FREE GADGETS, GAMES & KITS SUPPLEMENT INSIDE

Hobby Electronics

JULY '81

ISSN 0142-6192

60p

For A Down-To-Earth Approach To Electronics

Burglar Alarm

Protect your home *cheaply* with our ultrasonic system

Guitar Treble Booster

- adds punch to your music
- easily built

Electronic Aids For The Disabled
Special Feature

EXCLUSIVE OFFER!

High-quality Furniture Kits for your Hi-fi

• modular design • low cost - *See inside for details*

JULY 1981
Vol 3 No 9

Hobby Electronics

Editor: Hugh Davies Group Art Editor: Paul Wilson-Patterson BA
Advertisement Manager: Stephen Rowe

PROJECTS

FEATURES

NEWS & INFO

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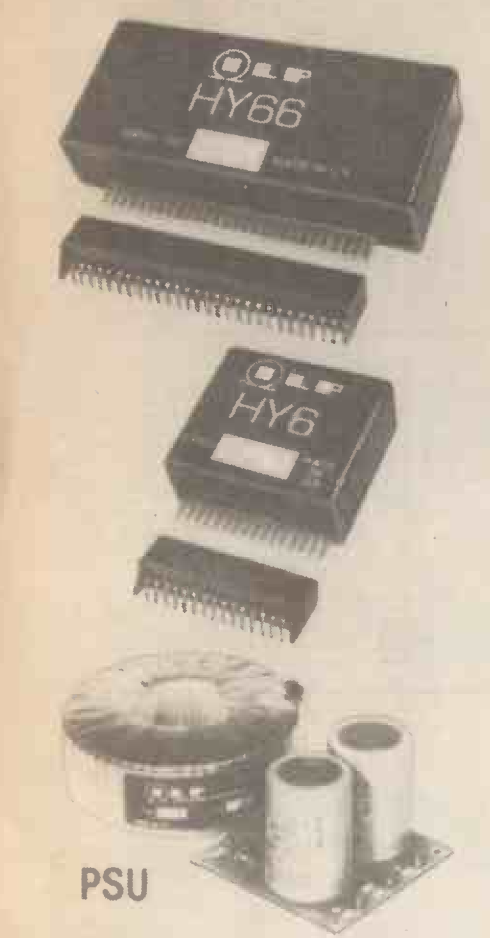


NO QUIBBLE 5 YEAR GUARANTEE
7-DAY DESPATCH ON ALL ORDERS
BRITISH DESIGN AND MANUFACTURE
FREEPOST SERVICE

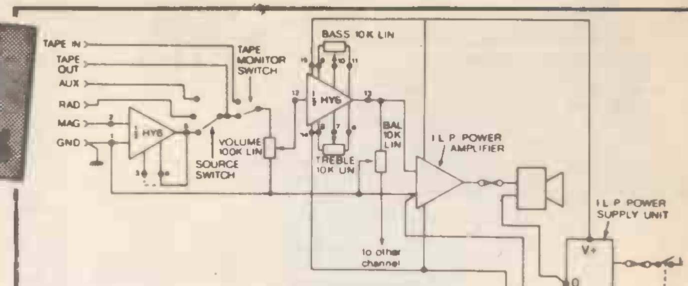
NEW PRE-AMPS

HY6 (mono) and **HY66** (stereo) are new to I.L.P's range of advanced audio modules. Their improved characteristics and styling ensure their being compatible with all I.L.P power-amps both MOSFET and BIPOLAR, giving you chance to get the best possible reproduction from your equipment. HY6 and HY66 pre-amps are protected against short circuit and wrong polarity. Full assembly instructions are provided. Mounting boards are available as below.
Sizes – **HY6** – 45 x 20 x 40 mm. **HY66** – 90 x 20 x 40 mm. Active Tone Control circuits provide ±12dB cut and boost. **Inputs Sensitivity** – Mag. PU. –3mV: Mic – selectable 1-12mV: All others 100mV. **Tape O/P** – 100mV: **Main O/P** – 500mV: **Frequency response** – D.C. to 100KHz – 3dB.

HY6 mono £6.44 + 97p VAT Connectors included
HY66 stereo £12.19 + £1.83 VAT Connectors included

B6 Mounting Board for one HY6 78p + 12p VAT
B66 Mounting Board for one HY66 99p + 15p VAT

COMPATIBLE WITH ALL I.L.P. MODULES



SCHEMATIC BLOCK DIAGRAM OF HY6 PRE-AMP, WITH STEREO CONNECTION SHOWN

- **DISTORTION TYPICALLY 0.005%**
- **S/N RATIO – 90dB (Mag. P.U. – 68 dB)**
- **38 dB overload margin on Mag. P.U.**
- **LATEST DESIGN HIGH QUALITY CONNECTORS**
- **ONLY POTS, SWITCHES AND PLUGS/SOCKETS NEED ADDING**
- **NEEDS ONLY UNREGULATED POWER SUPPLY ±15 to ±60v**

NEW POWER SUPPLY UNITS

IN A RANGE OF 11 MODELS USING LATEST TOROIDAL TRANSFORMERS

Of the eleven power supply units which comprise our current range, nine have toroidal transformers made in our own factory. Thus these I.L.P power supply units are space-saving, more efficient and their better overall design helps enormously when assembly building. All models in the range are compatible with all I.L.P amps and pre-amps with types to match whatever I.L.P power amps you choose.

PSU30 ± 15V at 100mA to drive up to 12 x HY6 or 6 x HY66	£4.50 + 0.68p VAT
● *THE FOLLOWING WILL ALSO DRIVE I.L.P PRE-AMPS*	
PSU36 for use with 1 or 2 HY30's	£8.10 + £1.22 VAT
● *ALL THE FOLLOWING USE TOROIDAL TRANSFORMERS*	
PSU50 for use with 1 or 2 HY60's	£10.94 + £1.64 VAT
PSU60 for use with 1 HY120	£13.04 + £1.96 VAT
PSU65 for use with 1 MOS120	£13.32 + £2.00 VAT
PSU70 for use with 1 or 2 HY120's	£15.92 + £2.39 VAT
PSU75 for use with 1 or 2 **MOS120**	£16.20 + £2.43 VAT
PSU90 for use with 1 HY200	£16.20 + £2.43 VAT
PSU95 for use with 1 **MOS200**	£16.32 + £2.45 VAT
PSU180 for use with 1 HY400 or 2 HY200	£21.34 + £3.20 VAT
PSU185 for use with 1 or 2 **MOS200**	£21.46 + £3.22 VAT

We want to know

We have always maintained good working relations with our customers, and therein lies a large measure of the company's success and growth. Now that we are running our most exciting programme yet, we would like to have your comments about our current products and any others you would like to see coming from I.L.P. Send us your letter (with your age, job, etc., if you don't mind) to: Customer Liaison, I.L.P. Electronics Ltd., FREEPOST, Roper Close, Canterbury CT2 7EP (No stamp required).

★ **Freepost facility**
When ordering or writing about I.L.P products, you do not need to stamp the envelope. Mark it FREEPOST plus the code shown in the address below. We pay the postage for you.

★ **TO ORDER** Send cheque or money order payable to I.L.P Electronics Ltd and crossed. Or pay by ACCESS or BARCLAYCARD. Cash payments must be in registered envelope; if C.O.D. payment is wanted, please add £1.00 to TOTAL value of order.

★ Now turn to page six for our ad. on a bigger than ever range of transformers.

I.L.P ELECTRONICS LTD.
FREE POST 6 Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP.
Telephone (0227) 54778 [Technical (0227) 64723] Telex 965780
Available also from MARSHALLS, WATFORD ELECTRONICS and certain other selected retailers

BRITAIN'S FOREMOST QUALITY MODULE SUPPLIERS

To: I.L.P ELECTRONICS LTD. CANTERBURY CT2 7EP
Please supply ....
.... Total purchase price £ ....
I enclose Cheque ☐ Postal Orders ☐ International Money Order ☐
Please debit my Access/Barclaycard Account No. ....
....
NAME ....
ADDRESS ....
....
Signature ....

ALL U.K. ORDERS DESPATCHED POST FREE

MONITOR

Pele Kicks Off TV Football Game

Thursday 30th April saw the public launch of Atari's new football games cartridge for the Atari Video Computer — Pele's Championship Soccer. The game, for one or two players, is personally endorsed by the brilliant Brazilian footballer, Pele, who flew into London the day before the launch.

Pele spent a hectic five days in the capital, signing autographs and at the mercy of press, radio and television journalists.

As yet we haven't managed to get our hands (or should we say feet?) on a games cartridge for more than just a few minutes, but we hope to review it in next month's Gadgets, Games & Kits supplement. Suggested retail price of the cartridge is £29.95 including VAT.

Also released by Atari were two other games cartridges — Video Pinball and Othello. Suggested retail price of these games is £23.95 including VAT.

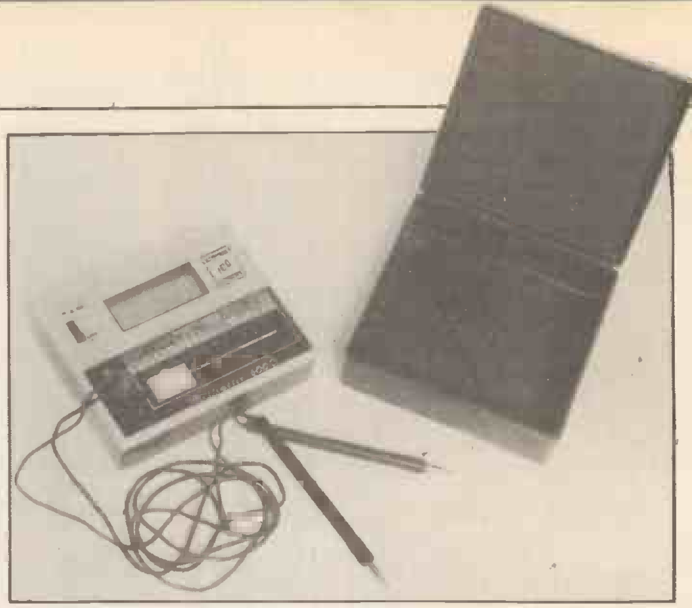
Budget Toroids

Cotswold Electronics is offering a 'budget range' of toroidal transformers for use by professional and do-it-yourself enthusiasts in 30, 60, 100, 160, 230, 330 and 530 VA sizes at prices ranging from £4.55 to £15.80.

All types are normally supplied with 240, 110 or 220 V primary windings, but special windings can be supplied on request.

Toroids have some significant advantages over traditional stacked-laminate types. They are, for instance, about 50% lighter and have 50% lower volume because they are more efficient. Unlike laminated types toroids have no air gap, and thus have less reluctance (magnetic resistance) and less magnetic radiation. The low height profile of toroids makes them suitable for use in slim-line equipment.

More details are available from Cotswold Electronics Ltd, Unit T1, Kingsville Road, Kingsditch Trading Estate, Cheltenham GL51 9NX (tel 0242 41313).



Digital Multimeter — Introductory Offer

Danesbury Marketing is offering a pocket-sized digital multimeter at a special introductory price of £49.95 for orders of one to four, or £47.45 for orders of five to nine. These prices include VAT and carriage in the UK.

The meter, model DMM 600D, has a liquid crystal display (LCD) with 3½ characters 13 mm high. It has 21 ranges, covering DC voltage and current, AC voltage and current, resistance and a diode check facility. Accuracy on the DC voltage and resistance ranges is claimed to be 0.5%.

A brief specification is as follows:

DC voltage	1 mV to 1000 V
DC current	1 uA to 1 A
AC voltage	1 mV to 500 V
AC current	1 uA to 1 A
Resistance	1R to 20 M

Overall size of the meter is 105 mm by 85 mm by 32 mm, and it comes complete with a moulded carrying case 109 mm by 110 mm by 37 mm, test leads and a handbook.

Danesbury Marketing Ltd, 22 Parkway, Welwyn Garden City, Herts AL8 6HG (tel 07073 29112).

New Source Of Electronic Components

RKS Electronics, which came into operation in the last couple of months, aims to cut the cost of electronic components by means of low overheads.

Kelvin Whittaker, who runs RKS Electronics, claims that every order will be sent by return of post, first class, and orders should be received within three days of dispatch.

Whittaker told HE that he had been planning this venture for two years. Because of where he is situated in Dorset, he has sought, and is still waiting for, assistance from COSIRA (Council for Small Industries in Rural Areas).

At present he offers only a mail order service but he hopes to add a counter service later. Similar expansion is planned for his catalogue, which at present spans only a small selection of popular components for the hobbyist.

Apart from electronic components, Whittaker offers an express PCB drilling service (0.9p/hole for 18p/board postage, additional boards 4p postage).

Send a stamped-addressed envelope for the catalogue and further details to K Whittaker, RKS Electronics, 13 Queens Terrace, Sherborne, Dorset DT9 4ED (tel 093581 2488).

G8EOP Petition

We received details of a petition, organised by Melvyn Jackson (G8EOP) in the wake of the recent proposals for a UK citizens' band.

The petition sets out 'slight modifications to the radio ham licence', as follows:

- The use of CW by class B radio hams receiving and sending as part of the self-training in *communication* by CW on VHF bands
- Limited use of station *under supervision* (eg, jamboree on air, radio conventions, radio clubs, SWLs, XYLs, YLs, etc)
- The 27 and 930 MHz CB bands to be used by radio hams on existing licence at no extra fee and not with type-approved rigs
- The 10 and 4 m ham bands to extend to class B radio hams (eg, the 10 m band *not taken over* by *CB* to be used by licensed radio hams).

The petition, signed by Melvyn Jackson, G8EAH, G8PSE, G8WWE, G3LHQ, G4LED and '460 others' also invites any club requiring a copy of the signature sheet to send a stamped addressed envelope to M Jackson, 17 Bywell Road, Dewsbury, West Yorkshire ZN2 2C (tel 0924 463850).

Hi-fi ICE From Blaupunkt

Latest addition to Blaupunkt's ICE (in-car entertainment) range is a three-way hi-fi sound component system.

Four slim-line speakers are used for each channel of this system to allow greater flexibility in fitting to individual makes of car and for the best sound radiation (particularly from the tweeter).

The system consists of the following:

- two woofers, each 100 mm by 100 mm, installation depth 45 mm and linear frequency response 40 to 600 Hz
- one mid-range speaker, 85 mm by 85 mm, installation depth 33 mm and linear frequency response 600 Hz to 4 kHz
- one tweeter, 42 mm radius, installation depth 23 mm and linear frequency response 4 to 20 kHz
- a three-way divider.

The system conforms with the DIN hi-fi standard 45,500 and has 60 W/channel music power handling capability.

Price of the system (eight speakers and two divider units) is £90.85 including VAT.

For those preferring a four-channel installation in their car, Blaupunkt has recently introduced an equaliser on a flexible stalk. This gadget has slide controls and two illuminated VU meters. It costs £79.35 including VAT.

The four channel booster amplifier (4 x 20 W), model 7 607 367 111, which goes with the equaliser will set you back another £79.35 including VAT.

HE was given a demonstration of all the above items fitted in a Ford Cortina. One of Blaupunkt's Bamberg QTS CR receivers was fitted in the dash and the sound, coming from the front door panels and from the rear parcel shelf, was very impressive. The equaliser stalk sprouted close to the steering column.

If you're interested in the whole system described above, start saving (the Bamberg QTS CR costs £517.50 including VAT). Alternatively, you could opt, for example, just for the speakers.

Details from Robert Bosch Ltd, PO Box 166, Rhodes Way, Watford, Herts WD2 4LB (tel 92 44233).

Response To Club Call

In response to our Put Your Club On The Map invitation in Monitor in the May '81 issue of HE, we are starting to receive details of a variety of clubs. Details of one are given below.

This could be an opportunity to increase your membership: send us details of your club and of any coming events likely to be of interest to HE readers.

ZX Guaranteed

Recently we received details of a new club called ZX Guaranteed, which could be of interest to owners of Sinclair ZX80 microcomputers (and possibly ZX81 owners in the future).

We looked at a copy of the club newsletter, also titled ZX Guaranteed and printed quarterly. It contained six programs for the ZX80 which, according to G A Bobker, who runs the club, *are guaranteed to work*.

Membership stood at 27 when we received the information but the classified advertisement placed in the June '81 issue of HE could well have increased this.

Membership costs £5 a year. Contact G A Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

Easi-Grip Lightweight Handtools

A set of miniature handtools, designed for use in electronics and fine modelling, have been introduced by Tele-Production Tools.

The set comprises miniature carbon steel side cutters, fine-nosed stainless steel tweezer-pliers and a serrated stainless steel scissor-shear for light cutting work.

Each tool is fitted with what are described as 'ergonomically-styled self-opening handles', intended for fingertip operation. The handles are held in the open position by means of a plastic strip linking the ends of the handles. Average weight of each tool is only 40 g.

Cost of each tool is £3.75 or £10 for the set of three (these prices inlcude post, packing and VAT).

Also available is the K-40 plastic lockable tweezer-plier, moulded in glass-filled propylene and incorporating self-locking handles. This locking facility enables the serrated jaws to grip and hold objects up to 7 mm wide.

The K-40 costs £1.44 including post and VAT.

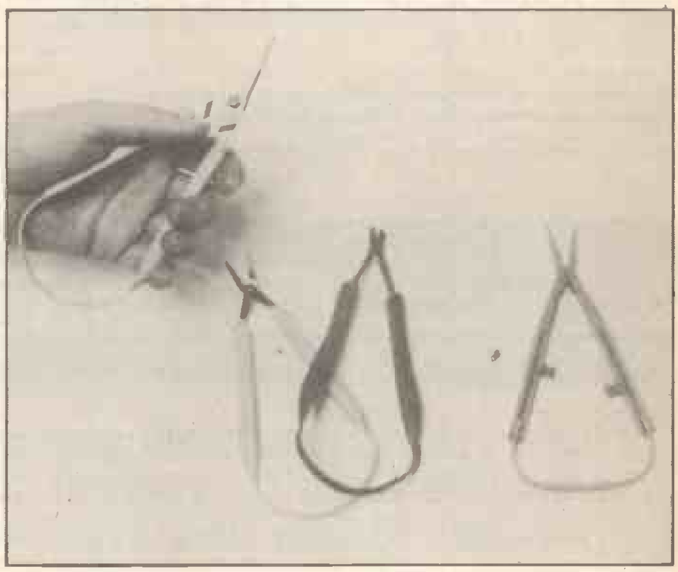
We tested all the above tools and found them to be good value for money.

The side cutters had a novel feature: if you tried to cut a wire which was beyond the capability of the cutters then the flexible handles simply bowed under the applied pressure.

The tweezer-pliers proved to be fine for holding small components and for tightening small nuts, while the shears were sharp enough to nibble through a piece of Veroboard without cracking it.

We found the K-40 lockable tweezer-plier particularly useful because, as claimed by the supplier, it will even grip and hold a human hair.

All these products are available from Tele-Production Tools Limited, Stiron House, Electric Avenue, Westcliff-on-Sea, Essex SS0 9NW (tel 0702 352719).



Electronic Aids For The Handicapped Child

On Thursday 25th June 1981 an intensive day course, covering a broad range of technical aids, equipment and techniques developed for physically and mentally handicapped children, will be run at St Josephs' College, Lawrence Street, Mill Hill, London N7.

The course, starting around 10 am, will include a small exhibition of aids, including a special display of microcomputers. Although of particular interest to specialists and professional people, anybody who would like some insight into these developments will be welcome. Relatives of handicapped children are especially welcome.

This course will cover some of the subjects discussed in Electronic Aids For The Disabled, this month's special feature on page 15.

Nearest underground station is Burnt Oak (Northern Line), then take a 251 bus to the college. By road, the college is 500 m north of Mill Hill roundabout (Watford Way). An access map will be sent to all who register.

The fee is £7 to professionals or £6 to relatives of handicapped people and non-professionals. Fees must be paid in advance to Castle Priory College, Thames Street, Wallingford, Oxfordshire OX10 0HE (tel 0491 37551). Cheques should be made payable to Castle Priory College.

Although tea and coffee are provided, those attending must bring their own packed lunch.

Hobby Electronics

RPM METER

Anywhere or anytime you need a reading of the revolutionary speed of a motor, shaft, oscillation etc, consider our revs-per-minute-meter project featured next month. This ingenious device is battery-powered, making it an ideal hand-held meter which measures rotational speed within the range 300-30,000 RPM.

RADIO CONTROL

The first radio-controlled model aircraft were developed well before the Second World War. Today, radio-controlled modelling has become a hobby shared by thousands of enthusiasts throughout the world. Guest writer Peter Christy traces the history of radio control and outlines some of the technological advances in the equipment. He also gives some advice on how to get started in the hobby, the choice of equipment . . . and the likely cost.

ELECTRONIC CAR IGNITION

With the HE Electronic Ignition project next month you'll be able to get better performance and greater fuel economy from your car than with its conventional ignition system. The HE Electronic Ignition is a transistor-assisted, capacitive discharge system which virtually eliminates points-wear and allows more healthy and dependable sparks to be generated at the plugs.

This project doesn't cost the earth and is simple-to-build. With the current high fuel prices the chances are that it will pay for itself very quickly. Can you afford not to build it?

POWER SUPPLY

Of all the pieces of equipment that you're ever likely to need in your hobby a power supply unit is, arguably, the most important. If you are going to build your own, it needs to be rugged, cheap, reliable and easy-to-build. Next month we give details of a power supply which is all these things and more.

Output voltage is fully adjustable from about 1 V up to 15 VDC and it is capable of supplying currents of over an amp. A complete kit of parts will be available for this superb project.

Items mentioned here are those planned, but unforeseen circumstances may affect the actual contents

PUSHBUTTON CONSO TELEPHONE

This is a superbly styled, one-pice, very compact push button telephone with last-number re-dial facility (on pressing one button it will redial the last number you dialled). A special MUTE Button enables you to talk at your end without the other party hearing you. The electronic buzzer can be switched on or off.

£23.95 + £1.95 P&P

DUAL TIME MUSICAL ALARM CHRONOGRAPH

Continuously displays hours, mins., secs., day of the week, AM/PM indicator and alarm-on indicator – 1/10th sec. chronograph with lap time facility. Alarm plays "YELLOW ROSE OF TEXAS." Comes with a fully adjustable stainless steel matching bracelet. (Chrome colour).

£12.95 LM101 +50p P&P

SLIM PENDANT WATCH

This watch is beautifully designed as a slim pendant and comes complete with a 26in. long neck chain. The functions include: hours, minutes, seconds, day, month and 4-year auto calendar. Comes in gold colour and is ideal for day and night wear.

£6.95 + 50p P&P

SOUND-A-ROUND STEREO PLAYER

You can enjoy a very high-quality perfect stereo wherever you go or whatever you are doing. This very high quality stereo player comes complete with a carrying case, a set of super sensitive extremely lightweight headphones and a demonstration cassette. A very special feature is the 'HOT LINE,' this enables you to hear what is going on around you through a built-in microphone. It has a socket for additional headphones.

£44.95 + £1.95 P&P
Extra headphones
£7.95 + 75p P&P

COMPUPHONE LAMBDA 738

This is the most advanced computerised telephone on the market. It has a built-in calculator, clock with seven alarms, a stop watch/timer, 28 memories to store most frequently used telephone numbers, automatic dialling of pre-programmed number, automatic re-dial with repeat dialling at short intervals until the other party answers, a one-way speaker enables you to monitor the line. Push-button dialling, built-in telephone index and lots of other features. It is being sold in Exchange and Mart at £150.00, but we are offering it at a very special price.

