speakers, tel: 01703 559312

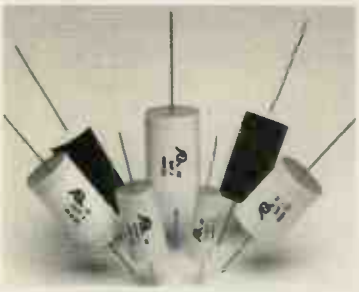
WILMSLOW GO STRAIGHT FOR THE HART

Leicester-based Wilmslow Audio Limited are taking over distribution of Hart Electronic kits. This will add to their existing portfolio of drive-unit distribution and loudspeaker kits.

Wilmslow Audio
50 Main Street,
Broughton Astley,
Leicester
LE9 6RO
Tel: 01455 286603

A SOUND CAPACITOR RENAISSANCE

SCR is a French company better known in this country for capacitors bearing the Solen legend. With serious audio applications in mind, SCR have developed a range of aluminium metallised-polypropylene capacitors, including a range with tin-foil electrodes. These are said to give a superior sound quality, in part helped by the flexibility of the tin foil which prevents vibration of the electrode. They can be used at high frequencies without incurring high losses from the Joule effect (where electrical energy is turned into unwanted heat), and their construction makes them non-inductive and insensitive to humidity. A typical value used in loudspeaker crossovers, the P-Series 4.7uF 400v, is priced at £1.75.



Wilmslow Audio
(as above)

TRANSFORM A NAIM

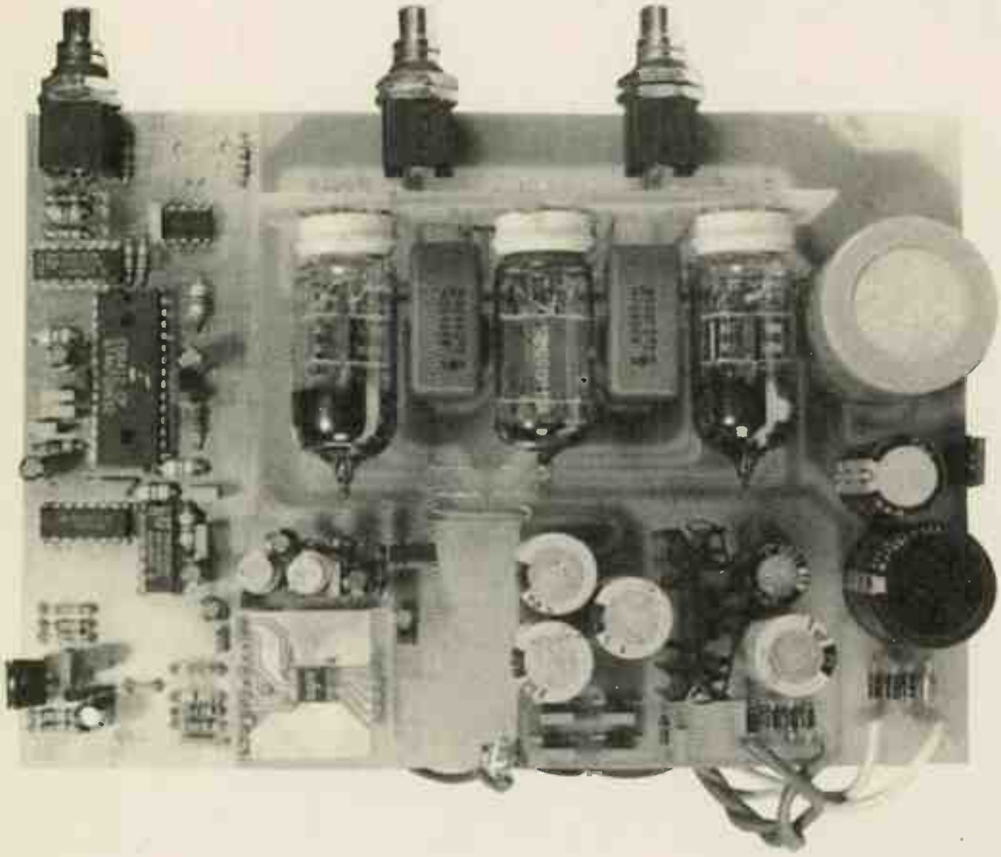
Avondale Audio are currently experimenting with C-core transformers as an alternative for the near-ubiquitous toroids found in solid-state amplifiers. Said to produce less harmonic distortion, particularly third order, compared to toroids, some promising results have already been found with Naim amplifiers. The biggest problem is finding a C-core with a low enough profile to squeeze into existing boxwork.

Also on the subject of Naim amplification, Les Wolstenholme at Avondale is soon to publish a book on Naim mods. Until then, there is a comprehensive listing of parts and components to modify and tune up your system, available on a 3.5in. PC disc for £5. This includes a £5 voucher against any purchase.

If powering your Linn or Rega turntable with a first-class power supply is a priority (as it should be!) then look out for an innovative digital word generator-based supply, currently under development.

Avondale Audio
The Hollies,
Avondale Road,
Chesterfield,
Derbyshire
S40 4TF
Tel: 01246 200096

CRYSTAL CLEAR



Chris Found details the design of a 24-bit DAC with valve output stage.

In a previous article (published in December 1997's Supplement), I looked at the AKM 4324 96kHz 24-bit DAC IC and the kind of performance it offered in a prototype convertor. Now it's the turn of Crystal's CS4390, which, although limited to the current 44.1kHz sampling rate, has in my view a better sound than the AKM. Both convertors offer truly high-end sound but they have two quite different and distinctive characters.

To get the best out of the CS4390, I decided to partner it with a valve output stage.

TO BEGIN AT THE BEGINNING

To ensure that this DAC unit serves for all but the most ardent digital users, I have incorporated two digital inputs. Each of these inputs takes signals from the transport and processes them in a dual RS232 receiver package (uA9637). This removes the problem of signal overloading that can be caused by some transports which have a higher than specified digital output. The RS232 receivers provide a controlled and pre-defined signal level irrespective of input signal level and allow the next digital section to do its job properly.

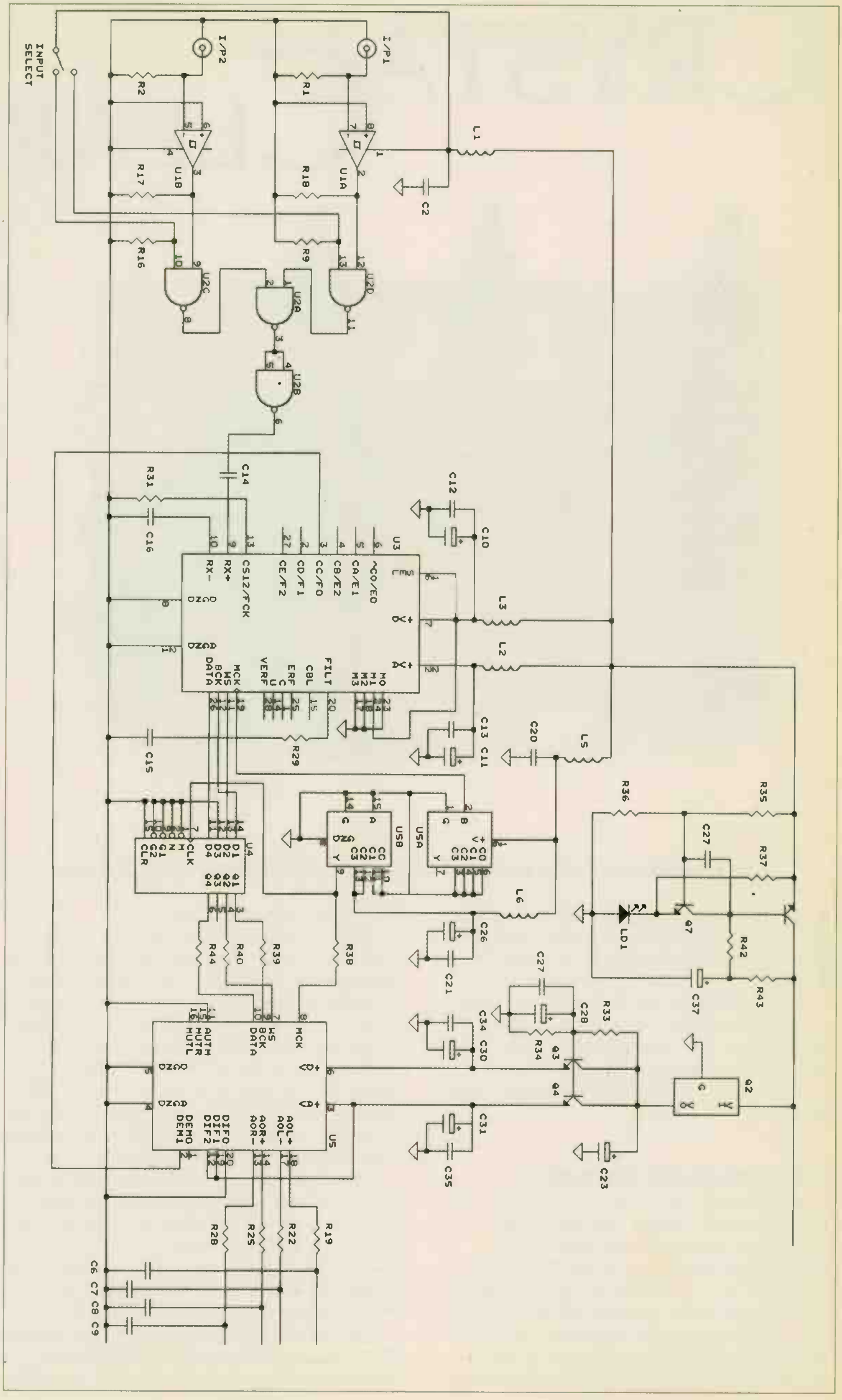
Next is the input channel switching logic. This is handled by a 74HC00 'quad nand' gate that adds the two signals together and finally re-corrects the phase error created by the logic gates. Other devices can be used in this location, but the 74HC00 has a very consistent gate structure and this can reduce problems in other areas.

Then comes the Interface Receiver, the renowned Crystal CS8412 in its latest incarnation of Rev. G. This chip separates the SPDIF data stream of the transport into its constituent parts of Word Select, Bit, Master Clock and Data signals that feed the following stages.

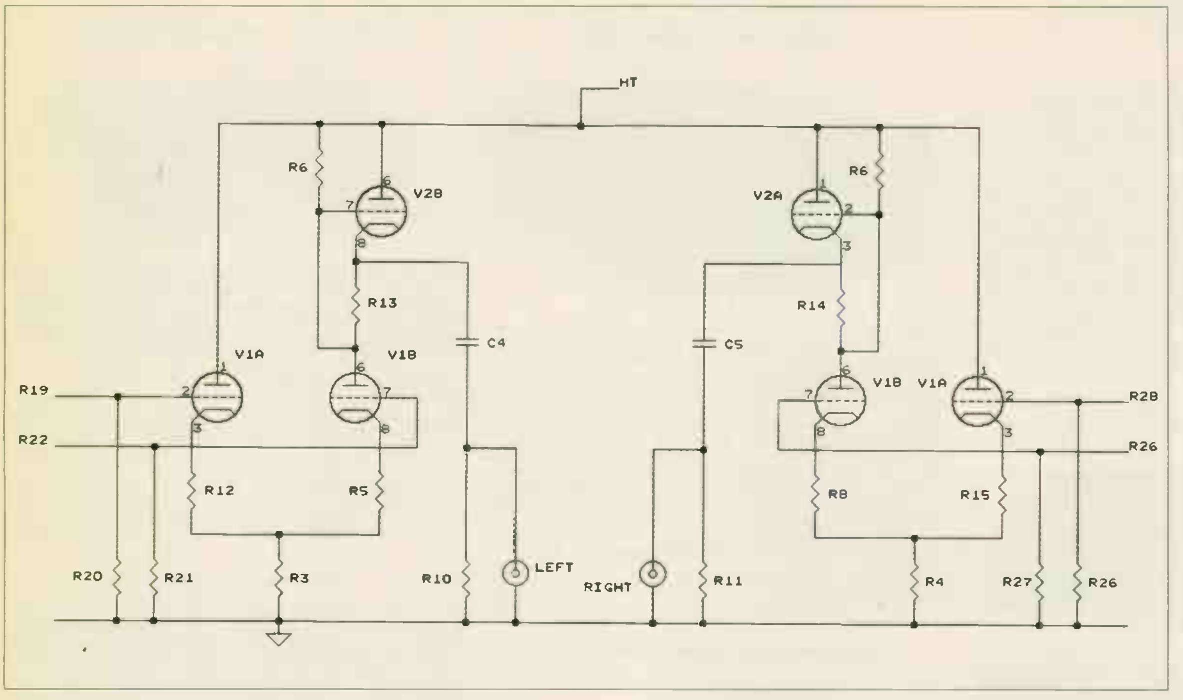
Although the Voltage-Controlled Oscillator built into the 8412 provides a good signal, if you want to extract the best performance from systems such as these, certain changes need to be implemented.