£89.95 + £2.90 P&P

FLIP CALLER PUSHBOTTON TELEPHONE

This is a very compact beautifully designed, high technology digital telephone. It has last number re-dial facility at the touch of a button. The folding part directs the sound into a built-in microphone during use, and protects they keys when not in use.

£23.95 + £1.95 P&P

DUAL MELODY WORLD TIMER

At a touch of a button it displays time anywhere in the world, with geographical position indicated by flashing that zone on the world map.

It has two alarms, a home time alarm and a world time alarm, each play different melody for approx. 30 secs. It also has song demonstration facility.

£24.95 + 75p P&P

LADY'S SUGAR COATED WATCH

Lady's 9-function LCD watch. Hours, minutes, seconds, month, date, backlight, auto date/time display mode. 4-year auto calender. This watch has an optional auto date/time display mode. In this mode, time and date is alternatively displayed every 2 seconds. (Chrome or gold).

£5.95 + 50p P&P

HANDHELD SPACE INVADERS

A superb game, provides endless fun for children and adults alike. (WARNING – THIS GAME CAN SERIOUSLY EFFECT YOUR PAST-TIME). It gives you 90 seconds to hit enemy craft. The elapsing time and 4 digit score is constantly displayed. Score is decremented if you hit a friendly ship or if enemy missile penetrates your defence.

£10.95 + 75p P&P

DUAL TIME COUNT DOWN ALARM CHRONOGRAPH

This superb watch has all the features one would ever need. It has selectable 12/24-hr. display count-down timer/alarm dual-time zone, chronograph with lap time facility, 24-hr. alarm with 5 min. snooze facility, back light fully adjustable stainless steel bracelet and we are offering it at our incredibly low price.

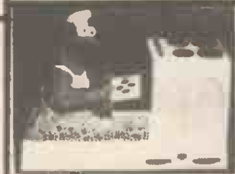
£8.95 + 50p P&P

6-DIGIT LADY'S SNOOZE ALARM

This is a very good value for money, it has large easy to read 6-digit display and shows hours, minutes and seconds, pressing a button it shows date, month, and day of the week, the 24-hour alarm has 5 min. snooze facility. It has a fully-adjustable bracelet and a backlight. (Gold colour).

£7.95 + 50p P&P

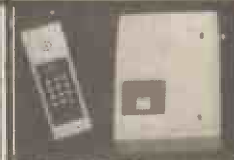
COOKIE MONSTER ALARM CLOCK RADIO



This is an ideal gift for young children, it has a top quality wind-up clock movement with sweep second hand. Wake to radio or buzzer alarm. Radio uses 4 penlite batteries and has rotary tuning and volume controls.

£10.95 + £1.25 P&P

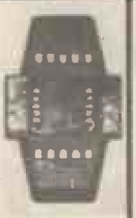
ALCOM CORDLESS TELEPHONE



This telephone system gives you freedom from the desk, the base station connects to your telephone line, the remote hand set can be carried in own case with shoulder strap or clips to your belt. You can receive calls or make calls from within a radius of ¼-mile from base station. The hand set has push-button dialling with last number re-dial facility and has rechargeable batteries. The batteries are charged when plugged into base station. It is being sold elsewhere for £169.00, we are offering it at a very low price.

£139.95 + £2.90 P&P

GALAXY GAME II



This hand-held computerised game unit has three different games, and allows one or two players to play at two skill levels (slow and fast). A two-digit display shows the score.

The three games are:
1. CROSS FIRE
2. PASS THROUGH
3. FOLLOW ME

£10.95 + 75p P&P

ELECTRONIC LIGHTERS

Beautifully styled lighters for gentlemen and ladies. No need to change flint or put in new batteries. Battery-operated models also available if required (please specify). These lighters come in attractive presentation cases and are ideal gifts.

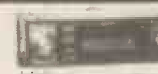
£4.50 +50p P&P

SUPER SLIM PEN WATCH

Beautifully-styled super slim stainless steel ballpoint pen (replaceable refill) combined, with precision quartz timepiece, normal display is, hours and minutes with flashing colon, date and month and second, can be displayed by pressing a button, 4-year auto calendar. It comes in a very neat presentation case. Our price

£8.95 + 50p P&P

CAR STEREO PLAYER WITH AM/FM-MPX RADIO



This compact, quality product is designed to provide you with exceptional listening pleasure. The features include: AM/FM dial-in-door, local/distance attenuator switch for better stereo reception, AM/FM indicator, FM stereo indicator. Fast forward and eject button for cassette, balance, volume and tone controls. 7-watts per channel output.

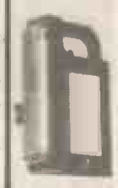
£29.95 + £1.90 P&P
Suitable speakers £5 per pair + 95p P&P

STAR CODE 10 WALKIE TALKIES

Made by GENERAL ELECTRIC COMPANY use 49MHz AM (Crystal controlled – single channel). The other features include: STAR CODE signal key for sending morse code messages (range approx. ¼-mile).
Combination speaker/mic. (range approx. ⅛-mile).
S.A.E. for details.

£23.95 + £1.95 P&P

FLUORESCENT PORTABLE LIGHT



A very useful battery-operated high-power fluorescent light for use in the car or for camping. Uses 8 'D' size cells and it has a socket for 12V DC input for use in the car. Power consumption is 6 watts. New circuit makes batteries last longer.

£4.95 +95p P&P

FM WIRELESS MICROPHONE

This high quality Electret microphone can be tuned to transmit in the range 85-95MHz FM. It can be received on any FM receiver, the range depends on the sensitivity of the receiver. Uses one penlight battery which fits inside the microphone. Ideal for parties, discos and clubs.

£8.95 + 50p P&P

SMOKE DETECTOR FIRE ALARM

Statistics show that it is not the fire that kills, it is the toxic fumes before the flames which are the killers. This early warning smoke detector can detect the fire at its early stages, and give those extra vital minutes to save life. At our offer price you could put one in each room. If you buy four, we will give you one free. Each unit comes complete with a battery. (Please note that all units are tested before despatch in case of malfunction, our liability is limited to the replacement of alarm unit).

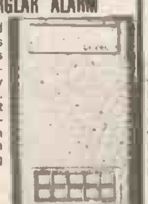
£8.95 + 75p P&P
(P&P for than one unit is £1.50)

NENTONE WALKIE TALKIES

These impressively designed Walkie Talkies are very good value for money. These have built-in morse-code button, volume control, telescopic antenna, belt clip, transmit receive indicator, 49 MHZ AM crystal controlled transreceiver. The effective range for morse code is approx. ¼-mile and for speech approx. ⅛-mile. Use standard PP3 type battery.

£18.95 + £1.95 P&P

32 TUNES DOORCHIME/BURGLAR ALARM



This doorchime is powered from 9V d.c. source, and has battery back-up facility. It has an automatic tune advance facility and single or dual play options at 3 selectable speeds. A built-in burglar alarm circuit allows construction of a NORMALLY CLOSED alarm system. two bell pushes can be connected, each playing different tunes.

£9.95 + 95p P&P

THREE-IN-ONE FLUORESCENT

This very compact unit is a torch, a portable fluorescent light and a hazzard flashing amber light, all built into one neat case. It comes complete with a shoulder strap to allow both hands to be free. Ideal for campers, hikers and motorists. Runs on six 'C' size batteries.

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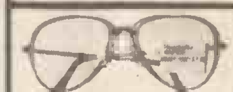

These photochromatic sunglasses get darker as the sun gets brighter, and are crystal clear in the shade. These are available in strong metal frames in silver, gold or black colour. These come complete with a simulated leather carrying case. The suggested retail price is £12.95, but we are offering them at a very special price of

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'Sunsitive' Photochromatic sunglasses
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You can buy this AM/FM Headphone radio for the price of just headphones. Runs off a single PP3 battery, has a volume control and a telescopic aerial for FM waveband. The ideal gift for youngsters.

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LIGHTWEIGHT HIGH QUALITY STEREO HEADPHONES

This is a very high quality stereo headphone, to minimise the size and weight it uses Samarium cobalt magnet and a sensitive polyester film vibrator unit enables very stable Hi-Fi stereo sound, with minimum distortion. The frequency range is 20-20,000Hz, impedance 32 ohms, sensitivity 98 db/mw, maximum input power 100mw, weight 40 gms (excluding cord).

£7.95 + 25p P&P

CAR ELECTRIC AERIAL

Add a little luxury to your car by installing this motorised car aerial. Can be installed in any car or truck with 12V supply. It is an excellent value for money and is an ideal gift.

£8.95 + £1.25 P&P

QUARTZ TRAVEL ALARM CLOCK

This is a very versatile alarm clock, you can use it in the car, in the kitchen or as a desk top clock. Large (1cm character size) display makes it easy to read from a distance. It has 4-year auto calendar, backlight, AM/PM indicator and alarm on indicator.

£7.95 + 75p P&P

TALKING ALARM CLOCK/STOPWATCH

This 'Sharp' Talking Clock is a 'state-of-the-art' product. On pressing the button it announces the time. At the preset alarm time a musical alarm is played and again the time is announced. It has 5 mins. snooze facility. Also has a useful timer and speaks time elapsed every 1 min., 5 mins. or 30 mins., whichever is selected in the stop watch mode it announces the elapsed time at preset intervals or on pressing of a button at any time it is an ideal gift, especially useful for blind people. Overall size is 11.4 x 6 x 2.2cms.

£39.95 + £1.95 P&P

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Lady's 9-Function Dress Watch	£4.95 + 50p P&P
Lady's 4-Function Dress Watch	£3.95 + 50p P&P
Gent's 5-Function Watch	£3.95 + 50p P&P
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Ultrasound Burglar Alarm

Protect your valuables with an invisible net of doppler ultrasound

IF YOU WANT to protect the family heirlooms or just keep prying fingers off your back issues of 'Hobby' then this is the project for you. The HE Ultrasound Alarm runs off a single 9 V battery and uses only three chips and a handful of other components. It's quick to build and easy to set up, offering good sensitivity and a choice of operating modes.

Shifty Sounds

The alarm works on the doppler shift principle. Sounds complicated doesn't it? But it's really quite simple. The pitch of a moving sound source will seem to be higher then lower as the source moves toward then away from a stationary observer. This change in frequency is called the doppler shift. The effect is often heard in daily life as a jet screams overhead or a police car whizzes by. Of course, your average burglar isn't going to visit in a jet or a police car so how does doppler ultrasound catch a thief?

Since the burglar moves with silent stealth we have to make the noise ourselves and the circuit generates and transmits a beam of sound which fills the room. Of course, at 40 kHz you would need supersonic ears to hear it. So long as the sound waves bounce off stationary objects the frequency remains unchanged and the alarm silent. However, when an intruder enters the sonic field the sound waves strike his moving limbs and the doppler effect produces reflected sounds shifted by a few tens of Hertz (cycles per second) from the original transmitted signal. We can detect those small changes in frequency by mixing the reflected sound and the original to produce a beat note. The beat note (the fancy name is 'heterodyne'), appears as a low-frequency envelope modulation of the ultrasonic carrier wave and we can detect it with a diode rectifier and low-pass filter in just the same way that an audio signal is detected in a radio receiver. The low-frequency signal can then be amplified and rectified and used to drive a relay, bell or tactical nuclear weapon.

Construction

Build-up the printed circuit board (PCB) as shown in Fig.2. Insert and solder in all low-profile components first (eg, resistors, diodes, IC sockets and preset resistors). Make sure the diodes are the right way round.

Use PCB pins where the 11 off-board connections are to be made.

Next, insert the remainder of the components to be soldered; capacitors and transistors — noting the correct polarity where appropriate.

Push-fit the ICs into their sockets, aligning the dot or notch on top of each IC with the notch shown in the overlay in Fig.2.

Now, mark and drill the case for the six, 4 mm sockets and switch SW1 (in the back panel) and the two ultrasonic transducers (in the front panel) and fit them in. The holes for the transducers should be ⅜" (9 mm). Glue the transducers to the inside of the panel behind the two holes. Their bodies should be electrically isolated so check that the layers of glue you use to hold the transducers to the panel also provide insulation.

Finally, wire-up your project as Fig.2 shows. Use screened cable to connect the receiving transducer (40R) and make sure that the lead which is soldered to the body of the transducer connects to the earthed screen of the cable.

Tuning Up

Sensitivity can be controlled by adjustment of RV2 which alters the gain of the low-frequency amplifier.

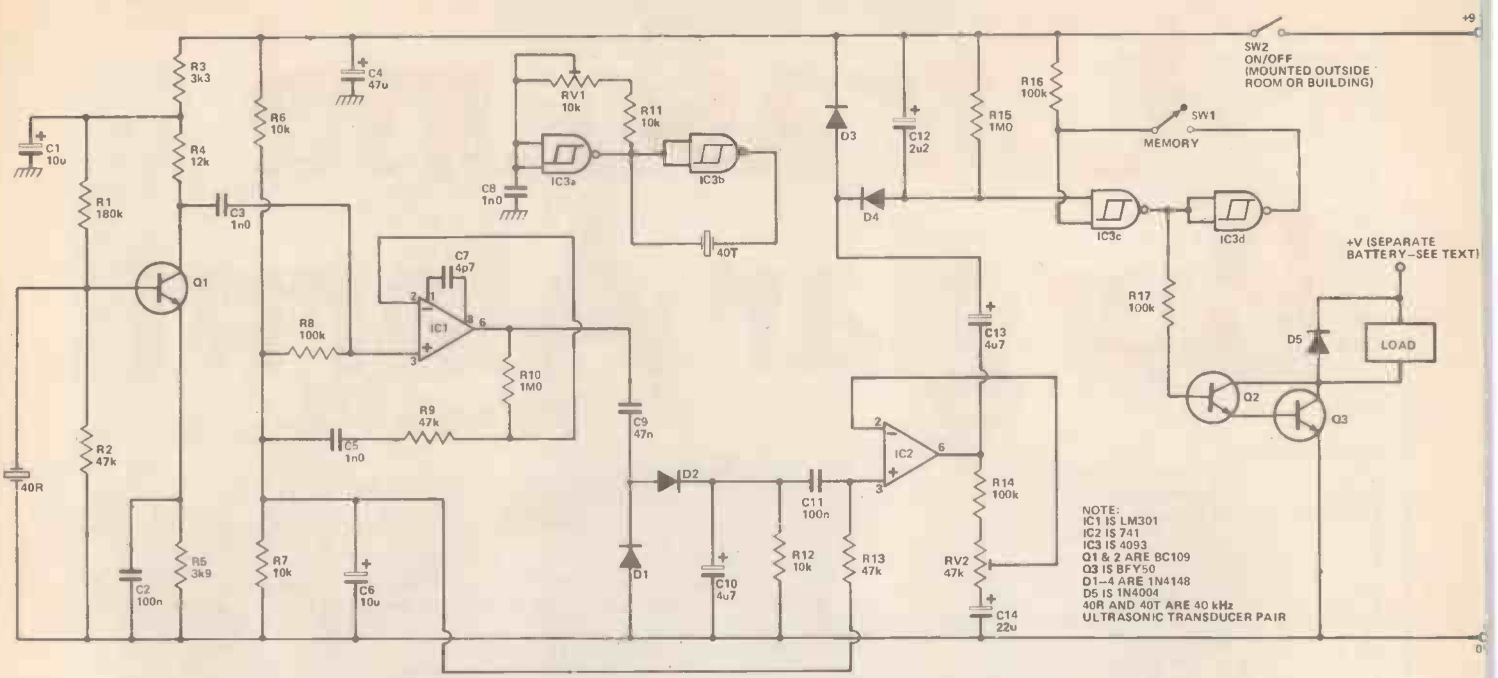


Figure 1. Circuit of the HE Ultrasound Burglar Alarm

However, the circuit is at its most sensitive when the detector is just not quite saturated. The transmitted and reflected signals mix in the receiving transducer and ultimately drive the relay. If the transmitted signal is too strong then IC1 will clip the signal, C10 will charge up to a maximum and the low-frequency envelope will be 'sliced off'. We overcome this problem not by controlling the amplitude of the transmitted signal but its frequency. As we tune the transmitter away from 40 kHz the efficiency of the transducers is reduced and IC1 and the detector will operate in a linear region. In practice this means adjusting RV1 by trial and error or connecting a voltmeter across C10 and adjusting RV1 for a reading of about 3.5 V. The optimum setting for RV1 will depend on the siting of the HE Ultrasound Alarm, in the area to be protected.

Ultrasound is quite directional but will readily bounce off walls and ceiling. Greatest range will be obtained in sparsely furnished rooms (put your valuables in the bathroom) as soft furnishings, curtains and carpets tend to absorb the ultrasound. Remember that the circuit will detect anything moving and that means people, curtains or even hot air from a radiator or air conditioner.

A switch is included to latch the output. This means that you can select either *unlatched:* alarm triggered during the period of detected movement or *latched:* continuous alarm from the moment of detection.

On/off switch SW2 can be any commonly available switch and it should be mounted outside the room which the alarm is protecting. That way you can switch off the alarm before you trigger it by walking into the room. If you do select a tactical nuclear weapon in favour of a bell, use cheap components . . . you'll only need them once.

Other uses for the HE Ultrasound Alarm:

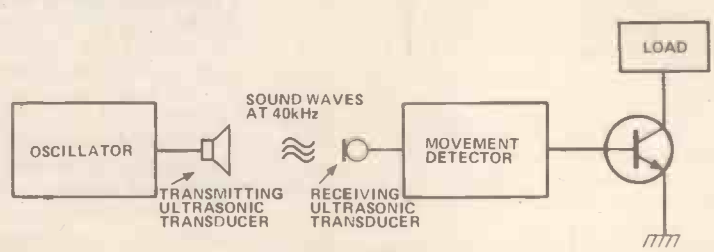
- Annunciator — it will keep an 'ear' open for you in unattended reception areas, shops, etc.
- Detector/counter — linked to a counting device (electro-mechanical or electronic) it will log moving objects such as people, vehicles, dogs, cats, flying saucers, etc.

An ideal audio alarm for use with the HE Ultrasound Alarm is the Super Siren, described in the April '81 issue of HE, pp 25-27. This will produce an ear-splitting noise of your choice when the ultrasound circuit is triggered.

How It Works

Ultrasound Burglar Alarm consists of two main parts:

- **A multivibrator oscillator which produces a 40 kHz squarwave transmitted by an ultrasonic transducer.**
- **A receiver which detects change in the received ultrasonic waves due to any movement of an object within the sound field. This movement detector triggers a transistor which activates the load. The load may be a relay or an alarm etc.**



The ultrasonic signal is generated by an oscillator built around IC3a. Frequency is set by adjustment of RV1 and inverter IC3b provides an anti-phase drive to the ultrasonic transmitter.

The signal from the receiver transducer is amplified by Q1 and IC1. Resistor R1 shunts the transducer, giving it a less 'peaky' response. Integrated circuit IC1 is configured as a non-inverting amplifier with a gain of about 50. The output from this chip is rectified by D1 and D2 and smoothed by C10 and R12. The combination of C11 and R13 acts as a high-pass filter, transmitting the signals caused by human movement but rejecting the very low frequency signals from moving air currents. Amplified by IC2 and smoothed by C12, the signals trigger IC3c and turn on Q2 and Q3 thus energising the load. When there is no signal C12 will discharge through R15 and the load will de-energise. However, the circuit can be latched by closing SW1.

Parts List

RESISTORS (All ¼ W, 5%)

R1	180k
R2,9,13	47k
R3	3k3
R4	12k
R5	3k9
R6,7,11,12	10k
R8,14,16, 17	100k
R10,15	1M0

POTENTIOMETERS

RV1	10k miniature horizontal preset
RV2	47k minature horizontal preset

CAPACITORS

C1,6	10u, 16 V tantalum
C2	100n polyester
C3,5	1n0 ceramic
C4	47u, 16 V tantalum
C7	4p7 ceramic
C8	1n0 polyester
C9	47n ceramic
C10,13	4u7, 16 V tantalum
C11	100n ceramic
C12	2u2, 16 V tantalum
C14	22u, 16 V tantalum

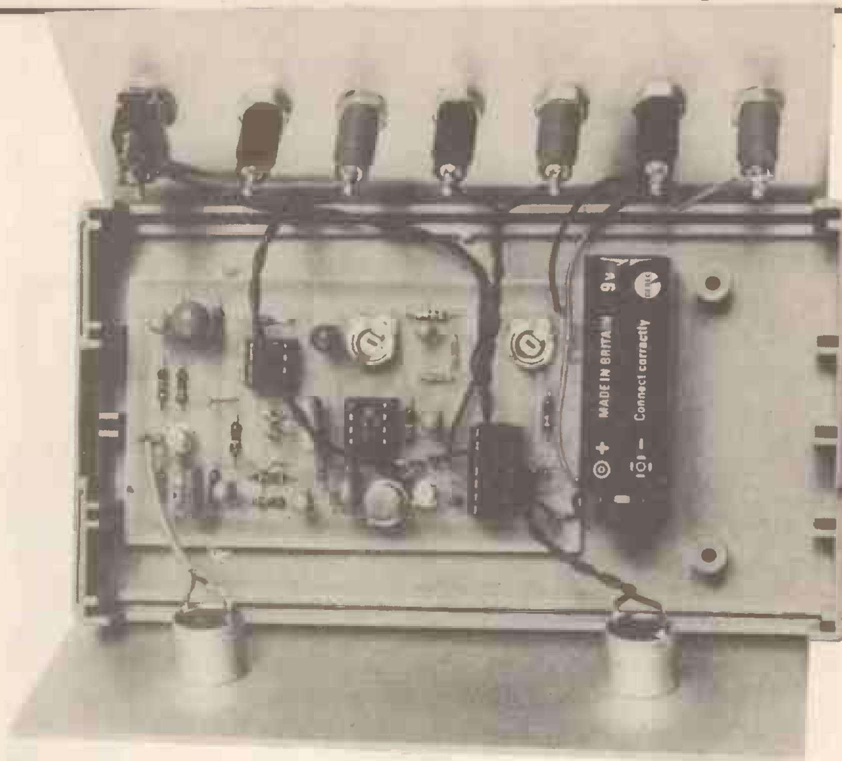
SEMICONDUCTORS

IC1	LM301 operational amplifier
IC2	741 operational amplifier
IC3	4093 quad, 2-input NAND, Schmitt trigger
Q1,2	BC109 NPN transistor
Q3	BFY51 NPN transistor
D1-4	1N4148 diode
D5	1N4004, 1 A diode

MISCELLANEOUS

SW1	single-pole, single-throw toggle
SW2	on/off switch
40R,40T	40 kHz ultrasonic transducer pair

Batteries, bell, nuclear warhead etc
Case to suit



Above. Internal layout of the project

Buylines

All parts are easily obtainable — the ultrasonic transducers being the possible exception. Most of the mail order companies who advertise in HE should help.

The approximate cost of components, excluding the case and PCB will be £15.