After the data signals are separated by the CS8412, the Master Clock is regenerated and cleaned up to give a more respectable waveform by the 74HC153 IC.

This re-generation serves two purposes. First, it isolates the Master Clock output signal of the 8412 from the effects of capacitance. The Master Clock waveform from



This schematic for the 24-bit DAC shows all the circuitry bar the valve output stage.



The valve output stage combines the benefits of a Long-Tailed Pair configuration with those of Shunt Regulated Push-Pull.

the CS8412 will degrade substantially, if there is even the slightest capacitance presented to this pin. Buffering helps, but it is better to totally reconstruct a new clock signal. The improvement in rise times created by the re-generation means a cleaner Master Clock signal, reducing jitter and boosting the overall performance. It also ensures that the timing for the rest of the circuit is pre-defined.

As with any Bitstream DAC, the performance of not only the Master Clock waveform but also the timing relationships of other parts of the circuit to this clock determine how low the audio noise floor will be. In this design a full re-time of all the data signals from the CS8412 to the new Master Clock was necessary to correct any timing errors. This task was delegated to a 'quad D' flip-flop package, the 74HC173.

An example of the performance differences which re-timing and Master-Clock regeneration make come from a couple of measurements I made. Without the extra circuitry the DAC's noise floor barely bettered 100dB and consisted of a large number of narrow pulses which could be described as jitter artefacts. With the circuitry in place, there was a 10dB improvement in this figure.

Re-timing has sonic advantages too. Without these chips, music sounds 'recessed', with poor representations of instruments at the back of the sound stage. Everything falls into place with re-timing, each instrument occupying its own position in space and a wealth of previously-covered subtlety making its presence felt.

CONVERTED

Now we come to the all-important Digital-to-Analogue conversion section. Many years of research have found that poor performance in Bitstream devices can be blamed on three main sources: the timing relationship of the data (as already mentioned); grounding of the intersection between digital and analogue circuitry; the power supply and its noise characteristic.

The CS4390 DAC chip is altogether different from other DACs in its grounding requirements. It must be treated as an analogue component. Much of the competition require separate ground planes for both the digital and analogue sections, with a termination of these grounds at, or very close to, the power supply.

As for the last point, all DACs, whether Bitstream or Multi-bit, need a very clean power supply. Any noise or ripple here show up as changes in the audio noise floor of the convertor. In addition, poor PSU regulation degrades not only the noise performance but also increases the 0dB distortion in certain applications. Two stages of regulation are employed in this design. A high-current regulator (78S05) in the supply line reduces noise and removes ripple from the input. A high-current regulator in a low-current circuit has the benefit of reducing thermally-generated distortion within the regulator chip.

Suppressing noise even further are the two single-transistor gyrator regulators, one for each of the two supply rails. These isolate the digital and analogue rails from each other and give superior power supply noise rejection. This kind of isolation yields minimal noise interaction between each stage, and any excessive current delivery from one section of the power supply won't affect the other.

THE AUDIO STAGE

The audio section of the Crystal CS4390 is different from most of the other DAC chips on the market in its use of differential audio output stages. Crystal opted for this arrangement because the CS4390 runs on a single 5V supply, which makes it impossible to get a 0dB output signal of 2Vrms, as dictated by Philips' and Sony's Red Book standard. Increasing the output level to comply, the distortion performance would suffer greatly.

The differential topology simplifies the internal filtering of the DAC chip too. It would be virtually impossible to control the signal-to-noise ratio with filtering without affecting the sound performance in a single-ended design.

HART

The Home of *Hi-Finesse.*

Hart Audio Kits and factory assembled units use the unique combination of circuit designs by the renowned John Linsley Hood, the very best audiophile components, and our own engineering expertise, to give you unbeatable performance and unbelievable value for money.
We have always led the field for easy home construction to professional standards, even in the sixties we were using easily assembled printed circuits when Heathkit in America were still using tagboards!. Many years of experience and innovation, going back to the early Dinsdale and Bailey classics gives us incomparable design background in the needs of the home constructor. This simply means that building a Hart kit is a real pleasure, resulting in a piece of equipment that not only saves you money but you will be proud to own.
Why not buy the reprints and construction manual for the kit you are interested in to see how easy it is to build your own equipment the HART way. The FULL cost can be credited against your subsequent kit purchase.

'AUDIO DESIGN' 80 WATT POWER AMPLIFIER.

Our John Linsley Hood designed 80 watt Power Amplifier continues to amaze all who listen to it, and it is now finding new friends among speaker manufacturers who use it to show their own products to their best advantage. Its flawless performance is a result of the combination of inspired circuit design and the very best components, specified by the designer. Such innovations as the six rail fully stabilised power supply make great contributions to the overall reproduction quality yet are not found on even the most expensive run-of-the-mill designs in the High St shop window.

We have long known that the delicacy and transparency of sound from this amplifier placed it in the world class and side-by-side comparisons with amplifiers costing five times as much still show small performance advantages, which suggests that even the most expensive amplifiers will only equal rather than exceed, its sound quality. All amplifiers in the range have the same basic quality and the decision about whether to use a preamplifier is governed by the facilities you need. The STANDARD amplifier has switching for up to three inputs, if you need more than this then a preamplifier feeding a SLAVE power amplifier will give you up to seven inputs.
If you would like to hear this incredible amplifier in action then arrange a visit to Wilmslow Audio's new premises at Broughton Astley, near Leicester. Their phone number is 01455 286603, speak to Shaun or Terry.

All amplifiers are available in kit or factory assembled form.

K1100 Complete STANDARD Amplifier Kit	£415.21
A1100 Factory Assembled version	£515.21
K1100S Complete stereo SLAVE Kit	£353.62
A1100S Factory Assembled	£522.22
K1100M MONOBLOC Amplifier Kit	£271.20
A1100M Factory Assembled	£351.20

Super Audiophile (SA) Versions of all the above come with selected audiophile components at an extra cost of only £39.30 per channel.
All HART kits are designed for easy home construction to the very highest standards, and can be built by anyone of average manual ability. If you are still not convinced how easy it is to build it yourself with a HART kit you can order the Instruction Manual to read for yourself and we will refund the cost when you buy your kit!.

JOHN LINSLEY HOOD 15W SINGLE ENDED CLASS 'A' POWER AMPLIFIER

A design for the experimenter who wants to try and re-create the warmth and purity of sound given by valve amplifiers from the vintage years, without the problems of cost, deterioration and danger associated with trying to use valves today.
It employs the newly re-discovered single-ended circuit configuration to give total freedom from crossover artifacts and to give a sound that is indistinguishable from the famous 'Williamson' design, the undisputed leader of the field, with its triode connected KT66s and all-triode drivers. See our list for full details.

Reprint of Article	£2.50
CM4000 Construction Manual	£5.00

MAINS LEADS & POWER DISTRIBUTION.

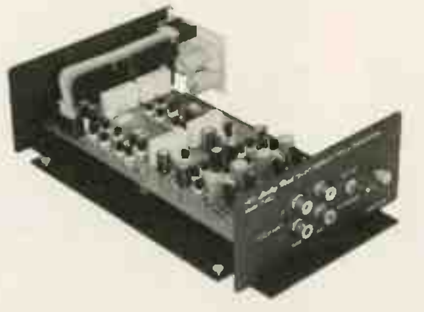
All our kits use standard IEC mains leads and these are available for a range of countries. We also stock distribution boxes with IEC sockets to minimise the space needed for power leads. See our lists for details.

"CHIARA" HEADPHONE AMPLIFIER.

Highest quality, purpose designed, 'single ended' class 'A' headphone amplifier for 'stand alone' use or to supplement those many power amplifiers that do not have a headphone facility. Easy installation with special signal link-through feature, the unit uses our 'Andante' Ultra High Quality power supply.
Housed in the neat, black finished, Hart minibox it features the wide frequency response, low-distortion and 'musicality' that one associates with designs from the renowned John Linsley Hood. Volume and balance controls are Alps "Blue Velvet" components. Very easy to build, or available factory assembled, the kit has very detailed instructions, and comes with Hart audiograde silver solder. A valuable personal listening option and an attractive and harmonious addition to any hifi system.

K2100 Complete Standard Kit	£112.50
K2100SA 'Series Audiophile' Kit with selected audiophile components	£115.46
A2100SA 'Series Audiophile', Factory Assembled	£115.46
CM2100 Construction Manual	£2.50

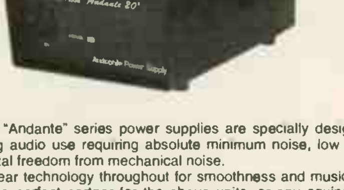
SHUNT FEEDBACK PICKUP PREAMPLIFIER



If you want the very best sound out of vinyl discs then you need our high quality preamplifier with Shunt Feedback equalisation. The K1450 also has an advanced front end, specially optimised for low impedance moving coil cartridges as well as moving magnet types. Selected discrete components are used throughout for ultimate sound quality. The combination of John Linsley Hood design, high quality components and an advanced double sided printed circuit board layout make this a product at the leading edge of technology that you will be proud to own. A recent review in "Gramophone" magazine endorsing this view. Bought in kit form our step by step instructions it is very easy and satisfying to assemble, or you can buy a factory assembled version if you wish.
This magnificent kit, comes complete with all parts ready to assemble inside the fully finished 228 x 134 x 63mm case. Comes with full, easy to follow, instructions as well as the Hart Guide to PCB Construction, we even throw in enough Hart Audiograde Silver Solder to construct your kit!

K1450 Complete Kit	£116.58
K1450SA Audiophile Kit	£138.94
A1450SA Factory assembled Audiophile unit	£188.94

"Andante" Linear Technology AUDIOPHILE POWER SUPPLIES



The HART "Andante" series power supplies are specially designed for exacting audio use requiring absolute minimum noise, low hum field and total freedom from mechanical noise.
Utilising linear technology throughout for smoothness and musicality makes it the perfect partner for the above units, or any equipment requiring fully stabilised ±15v supplies.
There are two versions, K3550 has 2 ±15v supplies and a single 15v for relays etc. K3565 is identical in appearance and has one ±15v. Both are in cases to match our 'Chiara' Headphone Amplifier and our K1450 "Shunt Feedback" Pickup preamp.

K3550 Full Supply with all outputs	£94.75
K3565 Power Supply for K1450 or K2100	£84.42
A3550 Factory Assembled Full Supply	£147.25

ALPS "Blue Velvet" PRECISION AUDIO CONTROLS

Now you can throw out those noisy ill-matched carbon pots and replace with the famous Hart exclusive ALPS 'Blue Velvet' range components only used selectively in the very top flight of World class amplifiers. The improvement in track accuracy and matching really is incredible giving better tonal balance between channels and rock solid image stability. Motorised versions have 5v DC motor.

MANUAL POTENTIOMETERS

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

MOTORISED POTENTIOMETERS

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

ALPS PRECISION SWITCHES.

At long last, switches to match the quality of our Alps pots. These switches not only solve the quality gap but also have features facilitating their use in real audio applications. The "Flex" version having a panel mounting control coupled to a rear mountable switch unit by a 190mm Flex Link. Also available is a motor driven option which, like the pots, can also be operated with its control knob.

HC5520. 4P 4W. Manual Control	£16.73
HC519. 4P 6W Manual	£17.95
HC5545. 8P 5W Flex Switch	£21.60
HC5560. 4P 6W Motorised	£29.80

SOLDERING

The size of modern components makes the right soldering equipment essential for good results. Everything we offer we actually use in our own workshops!. See our Lists for the full range.
845-820 XS240 ANTEX 240v 25w Soldering Iron. This is the ideal Multi-purpose iron as the bit is designed to totally surround the element giving the best heat transfer. This excellent design also means that although it is small and handy enough for modern components its heating capacity is better than larger irons of conventional construction. Excellent Value. £12.43
845-080 ST4 Lightweight Soldering Iron Stand. This has provision for the classic damp sponge for bit wiping. £3.95

HART SUPER AUDIOGRADE SILVER SOLDER.

Hart Super Audiograde Silver Solder has been specially formulated for the serious audiophile. Not only does it give beautiful easy-to-make joints but it is designed to melt at normal soldering temperatures avoiding the possibility of thermal damage to components or the need for special high temperature irons. A very low residue flux makes perfect joints easy but eliminates the need for board cleaning after assembly.

845-007 3mtrs 22SWG in Hart Mini Tube	£3.90
845-008 100g. Reel Special Valve Grade, 20swg	£12.90
845-009 100g. Precision PCB Grade, 22swg	£14.75
845-110 100g Reel Superfine 24swg for ultra precise control and easy working	£21.45

PRINTED CIRCUIT BOARD SOLDERING PRACTICE KIT.

Unsure whether you can construct a HART kit?, this is your chance to try!.Your HART Printed Circuit Board Soldering Practice Kit comes with a range of modern components, a typical Hart quality PCB, a roll of the correct grade of solder and full instructions. It enables the enthusiast who is uncertain of his, or indeed her, ability to put together and solder a printed circuit to try their hand at minimum cost. The instructions explain the right technique and guide even an absolute beginner through the seemingly daunting, but in fact very simple, art of making a good soldered joint. Excellent value for money at only £4.99
Super Version with Hart Silver Solder £6.95

LINSLEY-HOOD 400 SERIES SUPER HIGH QUALITY FM TUNER.

This ultra high quality analogue tuner system is the ideal companion to the 80W Audio Design Amplifier in any ultimate hi fi setup, with case size, front plate layout and even control pitches unified for stacking. Like the 80W Audio Design Amplifier this is your route to ultimate performance at incredibly modest cost!. Novel circuit features include ready built pre-aligned front end, phase locked loop demodulator with a response down to DC and advanced sample and hold stereo decoder together making a tuner which sounds better than the best of the high-priced exotica but, thanks to HART engineering, remains very easy to build and set up. Since all components are selected by the designer to give the very best sound this tuner is not cheap, but in terms of its sheer sound quality it is incredible value for money.

K400 Complete Kit	£256.82
RLH8 Reprints of 3 articles covering the FM tuner.	£3.70
CM400 Construction Manual	£4.95

Send for Your FREE copy of our LISTS

All Prices include UK/EC VAT.

Its not what you do, its HOW you do it that counts!.

ASM100 ACTIVE SUBWOOFER MODULE

This attractive module consists of a low pass filter and power amplifier ready for you to mount in a suitable sub-woofer cabinet. The combined unit can then be combined with any new or existing hi fi or home cinema speaker system to add in the real bass punch missing from most setups.
The ASM 100 module comes as a ready-to-mount unit on a solid diecast aluminium frame/heatsink. Input signal can be at line or speaker level for easy system integration. There are three separate stereo inputs at line level and the unit will use any signal presented or mix all inputs to add bass to any signal. The speaker level inputs are used by simply wiring the unit in parallel with the existing speakers to provide them with strong bass support. Crossover frequency can be selected to 50, 100 or 200Hz and the bass level can be adjusted by a front panel control. The 'Green' power supply switches the unit to standby if no signal is present. Drawings are included free for the compact 418 x 380 x 303mm cabinet.
With its powerful 125 watt output and versatile filtering the ASM 100 is the ideal universal active driver module for all subwoofer requirements.
ASM 100 Module, complete with IEC mains lead, instructions and ASM - W20 cabinet drawings. Pt. No. V7000 . . . . £185.29
W 200 S 20cm Long Throw Drive unit for use in ASM - W20 cabinet £36.68

VISATON HI TOWER SPEAKER KIT

A speaker kit from the VISATON range that really fits the modern idiom, giving a full uncoloured, and highly defined, sound stage combined with unobtrusive elegance that does not look out of place, even in a smaller room. A frequency response from 38-20,000Hz and a power rating of 100W make it easy to drive. The novel arrangement of five high/mid tweeters, angled at 45 degrees, creates a really dynamic sound stage with sharply defined sound staging. With its compact 200mm square section it can also be used as ultra high quality main speakers for home cinema applications. The kit includes all drive units, crossovers, terminal blocks and damping materials for you to make a stereo pair of speakers.
LK5961 Kit £392.42

EXPERIENCE V20

A real heavyweight performer with a total of no less than five drive units in each cabinet. Together these produce a satisfyingly smooth and wide frequency response. The single tweeter is a special 25mm high-end unit with a double coated fabric dome and ferrofluid for cooling and damping. There are two 13cm mid-range speakers and two 20cm long throw woofers for extended bass.

Nominal Power Rating	180W
Max. Music Power	300W
Impedance	4Ω
Freq. Response	29 - 30,000Hz.
Crossover Frequency	450Hz, 3KHz
Mean Sound Pressure	88dB
Box Volume	100Ltr. & 7Ltr.
Size.Height	1,300mm
Width	300mm
Depth	360mm

LK5965 Per Pair £538.70

ASM - T20 SUBWOOFER

An easy to build, but very effective, bass reflex cabinet design using the ASM 100 Active Sub-woofer Module and the W200S, high compliance, 8" driver, with its 20mm maximum cone displacement!. Easy to incorporate into a modern living environment the size of the cabinet has been kept as small as possible at 418 mm high, 303 mm wide, and 380 mm long. To aid its ease of positioning in the room both the drive unit and the vent are situated on the front of the cabinet. Despite these compact dimensions, and with a volume of only 31Ltrs, the ASM T20 gives up to 106dB with an acoustical cut-off frequency of 25 Hz.!. The cabinet is made from 19mm MDF, and needs about 8 sq.ft.

W200S 20cm. Long Throw Drive unit. Part No. 9030 . . . . £36.68

COUPLED CAVITY SUBWOOFER.

An alternative design by David Purton, from his little "Coupled Cavity Handbook", using the same drive unit but requiring a bit more woodworking skill as the speaker is set on a baffle in the middle of the box. The total box size is even smaller than the ASM T20 at only 418 mm high, 303 mm wide, and 344 mm long.
Construction Drawing. £1.50

SPEAKER DESIGN SOFTWARE

All programs are for IBM or compatible computers.

VISATON SPEAKER PRO 6. Software (PC) for cabinet and crossover design and calculation with full extendable data bank of drive unit parameters with performance curves aquired in tests in VISATON's own anechoic chamber. This is the essential tool that turns you into a speaker designer!.
Full Version (3") £45.51

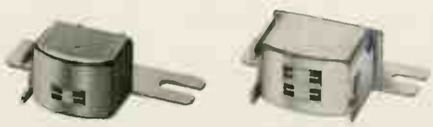
BASSBOX 5.0 for WINDOWS. Harris Technologies.
This program aids the design of bass enclosures by allowing you to model how a speaker will sound in a variety of boxes and then modelling the maximum loudness of the speaker/box combination. It then helps to calculate the dimensions of the box and port, if vented. Needs Windows 3.1+, DOS 5.0+, 386 or better, 4MB RAM and 44MB hard disk space. With easy-to-use printed manual. Shipping Wt. 450g
SOF-BAS £87.50

BASS HORN DESIGN. A.L.Senson.
This program, patterned after Brian Smith's tractrix horn design program, calculates dimensions for a catenoid, exponential or hyperbolic bass horn and prints out in less than a minute. Provides mouth and throat areas, back chamber volume, and dimensions to design your enclosure.
SOF-HOR £17.95

X*OVER 2.0 for WINDOWS. Harris Technologies.
This package helps in the design of two and three way passive dividing networks as well as load compensating circuits and calculates values for first, second, third and fourth order networks. Same computer requirements as above but only needs 1.5MB disk space.
SOF-XOV £27.90

"QUICK & EASY TRANSMISSION LINE LOUDSPEAKER DESIGN" Larry D.Sharp.
Explanetary booklet plus computer disk that requires Lotus 123, or equivalent spreadsheet software on your machine. 1993. 22pp. 215 x 280. Spiralbound.
SOF-QET £8.95

REPLACEMENT CASSETTE HEADS.



The excellent performance of modern cassette recorders depends totally on the quality of the R/P head. Even the slightest amount of wear can impair the frequency response and distortion levels. Our HC80 is a top quality head from one of the foremost manufacturers in Japan.
It is easily fitted to most standard stereo recorders (except Sony) and will transform the performance over a worn head. The fact that we buy these in vast quantities enables us to offer them at the amazing price.
HC80 R/P Head, Std Mtg £11.70
Special Offer. 2 for £17.60

HRP373 Downstream monitor combi head.
SPECIAL OFFER HALF PRICE £29.50
HQ551A 4-Track R/P £14.60
HQ551S Sony Mount 4-Tr. R/P £14.90