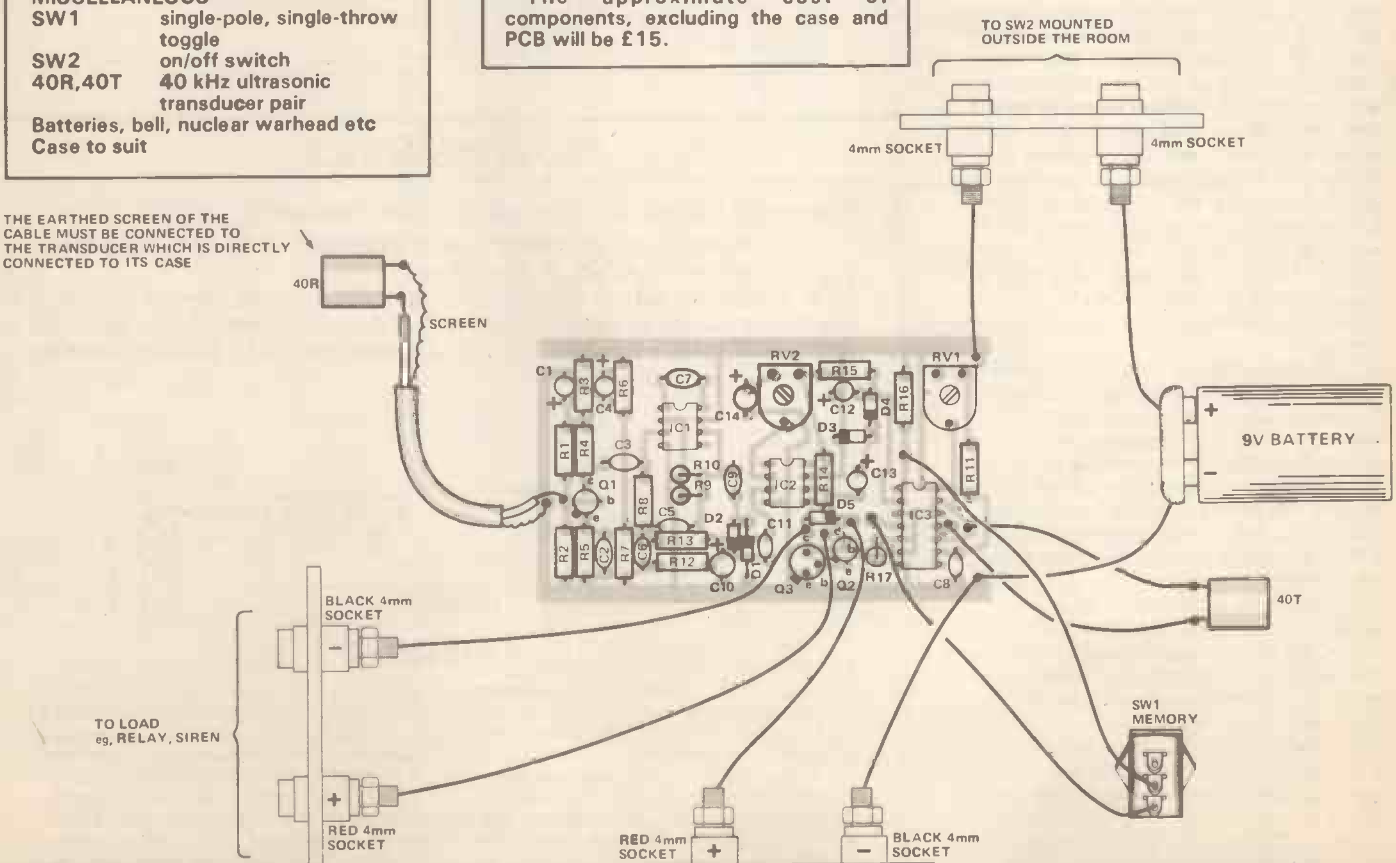


Figure 2. Component overlay of the printed circuit board and all connection details. Note the use of screened cable to connect the receiving transducer 40R

HE

Electronic Aids For The Disabled

Hugh Davies interviews Roger Jefcoate, consultant assessor and lecturer on technical aids for disabled people

Roger Jefcoate demonstrating the Lightwriter, a communication aid developed by Toby Churchill of Cambridge. Toby lost the use of speech and the use of all his limbs apart from his left hand. His handicap struck while in the third year of an engineering course at Bath University and he used his skills to design this machine, which converts typed characters into a message moving across the display strip

THROUGHOUT THE HISTORY of mankind, to be mentally or physically handicapped from birth, or disabled later in life, meant relegation from the life of normal healthy people. While advances in electronics have been proclaimed in areas such as communications, weaponry, medicine and space technology, simple electronic aids for handicapped and disabled people have been sadly neglected. One obvious reason has been the low return compared with other more profitable ventures.

But slowly, over the last two decades and thanks to the work of a handful of people like Roger Jefcoate, a neglected part of society has begun to receive recognition and help through the ingenious application of readily-available electronic devices.

In this interview with Roger, you will see how a little ingenuity and a low outlay can bring pleasure and fulfilment to a handicapped person's life.

Last 20 Years

I asked Roger Jefcoate what he considered were the main technological advances in the last 20 years. He saw the first as being Possum, which he helped to develop from 1962 and which is still commercially available. As the best known of electronic controls, it consists of a range of remote-controlled devices for disabled people, and is operated by various kinds of switches.

"Possum showed that disabled people, with appropriate electronics, can gain greater meaning from life."

Can you give any details of the electronics used in Possum?

"Yes, the original Possum was very simple, based upon standard electromechanical devices; that is, relays and Post Office type selectors — Uniselectors."

Possum enabled a single switch to operate a Uniselector which in turn enabled a light, a radio, a television, a heater or other appliances to be switched on.

He saw the next development as being Electraid, in 1969: "the first solid-state remote-controlled typewriter".

Possum had made use of typewriters for some years, but Electraid used solid-state electronics and was very versatile.

"The really clever bit about the Electraid is that for the first time the teacher or the therapist (or, indeed, if it is an adult, the disabled person) can program the machine by switching two knobs on the front, to provide a continuing physical and mental challenge."

Those with extreme handicaps can benefit from use of an Electraid. Roger gave the example of children with cerebral palsy (CP) who could try repeated actions with a single switch. It has been found that this repeated action gives improved *residual* ability — the child becomes less handicapped.

"This was first discovered with a project I initiated called the Toy Aids projects where I realised by modifying toys and games in a very simple way — and this is right up the street of your Hobby Electronics readers — handicapped people were having more fun."

With the Electraid electronic typewriter, as few as one or two switches can be used to operate the machine. After the handicapped person has mastered these switches, the inputs can be increased to four, possibly coupled to a joystick. So with an increased number of switches, operation becomes faster. The machine, costing around £2,500, is especially useful for assessing the physical and mental ability of a child, and has been supplied to special schools and centres for the handicapped.

In 1981 came the application of the microcomputer to the needs of the handicapped. Roger sees this as being probably more significant than either of the other two developments, and he is heavily committed to the application of microcomputers.

"Apple have been very sensible here and they are the first microcomputer suppliers to set up an agency with national responsibility for disabled people."

The agency has been awarded to John Flack, principal of Electraid, after Apple saw the work he had been doing.

I visited Electraid at the Old Labour Exchange, Aylesbury, and I will give my own impressions of the work going on there in a later article.

Electraid Typewriter Control 5600, with visual indicator, Brother large-print typewriter and trolley. It incorporates the facility for one, two or up to eight switch inputs

Toy Aids

Roger was given the idea for starting Toy Aids by Peter Toft of the Inner London Education Authority's Engineering Centre for Special Schools at Woolich College. Peter had for a long time taken an interst in the possibilities for modifying toys for use by disabled people. It was he who had run the first workshop for parents, teachers and therapists to come and make these leisure aids.

"It was through discussions I had with Peter that I then asked the AIDIS (aids for diabled and elderly people) Trust if they might be prepared to support this. A former AIDIS trustee, Mr Colin Dann, decided that this was something worth pursuing."

The long-term result has been the setting up of a separate charity called the Toy Aids Projects, under the direction of Colin Dann. This makes available fully modified toys and leisure aids at reasonable cost to anyone working with handicapped people.

How The Electronics Hobbyist Can Help

Although Possum, Electraid or microcomputer aids are of great benefit to the handicapped, often simple home-made gadgets can also be of value, as Roger discovered when helping to set up the Toy Aids project.

"A two-year old, for example, isn't interested in Electraids and Possums — it wants to play with its doll. Kids can be so handicapped that they can't even reach out and hold a doll. This problem can be solved by buying an electric doll from Woolworths and bringing out its control to a pair or switches. It will give movement, colour, sound — and stimulation. A kid can become, by repeated use of the toy, less handicapped."

Roger runs courses throughout the year to bring professional and non-professional people up to date with technological developments and to enable those attending to share their ideas and experience. More details of these will be given later. During the talks, Roger says: "Isn't it exciting that we've got this wonderful technology? Now let's look for ways in which we can avoid it!"

He sees the need for those designing aids and equipment (and this includes hobbyists) to make life simpler and cheaper for disabled people.

Between 1973 and 1975 he realised that the technology was available but it cost a fortune. Ready-made commercial equipment did not suit every need because every disabled person's needs are different. Roger then considered how he could harness the talents of do-it-yourself enthusiasts — amateur or professional (but preferably amateur) — to make life more *enjoyable*, not just more meaningful, for the disabled. His solution was to start an organisation called ACTIVE: "because we're active people wanting to help disabled people themselves to be more active."

ACTIVE

The ACTIVE Association* was founded to promote do-it-yourself leisure, learning and communication aids. Roger Jefcoate sees it as his main vehicle for finding technicians to do odd jobs in particular areas. What is more significant is that, once enthusiasts become members of ACTIVE, they can set up their own links with a special school, centre for the handicapped and so on. As Roger said, ". . . if one of your Hobby Electronics readers reads this article and says, 'Well now, how can I help?', first thing they should do is to either join ACTIVE nationally, which will cost £4.50, or equally as good, initiate an ACTIVE group in their own patch if there isn't one.

"If there is one, join it, and then go charging along to the local special school, the local centre for disabled people, saying, 'My hobby is electronics. I am a member of ACTIVE. How can I help?'".

Roger sees this approach as being a very fruitful way of using people's skills. He gave an example of someone, armed with some knowledge of electronics, approaching a special school.

"They will say, 'Well, isn't there in ACTIVE's design index a "wee detector" — a device which will tell when a child has urinated in the potty — part of toilet training?'

"If you are a mentally handicapped child you do need positive reinforcement. It's very hard to train a mentally handicapped child to the potty. And it's not unusual to have people 15 years old still in nappies. Yet with appropriate technology — simple technology — this can all be avoided, because you can stick a little sensor inside the potty which can be linked to something that will give immense reward to that child. It might be a roller-coaster which performs. It might even be, obviously through very safe circuitry, something which switches on the telly."

Enthusiastic Amateurs

Roger is keener to pick up the amateurs rather than the professionals ". . . because it is the amateurs who seem to have more enthusiasm and certainly seem to be willing to give the time." He has found a furitful area of talent among sixth-form schoolboys.

He turned to the example of a remote on/off control for a TV. Many people, particularly the elderly, are forced to spend a lot of time in bed. Roger sees the television as a "window on the world" — but not everybody can afford colour TVs with remote control built in. And there are virtually no sets available with remote on/off control.

"It's not a difficult job, using basically a few commercial components, to build a device that will give, very safely, remote on/off over a telly."

So it's left to the amateur to see the idea through to its conclusion?

"Oh yes, involvement must be the name of the game. What we would hope is that if they do a thing like this (on/off TV control), they shove the circuit, and preferably a picture or two of the end result, up to ACTIVE's headquarters so that we can put it, if it is felt suitable, desirable, in our design index. ACTIVE produces a design index of well-proven designs so that other people can copy a good initial job."

What about the safety of a design: does ACTIVE exercise any control?

"If somebody is doing a remote TV control (for example), my usual suggestion is to base it on an existing well-tried commercial device, such as the Home Automation single-channel infra-red device, where the bit at the mains end is already tied up and organised.

"The clever part, from the amateur's point of view, is to modify the infra-red unit so that the disabled person can work it."

Which is presumably at low voltage?

"On the whole, we in ACTIVE are not too enthusiastic about using mains voltage on anything. But you know you've got to let people use their own heads."

Windmill Teaching Aid

One example he gave of where mains might be used was of a motor driving a rotary pointer on a learning aid for children in a special school. Care was obviously needed to ensure that the switching circuit was either double-insulated or, preferably, operating from a low voltage (that is, 12 V or less).

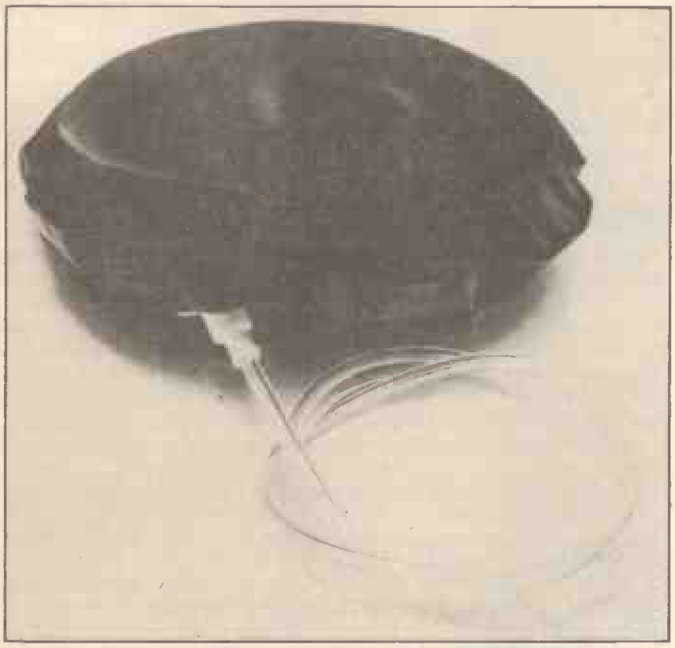
Roger is still looking for a better design of this teaching aid — nicknamed a windmill. The model shown was developed for a school in Chipping Norton. He considered that HE readers could come up with better designs of their own. (Don't forget the HE Project Design Competition for the International Year of Disabled Persons, first announced in the April '81 issue. A fresh application form is provided on page 19.)

Roger said that mechanical rotary pointers (preferably single pointers) were more successful than circles of LEDs.

Early 'windmill' teaching aid in use. The spastic child can operate switches to make the pointer come to rest at the word which corresponds to the picture being indicated. The machine is made from Meccano components and is battery-operated

Electronic Aids For The Handicapped

Roger was asked to give specific examples of handicaps and how these had been made easier to bear by the use of some electronics ingenuity.



Head-operated pad from Electraid. This pad is made from a car spot lamp cover and produces changes in air pressure at the end of the tube when pressure is applied to the pad. These changes are converted in turn to on/off functions by a remote pressure-sensitive switch

"As I said earlier, it's always the ability which counts. In operating any remote-control device you've got to look for what the person can do. And if they've got good hand control, well you're home and dry. If they have good hand control then you've go to be very careful in mounting a switch or switches to operate some form of remote-control device.

"For the severely handicapped people there's often very small movement: for a person with advanced motor neurone disease it can be just a flicker in the foot.

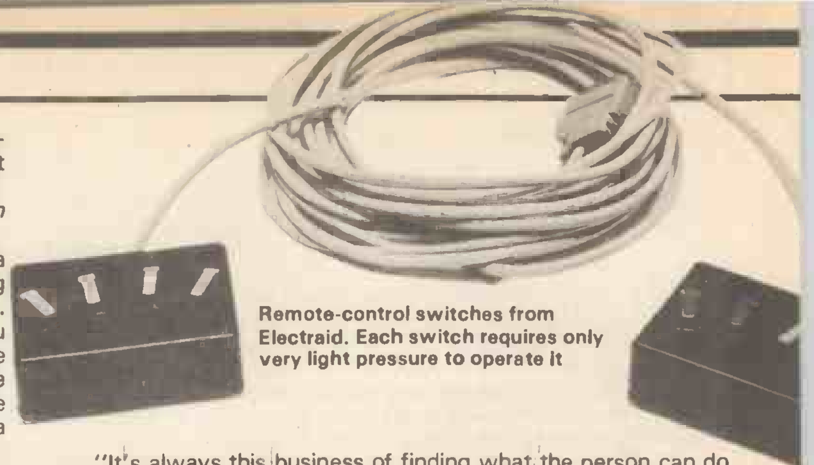
"For the heavily handicapped spastic child, whose arms flail all over the place, you might have to end up with a single or dual switch in the head area, perhaps for side-to-side movement of the head."

He saw the ideal switch, because it's socially and psychologically acceptable, as being a standard switch operated by hand. But for a disabled person, a standard switch could be one that is 6" square, specially that made by an enthusiastic amateur.

Roger sees switches as being an interesting area of development because he considers nobody has yet designed a really good large flat surface area switch. He is looking for a good design for an electromechanical switch, possibly based on a microswitch, that can be logged on ACTIVE's design index. He is equally interested in a good design for a touch-operated switch (sensitive to a change in capacitance), with variable sensitivity. He put these designs forward as a challenge to you, our readers.

Commenting on touch switches he said: "Even now we have got a long way to go. Nobody has produced a good design. There is one commercially but it's very expensive."

Head control of a modified train set. Roger Jefcoate is seen sitting next to a spastic boy who can only move his hand, to which a magnet is attached. The magnet can be dropped into any one of 20 slots, each one controlling a signal, a point, a start or a stop. The picture was taken at one of ACTIVE's conferences



Remote-control switches from Electraid. Each switch requires only very light pressure to operate it

He is a 'microswitch man' primarily ". . . because it's an electromechanical thing, you can feel as the pressure increases against the switch and you can feel it as it snaps open."

Let's take a few examples of handicaps and what has been done for them.

"Take advanced multiple sclerosis, for a start. Here we have a person who is wheelchair bound, and who wants to do something remotely. Well then, looking for the ability: *they've got no ability*. They can't even turn their head from side to side. What can you do? Well, they can still drink. So you can get hold of an air-sensitive switch — you can either buy them commercially or go down to the washing machine service depot and scrounge a second-hand one — which could be operated by light sucking or light puffing down a tube."

He went on to give an example of a water level sensing switch from Hoover. Even those that are no longer reliable for the original function of switching a mains-operated pump or heating element are still satisfactory for low-voltage operation.

"At the other end of the range you've got a fairly badly-handicapped spastic child, arms flailing all over the place. Usually the spastic child hasn't got good puff and suck control because they can't close their mouth and seal their lips. Then we're going to have to look for an extra tough switch which on the one hand will trigger with a relatively modest pressure, say ½ lb, but at the same time will withstand a wack of 20 lb on the same switch. Tough specification, that."

One technique he suggested was to use two pieces of wood, hinged at one end, and with a very low profile. With a microswitch fixed between the hinged arms, the operating pressure can be adjusted simply by packing in a desired amount of plastic foam. Thus the more foam that is used, the tougher the switch is to operate. Such a design makes use of simple everyday materials.

Another example he gave of a handicap was muscular dystrophy in children, a progressive disability with progressive weakening of the muscles.

"There's no spasm there like there is with the spastic child. You need a light-duty, light-pressure switch — because it's never going to have to withstand a real bash — which can respond to whatever they can do. And I find that a muscular dystrophy child is particularly successful using joysticks."

Roger said that very easily home-made or commercial joystick assemblies can be used in this application.

"It's quite easy to build a sensitive joystick, with a spring underneath it to keep it in a central position against a couple of simple microswitches.

"The great advantage of joysticks is that you can get more than one result from the single lever action."

One example he gave for the use of a joystick was for it to enable the handicapped person to turn the pages of a book.

Eight-way toggle switch from Electraid

He next described a disability common to many of us.

"Arthritis is a very distressing handicap amongst the older population — although even that can hit children. There is an unfortunate combination: it isn't just paralysis, it's pain to go with it as well as disfigurement. But again the same kind of fairly sensitive switches that would be used, for example, by a person with multiple sclerosis or a child with muscular dystrophy, would be relevant.

"It's always this business of finding what the person can do easily and satisfactorily: what they themselves feel is most appropriate."

What about the needs of adults?

"Adults have different needs. I find adults enjoy much more their window on the world — the telly. And of course we have this problem of safety with the mains and so on. And again it's the old story: what can they do most easily, balanced against what is socially and psychologically acceptable, because disabled people don't want to look like men and women from Mars, with wires festooned in every direction. How can we give them the remote control that they need without the wires, nice and discreetly?

"I find, with your average handicapped adult, a modestly-sized switch will work out quite successfully. Even the quite heavily handicapped spastic adult can manage a switch that would, for example, be about the size of a C-60 cassette holder."

Proportional Control

All the switches described so far have been simple on/off devices, so I asked Roger whether any proportional movement controls were used by handicapped people.

"Certainly there are proportional joystick controls, for example on electric wheelchairs, where you do indeed want quite fine movement. But other than that there's not a lot of need for proportional control except on things like microcomputers, model aircraft, model boats and this kind of thing."

Would proportional control help a disabled person to paint a picture?

"If they can't manage to cover the whole painting area then a straight on/off control on a motorised easel is perfectly adequate."

One such easel was initiated by Roger and designed by REME (Royal Electrical and Mechanical Engineers).

Notting Dale Technology Centre

Designing aids for handicapped people can have some unlikely benefits, not least to the designers themselves. One such example of where this has happened is the Notting Dale Technology Centre at Hammersmith, set up by Christopher Webb. Here a group of unemployed youngsters from the Hammersmith area, most of whom have an interest in electronics, are being given a basic training, and are helping handicapped people through their work. It is in this concept of teaching a trade, linked to social awareness, that Roger comes in.

"I shove at them good projects which these lads can get stuck in with, they can tackle, they can see the disabled person who needs it, they can install it — and it's already working out quite successfully."

An example he gave was of a gadget called the Microprocessor-assisted Communicator, invented by Patrick Poon, a graduate student at Kings' College. It is a new communication device for disabled people.

"The beauty of Notting Dale is that they'll tackle things where they'll make them in ones and twos where commercially it would not be viable."

At least one of the lads has been offered employment as a result of his work at the centre.

Courses

It was mentioned earlier in this article that Roger Jefcoate runs courses throughout the year. These take two forms: in-depth residential courses on technology for the handicapped child, and single-day courses. The first are held at the Spastics' Society's Educational Centre, at a cost of £150, and are aimed at professional people throughout the world.

The second — and of interest to our readers — are held at various places throughout the UK at a cost of £7 to professional people and £6 to non-professionals (the £1 reduction is a subsidy from one of the charities to which Roger is linked).

Readers are welcome to attend the next day course on Thursday, 25 June 1981 at St Joseph's College, Lawrence Street, Mill Hill, London NW7. The course opens with arrivals and coffee at 9.45 am. Fees must be payed in advance to the organisers: Castle Priory College, Thames Street, Wallingford, Oxfordshire OX10 OHE (Telephone 0491 37551).

Further details of this course are given under Monitor on page 6.

In a coming issue of HE, I hope to give details of my visit to Electraid in Aylesbury, and to outline some of the latest microcomputer aids for the handicapped.

Roger Jefcoate

In the early 60s, Roger Jefcoate was one of the original trio who developed Possum, the first fully adaptable electronic aid for the disabled, at the National Spinal Injuries Centre, Stoke Mandeville Hospital.

He saw a need in the early 70s for a freelance consultant on electronic aids to advise those concerned with rehabilitation about the most appropriate aid for a particular disability. So he set himself up in this rôle after leaving the Possum project in 1972. Without any commercial links whatsoever, he works with therapists, teachers, health visitors, district nurses and doctors, and liaises with societies such as the Spastics Society, the Multiple Sclerosis Society, the Muscular Dystrophy Group and many smaller ones both in the UK and abroad.