REEL TO REEL HEAD 999R 2/4 R/P 110mH £16.84

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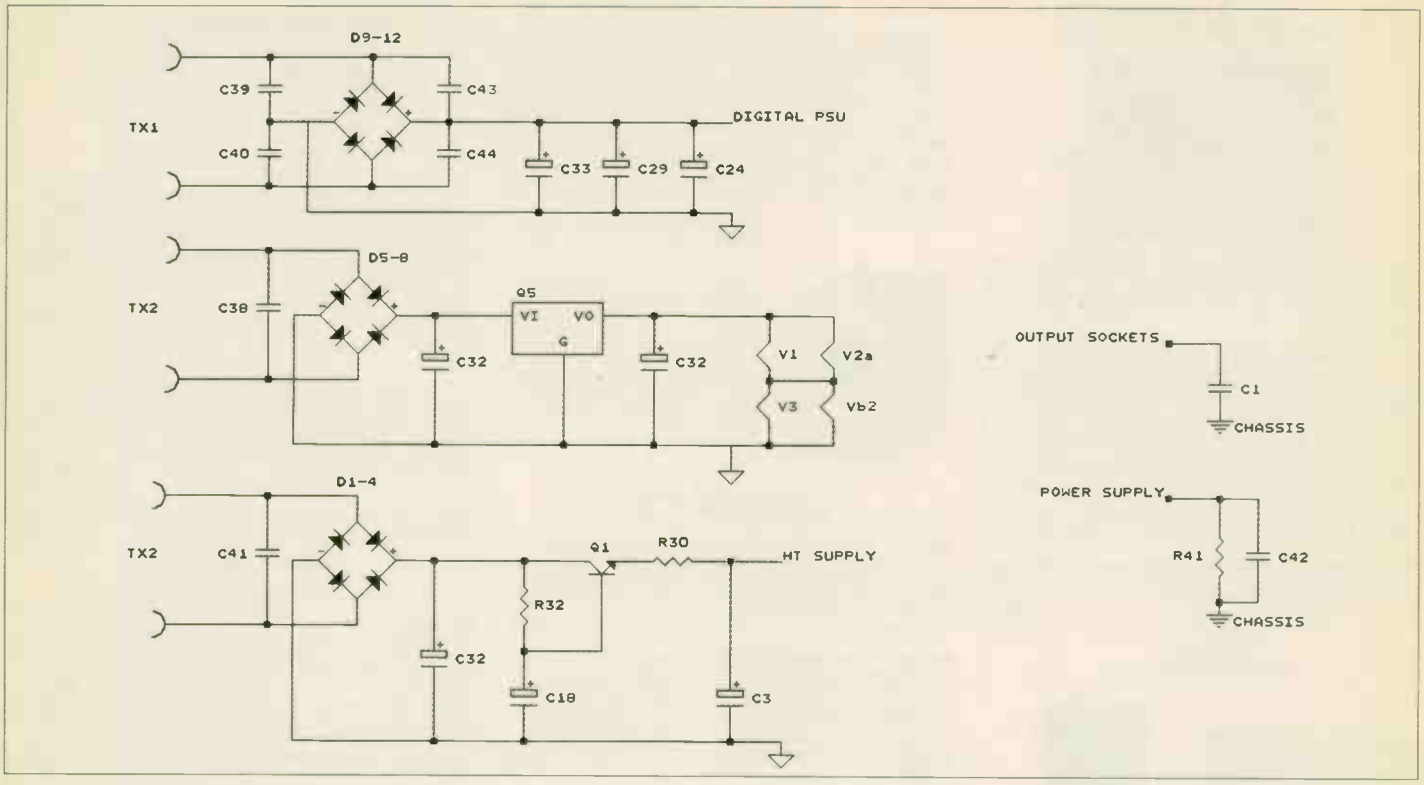


The power supply design offers a combination of simplicity and performance suited to DIY construction.

As most audio engineers will agree, the benefits of working in balanced (or differential) mode are tremendous. Removing noise from a DAC is far easier to achieve due to the cancellation properties of this arrangement. Balanced working has been proven to be the best way to transmit audio signals over distances too, so all recording and broadcasting studios adopt this system.

BOTTLES IN THE BOX

As the DAC outputs are of a balanced configuration, a new valve output stage had to be developed, one which would perform as well as a solid-state version while offering the unique transparency of valves.

When designing any valve audio stage, certain criteria have to be considered. These are related more to the simplicity of the audio circuitry and the high-voltage supply rails than the valves themselves.

In most circuitry, valves are not generally capable of providing the same kind of signal-to-noise ratio as transistors but they do have a more amenable sonic character. My brief was to match the low noise levels of solid-state closely, and this required some radical ideas.

I did not want any negative feedback or a mass of valves; one circuit configuration had no less than four valves per channel, which was just a little excessive!

After exhausting all available avenues, I finally settled on a basic differential valve stage. However, at this point I was presented with a problem, the high output impedance of these stages coupled with low drive capacity. What I really wanted was a differential stage with low output impedance and high drive capability.

Adding a cathode follower to the differential stage would solve the problem but insert another capacitor into the signal line. This was deemed unacceptable - direct coupling a stage in this manner requires matched valves, otherwise biasing changes with temperature and time.

The answer turned out to be a Shunt Regulated Push-Pull stage. This combines a low output impedance with a drive capability of some 40V before the onset of clipping. Then the little light bulb above my head lit up. What if I used the differential stage in the bottom of the audio output for its noise-cancellation properties and coupled it to the SRPP? Bingo!

If you're a little confused, let me explain. The differential configuration (more commonly called a Long-Tail Pair) has seen use in both solid-state and valve amplifiers for a very long time. It forms a two-input high-impedance stage that can be used as the front end in an op-amp or a power amplifier, where one side is usually employed to couple the feedback return from the output stage and control the amplifier within certain parameters. This type of topology can be found in circuits for converting balanced signals into unbalanced in professional mixers and broadcasting equipment.

For most applications the outputs of the Long-Tailed Pair lead on to many further stages of amplification to provide the high open-loop gain necessary before negative feedback is wrapped around the circuit.

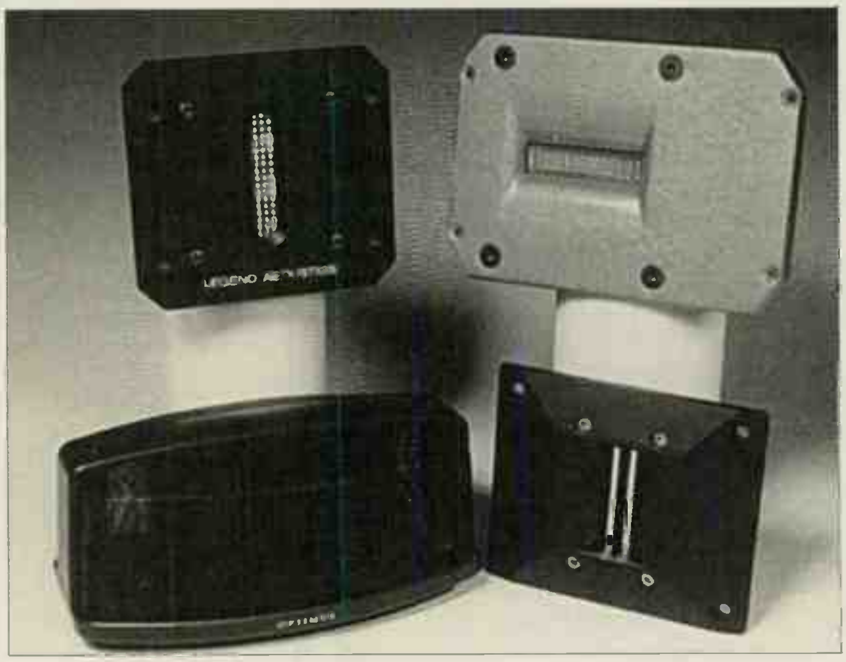
If all of the additional gain stages and negative feedback are removed, what remains is a stage that boasts all of the properties previously sought, but with a lower gain.

Coupling the LTP and SRPP stages together, we get the best of both worlds, cancellation of noise from the differential pair and the drive capability of the cathode follower section of the SRPP.

IN THE NEXT SUPPLEMENT. . .

In the second part of the 24-bit DAC article, we'll be publishing the PCB layouts and details of how to build the DAC.

Ribbon Round Up



By
Noel Keywood

Ribbon tweeters can provide superb treble. The Tonigen unit I have tested here is one of my favourite drivers. I used it many moons ago in our first kit loudspeaker, KLS1, having first come across it in the Heybrook Sextet loudspeaker. The Tonigen can give incisive treble - steel guitar strings really cut like a knife. Yet it's so clean the sound never becomes offensive - violins are defined with crystal clarity and little sign of coloration. Stereo images in particular are pin sharp, although this holds only over a fairly restricted listening position. So why aren't ribbons more popular? Well, they have their have problems in addition to their plus points.

To reproduce high frequencies cleanly a loudspeaker drive unit diaphragm must move fast. It has to oscillate at up to 20000 times per second, reversing direction twice every cycle, to reproduce a 20kHz signal. This means it's subject to large accelerations and decelerations. To follow the signal faithfully without employing excessive driving force, low mass is a prime requirement.

The popular dome tweeter has a small coil-former attached to it, wound with fine wire which carries the signal current from the amplifier. The former and wire constitute most of the moving mass, typically 0.3gm or so. Dispensing with this coil reduces the moving mass enormously, but how then can the dome be driven?

One way is to make the dome out of metal so it conducts an electrical current and then place it in a magnetic field. In essence, the moving element becomes the motor. This is how a ribbon tweeter works. The moving element is traditionally a metal ribbon rather than a dome, through which is passed the signal current. Close to it are the field magnets.

In the HRL-1 ribbon tweeter tested here the makers claim ribbon weight is 0.01gm, thirty times lighter than a dome. So when it comes to weight reduction the ribbon tweeter is a great idea. So what are the problems?

The low impedance of a ribbon would short out an amplifier if connected direct, so a transformer must be used to match it in, making for extra expense and complexity. The close proximity of the magnets to the transformer can badly affect frequency response, sensitivity can be poor and power handling low too, if attention isn't paid to these areas.

Finally, as if all this wasn't enough, vertical dispersion is very limited, so the tweeter only sounds right when at ear height. Stand up and the sound will suffer, upper treble disappearing and stereo imagery going to pieces. This makes the ribbon tweeter an enthusiast's device, as does its generally high price: expect to pay from £100 to £300 or so per pair. Quality dome tweeters typically cost £30 per pair by way of comparison.

Most of the problems listed have been tackled in the units tested here, albeit with varying degrees of success. They are an interesting, if slightly frustrating bunch.

TESTS

To avoid the risk of over-driving from low-frequency signals I tested these ribbon tweeters with band-limited pseudo-random noise with a 500Hz-50kHz energy spectrum. Input level was around 1volt. The frequency response analysis similarly runs from 500Hz up to 50kHz. However, our B&K measuring microphone starts to lose accuracy above 20kHz and the sharp suckout seen at 30kHz in all the analyses is likely a phase suckout in the mic. head, rather than an effect common to the tweeters themselves.

The response shown is that achieved on-axis and slightly off-axis, the two being combined by averaging.

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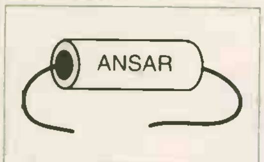

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CW470N	CAP PROPYL 470nF	£1.25
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CW1U0N	CAP PROPYL 1µF	£1.25
CW1U5N	CAP PROPYL 1.5µF	£1.50
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CPP330P	CAP PROPYL 330pF	250V	£0.35
CPP470P	CAP PROPYL 470pF	250V	£0.35
CPP1N0	CAP PROPYL 1nF	250V	£0.35
CPP1N5	CAP PROPYL 1.5nF	250V	£0.35
CPP2N2	CAP PROPYL 2.2nF	250V	£0.35
CPP4N7	CAP PROPYL 4.7nF	63V	£0.50
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10H63	LO Z HI TEMP 10µF	63V	£0.25
22H63	LO Z HI TEMP 22µF	63V	£0.30
47H63	LO Z HI TEMP 47µF	63V	£0.35
100H63	LO Z HI TEMP 100µF	63V	£0.50
220H50	LO Z HI TEMP 220µF	50V	£0.75
470H63	LO Z HI TEMP 470µF	63V	£1.25
1000H35	LO Z HI TEMP 1000µF	35V	£1.50
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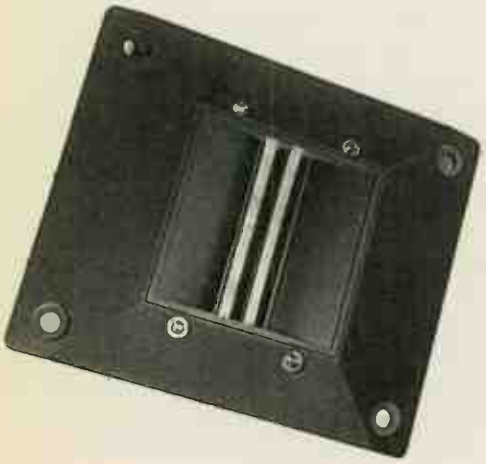
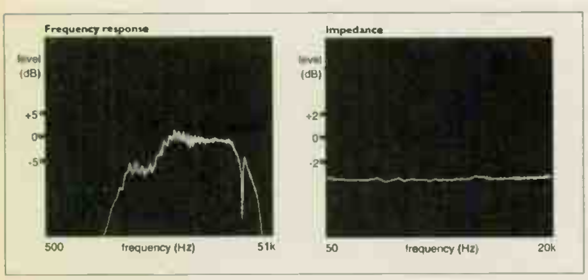
With ribbon tweeters the latter can be a little bit flatter than the former. However, the Optimus changes its response considerably over the forward listening angle, so we show a forward averaged value.

Sensitivity was also measured with a nominal watt (2.8V) of band-limited noise, the mic. set up 1m from the drive unit.

TONIGEN RIBBON TWEETER





Made in Japan, the Tonigen ribbon tweeter was one of the best-known commercially available designs, until a year or so ago when Tonigen announced it would become unavailable unless ordered by the thousand. It has become difficult to obtain ever since, although manufacturer's surplus stock does sometimes appear.

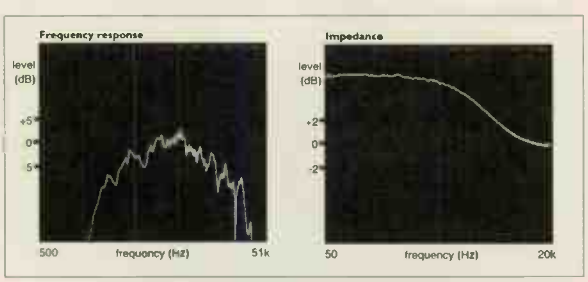
The unit has a black plastic face plate and a shallow sealed magnet assembly. The magnet is very powerful though. As a result the tweeter has a habit of doing destructive somersaults, if put anywhere near steel, and screws and metal parts will hurtle towards it, if thev get too close. Other designs, with closed magnetic circuits, have weaker external fields.

The ribbon vents through a narrow front aperture, with a shallow horn flare to improve efficiency and lateral dispersion. Above and below the unit's forward axis dispersion is poor; Tonigen have made no attempt to tackle this problem. Laterally it is quite good though; 30degrees off-axis frequency response was much like that shown in our analysis.

The most impressive feature of this conventional looking ribbon tweeter is its frequency response. Considerably flatter than a conventional dome tweeter, it runs smoothly from 6kHz up to 20kHz. Other tweeters just cannot match its flatness and, in my experience, the Tonigen subjectively fulfils just about every expectation you might have of this resonance-less, phase-anomaly-free behaviour. It does need to be partnered with a very able midrange unit though, since not so many reach smoothly up to 6kHz.

Another weakness of ribbons Tonigen have overcome is that of low sensitivity. This one delivers no less than 92.5dB sound pressure level from 2.8V input, higher than any other unit tested here and high enough to match most commercial drive units. To achieve this Tonigen have used a low impedance of four ohms to draw power, as our impedance plot shows. Of course, in use the unit must be fed from a capacitor at least, to remove bass signals. The high sensitivity of the unit means that in practice an attenuating resistor is often needed, bringing system impedance up to five to six ohms minimum above 6kHz.

This is a great ribbon with a great sound. It measures superbly and sets a benchmark for others to emulate. Doubtless both cost and a lower limit of 6kHz militated against it, as well as its manufacturer's insistence on large order quantities. What a pity.



OPTIMUS DIPOLE RIBBON TWEETER

The Optimus comes from Tandy and is priced competitively at around £80 for a pair, much less than the other units here. It is necessary to bear this in mind when judging value, for the Optimus is a trifle "unusual" in its behaviour.

The Optimus is a clip-on tweeter that possesses its own simple internal crossover, comprising a series capacitor to block bass frequencies. This driver is meant to be mounted on top of a conventional loudspeaker cabinet.

Tandy print a small diagram in the accompanying manual (if you can call a single piece of paper a manual) showing sound being radiated from either side of the driver, whereas this is in fact a dead area. The Optimus radiates forwards and rearwards, dipole fashion, through its open-mesh grille, as you might expect. The diagram is actually wrong.

Measurement showed the Optimus imposes no load at low frequencies, but above 5kHz, where its impedance hits 15ohms, it will make itself known to the amplifier. Reaching a minimum of 8ohms above 10kHz it will bring overall impedance down to 4ohms or less at high frequencies. Although this doesn't sound too amenable, there isn't much power up at these frequencies so most amps will handle the small extra load.

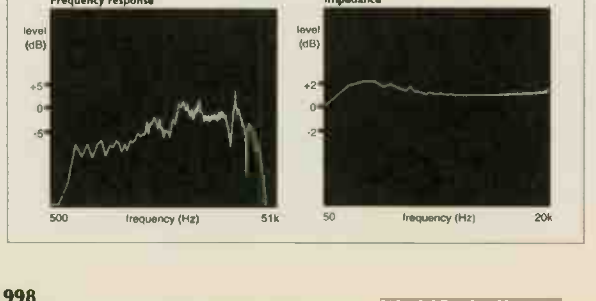
By radiating over a wide forward and rearward angle, the Optimus is meant to provide a sense of spaciousness, bouncing treble off surrounding walls. Various manufacturers have given us this effect in the past - and it is just an effect.

The Optimus has a low sensitivity which measured a mere 82dB, which doesn't strengthen its hand. This sort of figure means the resulting loudspeaker would be seriously insensitive.

Perhaps not unexpectedly, the Optimus does not have a flat forward response. Averaged over a small forward angle it works from around 3kHz up 6kHz, rolling down progressively above this frequency. However, greater than 45degrees off axis, high-frequency output becomes strong, so this unit fires a lot of high-frequency energy out sideways, at walls or whatever happens to be in the way.

Obviously, the Optimus is no conventional ribbon tweeter. With a ragged and variable frequency response, as well as low sensitivity it doesn't look like one of the best of the breed.

HOWARD DAWSON HRL-1



The HRL-1 is hand-made in Norwich and, at 2.7kgs, was easily the heaviest unit of the group. The face plate and rear magnet housing are cast alloy, making the whole assembly very sturdy. A small signal transformer is attached to the rear of the face plate. The instructions supplied give lots of advice on appropriate matching networks, which is useful for DIYers.

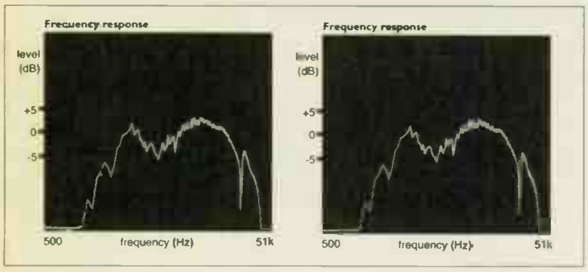
The manufacturer suggests the drive unit be used with second or preferably third-order crossovers if it's to be run at its lowest practical crossover point of 3kHz. If you choose a first-order instead, the roll-off has to be moved up to 10kHz to prevent bass frequencies damaging the ribbon. In this case, the HRL-1 is working more as a super tweeter than a standard tweeter.

The frequency response of the HRL-1 looks a little ragged overall, but if the sharp peak/trough of a phase suckout at 19kHz is ignored - and the ear will not readily detect this - the HRL-1 manages pretty well right down to 6kHz. Output remains even within 2dB limits. Like the Tonigen this driver ideally needs to be partnered with a high-quality midrange unit that can reach 6kHz without excessive break-up. However, by maintaining output down to 3kHz (-6dB) the HRL-1 can be combined with a bass/midrange unit, albeit with a less even frequency response. The two-way 12dB/octave crossover shown in the literature for this purpose is a second-order Butterworth that rolls in at 3kHz.

As with the Tonigen the HRL-1 displayed reasonably even response laterally off-axis, but treble output plummeted above or below the forward axis. So a listener's ear would have to be at or near tweeter height to hear fully what the unit can do.

Impedance measured 12ohms-15ohms across the band of operation, a good figure for matching purposes. Output measured 87dB sound pressure level at 1m for 2.8V of band-limited noise input. This should yield a more sensitive system in practice, when energy from a bass/mid driver is added, assuming a constant voltage source (i.e. conventional transistor amplifier). I'd hesitate to be too specific, because crossover network losses will have a negative effect, but an 88dB sensitive loudspeaker may well be possible.

LEGEND ACOUSTICS HIGH-FREQUENCY RIBBON



The Legend ribbon is neatly made, with a thick, solid face-plate and strong cylindrical rear body. At 2.3kgs it's heavy, if not quite as heavy as the HRL-1. The ribbon itself vents through the customary slot aperture. The manufacturers claim the unit is, "an effective upgrade for any dome tweeter operating from 3kHz".

I measured 88dB from the 500Hz-50kHz band-limited pseudo-random noise signal produced by our spectrum analyser, without the intervening inductor recommended. This makes the Legend the second most sensitive design, with 4.5dB less output than the Tonigen. However, this is largely down to its much higher 12ohm impedance.

In terms of real electrical efficiency the Legend is similar to the Tonigen, but this is somewhat academic. It makes more sense for a ribbon designer to aim for the lowest possible impedance, four ohms being about the lowest acceptable, to gain the highest possible voltage sensitivity to match the widest range of bass/midrange, or midrange only, drivers. If the design is too sensitive for a driver, it can then be matched in easily with an external resistor. All the same, the Legend will still match a good range of drive units in terms of sensitivity.

The manufacturers recommend the unit is connected up through a 0.2mH inductor to flatten its response. Without this item its response is a little mountainous, as our analysis shows. However, full output is maintained until 20kHz. With the inductor treble output flattens out up to 12kHz and starts to fall off above this frequency, becoming -6dB down at 20kHz. This will not so much dull treble as remove sting or real incision. A compromise of 0.15mH-0.18mH may be best.

With any inductor in place though, a 4dB peak at 3kHz appears, especially on-axis. This peak is slightly less of a problem laterally off-axis, so the Legend is best pointed forward such that it is listened to off-axis. The inductor lowers sensitivity by a dB or so, by the way.

From experience I suspect a second-order high-pass filter peaked up at 5kHz might be a better solution to the humped response problem of the Legend than a simple series inductor. This would fill in the 5kHz dip and attenuate the 3kHz peak, giving a flatter overall result. Otherwise, the 4kHz peak is going to add some noticeable spitch to the sound of this unit.

CONCLUSION

There are so many variables that affect the sound quality of these drivers we felt it unfair to try and assess them subjectively. With enough effort, both the HRL-1 and the Legend can be engineered reasonably flat. In this condition they should sound similar to a Tonigen. However, the manufacturers of both designs could usefully do more to improve their innate characteristics. As they stand, sound quality will be less than perfect because of the undulating response shapes our analyser revealed.

By contrast the difficult-to-obtain Tonigen neared perfection. It has a flatter, smoother frequency response than any other tweeter, bar the Audax HD-3P, which is a dome, not a ribbon, or we would have included it here. That the Tonigen was something special I never doubted. It is far and away one of the best treble units I have ever heard, although my ears tell me the Audax is a tad better - and domes lack the vertical dispersion problem of ribbons. Knowledgeable enthusiasts will be able to get fine results from the HRL-1 and the Legend, but neither is perfect.

The Optimus doesn't measure as well as either of the other two drivers in terms of frequency and sensitivity, but considering its lower cost might still be an option worth considering. Connection via an active crossover such as those offered by Maplins would make its low efficiency less of a difficulty ●

Optimus Dipole Ribbon Tweeter £79.90/pair

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Tel: 0500 300666

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Howard Dawson
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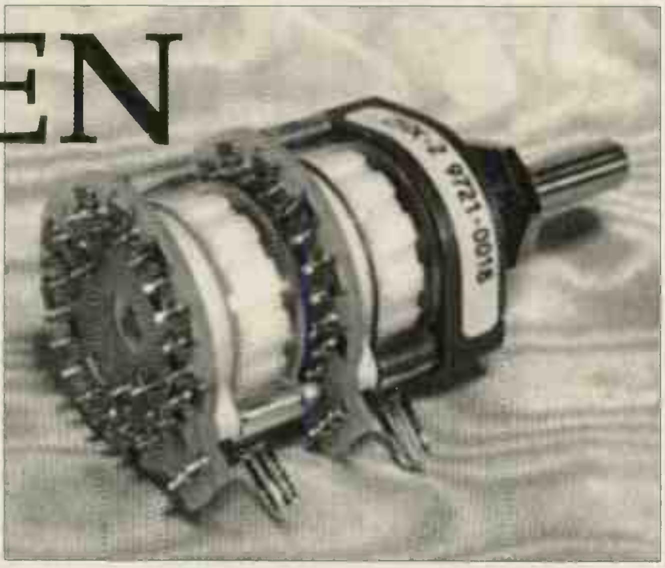
STEPS TO HEAVEN



Andrew Harrison and Ketan Bharadia step out with Danish Audio Connect's CT1 stepped attenuator.