Roger founded the AIDIS Trust in 1975 to sponsor urgently needed electronic equipment and aids for disabled and elderly people. He also founded ACTIVE, an association which promotes do-it-yourself leisure, learning and communication aids.

To keep people in touch with the latest developments in aids and to pool ideas, Roger runs residential and single-day courses throughout the UK. These are attended by people from many parts of the world.

He is concerned with all kinds of handicaps, and primarily with extreme cases. Having established the person's ability he will set about seeking a practical solution and the funds with which to achieve it.

Although Roger Jefcoate has no formal qualifications for this work, he received an honorary degree from the Open University in 1980 for his services to disabled people.

His interest in electronics stems from electronics as a hobby. One of his early achievements was to help develop the world's first electronically-controlled ventilator machine, which operates as an artificial lung.

COMPETITION Project Design for the International Year of Disabled Persons

19 81

AS A REMINDER, we are repeating the entry form for our competition, first announced in the April '81 issue. Design an electronic aid for the disabled — even a very simple one — and you could win the first prize of £200 cash.

No restriction is placed on the area of electronics that you wish to use: transistors, integrated circuits, valves (if it is *impossible* for semiconductors to do the job!), electro-mechanical aids (electronically controlled), computer programs — the choice is yours.

The only restriction we place on entries is that of ORIGINALITY: the design must be original, or an original adaptation that has not been published or marketed.

No Design Is Too Small

Entries can be as simple or as complex as you like, but we envisage that the winning entries will be ingenious solutions to a problem or problems encountered by a disabled person rather than an enormous (and expensive) box of tricks.

We will, if necessary, segregate designs into 'classes of complexity' or specific types. In judging, we may also take into consideration the ages of the entrants.

First Prize £200 cash
Second Prize Kikusui 538A oscilloscope
PLUS
Three runners-up prizes

Closing date for the competition was fixed as 31 July 1981 in the April '81 issue. So far the response has been low, so we have decided to extend this date to **1 September 1981**.

No correspondence will be entered into after this closing date.

As a guide, set out your design along the lines of an HE project — we will publish the winning designs.

Send your design to:

Project Design Competition
Hobby Electronics
Modmags Limited
145 Charing Cross Road
LONDON WC2H OEE.

AND include the following:

- the completed entry form (see below)
- written details of your design, including drawings or black-and-white photographs
- a suitable sized stamped and addressed envelope (if you wish to have your material returned)

If your design is 'boxed' or breadboarded, *keep it intact* until at least two weeks after the closing date: if you haven't heard from us by then you can assume that your design is not among the winning entries (your daytime telephone number would be very helpful). **HE**

PROJECT DESIGN COMPETITION
ENTRY FORM

I certify that my design, to the best of my knowledge, is original and has never been offered for publication or manufacture

Signature . . . .

Name . . . .
(CAPITALS)

Address . . . .
(CAPITALS)

. . . .

. . . .

Daytime tel.no . . . .

Project title . . . .

Electronic Organ-3

Part 3 of our super organ project outlines further constructional details

WELL AT THIS STAGE, you'll be pleased to know that you are halfway through construction work on the HE Electronic Organ. This month we deal with the remaining printed circuits and we'll leave the final interwiring between PCBs and the keyboard till next month. Are you sitting comfortably? Good, then we'll begin.

Construction

Build-up Boards 3 and 4 according to the overlay in **Fig.1**. The diagram is an overlay of the top half of the boards only. We'll call it the 'topside' overlay.

Note that you have two extra holes to drill on each board for earth (ie 0 V) connections (actually the right-hand hole on Board 4 isn't strictly necessary).

Insert and solder PCB pins where all interboard connections are to be made (50 on Board 3, 44 on Board 4).

Differences in component values of the topside overlays for both boards exist for capacitors C1 to C30 and the top line of resistors. The values of Board 3 capacitors are shown unbracketed, while those of Board 4 are shown bracketed. Resistor values are found from **Fig.3** for Board 3 and **Fig.4** for board 4.

Use sockets for all integrated circuits. All six ICs are of the CMOS variety and you run the risk of damaging them if they are handled incorrectly, so we advise that you leave them aside for now.

Make sure the polarity of all capacitors and transistors is correct before you solder them in.

When you have completed the topside construction fasten the two boards down, in position on the PCB guiderails. Now, solder the seven short links (made of single-strand wire) between the two boards.

Take the boards (now joined by the seven links) off their guiderails and turn them over so that they are in a position as shown in **Fig.2**, the bottom overlay.

Solder the 48 resistors into place, between pads, as shown. Make sure that none of the resistor leads touch any parts of the copper, other than those intended.

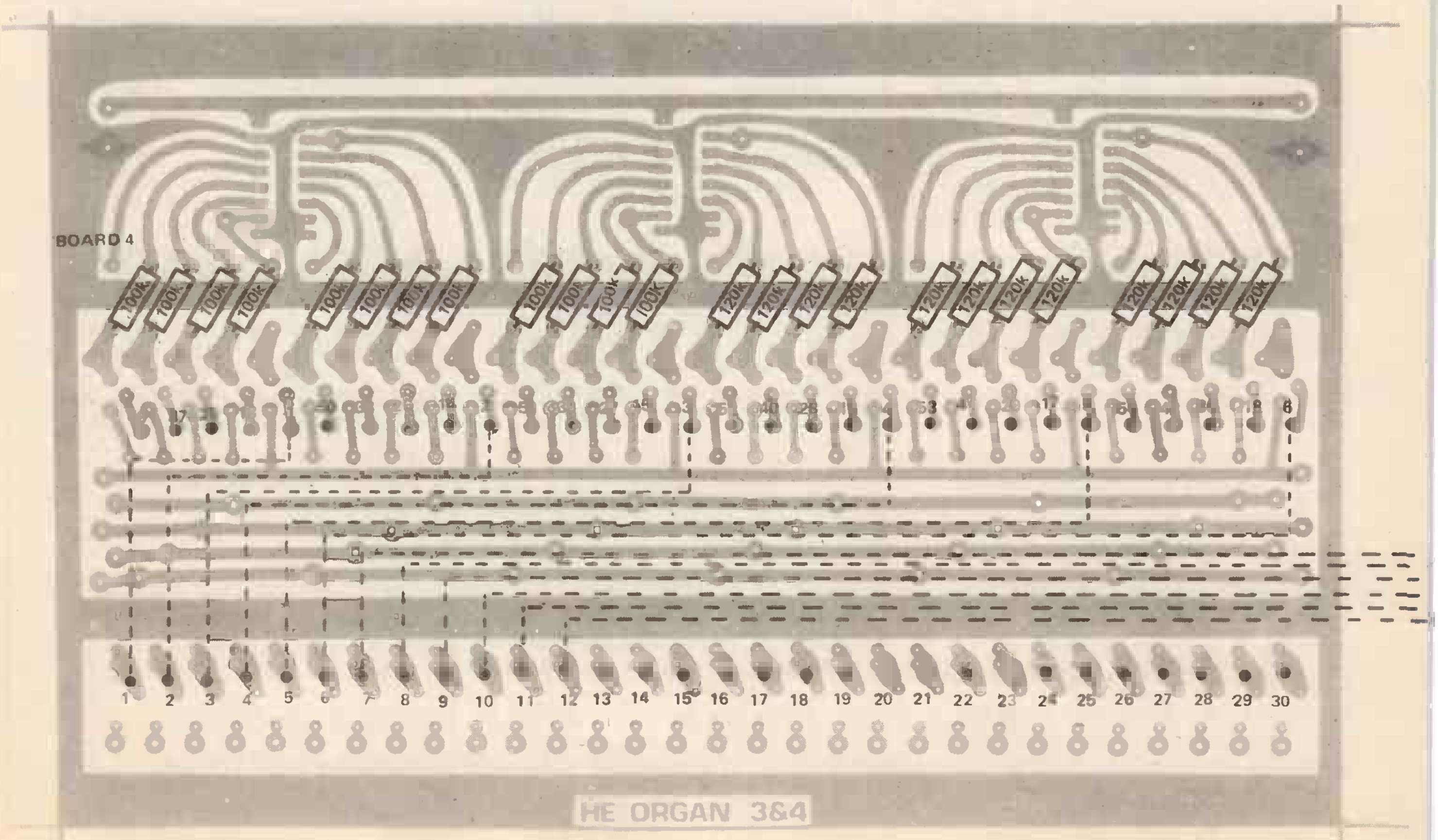
Now, connect the 60 thin, insulated wire links from each numbered pad on the bottom row (eg, 1 to 1, 2 to 2 etc). This is a long, monotonous job, but try to keep them as neat as possible. Once done, cable-tie the group of wires at a few points along the line, to hold it neatly together. If you haven't got plastic ties (as we used) then string will do.

Turn the boards over again and put them back onto the PCB guiderails in their correct position and screw them down tightly.

Connect the six links (of single-strand wire) from Board 3 to Board 1.

The only power supply connection now necessary is an earth from Board 3 to Point 1 on Board 1. Use insulated wire for this connection.

Finally, push-fit the six ICs into their sockets, making sure they are the correct way round.



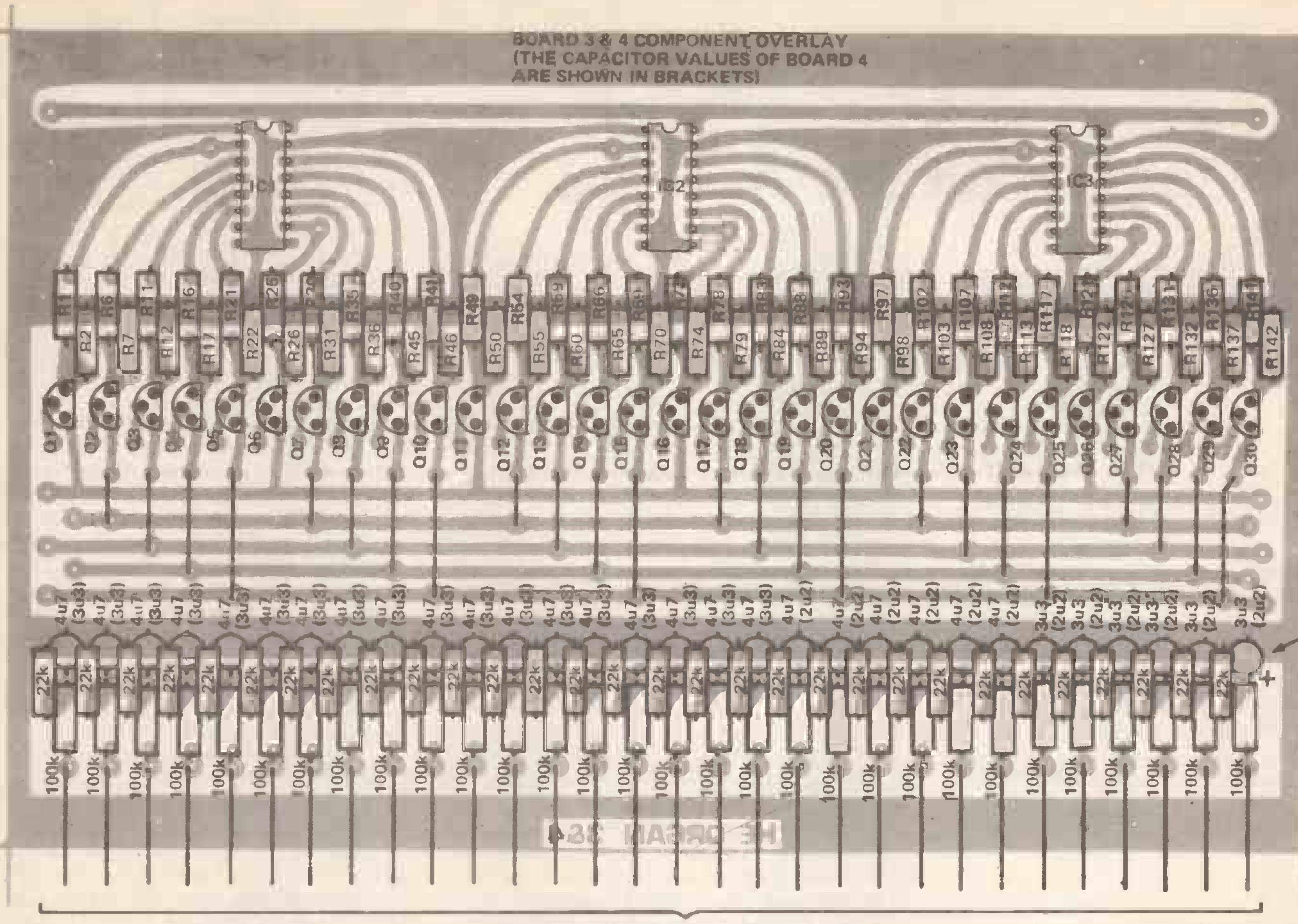
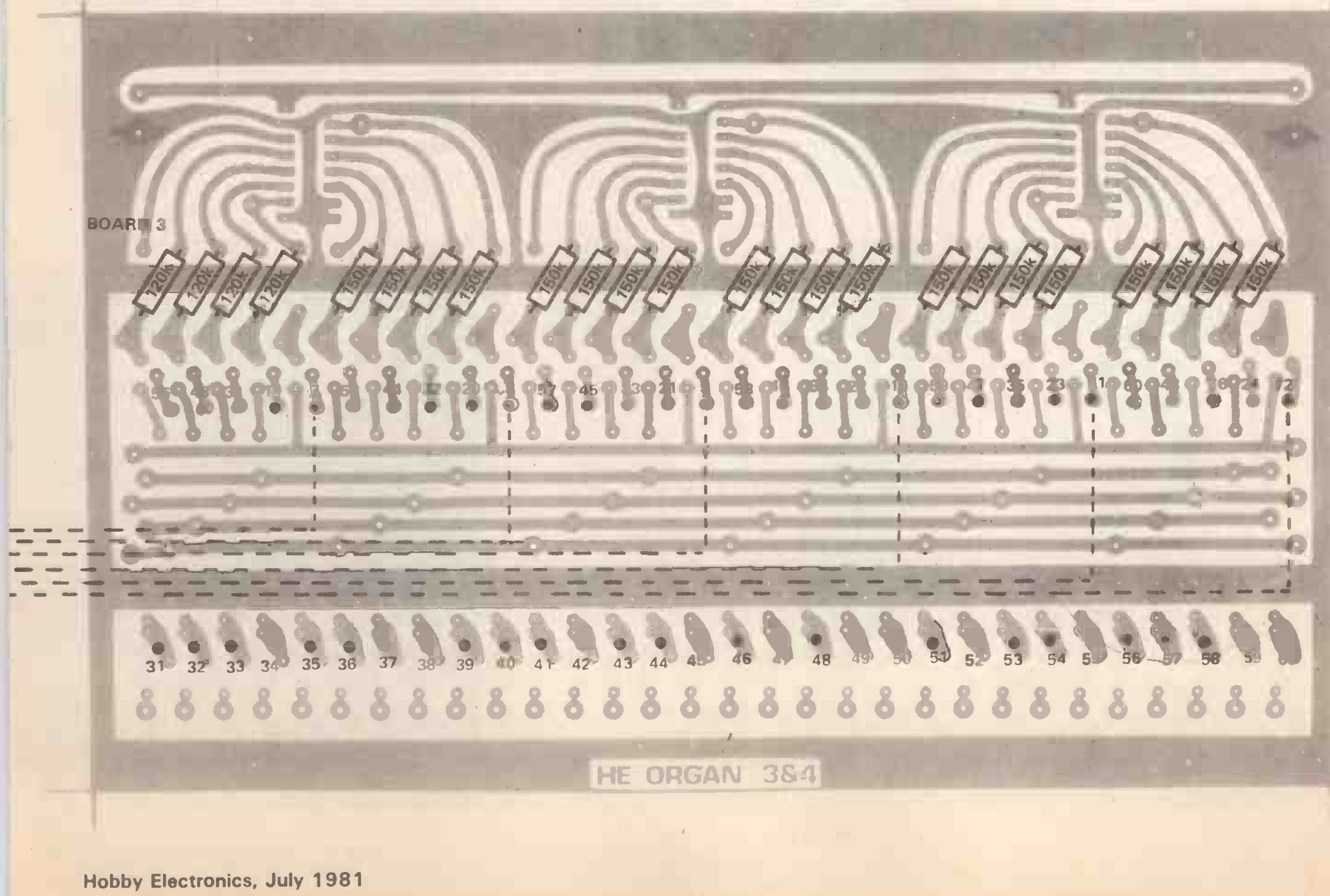


Figure 1. The topside overlay diagram of Boards 3 and 4. Resistor, transistor and IC values are identical on both boards. Board 3 capacitor values are shown unbracketed and those of Board 4 are shown bracketed

Figure 2. The bottom overlay of Boards 3 and 4. Resistor value are as shown. After all connections have been made between the numbered pads, carefully cable-tie the group of wires together



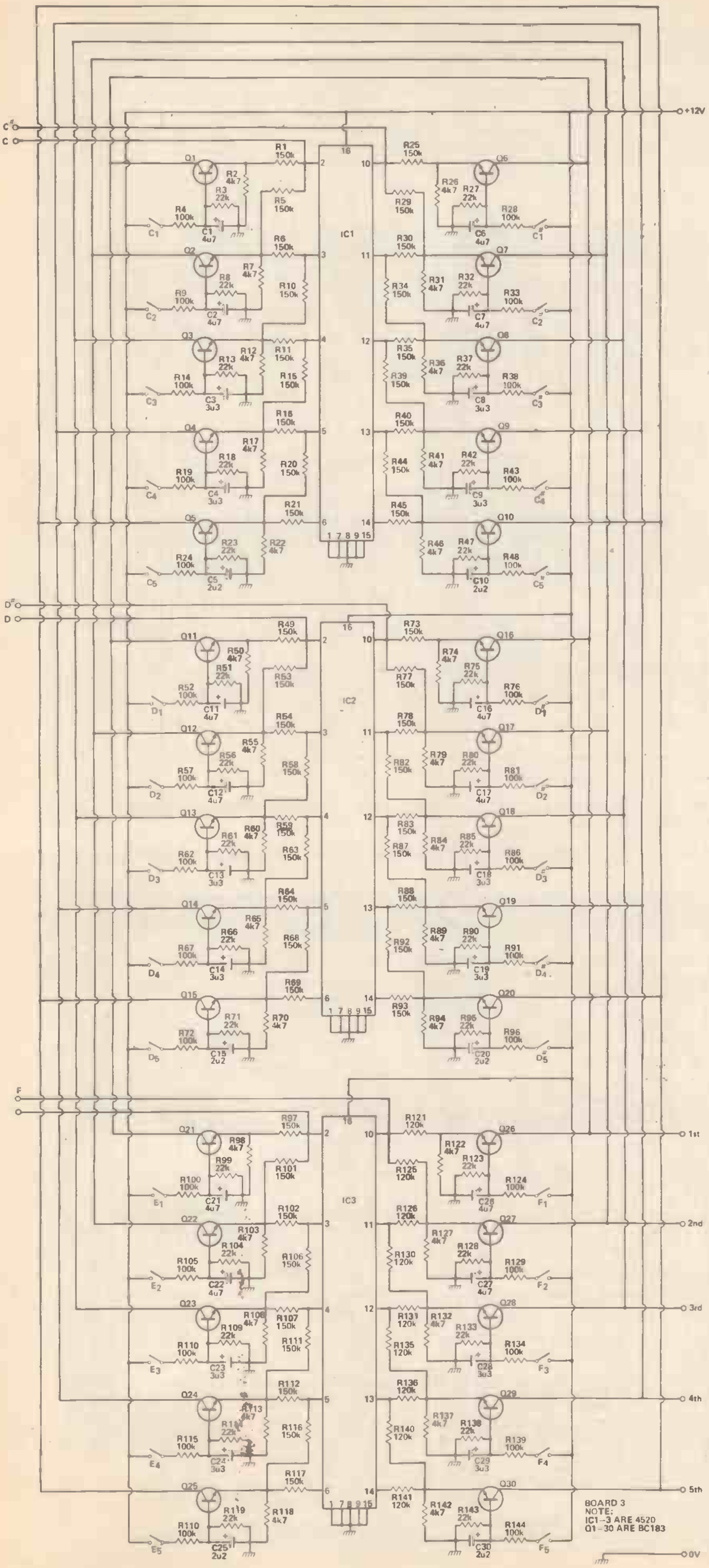


Figure 3. Circuit of Board 3

Parts List

Parts List Board 3

RESISTORS (All ¼ W, 5%)

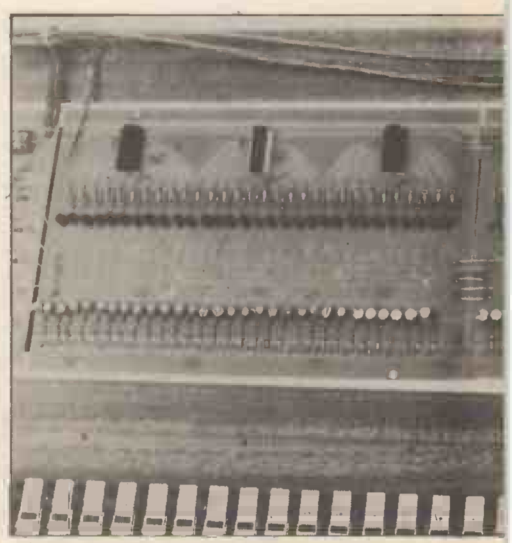
R1,5,6,10,11,15,16,20,21,25,29,30,34,35,39,40,44,45,49,53,54,58,59,63,64,68,69,73,77,78,82,83,87,88,92,93,97,101,102,106,107,111,112,116,117	150k
R2,7,12,17,22,26,31,36,41,46,50,55,60,65,70,74,79,84,89,94,98,103,108,113,118,122,127,132,137,142	4k7
R3,8,13,18,23,27,32,37,42,47,51,56,61,66,71,75,80,85,90,95,99,104,109,114,119,123,128,133,138,143	22k
R4,9,14,19,24,28,33,38,43,48,52,57,62,67,72,76,81,86,91,96,100,105,110,115,120,124,129,134,139,144	100k
R121,125,126,130,131,135,136,140,141	120k

CAPACITORS

C1,2,6,7,11,12,-16,17,21,22,26,27,	4u7,16 V tantalum or electrolytic
C3,4,8,9,13,14,18,19,23,24,28,29,	3u3,16 V tantalum or electrolytic
C5,10,15,20,25,30	2u2, 16 V tantalum or eletrolytic

SEMICONDUCTORS

IC1,2,3	4520 programmable counter
Q1-30	BC183 NPN transistor



Above. Boards 3 and 4 in final position showing all single-strand wire links

Parts List

Parts List Board 4

RESISTORS (All ¼ W, 5%)