A volume control is one necessity that even the most hair-shirt purist could not forgo. Balance control - expendable; tone controls - unnecessary; but control over music's volume - essential. Problem is that in most applications a potentiometer (variable resistor) will be used directly in the delicate signal path. This can have potentially disastrous effects on sound quality.

Nowadays any £500+ amplifier worth its salt should have at least an Alps Blue pot fitted, its metallised, conductive plastic track offering audible advantages over the most basic carbon-track variant. But beyond the potentiometer lies the stepped attenuator.

This uses a multi-way rotary switch with a 'ladder' of high-quality discrete resistors making up its rungs. You move up and down the ladder to change volume by simply turning the knob.

Danish Audio Connect make one such device, their £105 CT1 Audio Attenuator with its 24 steps. We tried their 250kohm version in our World Audio Design KLPP1 valve line and phono pre-amp as well as in front of some DPA amplification (although 10kohm would be a more normal value here).

Hooking up the CT1 instead of a DPA 50S pre-amplifier was certainly chucking it in at the deep end as the DPA is already a seriously good pre-amp thanks to its extremely high-grade Penny and Giles pot. Used as a passive volume control and connected directly to DPA's 50S power amp, there was just about enough volume but we had to use most of the attenuator's travel.

Our first impression was of a 'stripped-down' sound that initially lead us to think that something was missing. Further listening showed that the DPA pre, in contrast, was actually laying a thin veil over the sound.

Another bonus with the CT1 was an increase in the boogie factor - rhythms had greater conviction and transients were that bit more precise and snappy. Subtle details previously overlooked made themselves felt - tonal colours were more realistic and sound staging that much more focused, with images firmly located. After this promising start, next up was the KLPP1.

A few wafts of multi-core flux later and the re-tweaked KLPP1 was mated up to a Chord SPM 400 power amp for auditioning. One ability of this attenuator that's very obvious is its truly crystal clarity. The spaces in a sound stage between the various images were clearer and more open, as if a fine coating of mush had been peeled off them. The top end was more extended and a little sweeter, while lower down bass and midrange had lost some of their slightly tubby cuddliness in favour of a drier, more detailed character.

The CT1's 'invisibility' was its finest asset. If you're accustomed to cheaper pots, you might think the CT1 a touch grey and lean when you first encounter it. Give its sound a chance to sink in though, and you'll wonder how you never noticed the blatant colorations of less elevated volume controls.

There are other claims made for the CT1 by the manufacturer on top of the purely sonic: increased reliability, lower distortion and better tracking accuracy between channels. The reliability factor I am not inclined to question given the superb build quality and use of gold-plated contacts on precision wafers sourced in Switzerland. And precise channel matching comes from the high-tolerance surface-mount Metal Film resistors.

Danish Audio Connect CT1 attenuators are available in 10kohm, 20kohm, 50kohm, 100kohm and 250kohm values, with a four-wafer version for balanced audio applications priced at £165 each ●

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AUDIO IC USERS' HANDBOOK

By R.M. Marston

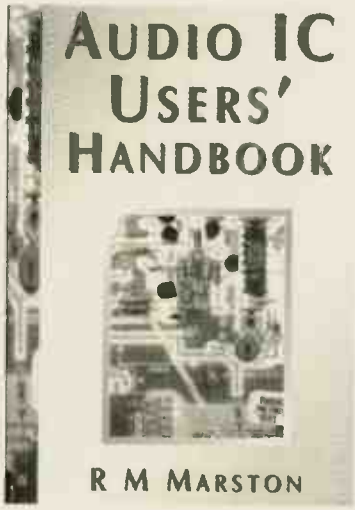
Reviewed by Haider Bahrani.

The advent of the analogue IC (integrated circuit), and in particular the operational amplifier, has made amateur electronics, and especially audio electronics, a great deal more accessible and a lot more fun. In professional terms, audio ICs, be they op-amps, power amps or other processing devices, have allowed designers more scope and, yes, they have made life easier. Audio IC Users' Handbook covers all of the above.

The book is split into 10 sections. The opener, titled 'Audio Basics', gets to grip with some of the commoner words used in audio electronics - fidelity, noise, dynamic range and harmonic distortion are explained in a clear and uncomplicated fashion. Coverage is also given to pre-emphasis, de-emphasis and signal compression as in CD data encoding. One little area of interest for ageing hi-fi reviewers: Mr Marston seems to espouse the view that anyone over the age of 25 lacks the ability to hear full-range audio above 500Hz. For further elucidation on this somewhat contentious point, consult the author and the Handbook.

The most widely used ICs in audio, op-amps are first off the mark with a comprehensive airing in Chapter Two. The section starts with an overview of basic voltage-in, voltage-out op-amp circuit configurations including inverting, non-inverting and differential amplifiers, with some of the favourite layouts compared and contrasted. The chapter progresses from the simpler forms of circuitry (with very clear, concise descriptions) to their more complex incarnations in active filters such as tone controls and RIAA networks.

Chapter Two is itself split into two halves. The second of these deals with operational



transconductance amplifiers, or OTAs for short. In a nutshell, an OTA is a voltage-in, current-out (transconductance) device. The practical applications of such devices (like Voltage Controlled Amplifiers, which are useful in active volume-control applications, and amplitude and ring modulators) are listed in some detail.

The following chapter focuses on ICs which are more specifically dedicated to signal processing. In other words, we have attenuator, compander, switcher, noise reducer, tone control and volume chips.

Dedicated pre-amplifier op-amps are the mainstay of Chapter Four. Much of the text here is taken up by the LM387 pre-amp and its implementation in audio mixing, tone control and RIAA filter circuits. Hints and tips on RF (Radio Frequency) pick-up and instability are also passed on. The later parts of the chapter deal with the costlier, higher-quality LM833 and showcase it in a number of applications.

The next two chapters are concerned with power amplification, as you might conclude from their respective titles of 'Audio Amplifier Circuits' and 'High-Power Audio Amplifiers'. The first tackles the basics of power amplification and introduces the reader to some low-power amp ICs. The more powerful chips follow in similar fashion in Chapter Six, with a variety of the more commonly available models that pump out up to 60watts discussed.

Bar-graph displays are more and more often seen these days on professional and some consumer audio gear. Their emergence has been at the expense of the moving-coil meter, which has been retired to the ranks of the retro styling industry. Hence bar-graph driver chips have been allowed an entire chapter in this Handbook. The chapter visits two families of devices, the U237 from AEG and the LM3914 from National Semiconductors.

Surround sound, AC3, Prologic, etc are all names and acronyms you'll come across, if you have anything to do with home entertainment systems. The eighth chapter in this text doesn't deal with the above-mentioned technologies specifically, but covers the topic of audio delay lines which are implemented in many pseudo-surround sound systems. Alongside echo and reverb effects amongst many others, delay lines have found and are finding themselves increasingly useful in audio reproduction. More than one class of suitable IC gets a look in in this section, hence it's more than substantial in relative terms.

Chapter Nine is a brief trawl through power supply ICs including regulators and bridge rectifiers. This leads into the final chapter which consists mainly of hints and tips on power consumption and heatsink design. All the basic calculations are included without any unnecessary complexities.

If insomnia is a problem you try to combat with dry, tedious tomes, you should probably steer clear of this lucid and helpful text ●

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VALVES FOR AUDIO FREQUENCY AMPLIFIERS

By E. Rodenhuis

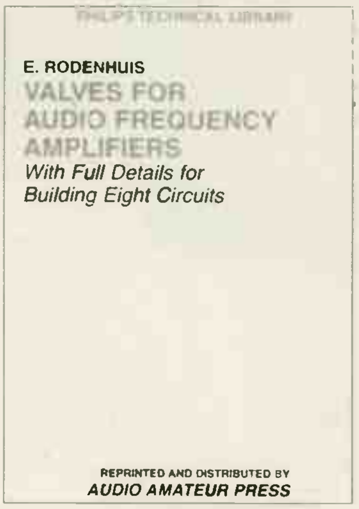
Reviewed by Noel Keywood.

There's always an air of confidence helped by the certainty of advice which accompanies books from Philips Technical Library. It's hardly surprising of course, since Philips have been Europe's premiere electronics company since the Thirties, maintaining comprehensive research and development labs. in many countries, including Britain. The advice that comes with Philips (and Mullard) books is straight from the horse's mouth and as a good a place as any for beginners to start.

Valves For Audio Frequency Amplifiers is built around short, technical descriptions and lists of properties of Philips' own audio valves. Alone, these descriptions don't amount to exciting reading, nor would they fill a book. As usual, it is what accompanies the data that is likely to be most attractive to enthusiasts - eight different audio amplifier circuits are included.

Philips' authors avoided today's gobbledygook plague; there isn't an acronym to be seen either. Instead, the descriptions are kept simple and are easily understood. There's plenty of useful information on the practical side of building valve amps, as well as avoiding their common problems - hum in particular - in the basic design. The only real limitation of a book like this is thoroughness. Some explanations were cursory to say the least, but then it is not a design reference book, and at £12.95 nor is it priced like one.

The first chapter alone may well be a god-send to those poor souls suffering hum. In just eight pages, with the help of a few succinct diagrams, the author explains the nature of a hum loop, how to arrange earth lines and what not to do. Then there are those practical hints and tips we see so little of nowadays - when drilling aluminium, use methylated spirits as a lubricant. It "secures freedom from



burr, and the cutting action of the drill is also improved".

Reasons for poor earth connections are noted too. Aluminium forms a surface oxide layer that, on a chassis, should be penetrated with burr washers. Protective coatings on steel must be scraped off. Our experience is that the poor earth connections which result from this introduce obscure problems that amateurs and professionals alike find hard to pin down. It's wise to prepare carefully when building a valve amplifier with the aid of a book like this.

I liked the amount of detail Philips provide on their valves here. There are Ia/Vg curves and Ia/Va curves, plus oodles more performance curves for the EL84/EL34 output pentodes. Anyone wishing to use either of these valves need look no further.

The EF40/EF86 small-signal/high-gain pentodes are covered, the ECC40/83 twin triodes, and the EL84 (12W anode dissipation) and EL34 (25W anode dissipation) output pentodes. Both the EF40 and ECC40 have rimlock bases and are neither common nor popular now. By contrast, the EF86, ECC83 and EL34/84 are very popular, inexpensive and easily available. Whilst Philips no longer manufacture any of these valves, others do; new EL34s pop up almost daily! There's also useful data on the excellent GZ34 double-diode full-wave rectifier - just remember that a Philips GZ34 takes a lot more stick than modern versions, and there are virtually none left in the world.

I noticed one characteristic omission from the book, an important point in the fight against hum that Philips seem peculiarly blind about. The EF86 has two screen pins, marked 's' on the base diagram. I found no mention of these in any of the text, the only vague allusion to them being in small base pin-out diagrams at the back. It's the same in Mullard's famous Circuits For Audio Amplifiers.