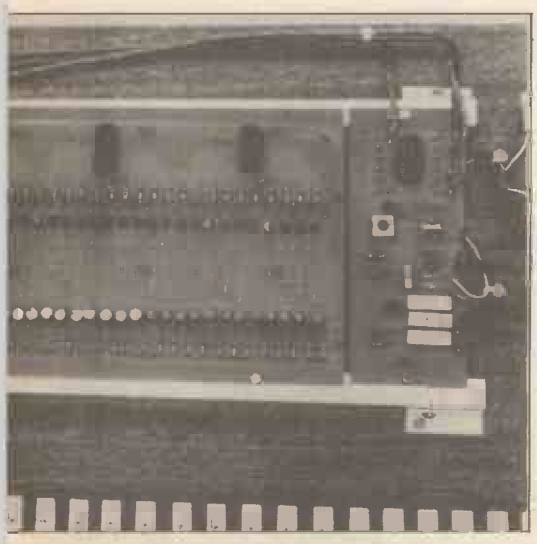
R1,5,6,10,11,15, 16,20,21,25,29, 30,34,35,39, 40,44,45,49,53, 54,58,59,63,64, 68,69	120k
R2,7,12,17,22,26, 31,36,41,46,50, 55,60,65,70,74, 79,84,89,94,98, 103,108,113,118, 122,127,132, 137,142	4k7
R3,8,13,18,23,27, 32,37,42,47,51, 56,61,66,71,75, 80,85,90,95,99, 104,109,114,119, 123,128,133,13-8,143	22k
R4,9,14,19,24,28, 33,38,43,48,52, 57,62,67,72,73, 76,77,78,81,82, 83,86,87,88,91, 92,93,96,97,100, 101,102,105,106, 107,110,111,112, 115,116,117,120, 121,124,125,126, 129,130,131,134, 135,136,139,140, 141,144	100k

CAPACITORS

C1,2,6,7,11,12, 16,17,21,22,26,27,	4u7,16 V tantalum or electrolytic
C3,4,8,9,13,14, 18,19,23,24,28,29,	3u3,16 V tantalum or electrolytic
C5,10,15,20,25,30	2u2,16 V tantalum or electrolytic

SEMICONDUCTORS

IC1,2,3	4520 programmable counter
Q1-30	BC183 NPN transistor



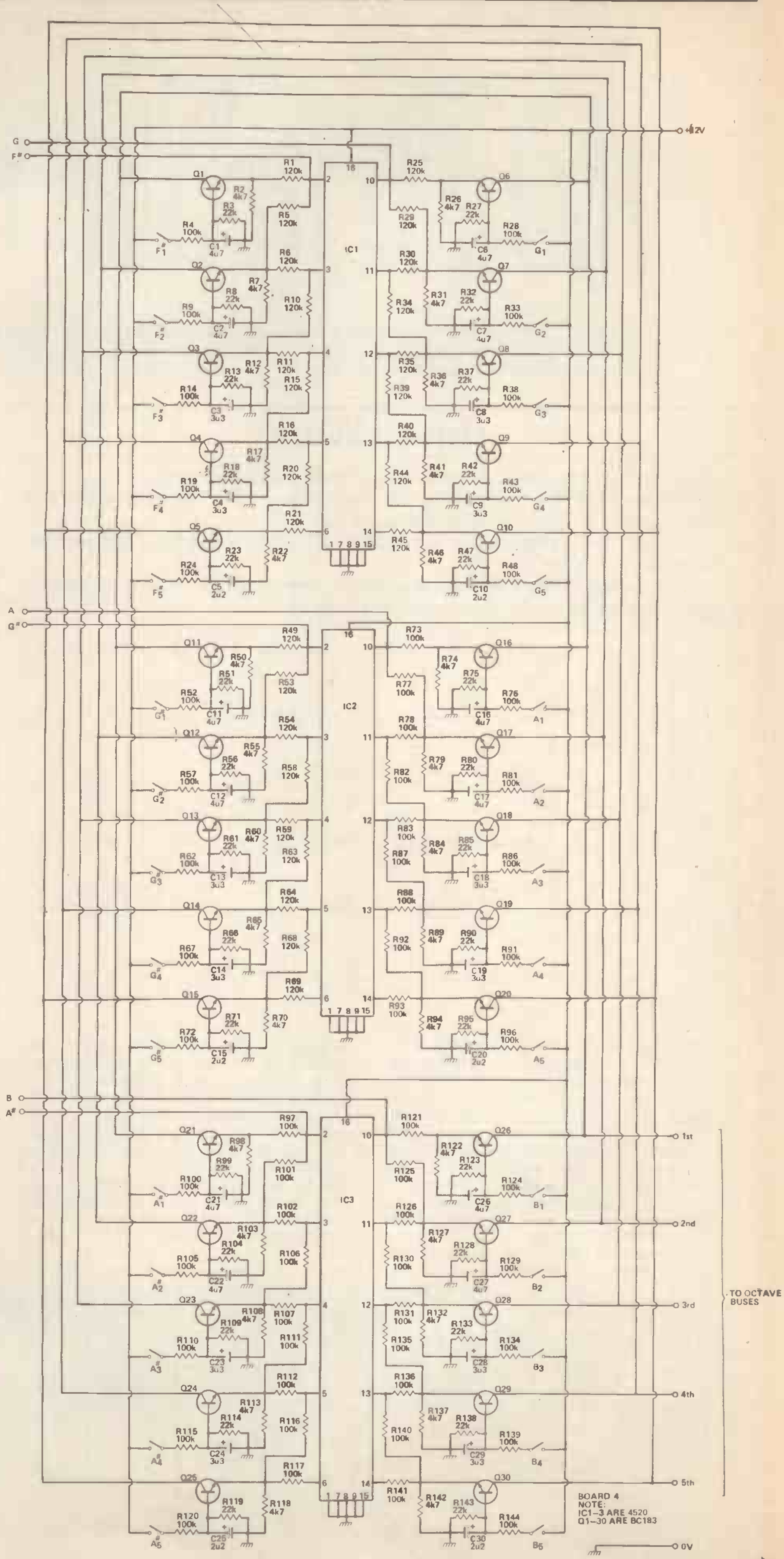


Figure 4. Circuit of Board 4

Figure 5. The HE Electronic Organ after this month's constructional stage

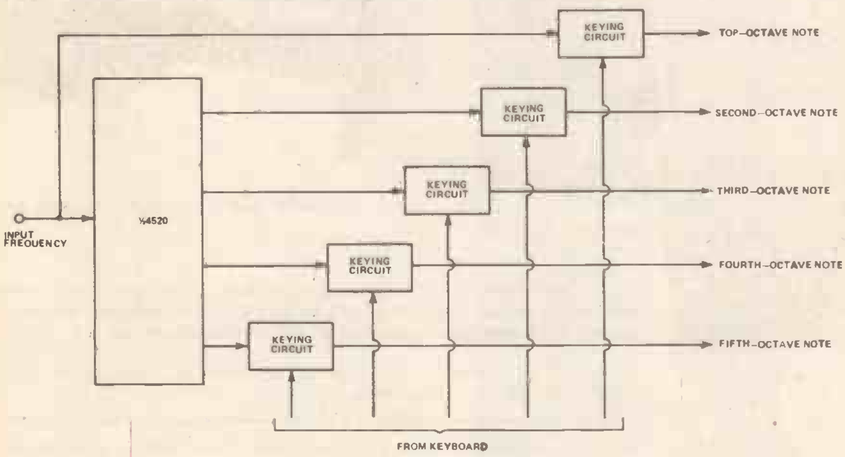
How It Works

Boards 3 and 4 comprise all Dividing and Keying Circuits.

Twelve notes comprising the semitones of the top-octave are fed from Board 2 to the six ICs of Boards 3 and 4.

Each note is divided by 2,4,8 and 16 by the circuit thus making five complete octaves.

As a key on the keyboard is pressed, one transistor key circuit allows an envelope of sound through to the output.



The divider circuitry is made up of six 4520 ICs which bear the official title 'Programmable, Divide-By-N, 4-Bit BCD Counters'. They are configured to divide any input frequency by 2,4,8, and 16, thereby producing one octave, two octaves, three octaves and four octaves below that of the input. Each IC divides down two separate input frequencies.

At the output of this part of the circuit all 60 notes of the organ are permanently available.

Depressing the key on the keyboard allows a +12 V pulse to trigger one keying circuit built up by a transistor, five resistors and a capacitor. Each keying circuit is essentially a simple envelope generator with a set attack and decay time defined by the value of the capacitor. To give a realistic organ sound the bass notes should have a longer attack/decay time than that of the treble notes, thus the capacitor values of the bass notes are correspondingly higher.

Buylines

A limited number of kits for the HE Organ can be obtained from:

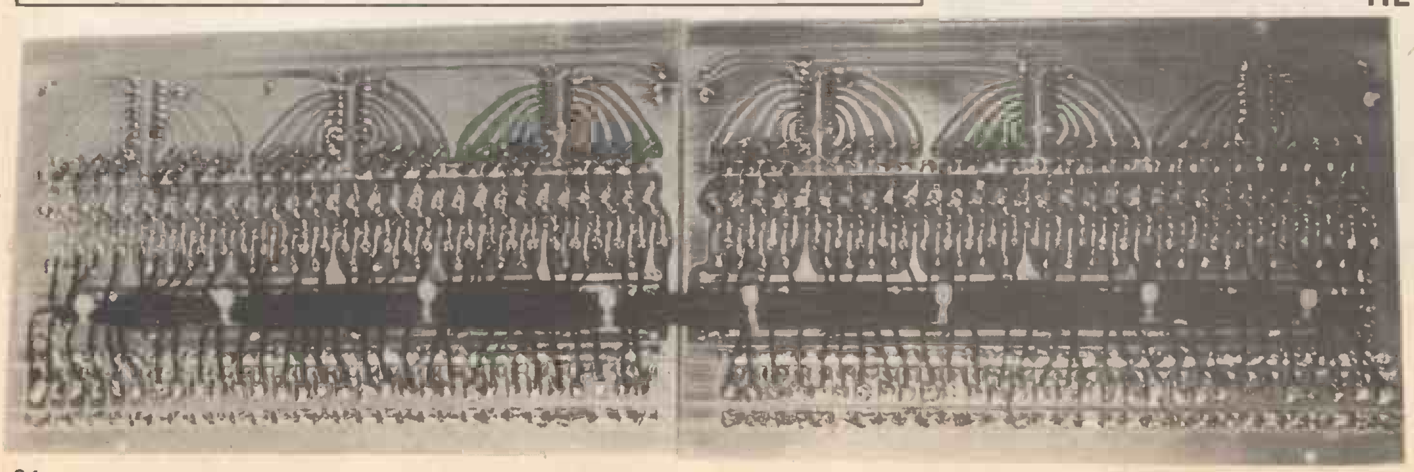
Mr A T Hawkins
23 Blenheim Road
St Albans
Herts AL1 4NS

for £99 inclusive. The kits contain all metalwork, hardware and PCBs, as well as the keyboard and components. You only need to supply your own baseboard and case.

For those readers who prefer to buy the components themselves, Mr Hawkins is willing to supply the keyboards seperately. None of the other items should be difficult to find.

Figure 6 (Below). Underneath our two prototype printed circuit boards. Note how the 48 resistors have been positioned diagonally on the boards. The 60 multi-strand connecting leads should be cable-tied together at a few points

HE



EXCLUSIVE OFFER

For HE Readers

High-quality Furniture Kits For Your Hi-fi

▲ Kit 2 This comes with one tinted Perspex door and without the metal divider

◀Kit 1 Two tinted Perspex doors are provided, together with a metal divider for separating two of the cabinets. In the example shown, a record deck has been mounted on the connecting shelf

The pictures show how the two kits can be used to mount and display your audio equipment

A LIMITED NUMBER of self-assemble modular furniture kits have been specially reserved at low prices for HE readers. This is your chance to mount your hi-fi equipment in attractive *real teak* veneered cabinets, complete with tinted Perspex doors and adjustable shelves.

These easily-assembled kits enable you to configure the equal-sized cabinets to *your* choice and to suit *your* room space requirements.

Kit 1 costs only **£79** and consists of three cabinet modules, 547 mm (1 ft 9½ in) wide by 375 mm (1 ft 2¾ in) high by 413 mm (1 ft 4¼ in) deep, complete with two tinted Perspex doors, four shelves and two matt black plinths. Also included is a metal divider finished in matt black which takes a fixed shelf and a back panel. One of the shelves can be used between two of the cabinets as shown.

Kit 2 costs only **£73** and consists of three cabinet modules, complete with one tinted Perspex door, three shelves and two matt black plinths. (No metal divider assembly is supplied with this kit.)

The above prices include VAT and delivery to your door.

Each kit comes with all screws, fittings and easy-to-follow instructions. Items from Kit 1 and Kit 2 can be used together to suit your requirements.

When assembled, this furniture is ideal for:

- mounting most types of audio equipment, with the advantage that unsightly leads are hidden from view
- holding your LP or cassette collection
- use as room furniture to hold books, ornaments, crockery, etc.

We stress that this is a *limited* offer. Once this consignment has gone it cannot be repeated.

Send your order today to:

**HE Furniture Offer, Modmags Limited,
145 Charing Cross Road, LONDON WC2H 0EE**

**Please send me . . . . . of Kit 1 at £79 each
. . . . . . of Kit 2 at £73 each**

I enclose a cheque made payable to Modmags for a total of £ . . . .

OR

I wish to pay by Barclaycard. Please charge to my account number

BARCLAYCARD VISA NO. 4929

Signature . . . .

Name . . . .
(BLOCK CAPITALS)

Address . . . .
(BLOCK CAPITALS)

. . . .

Please note that the offer applies to UK mainland only: allow 28 days for delivery

Radio part two

In the second part of this article Ian Sinclair describes the operation of tuned-radio frequency (TRF) and superheterodyne (superhet) receivers, and how signals are demodulated. He also looks at a practical radio

WE ENDED LAST MONTH having described what happens when a charged capacitor is connected in parallel with a coil. **Figures 11a to 11f** are shown again this month to remind you of how the see-saw action described in the first part takes place. The kind of waveform you would obtain if an oscilloscope was connected across the circuit is shown in **Fig. 11g**. The important point is that this circuit has generated a signal at a frequency which is set by the coil and the capacitor. This frequency is called the *resonant frequency*, and its importance is that it is the *natural* frequency of oscillation of this circuit. We can make this circuit into a continuous generator of oscillations simply by continually replacing the small amount of energy which is lost because of the resistance of the coil.

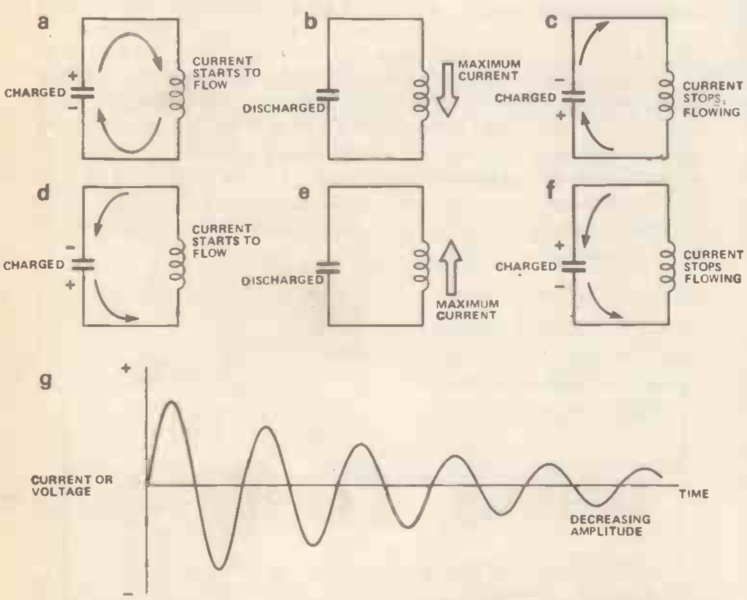


Figure 11. A charged capacitor in a resonant circuit. Figures 11a to 11f show how the charge produces a current which then charges the capacitor in the opposite direction, reversing the current until the charge is almost at its original value

From the point of view of radio reception, the interesting action of this circuit occurs when we try to feed a signal into it, as in **Fig. 12**. If the signal that we feed in is at the same frequency as the natural or resonant frequency of the coil-capacitor circuit, then the coil and capacitor will resonate — currents will start to circulate to and fro until there is a comparatively large amount of signal present, keeping in step with the input signal. If we feed a number of different signals into this circuit, the only one which will have any effect will be the signal whose frequency is the same as the resonant frequency of the coil and capacitor combination, which is called a 'tuned circuit'. The action can be neatly illustrated practically by the circuit shown in **Fig. 13**. The signal generator supplies signals at a constant amplitude, but at a frequency which can be varied. The oscilloscope detects the amount of signal across the tuned circuit and as the frequency of the signal generator is altered, the amplitude of signal across the resonant circuit rises to a peak and then falls again. What is happening is that the resonant circuit responds mainly to that frequency represented by the peak of the graph. It is as if the circuit had a high resistance for the signals at the correct frequency, but a low resistance for all other signals. It is called the 'dynamic resistance' of the tuned circuit.

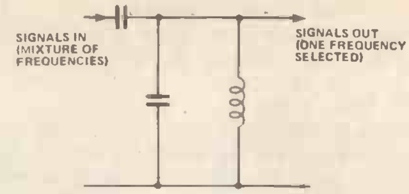
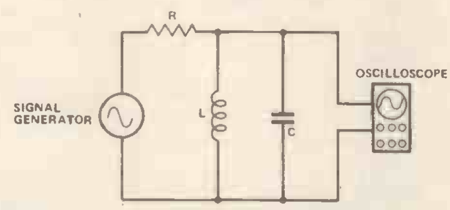


Figure 12. Feeding a signal into a parallel resonant tuned circuit



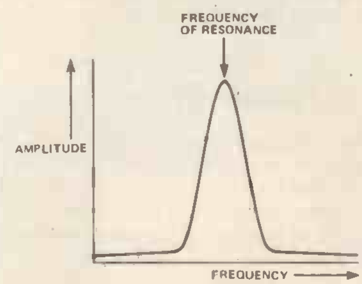


Figure 13. Experimental method (a) of observing the action of circuit in Fig. 12. The frequency of the signal from the signal generator is varied, and the amplitude of the output measured on the oscilloscope. The resulting graph (b) has a steep peak at the resonant frequency

You can see that resonant or tuned circuits allow us to sort out one frequency from another, and we can alter the frequency of resonance either by altering the capacitance or the inductance value (see **Fig. 14**), which is what we do when we tune a radio. The trouble is that one tuned circuit isn't selective enough to sort out the signal from all the nearby signals that exist on the crowded airwaves these days. In the days when there were only two or three transmitters on the whole of the medium-wave band around (550 kHz to 1.3 MHz) one tuned circuit was sufficient.

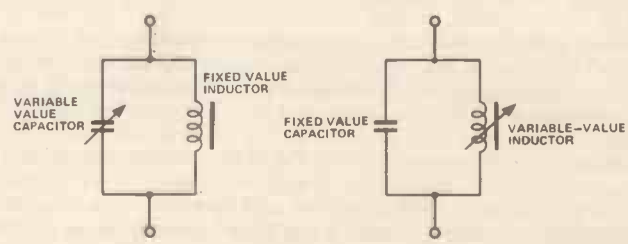


Figure 14. Varying the tuning. This can be done using (a) a variable capacitor or (b) a variable inductor

Adding Extra Stages

The obvious solution is the one that was used in the early days of radio; that is, to have several resonant circuits, each with variable tuning. The arrangement shown in **Fig. 15** is of a tuned-radio-frequency (TRF) receiver, the type used in the 20s and 30s, and still built even today. There are two tuned circuits, each tuned by a variable capacitor. The circuit can be tuned with one control because the variable capacitors are 'ganged' (connected to the same shaft so that both capacitors can be varied together).

The TRF receiver with one stage of (valve) amplification was such an improvement over the single tuned circuit receivers of the day that its development resulted in more receivers being sold, so that more transmitters opened up to fill the demand for radio broadcasting. Soon it became painfully obvious that two tuned circuits were not enough to separate the signals from transmitters that were on frequencies close to each other. The obvious step was to add another tuned circuit and another stage of amplification, but this turned out to be much harder. The snag this time was instability. With three tuned circuits and two stages of amplification, the slightest amount of signal fed back from the final amplifier to the aerial would cause oscillation. This not only caused the receiver to make unpleasant squealing noises, but it also interfered with other receivers around making the TRF receiver a thoroughly unpopular device.

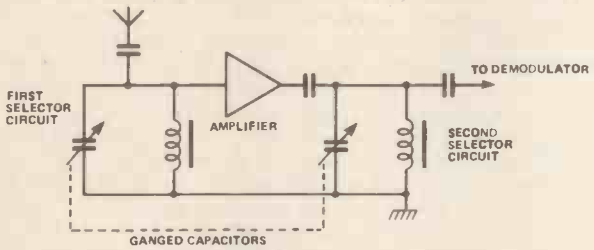


Figure 15. Outline of a TRF receiver. The signal is tuned, amplified and then selected by another tuned circuit

Supersonic Heterodyne

The answer lay in a different approach to receiver design, pioneered by the American engineer Edwin Armstrong. It was Armstrong's proposal that the first stage of a radio should be a frequency-converter, changing the frequency of the wanted input signal into a fixed frequency, the intermediate frequency (IF). Most of the amplification and selection could then be applied to this signal, with no need for variable tuning at this stage. Because there was no need to vary the tuning of the IF signal stages once set at the factory, the tuning components could be contained inside metal boxes, discouraging feedback of signals. In any case, feedback of signals to the aerial could cause few problems because the intermediate frequency was not the same as the frequency being received.

Armstrong called the principle the Supersonic Heterodyne — supersonic because the intermediate frequency is well above the highest frequency of sound we can hear, and heterodyne because this is the name for the action of mixing two frequencies together to produce one which is the difference between them (it's very similar to modulation). The name was soon shortened to superhet, and both the name and the principle have been the backbone of radio receivers ever since.

The arrangement of a typical modern superhet receiver is shown in Fig. 16. The tuning control affects two stages, the input tuned circuit, whose coil is the one around the ferrite rod itself, and the oscillator, which generates a signal at a frequency 465 kHz higher than the frequency to which the input is tuned. The mixer stage is the heterodyne part of the receiver. One input to the mixer is from the aerial, and consists mainly of the wanted signal together with signals at the frequencies close to the wanted one. The other input to the mixer is the oscillation at a frequency 465 kHz higher than the wanted signal. This oscillation is a sinewave, with no modulation, and as an economy measure is usually generated by having the mixer operate as an oscillator rather than having a separate oscillator stage.

Let's assume, for the sake of an example, that the wanted signal is at a frequency of 1 MHz. The oscillator signal then has to be at 1.465 MHz, and the signals from the output of the mixer will be at these two frequencies, along with a 465 kHz signal (the difference between 1.465 MHz and 1 MHz) and a 2.465 MHz signal (the sum of 1.465 MHz and 1 MHz). From this mixture it is easy to separate the lowest frequency signal of 465 kHz which, because of the action of the mixer, is modulated in exactly the same way as the original 1 MHz at the input. This 465 kHz intermediate frequency can then be amplified, using several tuned circuits set permanently at 465 kHz to make sure that the bandwidth is narrow enough to avoid interference from transmitters broadcasting at frequencies close to the one we want.