I wonder whether they did not want to mention these screens because the EF40 didn't have them, connecting its surrounding screen to the cathode, a less satisfactory arrangement. In my experience it is important to connect both screen pins (2,7) to the valve holder's central metal spigot and take the lot to ground when fighting the last vestiges of hum. This is shown in a wiring diagram in Mullard's book, but not in Valves For Audio Frequency Amplifiers. Why Philips were so reluctant to mention the EF86 screens is an enduring mystery to me!

The other minor mystery within this book is why it switches occasionally from 'valves' to the American term 'tubes'. First I suspected the book's American publishers had been making some illicit alterations! Then I noticed that the text in places uses the term 'tubes'. Seems like the Dutch authors were happy to swap between both terms.

Valves For Audio Frequency Amplifiers is a great little book. It's a must for anyone who wants to use any of these popular audio valves from Philips ●

Valves For Audio Frequency Amplifiers
£12.95
(+£2 UK p+p)
ISBN: 1-882580-16-8

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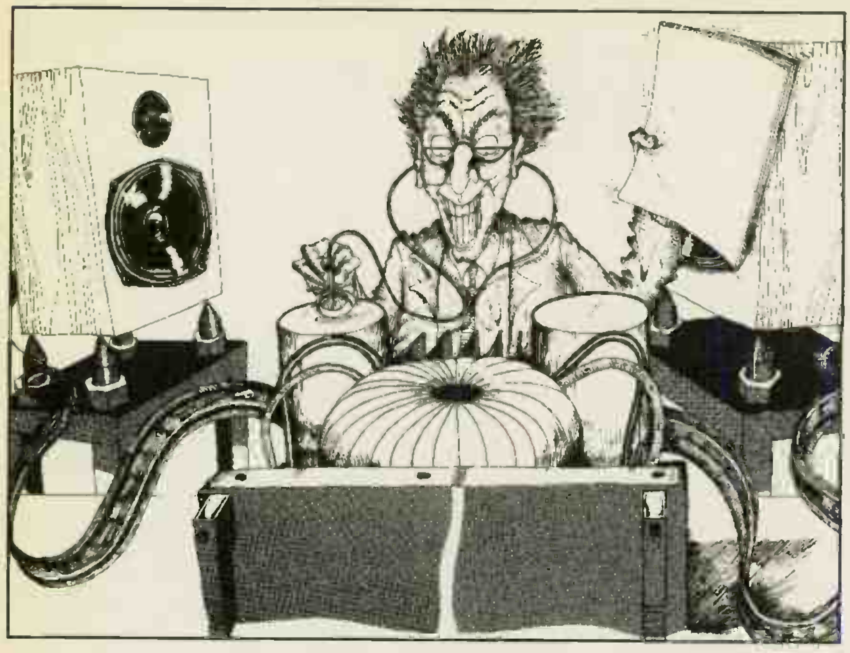

DIY Letters

AUDIO ACTIVITY

Until recently my system consisted of an Arcam Zeta One amp, Alpha One CD player, B&W 602 'speakers, an REL Q-Bass and a Rega Planar 3 with Audio Technica AT450. Ancillaries include Mission 761is and a Jamo Centre 200. I enjoy most types of music but prefer Rock or a good film. A Mission DAC 5 and a Rotel RQ-970BX equaliser found their way into the system as well and brought improvements to the sound, but only marginally.

With two small children around the house, one day the inevitable happened - fingers in the 602 tweeter units. Much alarmed by this but not wanting to lose the 'speakers for repair, I decided, having read about it in your Supplement, to try the Optimus ribbon tweeter from Tandy.

Disconnecting the damaged tweeters and soldering in the Tandies, the sound was obviously unbalanced due to the lower efficiency of the Optimus tweeter and lack of suitable crossover. It was, however, apparent that treble quality was clearer with more body.

Alterations to the crossover then ensued and for a time things were fine. In your next Supplement there was mention of the Maplins DR66 active crossover, though. I began to see the light at the end of the tunnel!

An Arcam Alpha 9 power amp was purchased along with the active crossover (a snip at £30). Speaker drive units were wired directly to the amps (the small crossover capacitor having been removed from the tweeters) and, hey presto, my first active system!

Chalk and Cheese is, I think, what they say. All the things which you read about that make the sound life-like and believable were now there - sound staging, timing, clarity of individual instruments and most importantly dynamics; I hadn't realised instruments could stop and start so quickly.

But now to my problem. How do I set the 'speaker crossover point and levels correctly? I am sure I am not a million miles away but I want to get the most out of the system. Is there some sort of test CD that I can use or is it all done by ear?

K. Foster
Wolverhampton.

If you take your time and listen to a wide range of music, you should be able to get quite close to a fairly flat response by ear. Voice recordings can also prove very useful for gauging a loudspeaker's response.

By the way, if you've fixed the Optimus to the top of the 602's cabinet you might be getting problems around the crossover frequency because of the large distance between tweeter and mid/bass unit. Ideally they should be as close together as possible or you can get a lumpy response. Try laying the cabinet on its side and fitting the Optimus on what is now thetop directly above the mid/bass unit. Because the tweeter will then be sitting on a large baffle which will tend to reflect a lot of sound, lay some felt over the upward-facing side of the 'speaker under the tweeter.

If you still think measurement is necessary, you can buy a test disc from Sony (tel: 01932 816000). Unless you're then prepared to spend rather a lot of money on a PC and some software, the next best thing is one of Tandy's little £25 Sound Pressure Level meters on a camera tripod (Tandy, tel: 0500 300666).

A quick and easy way to experiment with home-brew loudspeakers is to use one of Maplin's active crossovers to knit the drive units together.

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You'll need to test the 'speakers individually. Put one of the modded B&Ws on its stand in the middle of a (preferably large) room with the Tandy SPL meter about 1m away. It should be aligned with the horizontal and vertical centres of the two drive units. The crossover frequency of the 602s is normally 3kHz, so set both the crossover dials on the active crossover to this frequency, if you haven't already done so. Set the levels as well.

As the active crossover can't correct rising or falling driver response since it lacks the 'tilt' tone control that Quad's 34, 44 and 66 pre-amplifiers used to have, all you really need worry about is the response around the crossover point and the level-matching between drivers.

Sony sell a range of test discs which contain frequency sweeps from 20Hz to 20kHz and single-frequency tracks too. Information on these can be obtained through Sony service centres, who can order the discs too. You could use the single-frequency tests to get a series of measurements through the SPL meter and plot a graph.

Tweaking the active crossover and then re-measuring each time like this isn't the fastest or most accurate way of doing things but it's certainly a lot cheaper than a Bruel and Kjaer mic and an FFT! JM

CATAPULTING CONES!

It gives me great pleasure to write to you as the magazine that your team creates is an inspiration to a music/hi-fi lover especially if s/he is like myself and interested in DIY.

I'm a student very interested in good sound. My thinking runs along the lines of, "if it's at a good price, where can you go wrong? So I decided to get your DIY kit for the KLS9 'speaker. It has given me great pleasure building the kit and since I do physics in college (I'm especially interested in acoustics) I have learnt a lot.

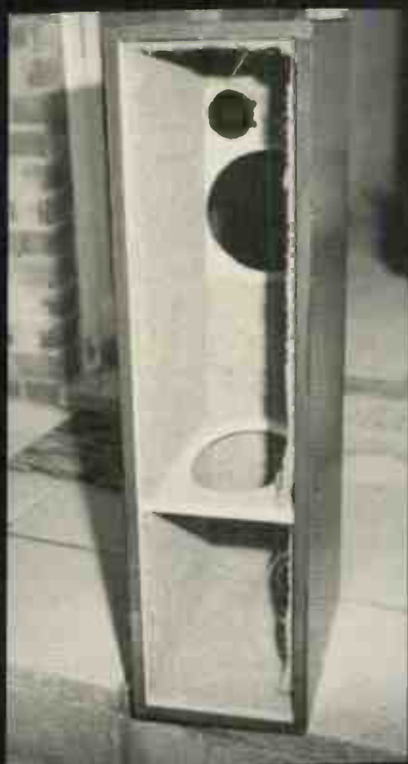
Anyway this brings me to the point of the letter. I have two questions. The first is what to do about the damping of the loudspeaker. Should I put the gauze over the long-haired wool, and should it go over all the panels of the cabinet? I know that there is a large amount of 'try it and see', but if you could give me a couple of basic guidelines I would really appreciate it.

The second question is this. I do like to play music loud every once in a while and this causes problems. The main one is having to get the cones replaced after they go flying across the room. I was wondering why manufacturers don't put fuses in loudspeakers to stop people getting hurt by these projectiles. It would seem a much cheaper solution. If viable, could you tell me what would be the best way to install them.

I would greatly appreciate any advice you can give me.

Dara Scott
dara.scott@ucg.ie

Using gauze to keep long-haired wool in place would be a good move. The wool has a tendency to settle with time, which can produce changes in sound quality - the gauze would stop this. In a reflex-loaded design like KLS9, don't go overboard with the wool; only about 30% of the cabinets' volume should be filled, and that lightly. Obviously a bit of experimentation will be needed before you home in on the most appropriate amount of stuffing.



An internal view of our KLS9 kit loudspeaker. Using gauze glued between side walls to hold long-haired damping wool in place is a sound idea.

Instead of lining the enclosures' inner walls with wool, try 1in. carpet felt instead - this is cheaper and will provide clearer midrange and bass. As above, you might well find you don't need felt on all six surfaces.

Another tip is to buy some self-adhesive felt and stick it to the upper half of the front baffle, having first cut out some holes for the drive units. This sharpens imaging and boosts detail.

If you're turning up your music so loud the cones are flying across the room then you're very likely to be causing permanent damage to your hearing. If you were turning up the bass via injudicious use of tone controls and then cranking the volume towards maximum when running loudspeakers with small mid/bass units, then it's no surprise you were blowing out the drivers - big bass takes big cones. You shouldn't experience flying cones with KLS9's 8in. Aerogel cones.

If a fuse does, however, turn out to be necessary, you could speak to Falcon Acoustics (tel: 01508 578272) about their Polyswitch protection devices. These come in 500mA, 900mA and 1.6A varieties for use on tweeter, midrange and bass respectively. They cost £1.30 each plus £3 P+P. The other option is simply a quick-blow fuse inside the 'speaker cabinet wired into the positive cable of whichever driver is failing. The downside with this approach is that it will most probably have a slight negative affect on sound quality - keeping volume levels down is a more sensible idea. JM

ENGINE TUNING

I was very interested in your article on upgrading Assemblage's DAC-2 and wanted to do the same for my DAC, an Audio Alchemy Decoding Engine V1.1.

I have already replaced the standard unregulated, stand-alone supply with one I made myself. This uses fast diodes, better caps (including bypass caps) and a superior transformer. This has resulted in a much cleaner midrange and a bigger sound stage. The bass extension could be better though - any suggestions?

I am also interested in making further mods to the DAC itself, as per your article on the DAC-2. Since the company is no longer in business I am having great difficulty in getting any schematic information on the unit and do not know where to start as far as the mods go. Should I just try the standard mods (eg, decoupling caps, op amps and regulators) or are there any others I should consider first (like battery power) short of replacing the unit?

Finally, I am using a Rotel transport which I would also like to modify, if you think there are gains to be made.

Salim Jiwa
Surbiton.

Unfortunately Path Premier, who used to import Audio Alchemy's components, no longer do so, nor do they have any schematics. Most of the mods we made to the DAC-2 are applicable to many DACs out there. Local decoupling caps (often 16V 10uF-22uF electrolytics) can be swapped for Sanyo Os-Cons from Audio-Links (tel: 01724 870432).

Audio Alchemy's Digital Decoding Engine DAC can be tweaked in ways similar to those we relied on when modifying The Parts Connection's DAC-2.

As long as you've got a basic understanding of what the various parts of the circuit do and you can measure the DC voltages around the PCB, you could also trace the tracks on the board and find those that supply power to the analogue section. These can then be cut where they join the main regulators (which feed both analogue and digital sections) and hooked up to a completely separate, regulated out-board PSU.