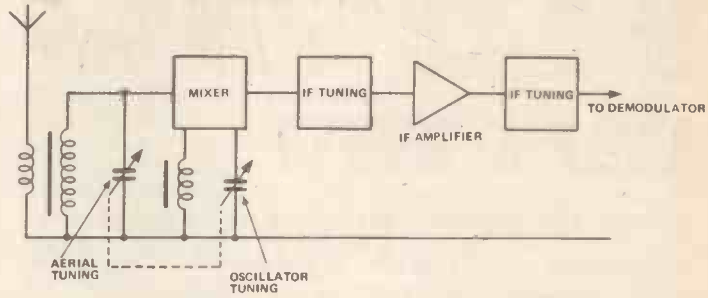


Figure 16. Block outline of a superhet receiver. The signals from the aerial are filtered by the first tuned circuit to select just a few. These are mixed with a sinewave from an oscillator. The mixing generates an intermediate frequency, which can then be amplified and selected by several tuned circuits. A much narrower bandwidth can be selected and much more amplification can be used than with a TRF receiver

When the tuning control is altered, the ganging of the variable capacitors ensures that the oscillator tuning is also changed, keeping the oscillator frequency 465 kHz above the signal input frequency and ensuring that the IF remains constant. Using the superhet principle then, we can have plenty of amplification and many tuned circuits without the risk of the oscillation which always haunted TRF receivers. The superhet principle is used, not surprisingly, for all types of receivers ranging from the humble medium-wave tranny to the early-warning radar receiver and — yes, your TV as well.

Extracting The Original Sound

No matter how much tuning and amplification you apply to a radio signal, it's still a radio frequency signal which, because of its modulation, is continually changing in amplitude. Loudspeaker cones cannot vibrate at the frequency of a radio signal, whatever its amplitude, and even if they could we would not be able to hear the sounds. We need some method of extracting the audio frequency signals from the modulated radio frequency (or more correctly, since we invariably use a superhet, IF) signal. The method of extraction is called demodulation, and for amplitude-modulated signals it almost invariably takes the form of a diode demodulator.

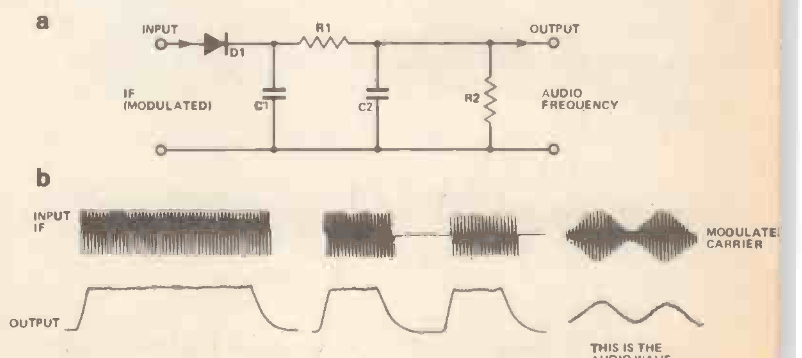


Figure 17. Diode demodulator (a) with the waveforms (b) produced by various inputs at IF

A typical diode demodulator circuit is shown in Fig. 17. The important components are the diode D1, the capacitor C1, and the resistors R1 and R2. The action is a combination of rectification and charge storage. To understand what happens, you need to know that the time-constant of C1 with R1 and R2 is greater than the time between IF waves, but is much shorter than the time between AF waves. This means that the voltage across the capacitor C1 will not change noticeably when the diode is cut off during the negative cycle of the IF, but will fall fast enough if the diode does not conduct for several IF cycles. If the amplitude of the IF was steady, C1 would charge up to the peak voltage of the IF and stay at that voltage with the diode conducting only at the peak of each wave to keep the capacitor charged, compensating for the loss of charge through R1 and R2. The amplitude of the IF is not steady, however, when the signal is modulated: it is changing at an audio frequency rate, and the voltage across C1 will alter at the same rate because the time-constant of C1 with R2 and R3 is not long enough to keep C1 charged for the time of one audio frequency wave.

You might gather from all this that the values of C1, R1 and R2 are fairly critical, and you'd be about right. Only about right, mark you, because there is a reasonable bit of leeway. You see, the IF for an AM radio is 465 kHz, which means a time of 2 microseconds (2 us) between wavepeaks, but the highest audio frequency we can transmit on the crowded medium wave is 5 kHz, a time of 200 us between peaks. We only have to choose a time-constant which is greater than 2 us and less than 200 us and we're there. In practice, we usually make the time-constant on the small side, and then smooth out the waveform with an additional capacitor (C2 in **Fig. 17**).

What we have now is a demodulated signal which we can amplify and use to operate a loudspeaker. This signal consists only of positive voltages when the circuit shown in **Fig. 17** is used, because of the diode, so that a DC voltmeter connected across C2 would read a positive voltage whenever a signal, *modulated or not* was received. We make use of this DC signal as well. The amplitude of the carrier signal from a radio transmitter, unless the receiver is very close to it, is seldom steady. This is because radio signals are reflected from the ground, from large metal objects and, most important, from a layer of charged particles called the ionosphere (see **Fig. 18**) well above the Earth's atmosphere (at a height of 30 to 150 miles). Unless you are very close to the transmitter, a fair proportion of the signal that you receive will have bounced from this layer, and what reaches the aerial of the receiver depends on how far the reflected wave has travelled. If the reflected and a direct wave (**Fig. 19a**) from the same transmitter reach the receiver in phase (their peaks coinciding), then the two waves add to give a stronger-than-normal signal. If the reflected wave has to travel just a half a wavelength more or less, however, the waves that reach the receiver will be in *antiphase* (**Fig. 19b**) and the resulting signal will be much smaller. If the signal wavelength is 300 m, for example, then a half wavelength is 150 m, and the reflected wave would travel this much more or less if the ionosphere moved by just 75 m, which isn't much. Needless to say, the reflecting ionosphere, being a layer around the spinning earth, is continually moving so that the radio signals are continually changing in amplitude.

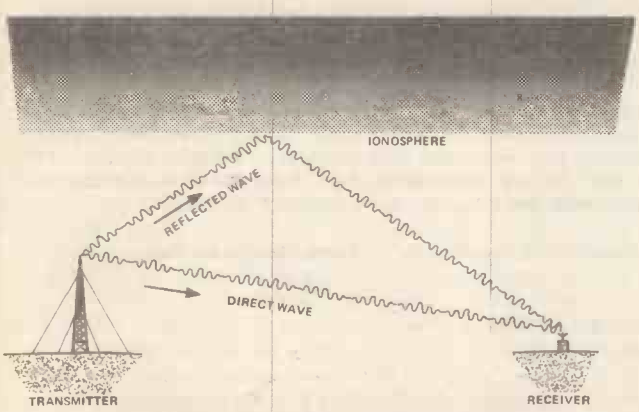
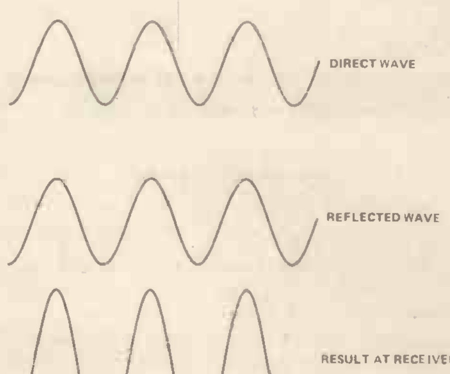


Figure 18. How reflections from the ionosphere cause more than one signal from a given transmitter to reach the receiver (not to scale)

a



b

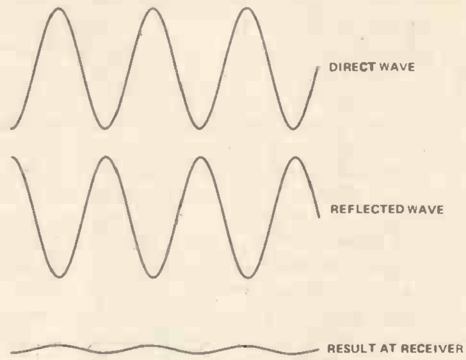


Figure 19. Direct wave and reflected wave add in phase (a), so that the signal at the receiver is stronger than normal. The two waves cancel in antiphase (b above right), so that the signal at the receiver is much weaker than normal

Automatic Gain Control

This would make the reception of all but the nearest radio stations useless if it were not for that DC voltage at the demodulator! As the signal strength fades, so the DC voltage (which has nothing to do with the modulation, remember) drops, and we can use this DC voltage to control the gain (amplification) of the IF amplifier or amplifiers of the receiver. By doing this we step up the gain when the signal strength is small, and step it down again when the signal strength is high, compensating for the continual changes in strength. Only if you have attempted to listen to a radio in which this feature, called automatic gain control (AGC) has been switched off, can you appreciate how useful it is!

Practical Receiver

Having been over the sections of an AM radio receiver, we need to finish off by looking at the complete circuit. **Fig. 20** shows a typical pocket tranny circuit, medium wave only for simplicity, which we can use to illustrate the circuits used.

Inductor L1 is the main tuning-coil wound on the ferrite rod that acts as an aerial. This coil is tuned by the variable capacitor VC2, part of a twin-gang arrangement (indicated by the dotted lines), and by a 'trimmer' capacitor VC1 which is set at the factory. The signal we want to receive will be across the ends of L1, but connecting a circuit to L1 will disturb the tuning so we use a separate winding, L2, of fewer turns than L1. The two windings act like the windings of a transformer so that L2, with fewer turns, has a lower voltage signal than L1, but one which can provide more current into the base of Q1.

Transistor Q1 is the mixer/oscillator. The signal from the ferrite-rod aerial is fed into the base of Q1, along with the DC bias current from R1. The emitter, however, is connected to the coil L4, which is coupled to the coil L3 in the collector circuit. These windings are arranged to provide positive feedback so that Q1 oscillates, and the frequency of oscillation is set by the tuned circuit comprising L4, VC4 and VC3. Variable capacitor VC4 is the other section of the ganged tuning capacitor, and VC3 is another trimmer capacitor, preset so that there is a 465 kHz frequency difference between the input signal and the oscillator frequency all over the range of tuning.

The IF is extracted from the mixture of frequencies by using IFT1, which is tuned to 465 kHz. The secondary winding of the transformer passes the IF signal to Q2, the IF amplifier, biased through R3. A second IF transformer IFT2 keeps the bandwidth

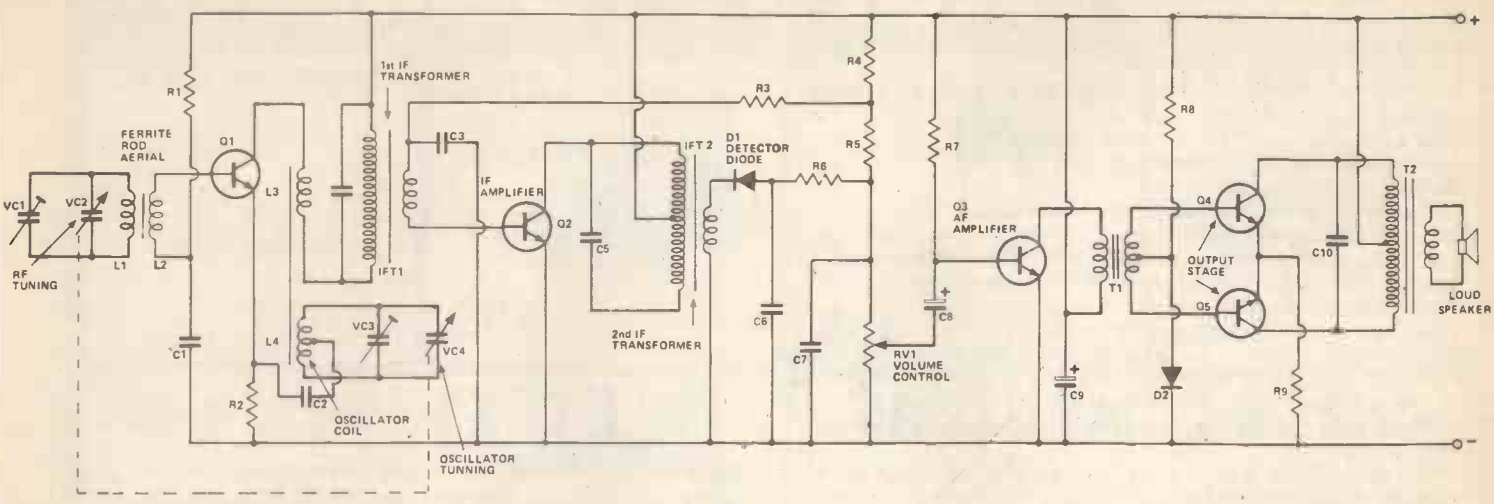


Figure 20. Typical portable transistor radio receiver (medium wave only)

narrow, at about 5 kHz, and its secondary winding provides a signal to the demodulator diode D1. The DC which is present as a result of demodulation (negative in this example, because the anode of D1 is connected to C6) changes the voltage at the point where R3, R4 and R5 join, and so changes the bias on Q2.

Because the gain of a transistor amplifier depends on the amount of current that flows through the transistor, the whole arrangement constitutes a simple form of AGC. Capacitor C3 has a large value and thus removes any traces of audio modulation from the AGC voltage. The rest of the circuit is now plain sailing — a volume control, an output stage, a loudspeaker, and that's your AM radio.

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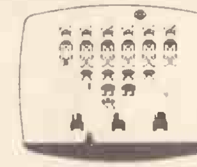

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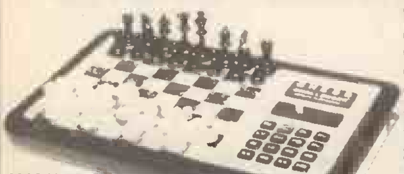

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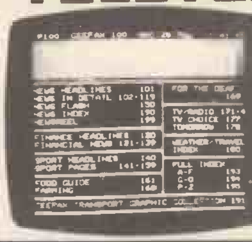

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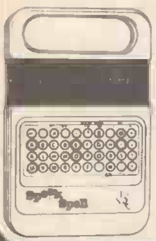

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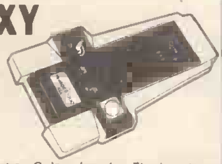

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The price of £135 (inc. VAT) includes the machine, an extra-light remote call-in Bleeper, the microphone message tape, A/C mains adaptor. The unit is 9¾"x6"x2½" and is fully guaranteed for 12 months. The telephone can be placed directly on the unit — no additional desk space is required.

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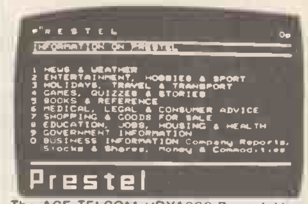

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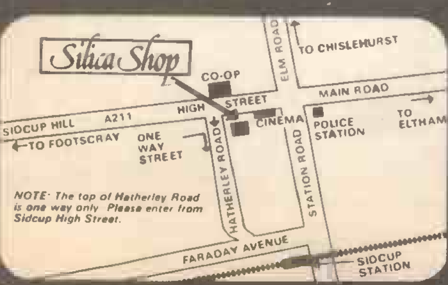

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GADGETS GAMES & KITS

Two do-it-yourself kits are featured in this month's GG&K. The first is the Sinclair ZX81 microcomputer – now available in kit form. The second is SoundLink, supplied as two modules from IMP Electronics. When built up, it couples your hi-fi system to an extension speaker – without trailing wires. We also review the Chess Partner 2000 game.

ZX81 Kit Review

In Monitor in the May '81 issue of HE we described the ZX81 microcomputer from Sinclair Research, launched in March as successor to the well-established ZX80.

Although it was said at the time that the ZX81 was available ready-built or as a kit, we had to wait some weeks before one of the first kits was available for review in GG&K.

At last it arrived, complete with mains-plug-mounted power supply. (This power supply is normally only supplied with the ready-built ZX81.)

Contents Of The Kit

The kit comprised separate bags of components (resistors, capacitors, discrete semiconductors and fittings), with the ICs and IC holders plugged into a protective strip of conductive foam plastic. All discrete components came with pre-formed leads, which took the pain out of bending and lining up the leads with the holes in the board.

Component numbers and outlines were clearly printed on the PCB. The underside of the PCB was coated with green solder-resist, which cut down the risk of bridged tracks by confining applied solder to the exposed pads. To aid checking of the layout, a blown-up drawing of the printing on the component side of the PCB was included on the instruction sheet.

Remaining items in the kit included the case halves, keyboard strip, connecting leads with fitted plugs and operating manual.

Documentation

We found the instruction sheet (fold-out A2-size) easy to follow.

The section on Preparations gave details of where you should build your kit ('. . . a clean, dry and well lit workspace') and a list of the tools and other items you were likely to need. Under the heading Precautions you were advised on how to treat your ICs; that is, to be careful to avoid static electricity discharges during handling. Sections on Component Identification, Circuit Board Assembly and Case Assembly were accompanied by some helpful line drawings.

To avoid any confusion, we took the step of adding three component changes given on a separate errata sheet to the main component list.

After reading the instructions carefully (as recommended in bold

letters at the top of the sheet) we were ready to start assembly.

Down To Business

In true hobbyist style, the kit was assembled on the kitchen table (within easy reach of a supply of coffee). To aid identification of the components (and to avoid losing any), the small packet of discrete components was tipped into a handy saucer.

After all the resistors had been inserted and soldered (we appreciated those pre-formed leads), it was found that a horizontal-mounting 1k0 resistor had been supplied instead of a vertical-mounting one. With a little improvisation it was found possible to nudge the resistor supplied into the PCB. As a prize, one spare 680R resistor was left in the saucer.

The remainder of the components were inserted into the board and the only problem experienced was with the regulator IC. When its leads were bent as instructed, it didn't line up with the holes in the board. It was necessary to bend the leads very sharply in a zigzag fashion to enable the regulator to be dropped into place, which could result in lead fracture for the unlucky constructor.

As recommended under the instructions for Testing, the board was checked very thoroughly and all components were checked back against the list.

All that remained was to connect the keyboard 'tails' to the edge connectors on the PCB. Some difficulty was found in inserting the narrower of these two tails into its socket, possibly because the socket was slightly distorted. These tails, carrying flat conductive ribbons on thin plastic tapes, are very fragile.

On Test

After three or four hours of soldering and coffee drinking, we considered that the PCB with keyboard attached was ready for testing. Because all the sockets are mounted on the board, it was only necessary to link the PCB to the aerial socket of a TV receiver and to the power supply.

Mains was applied to the power supply and a furtive search was made with the TV tuner to find the signal produced by the modulator mounted on the PCB. Suddenly the picture synchronised and went white — all except for a black letter K in the left-hand corner of the screen. A few tests proved that our kit worked first time.

It was noticed while the PCB was exposed during the test that a fair amount of heat is produced by the ICs. Perhaps this is not surprising since the specification for the power supply is given as 12 V maximum and about 8 V minimum (depending on smoothing), with current consumption not less than 600 mA. (This increases to 1.2 A if the printer — yet to become available from Sinclair Research — is run from the same supply.)

Tidying Up

The final job was to insert the PCB into its case, stick the keyboard in place (its underside is self-adhesive), link up the keyboard tails again and bolt the whole lot together.

Comment

Construction of the kit shouldn't be too difficult for those of our readers who have already had some experience with PCB construction and who take heed of the special precautions required when handling the ICs.

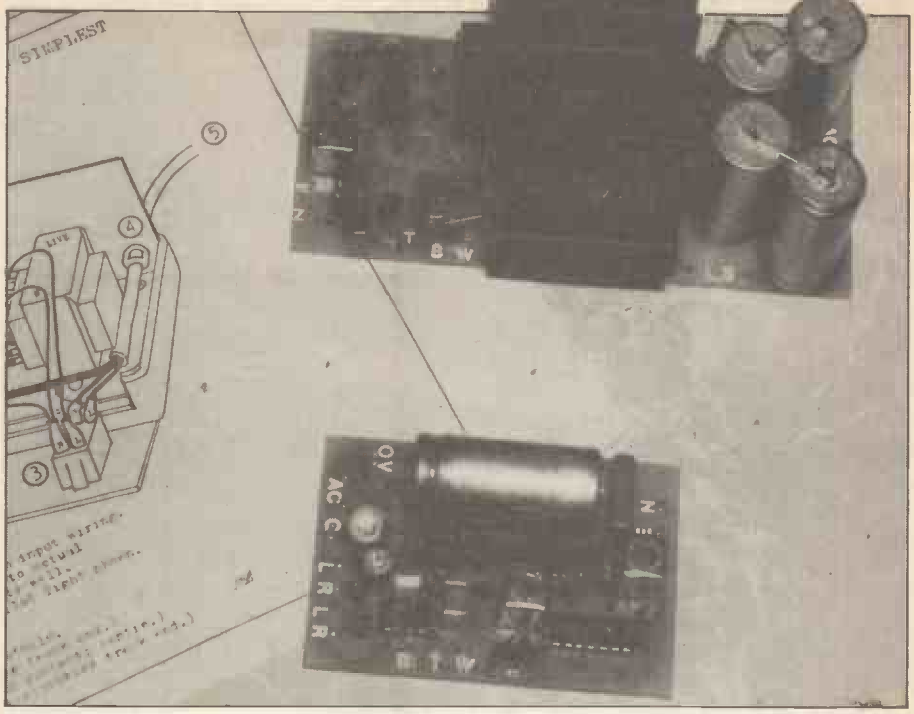
The penultimate section on the instruction sheet deals with fault-finding, and perhaps the best advice given is to 'check it again' if it doesn't work first time. Sinclair Research Service Department will repair completed ZX81 kits . . . for a fixed fee of £10. In exceptional cases, say if the ICs have been damaged by being inserted the wrong way round, there may be an additional payment. If the trouble is traced to faulty components then the full service fee is refunded. You can see why there is a need for careful checking!

The only niggle we had with the finished computer was about its keyboard. It is a compromise between a touch-sensitive keyboard and a switch-operated one: definite pressure is required to activate each key but there is no accompanying 'click' or 'bleep'.

On the other hand, at £49.95 for the kit (power supply £8.95 extra) or £69.95 ready-assembled (complete with power supply) there is a limit to what you can expect.

In a future GG&K we will comment on how we found the ZX81 to use and to program. We also hope to review the 16K plug-in RAM memory available for use with the ZX80 and the ZX81. And we hope to try out the printer, scheduled for launch in June 1981.

Extend Your Hi-fi . . . Without Wires



Fitting an extension speaker to your hi-fi system can present problems, either because of the need to route wires around the house or because of the electrical connections you must make to the system. With such difficulties in mind we looked at SoundLink, a system which couples your amplifier to an extension speaker through the house's existing *240 V ring main circuit.*

Soundlink comes as a kit comprising two ready assembled, prealigned printed circuit boards (PCBs), together with detailed layout, wiring and setting up instructions. Additional components are required, however, such as two 240 V/12-0-12 V transformers, switches, potentiometers, sockets, 13 A 3-pin plugs, an extension speaker and so on.

As the two PCBs form two separate units, and it is necessary to make connections to the 240 VAC mains from each, it is essential for safety reasons to house both in suitable boxes. The instructions suggest that the output module can be fitted inside the enclosure of the speaker it is driving, and this can save on outlay.

How It Operates

The input module is connected to the 'tape record' socket of an audio amplifier. When the input module is coupled to the AC mains it inserts a low-level high-frequency signal between the neutral and earth lines. The output module, coupled to a distant power point in the house, detects and demodulates this signal and amplifies it to drive the extension speaker. An output power of around 10 W is available from the output module.

How We Assembled It

We built the input module into a case (cost around £4) from Vero Electronics. For the purpose of the test, the output module was mounted on a wooden board, with an aluminium panel fitted on one side. We found the instructions easy to follow and the drawings were of assistance in the layout of components. All connection points were printed clearly on the PCBs.