Batteries would work very nicely here. The supply rails will probably be +/- 15V - check this with a multimeter. With a regulator on each rail to maintain the voltage under load you'll need around 18V (three 6V batteries in series) - the inputs on most regs need to be about 2.5V higher than the outputs for the devices to operate correctly.

Putting in more regulators helps too - you could go as far as giving each chip its own regulator. You've got to be careful when doing this, though, as it's easy to make the kind of mistake that'll have your DAC going up in smoke. Solder in a reg, go away and have a cup of tea and come back a while later to check your wiring, otherwise it can be all too easy to miss mistakes.

If you can get the schematics for your transport it's worth performing the same mods on its innards. Better regulation and decoupling will be audible here too. JM

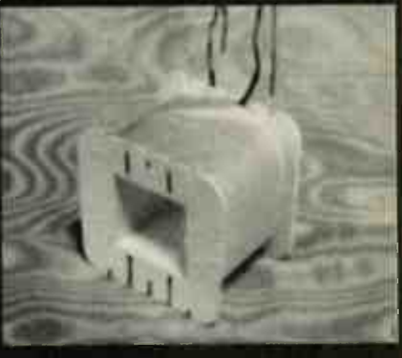
QUESTIONING CABLES

I am puzzled by the fact that quality loudspeaker cables make a large difference to the sound emanating from loudspeakers. Recently I had a friend blind-test me with a budget brand and Nordost Flatline Gold and consistently I was able to spot the superior cable. How can this be so, given that the average inductor found in a crossover may contain 10m-30m of fairly standard copper wire?

I have purchased air-cored inductors from Monacor and, whilst they claim very high purity levels for their inductors, it would seem that this is still a fairly standard design. I had assumed that, no matter how good a specialised 'speaker cable is, its benefits would not be apparent when combined in series with four times its length of 'inferior' cable, yet listening tests seem to negate this. I can only presume that the detrimental effects of the wire are not the same when the wire is wound within its own magnetic field as for an inductor. Otherwise we would find that inductor-grade copper wire (eg, 1.2mm thick single strand) is in fact a very good choice for 'speaker cable and only associated problems with installation prohibits it being a good alternative to the likes of Flatline Gold. Please help me resolve this dilemma, the differences between common sense and observation are driving me nuts!

Jon Lightbourne
jonl2@sdl.ug.eds.com

I think that what you have to remember is that literally every component an electrical music signal passes through has some kind of effect on the final sound quality. An inductor of bog-standard quality will not negate the benefits of a better cable between amp and 'speaker, as you've noticed. There are also inductors out there that sound superior to the ones found in many inexpensive crossovers. And 1.2mm thick single strand can make pretty good loudspeaker cable, as a glance at cables like DNM's Reson will prove. JM



Loudspeaker crossover inductors are just one of many components in the signal path.

SWISS PRECISION

As an impoverished student I have had to collect together my hi-fi equipment from the local newspaper and second-hand shops. My most recent acquisition is a Goldring-Lenco GL75 turntable, bought for the princely sum of £15. The elderly gentleman who sold it to me apologised for the clunking noise it made as the platter turned, explaining that he had played it that way for years and it had not reduced his listening pleasure.

After a swift look under the plinth I realised that he had put the springs on wrongly and the motor was rattling against it. I laughed to myself at the time, but even when I got the turntable home I could still not work out a sane method of arranging these springs. At present I have them set beneath the platter as in the normal arrangement, but nothing is holding them there apart from the force of gravity and the weight of the platter itself.

However, I feel I have more than got my £15 worth. Hi-fi reviewers often talk about the quietness that exists when a top-quality turntable plays a decent hunk of vinyl but I've never truly understood what that meant until now. When I set the GL75's platter moving and placed the arm on the record, I thought at first I had wired it up wrongly, so I pumped up the volume on my Cambridge A&R A60.

I frightened myself, and probably half the neighbourhood, when Sly Dunbar's drums kicked into life, closely followed by Robbie Shakespeare's throbbing from 'Private Life' as Grace Jones's Nightclubbing album began. I was amazed - where was all the noise that my old Dual 505 turntable made? The rumble? The slight hum? Where were the clicks and pops? Gone. Overly-favoured albums which had been loved into wear were made listenable again. It wasn't that the GL75 didn't register the scratches and marks, it's just that the aural picture it offered up was so large and full that it pushed the vinyl's flaws to one side, present but not important. Instruments were full-bodied, voices clear and almost alive.

And yet, despite the wonder of my new bargain, the hi-fi enthusiasts' desire for tweaking and improvement has already begun to kick in - hence my letter. For instance, how exactly are the springs meant to be arranged, and is there any way of improving the arrangement? Also, though the arm supplied with the turntable is adequate, it doesn't track very well, my Shure M75ED failing the most basic tracks on a test record. Is it possible to put another arm on the GL75? A Rega RB300 or a Linn Ittok perhaps, though I note that the hole that the arm goes through on the sub-chassis is rather small.

Other possible improvements that come to mind are improving the phono plugs and leads, changing the mat, adding an off-board power supply and replacing the ancient Shure with something more modern. Would a Goldring 1042 be aiming too high for a machine of the GL75's vintage?

I would be grateful if you could advise me whether any or all of these options would be worthwhile.

Paul Fitzgerald
Birmingham.

Goldring -Lenco's GL75 idler-drive turntable has launched many an aspiring audiophile on their way. For the best performance, make sure the sub-chassis springs are properly set up.

The Goldring -Lenco GL75 is one of those old chestnuts that has started many a hi-fi nut down the rocky road to sonic bliss. Its sound, as you have discovered, can leave many budget decks standing. But as far as tweaking goes, there is a ceiling on what can usefully be done to this turntable before it starts to become uneconomical and ineffective.

The GL75 started life around 1967 when the Swiss company Lenco, in conjunction with Goldring in the UK, put together this 'transcription turntable'. Like the Garrard 301s and 401s of past and current vogue, it used a large AC motor to drive the massive platter, although unusually this was implemented via an adjustable conical spindle. This allowed a wide range of speed adjustment to be made, from 30rpm to 86rpm, and even 15rpm to 18rpm for the old 16 2/3rpm spoken-word records.

The idler wheel drove against the underside of the platter - a possible cause of concern, as this can minutely affect the ride-height of the platter, and therefore influence groove-to-record interaction.

As far as spring set-up is concerned, there were several variations during the production run in the late '60s and early '70s. Best bet here is to check with an exploded diagram (try Technical and General on tel: 01892 654534), which will highlight the correct placement.

The weakest part of the turntable is the arm. The knife-edge pivot bearings are based on rubber which often deteriorates with use and time. The good news is that these bearings are also readily available from Technical and General, as are most other parts for this turntable.

The other option you mentioned, slotting in a new, modern arm, is not an easy task. The battleship-like top-plate will require drilling out to enlarge the arm hole for Linn and Rega tone-arms - not an easy job on 16-gauge steel without access to machine tools! So I'd recommend you restore the existing L75 arm, but by all means try a better cartridge such as the Goldring 1042. I have heard this combination and can vouch that the 1042 is not hampered by that brass armtube. Just make sure, as always, of accurate cartridge geometry to get the best results. AH

DOWN WITH THE BLUES

Hi-fi blues? Me? Once, but not now! I have been interested in hi-fi for four years and have slowly built up a system when funds allowed. I'm sure there are other readers who, like me, have walked into a showroom after standing outside drooling over the latest piece of hi-fi equipment. You go in and the dealers are very helpful and more than happy to demonstrate the kit to you. "How much?!" is your response when they tell you the price. This happened to me in York about two years ago. The sad tale involved a Michell GyroDec - fabulous, but I couldn't afford it, no way.

So, having already made my present pair of 'speakers, I decided to make my own turntable.

I gave Doug Hewett at Manticore a ring. He supplied a Mantra Megabearing with matching spindle, a Revolver drive belt (300mm dia), an old Impex AC synchronous motor (ghostly quiet in operation) with circuit board attached, a bottle of oil for the bearing and a piece of Fibrelam fibre-glass honeycomb for the sub-chassis. I had already bought a second-hand tone-arm, a Linn Basik LVX, from my local dealer for £20. Doug was more than happy to give me the distance from the spindle to the centre of the pillar on the tone-arm to achieve the right alignment geometry.

The finished result is a non-suspended design. The fibrelam sub-chassis is isolated from the 50mm MDF plinth by Target spikes, as is the plinth from the shelf. The platter is three pieces of 8mm perspex glued together to give a platter which is approximately 24mm thick. The motor was isolated on a board made of MDF by four wooden dowels set into PVC brewing tube and placed in holes drilled into the plinth, to stop noise from the motor getting to the tone-arm.

Having finished the turntable, I took it to my dealers to audition it and get their thoughts and advice. We set it up and it sounded great considering it was carrying an ageing Shure M75 ED cartridge (about 20 years old).

So my message to your other readers is to have a go - it's great fun and you end up with a piece of hi-fi equipment that is totally original and sounds great, if you listen to good advice from experienced turntable people. The rest of my system consists of an Arcam Alpha 8 integrated amplifier and an Alpha 9 power bi-amping home-brew 'speakers which use Audax 8in. paper-cone mid/bass drivers and a 25mm soft-dome tweeter which manage to go down to 40Hz in my room.

Nigel Purdy
Suffolk.

Nigel Purdy's system is fronted by his own turntable (bottom picture). At the other end of the line (top picture) sit a pair of home-made floor standing loudspeakers.

Supplement Advertiser's Index

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KIMBER KABLE

Jon Marks plugs into Kimber PowerKords

"When we auditioned mains cable from Moth and DNM back in June, we found really quite slight improvements to our systems's sound, but not so with the 4TCM. Even as I was walking over to our customary listening spot on the sofa, I could hear better bass definition and extension.

"Treble was also sweeter and there was a clarity that allowed the full acoustic through Jamo's Concert 8 stand mounters to provide a large, holographic sound stage.

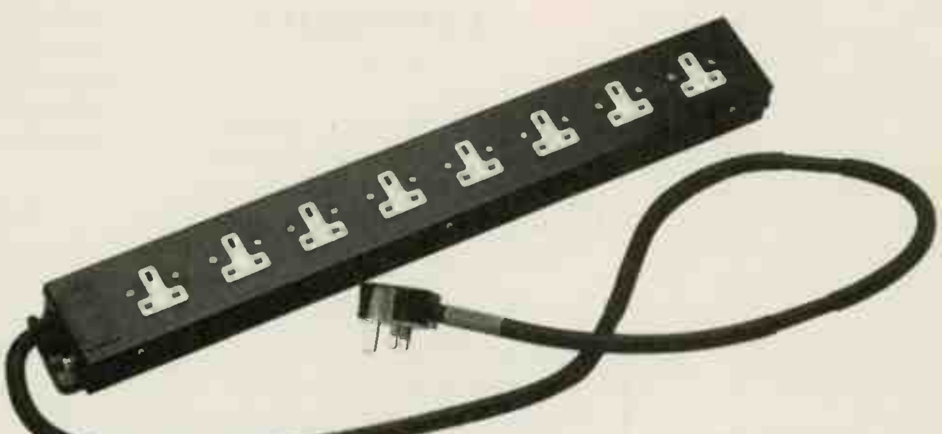
"So far, so good, and £73 very well spent.

"...if you wanted to shake a stick at the rhythm, it would now be the size of a telegraph pole.

"Last was a six-foot 8TCM - Kimber say the longer the better with these cables, as RF attenuation increases with length. Now the music coming from the Concert 8s had an addictively natural, organic feel to it. Switching back to normal leads, the sound was still enjoyable but had a hard mid and treble and soggy bass.

"I only hope Russ doesn't want these back, as they're now taken up permanent residence in our system!"

Jon Marks, Mains Maintance review, Hi-Fi World, Dec 1997



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