How It Worked

The SoundLink system was tested on two different hi-fi audio systems. Each amplifier was found on have a different tape output signal voltage. A small sensitivity switch is fitted to the input module PCB and this, together with the volume control, allowed the correct signal level to be set for each. If the volume control on the input module was advanced too far, then the sound from the extension speaker became distorted. Setting the control too low resulted in excessive background hiss.

It was also found necessary to trim the preset potentiometer on the output module to prevent distortion caused by the unit being de-tuned from the incoming signal. This trimming was critical.

With a good quality record deck as the signal source, and a three-unit, medium-sized enclosure as the extension speaker, the sound output was reasonable though not quite as good as that produced from the directly-coupled speaker. With the volume turned up high on the output module, and in the absence of a signal, a background hiss along with any severe bursts of mainsbourne interference (deliberately injected for our tests) could be heard.

Is It Worth The Cost?

The two SoundLink modules cost £45.50, including VAT and post and packing. As mentioned, it is necessary to buy additional hardware which could, we estimate, add between £10 and £20 to the cost. You have to weigh this against the convenience of being able to site an extension speaker wherever there is a ring main socket in the house. This flexibility has obvious advantages for events such as parties (no leads to trip over) or more permanent installations such as in bedrooms or workshops.

Our test was a critical one, using hi-fi equipment. When a 'bookshelf' loudspeaker, with not quite the dynamic range of the much larger three-unit speaker system, was coupled to the output module the sound produced was very pleasing. It is envisaged that the extension speaker used with SoundLink is likely to be of the bookshelf type.

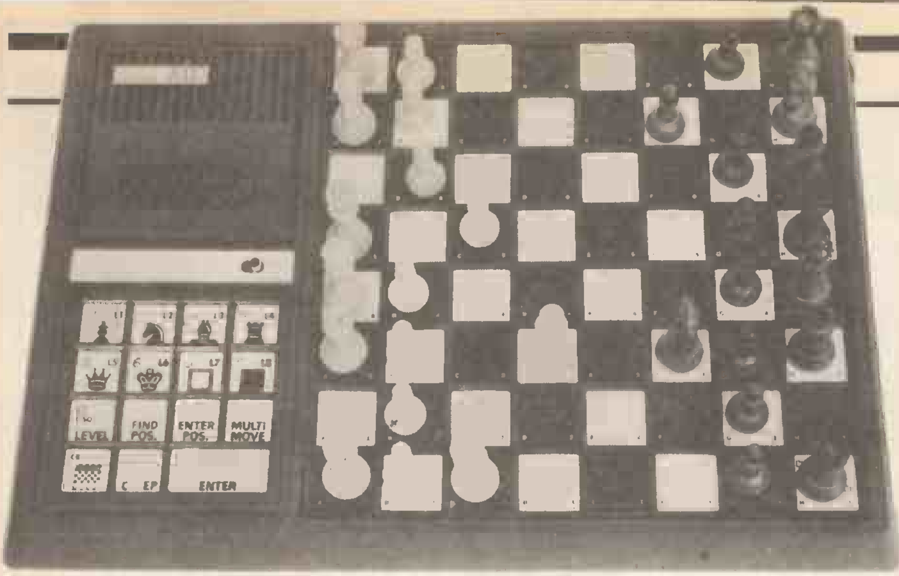
SoundLink is supplied by IMP Electronics, 34 Caraway Road, Fulbourn, Cambridge CB1 5DU (tel 0223 881105).

Chess Partnership

Here is yet another edition to the Chess Computer family. It is of the larger table-top variety and comes complete with mains adaptor for £77.50.

This innovative machine, called the Chess Partner 2000, works using sensors. This means that the moves are communicated to the computer by the pressure of the pieces on the squares of the chessboard as you play. The chess pieces for this game are of more or less normal size and have a reasonably attractive finish, as does the board and case.

Among the capabilities of the Chess Partner 2000 are eight levels of skill which can be changed at any point during the game, and a multi-



move key for setting up book openings as well as a simple way of setting up and verifying any position. It will also castle, make en passant captures and will play against itself. Sounds impressive doesn't it? So how does it work?

Setting up the board for a standard game is quite simple: you just press a button and the computer locks in. You then choose your level — if you don't, it will automatically play you on level 1, the simplest level. The first move, being white is yours, so you make it by pressing your piece on its original position until you hear a bleep, and then you move it, pressing again on the square. When you're satisfied that it's the right move you press ENTER on the keyboard and the computer will display its move. You must carry this out pressing the squares again, but you *don't press ENTER* for the computer's move. This is how it's done. Quite simple, you might think.

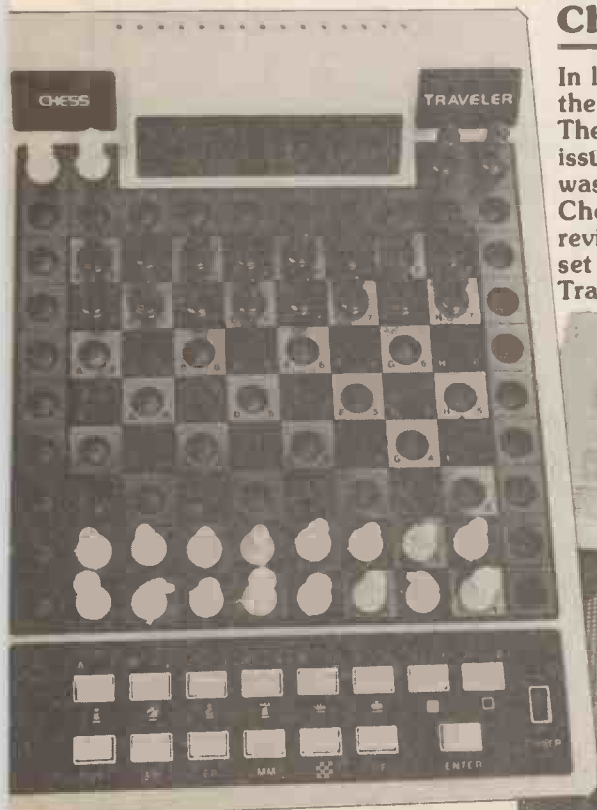
The complications set in after the first few moves. When a piece is taken you must press *twice* on the square which the piece has been taken from or chaos ensues, as it will do if you accidently press ENTER on the computer's move, as pressing this key also changes the side the computer is playing on! This can be very confusing as the computer doesn't actually display the side it's playing on, on the LED readout.

Castling can be equally as bewildering, as you must press the four squares in exactly the right sequence — the machine will bleep its discontent at you until you do. If you accidentally make an incorrect move you must repeat it backwards to clear the display before you try it again. It is unfortunate that there is no CLEAR ENTRY key, particularly useful when you're making a mess of castling and you feel like throwing the machine against the nearest wall!

In summary, this isn't really the right machine for a beginner, as it is an art in itself to master the idiosyncrasies of the machine before you can even contemplate playing chess with it. However, the fanatical chess-player would find it a great machine once the controls are mastered as it has eight brain-boggling levels to choose from. It is unfortunate that it doesn't have a built-in printer on the machine as, to avoid confusion, it's always useful to have notes of the moves that you are making.

Chess Boob

In last month's GG&K we reviewed the Chess Traveler (see Moves On The Move on page 37 of the June issue). The game shown, though, was *not* the Chess Traveler but the Chess Partner 2000, which is reviewed in this month's GG&K. To set the record straight, the Chess Traveler is shown below.



Both games are available from Silica Shop Limited, 1-4 The Mews, Hatherley Road, Sidcup, Kent DA14 4DX (tel 01 301 1111 or 01 309 1111).

Coming Kit Review

We received a sample of Adventures With Microelectronics, a kit from Unilab which teaches you about electronic devices and how they are used in circuits.

A quick look in the box and in the accompanying instruction book revealed that you can build a variety of different projects on Bimboard (no soldering required), ranging from simple logic circuits to a medium wave and long wave radio receiver.

We hope to review this kit in the August GG&K supplement.

Building Site

Keith Brindley gives more hints and tips on project construction

A QUICK LOOK at the projects in any issue of HE will show you that a project can be in one of two groups: mains- or battery-operated. A small project, such as this month's Ultrasound Burglar Alarm or the Treble Booster, requires only a low-voltage, small-current supply, and a battery is an ideal power source. On the other hand large projects, such as the Power Amplifier or the Organ, require a relatively high-voltage, large-current power supply and usually the only way to provide this is through the use of mains electricity.

Used properly, mains allows a convenient and, in the long run, cheap source of power — you don't need to keep changing batteries every so often. But, I'm sure I don't need to stress that, *handled incorrectly,* mains can be dangerous — *it can kill!* Whenever you use mains, the moral is to use it carefully and correctly.

Getting It In

One of the places where a problem can arise is the point where the mains cable gets into the project — normally through a drilled hole in the back panel of the case. Cable should never be allowed to go through an unprotected hole, because the sharp edges of the hole will rub against the cable and, through time, will cut the cable's insulation until the inside mains-carrying wires become exposed. At best, a fuse will blow but at worst, *part or all of the project will become live.*

Various methods of protecting the cable at this point exist and I've selected a few for you to look at. The simplest (and cheapest!) is a rubber grommet (see **Fig.1**) which pushes into the drilled hole before you feed the cable through. To prevent the cable from being pulled out, fasten a plastic cable tie tightly round it.

Secure And Safe

Plastic strain relief bushes, clamps or glands such as those shown in **Figs.2, 3** and **4** are available which clamp the cable securely while simultaneously preventing rubbing. The sort shown in **Fig.2** are very cheap — only a few pence each — but are quite fiddly to use. They nevertheless do their job well. The bush is in two parts connected by a thin plastic tie. The two parts are clamped together, with a cable in between, and the bush is pushed into the drilled hole. The outside ridge of the bush engages with the inside edge of the hole and the bush is then securely held.

Figure 3 shows a slightly more expensive (but still costing no more than about 20p) device which is operated by a screw-adjusted clamp. We've used this in the Power Amplifier this month and it is a very successful and safe method. The beauty of it is that if you need to disconnect or adjust the mains cable you can do so easily.

Another type of cable clamp (about 30p per device) is shown in **Fig.4**. This is a plastic gland with a compressible rubber washer inside. At one end of the gland is a nut and bolt arrangement which fastens to the panel of the project. At the other end is a similar nut and bolt which tightens the internal rubber washer onto the cable (which goes through the middle of the gland). This variety again allows you to remove or adjust the cable if you wish.

Finally, if you feel like doing the job professionally, you can use a plug and socket arrangement such as that shown in **Fig.5**. Inevitably, the cost is higher — over £1 for the two parts. This method is useful if you have a number of items of test equipment and you only use a couple at a time. Because any mains lead with the socket on can fit into any chassis plug, you only need a couple of made-up leads.

Well, that's given you a few tips on how to do it properly, and above all, *safely*. I'll be giving some more advice on mains, in future Building Sites, but that's all for now. See you next month.

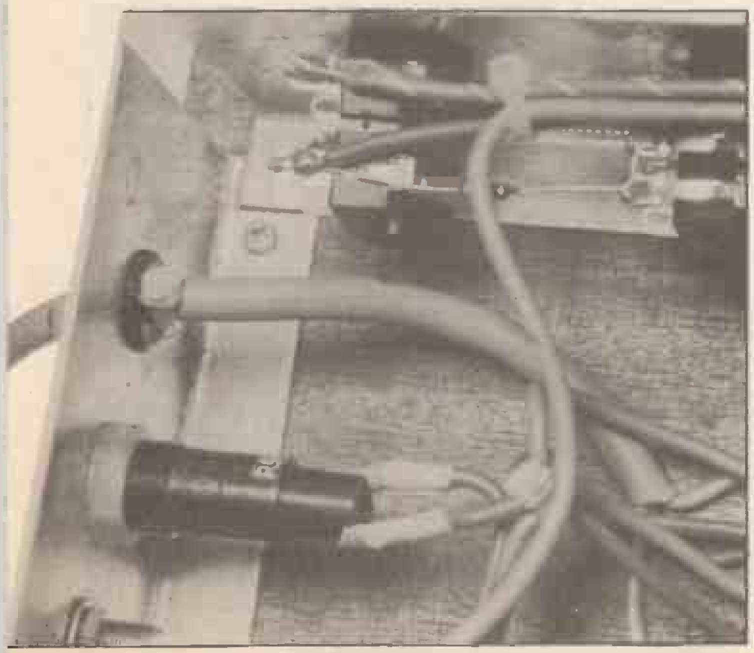


Figure 1. A rubber grommet used in the HE Electronic Organ. Note the plastic cable tie used to prevent the cable from being pulled out

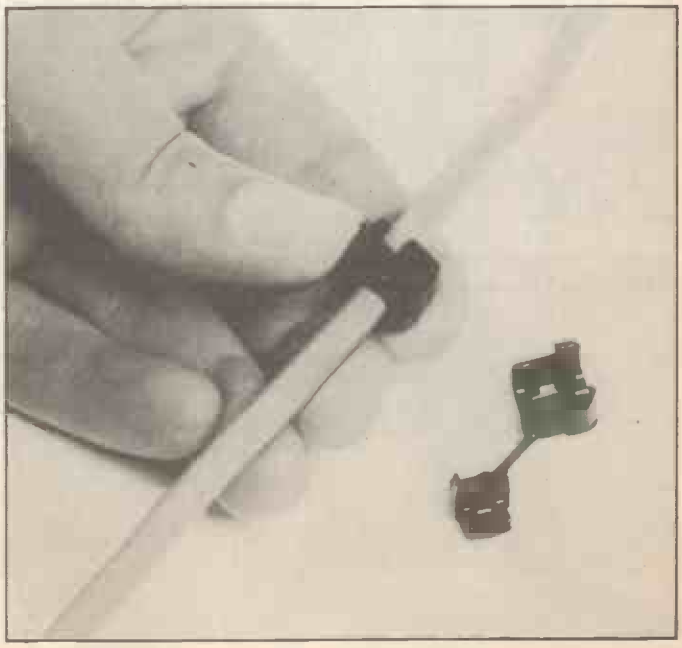


Figure 2. Two-part cable bushes. Once pushed into the drilled hole of a case, these bushes hold the cable securely

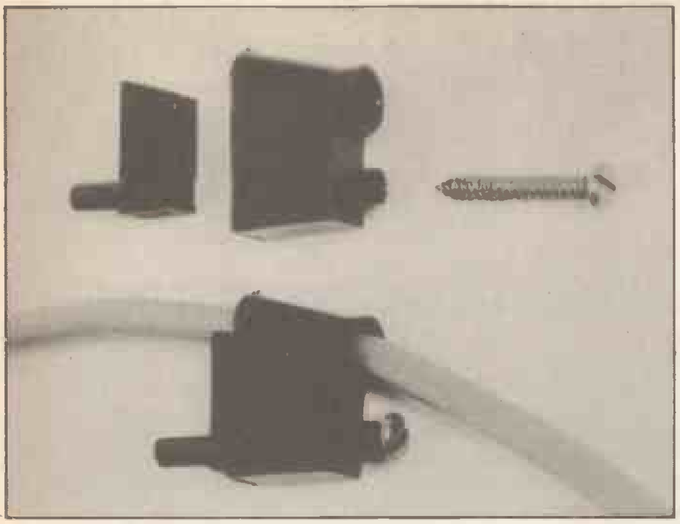


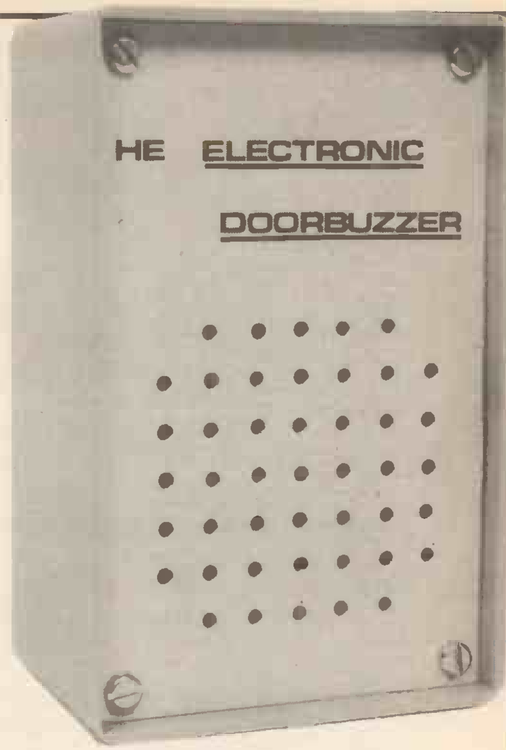
Figure 3. Screw operated cable clamps

Figure 4. Cable glands. The cable is tightly held by a compressible rubber washer inside the gland body

Figure 5. A mains plug and socket connector

HE

Electronic Doorbuzzer



This easily-built project for the home is an ideal alternative to the more expensive, commercially available door-chimes. Build it and it'll provide you and your visitors with a tremendous conversation piece!

ALTHOUGH AT FIRST sight an electronic doorbuzzer may seem to have no advantages over electromagnetic types, it will probably be more reliable and longer lasting. A further advantage is that you can build it yourself at low cost. Our electronic doorbuzzer produces a warbling tone that is quite attention-catching, but should not prove to be objectionable to other members of the household! For simplicity of construction and installation the HE Electronic Doorbuzzer is battery-powered, and a PP3-size battery should have virtually its shelf life (typically about six months or more) within the project.

Construction

Start construction with the Veroboard by cutting the tracks underneath the board, where shown in Fig. 2. Use a cutting-tool or a small (⅛") hand-held drill bit for this job. Hold the cutting edge onto the hole in question. Press gently and then rotate the tool or bit clockwise, until the coper track has broken in a clean-edged circle. Make sure no loose pieces of copper swarf bridge across to adjacent tracks.

Insert and solder all resistors and capacitors in the positions indicated in Fig. 2. Now solder in the IC socket, if you intend to use one, and transistor Q1. Push fit the IC into its socket (or solder it into the board).

Following the connection details of the project, wire-up the board into its box.

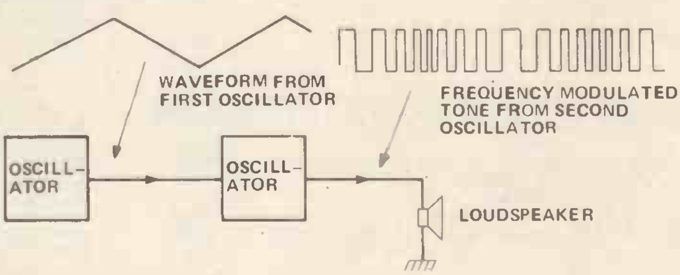
Glue the speaker to the rear of the front panel of the box, behind a grille of some kind. This can be a cutout with a piece of speaker fret fitted behind it, or a simpler solution is to drill a neat matrix of small holes. Make sure you don't get any glue on the speaker cone itself — only on the outside rim.

The hole for the lead to the bell push must be made in the casing, and it is a good idea to fit this with a small grommet which gives a neat finish and protects the lead.

Finally, mount the case securely to the wall where it is required, and wire it to the bell push.

How It Works

The circuit is based on two oscillators, one of which is used to produce the tone which is fed to the loudspeaker. The other is used to frequency-modulate the tone generator, and it is this variation in pitch that gives the warbling effect.



Integrated circuit IC1 is used as the basis of the tone generator, and it is a standard 555 used as a free-running oscillator. Capacitor C4 charges to about ⅔ of the supply voltage via R5 and R6, and then discharges down to approximately ⅓ supply by way of R6 and IC1. This process repeats indefinitely, with the main output at pin 3 of IC1 going high while C4 is charging, and low while it is discharging. The waveform produced here is fed to a loudspeaker which consequently emits an audio tone.

The ⅔ supply voltage threshold at which C4 starts to discharge is modified by applying a control voltage to pin 5 of IC1. When this voltage increases the charge and discharge times of C4 are lengthened, giving decreased operating frequency. As the voltage reduces the charge and discharge times of C4 also reduce, so that a higher operating frequency results. The tone produced by the second generator is therefore frequency-modulated by means of a control voltage applied to IC1 pin 5.

The warbling effect is obtained by using a control voltage that rises and falls a few times per second. The character of the output signal depends to a large extent on the waveshape of the modulating signal, and a waveform similar to a sawtooth is used in this circuit. This is of the type that rises fairly steadily in voltage and then suddenly falls back to its minimum level. This actually gives a steady decline in output frequency followed by a rapid return to the initial frequency although this action occurs too rapidly to be clearly heard, and a pleasant warbling effect is produced.

A unijunction relaxation oscillator is used to generate the modulating signal. Capacitor C2 charges through resistor R3 until a charge voltage of about 7 V is achieved, whereupon C2 rapidly discharges through Q1 and R2. Transistor Q1 then switches off, C2 commences to charge once again, and so on. R4 couples the output of Q1 to pin 5 of IC1.

Parts List

RESISTORS (All ¼W, 5%)

R1,R2	100R
R3,R5	10k
R4	27k
R6	82k

CAPACITORS

C1,3	100u, 10 V electrolytic
C2	4u7, 25 V electrolytic
C4	22n polyester

SEMICONDUCTORS

IC1	555 timer
Q1	2N2646 unijunction transistor

MISCELLANEOUS

LS1	miniature 40-80R loudspeaker
Veroboard	24 hole x 10 strip, 0.1" matrix

Case to suit
PP3-size battery + clip
Bell push and connecting cable

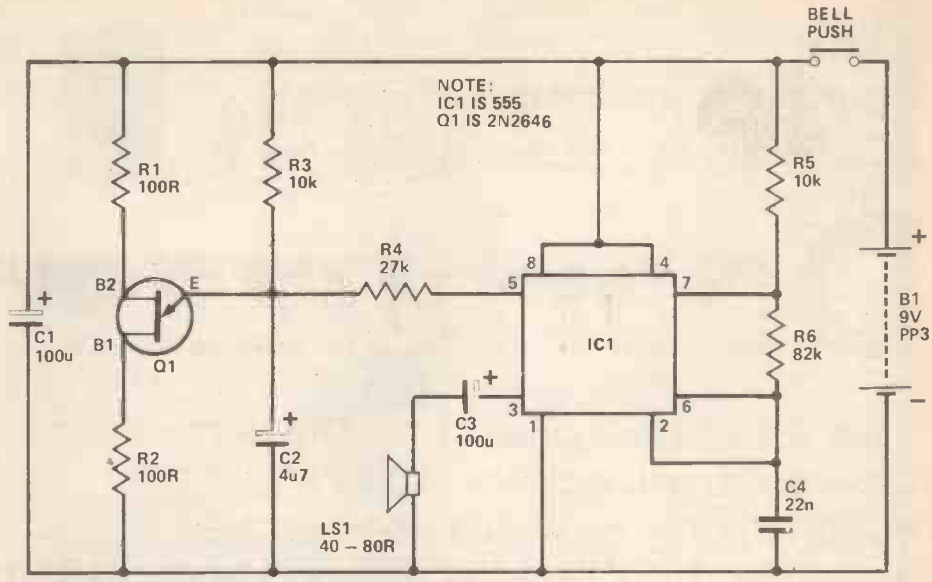
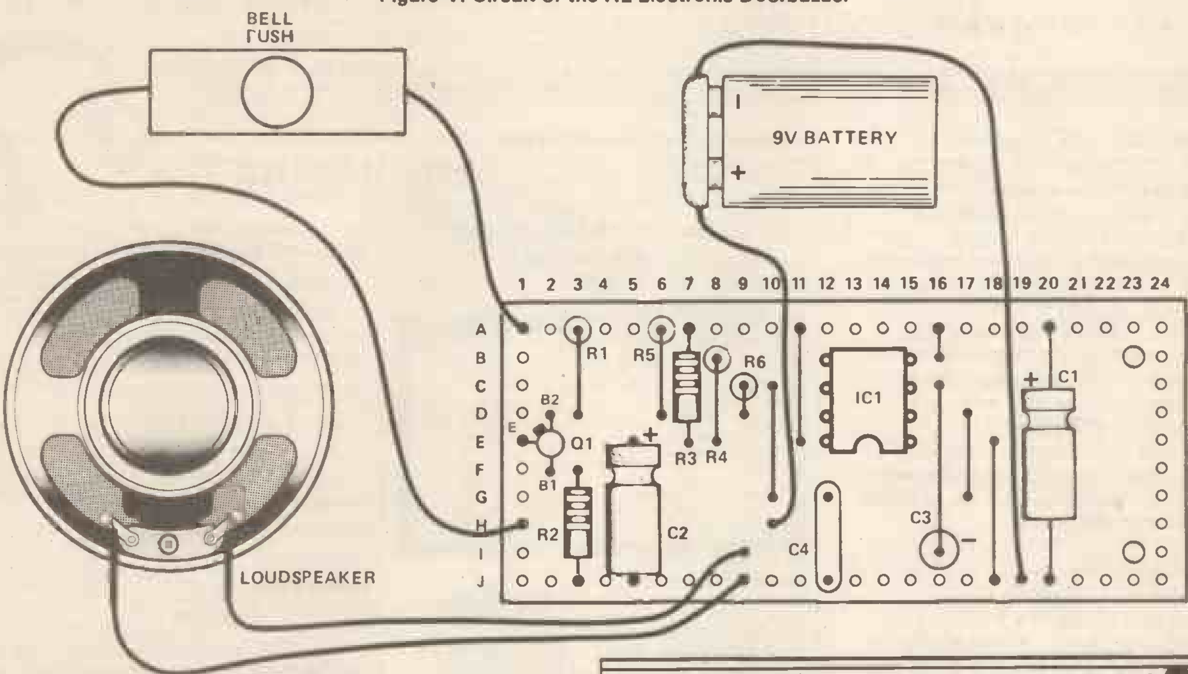
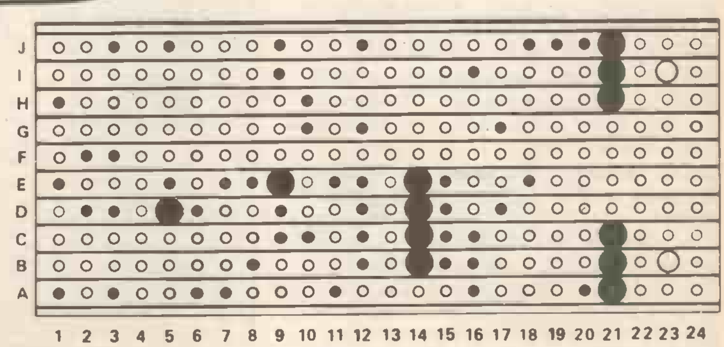


Figure 1. Circuit of the HE Electronic Doorbuzzer





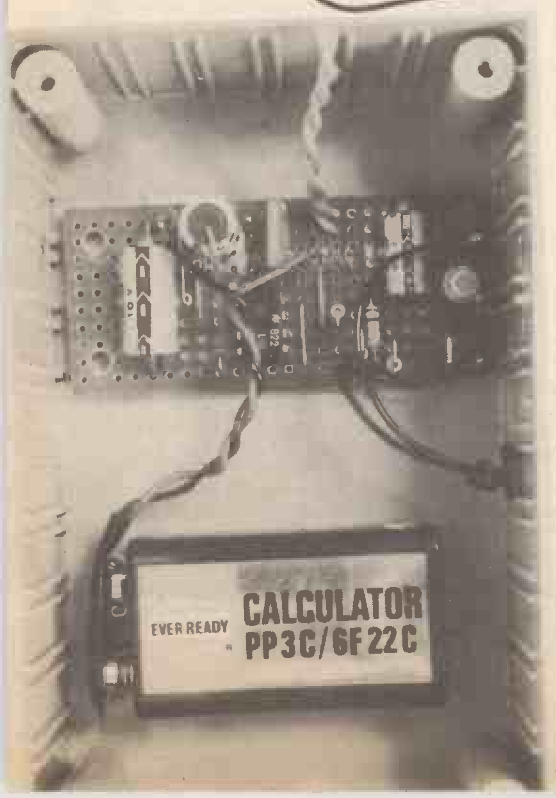


Figure 2. Veroboard overlay, underside track breaks and component locations, and connection details

HE

Buylines

The loudspeaker can be of any variety having an impedance between about 40 and 80R (low impedance types are not recommended), and types with a large-diameter cone are best if greater volume is required. The other components are all standard, readily available types.

Cost of all parts (excluding case and Veroboard) is approximately £4.

O Level Q&A

This month Nick Walton rounds off the series with a look at multivibrators and the storage of information in various ways, chiefly on disc and tape

MULTIVIBRATORS ARE A FAMILY of circuits whose importance has been much enhanced by the 'digital explosion' — that is, the huge increase in the use of electronic calculators, computers of all sizes and digital watches, all of which use the transistor as a switch and not as an amplifier. Hopefully when you have read this section you will begin to see why.

Let us begin by looking at how we can use a very simple transistor circuit to produce a single pulse. Consider Fig.1, which is similar to a circuit we saw in our study of amplifiers in the May 1981 issue of HE, but now we are only interested in whether the transistor is conducting or not, ie whether it is switched on (by supplying base current) or switched off (by absence of base current). We did not actually have the capacitor there before but we shall need it in a moment.

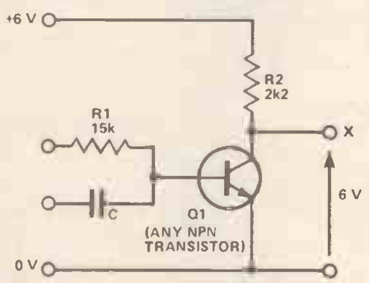


Figure 1. Basic transistor circuit. (Transistor not conducting and X is at 6 V)

In Fig.1 nothing much is happening. The transistor is not conducting because no base current is being provided, so just about all the supply voltage of 6 V is dropped across the transistor and so the potential at the point X is 6 V. When we get to Fig.2 the resistor R1 on the base of Q1 has been connected to the positive supply line, base current is provided and the transistor is switched on. As a result 6 V is dropped across R2 and the potential at X is just about 0 V. In Fig.3 much the same is happening but we have connected the capacitor to the positive line as shown so it charges up to 6 V. Notice which way round it is — the positive charge is on the lower of its two plates. Incidentally, we have also turned R1 round through a right angle but the transistor doesn't notice that.

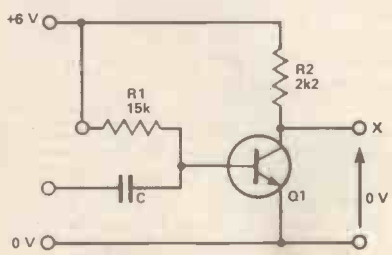


Figure 2. Transistor conducting. (X is at 0 V)

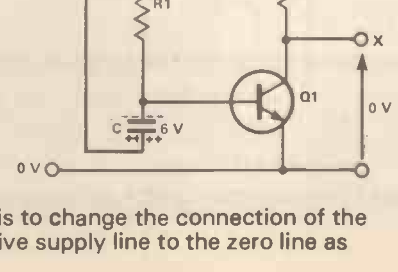


Figure 3. As Fig.2 but capacitor C1 is charging up

The next thing to do is to change the connection of the capacitor from the positive supply line to the zero line as shown in Fig.4. To begin with the capacitor conducts so easily that the current prefers to flow down to the zero line through it, rather than through the transistor. You see, a transistor will not conduct until there is about 0.5 V between its base and emitter, and initially the capacitor is letting current pass as though it were effectively a short circuit; so there won't be as much as 0.5 V across the transistor's base-emitter junction. But the charge soon builds up on the capacitor plates as shown in Fig.5 (opposite to before), the transistor will once again conduct and the voltage at X will return to zero. This little cycle of operations can be summarised by saying that the act of changing the capacitor connection from high to low voltage will make the voltage of point X go from low to high and back to low again. This is what Fig.6 is showing. The input voltage pattern is sometimes called a negative going edge because it starts high and goes down (negatively) to zero.

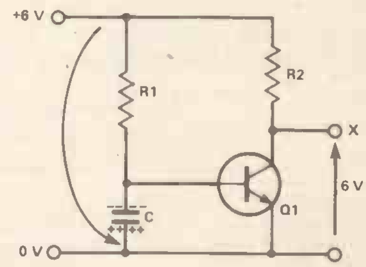


Figure 4. Situation immediately the lower (positive) end of C is taken from the +6 V line to the 0 V line. C is conducting as if it were a short circuit

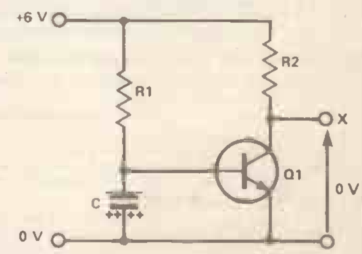


Figure 5. Base current is now provided again, Q1 conducts, and X goes to 0 V

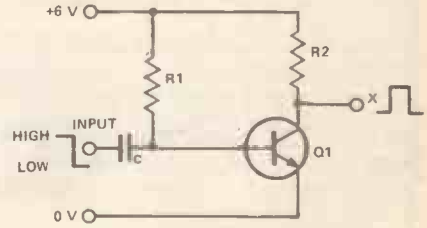


Figure 6. The high-to-low input pattern gives rise to the X output pattern of low-high-low

Around We Go

Now comes the clever bit. Notice that the output voltage pattern contains its own built-in negative edge (it finishes high to low) so we could use this to initiate the same thing on another stage. This idea is put into practice in Fig. 7.The two stages are connected together via the capacitor and the negative edge applied at the input on the far left triggers off a pulse at X whose own negative edge triggers off a similar pulse at Y. Actually you could have a string of these stages, one passing a pulse along to the next — like knocking down a row of dominoes. You could also feed the pulse you get from Y back to the *original* input and that would activate a pulse at X again which would give you a pulse at Y which would produce another at X and so on till you switch off or get fed up — or both. This is shown in Fig.8, with the feedback loop

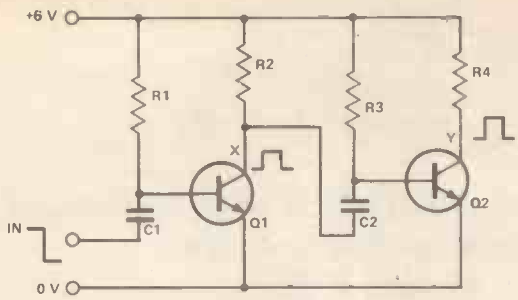


Figure 7. Production of two pulses, one after the other by the same input pattern as Fig.6

coming round and down below the 0 V supply line and up to C1. **Figure 9** shows how the circuit is usually drawn. Check

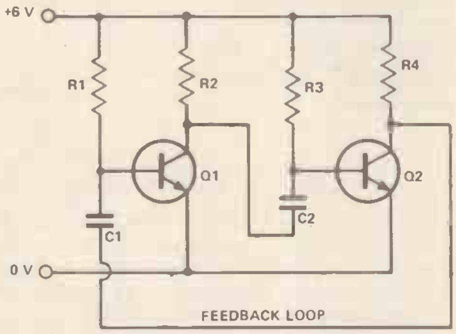


Figure 8. The arrangement whereby the pulse from Q2 is fed back to the input of Q1

carefully for yourself that **Fig.9** is, in fact, exactly the same as **Fig.8**. (I bet you never knew that there were right-handed and left-handed transistors!) The speed at which the pulses get passed round the circuit depends on the rate at which the capacitors change their voltage, and that in turn depends on the capacitance and the resistance values in the circuit. You can have a pretty wide variation in pulse rate, from one every few seconds to hundreds of thousands per second. So this pulsing multivibrator finds application wherever you need a series of pulses (eg, in computers and calculators where the operations are initiated by pulses).

The kind of multivibrator we have just looked at is called

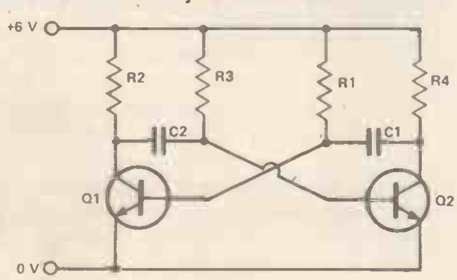


Figure 9. The usual representation of the circuit of Fig.8

an astable multivibrator; that is, it has *no* stable state but just keeps pulsing to and fro. The astable has a close relation called a bistable which is a device that is stable in either of *two* states. Consider **Fig.10** and suppose that we start things off by connecting the flying lead of R1 to the high voltage line. This will make Q1 conduct so the point X will be at low voltage (since 6 V will be across R2). This in turn means that

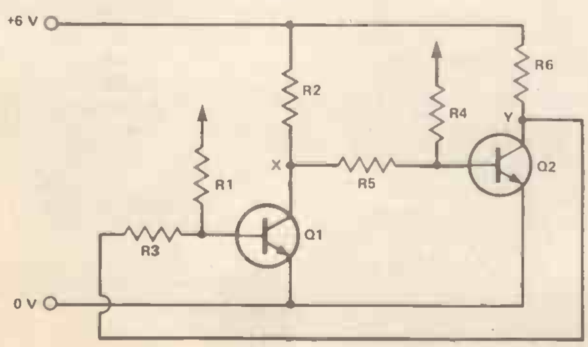


Figure 10. A bistable multivibrator arrangement

Q2 has no base current, so that it doesn't conduct and the point Y will be at high voltage. Now, by means of the feedback loop from Y round to R3 this high voltage is fed to R3, and so Q1 is maintained in the conducting state. Even if we disconnected R1 from the positive line, the system would stay in this state! It is stable.

If, however, we were to touch the free end of R4 to the positive line, think what would happen. (No, don't read on — have a think first!) The immediate result would be that Q2 would now conduct, making Y a low voltage point. The feedback loop from Y to R3 would no longer provide any base current and so Q1 would be switched off, making X a high voltage point which feeds **R5** with base current for Q2 — the circuit is stable again but Q2 is conducting — not Q1.

Memory

So it is stable in either of two states, hence the name bistable. We can flip it over into one state with ease and with equal ease get it to flop back again; so for this reason it is sometimes known as a flip-flop. The circuit can be thought of as 'remembering' which of R1 or R4 was the last resistor to be touched to the positive line and this is the basis of at least one form of computer memory. As with the astable, this circuit can be more neatly represented by turning one of the transistors round, as shown in **Fig.11**. This also shows a small modification with R1 and R4 made redundant and their job of touching the positive line being taken over by the two flying leads shown.

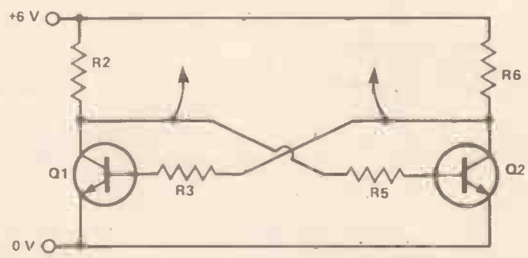


Figure 11. The usual representation of the bistable multivibrator

There is one other important modification of the bistable and this is one which enables it to act as a counter. If we now add the diodes D1 and D2, the resistors R7 and R8, bulbs in place of R2 and R6, and the capacitors C1 and C2 as shown in **Fig.12**, we can make the circuit flip from one state to the other by means of a *single* flying lead connected to point X and watch it happen. Space does not really permit me to analyse what is happening, but it would be an excellent logical brainteaser exercise for you to puzzle out, and it is not difficult. Start with the bulb R2 *on* (ie, Q1 conducting) and the point X at 6 V. Consider whether C1 will charge up (and why), and whether D1 will be conducting or not. Then consider what happens when **X** goes to 0 V and finally back to 6 V again.

Whether or not you do the brainteaser bit, or understand it or not, the overall result is, quite simply, that the circuit changes state (it flips or perhaps flops) only when the voltage at X drops from 6 V down to 0 V. When X goes from 0 V to 6 V, no change of state occurs. It is when X goes from 6 V to 0 V that it flops over (or perhaps flips).

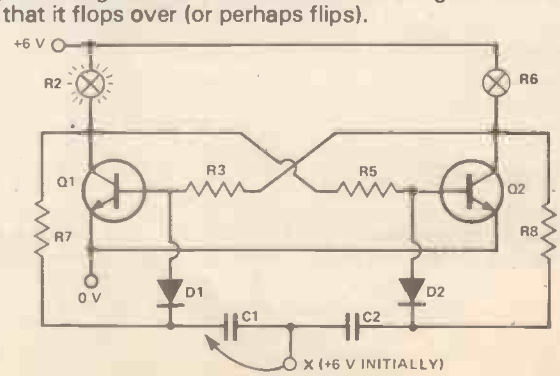


Figure 12. Modified bistable with single input

Dividing By Two

Behind this apparently innocent pastime of the bistable lies its ability to divide by two. It works like this. Suppose you feed a series of pulses into a bistable (to the point X which is sometimes called the trigger) then it will change states only when the voltage goes from high to low ie, on each negative-going edge. Thus a pulse train fed in looking like **Fig.13a** will come out looking like **Fig.13b**, where you will notice that each positive-going, then negative-going edge coincides with every negative-going edge of **13a** — the pulse train of **13b** has half the frequency of **13a**. And if this in turn is fed into a second bistable the output is again half the frequency of what went in, like **Fig.13c**.

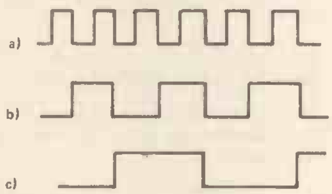


Figure 13. Pulses fed to a hungry bistable multivibrator. It eats every other pulse of a) and gives b) at the output

If you look closely at **Fig.14** and imagine all the bulbs are off to start with and we produce the pulses by turning bulb B1 on and off by means of switch SW1. **Table 1** shows what happens to the bulbs as this happens. You should notice that B2 changes state only when B1 goes from the on state to the off state; similarly B3 changes state only when B2 goes off, and similarly for B4.

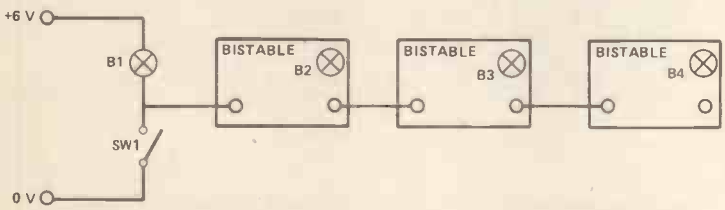


Figure 14. A binary counter

If we represent the off state by a zero and the on state by a one, then the table takes on the appearance of the binary series of numbers as **Table 2** shows. This function of a series of bistables to act as a binary counter is extremely useful in computer circuits and calculators.

B4	B3	B2	B1
OFF	OFF	OFF	OFF
OFF	OFF	OFF	ON
OFF	OFF	ON	OFF
OFF	OFF	ON	ON
OFF	ON	OFF	OFF
OFF	ON	OFF	ON
OFF	ON	ON	OFF
OFF	ON	ON	ON
ON	OFF	OFF	OFF
ON	OFF	OFF	ON
ON	OFF	ON	OFF
ON	OFF	ON	ON
ON	ON	OFF	OFF
ON	ON	OFF	ON
ON	ON	ON	OFF
ON	ON	ON	ON

Table 1. What happens to the bulbs of Fig.14

B4	B3	B2	B1
0	0	0	0
0	0	0	1
0	0	1	0
0	0	1	1
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	0	1
1	0	1	0
1	0	1	1
1	1	0	0
1	1	0	1
1	1	1	0
1	1	1	1

Table 2. The binary series of numbers (where an ON bulb gives a 1)

Memory Banks

The final item is the storage of information. This is a field which is changing rapidly and it has been said that the impact of the electronics revolution depends partly on the way information storage develops. The memory of a microcomputer may take all sorts of forms from special integrated circuits — in some cases containing literally thousands of bistables all on one little chip — to external memory banks like ordinary cassette tapes, the floppy disc, and looming up on the horizon some pretty unlikely sounding methods like magnetic bubbles or even the hologram — which is a sort of photographic plate giving rise to a three-dimensional image.

Of course, information storage is not restricted to computers and indeed a record or tape of your favourite pop group or classical symphony is really just a collection of a large number of bits of information. In the article on transducers we saw the way in which the wiggly track of a record's groove could be turned into audible information. The stylus was connected to a coil which moved in a magnetic field, thus inducing a current which was fed to an amplifier and then a speaker.

Making A Disc

The way the disc is made in the first place constitutes quite a story in its own right. Originally a tape recording is made of the performance and this is played back to produce a master disc copy of it using a diamond stylus. Then a layer of silver (followed by copper for strength) is electroplated onto the disc, which when it is removed is, of course, a negative. A further positive is made from which come at least two more negatives and it is *these* which are used to print the records which end up on your turntable.

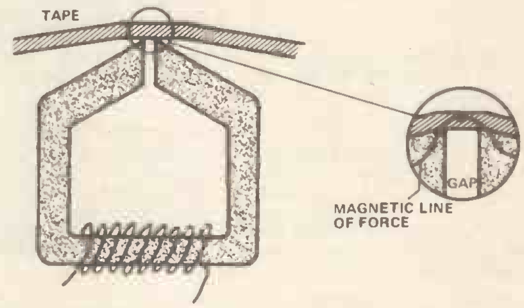


Figure 15. A tape record or playback head

Now you might wonder how the tape caught all the original information. That is no great problem to understand if you can think back to electromagnets and induction. The sounds from the orchestra or group are picked up by a microphone and after suitable amplification are fed to an electromagnet as shown in **Fig.15**. This electromagnet has a small gap of the order of a thousandth of a millimetre. Magnetic tape is drawn past this gap and the lines of force by preference go through the magnetic tape rather than across the non-magnetic gap. Thus the tape emerges with a series of regions like small magnets impressed on it as shown in **Fig.16**.

Figure 16. The way a tape is magnetised

Having magnetised the tape in this way, the information is recaptured by the process in reverse. As the tape passes the gap of the pickup head the little magnets ingrained on it induce small currents in the coil and it is these which are fed to an amplifier and speaker.

Our Time Is Over

Well, friends, that winds up this article and indeed the whole series. I hope you have enjoyed studying it as much as I have enjoyed writing it, and a special good luck to anyone taking the exam. I hope you will pass with flying colours; I'm sure you will if you: revise the basics (which you could do by re-reading the series); read the questions carefully; and answer what they ask and not the question you would have liked them to ask! One final bit of advice — *enjoy* your involvement in electronics. The best ski instructor I ever had said he had come to teach us to enjoy the mountains and *then* we couldn't help learning to ski. The more you enjoy your involvement, the better your involvement will be. I'd like to finish by quoting Tom Lehrer, the cynical American mathematician and songwriter very much in vogue a few years ago. He said, "Life (but he could equally well have said enjoyment/involvement in electronics) is like a sewer; what you get out of it depends on what you put into it." Cheers! **HE**

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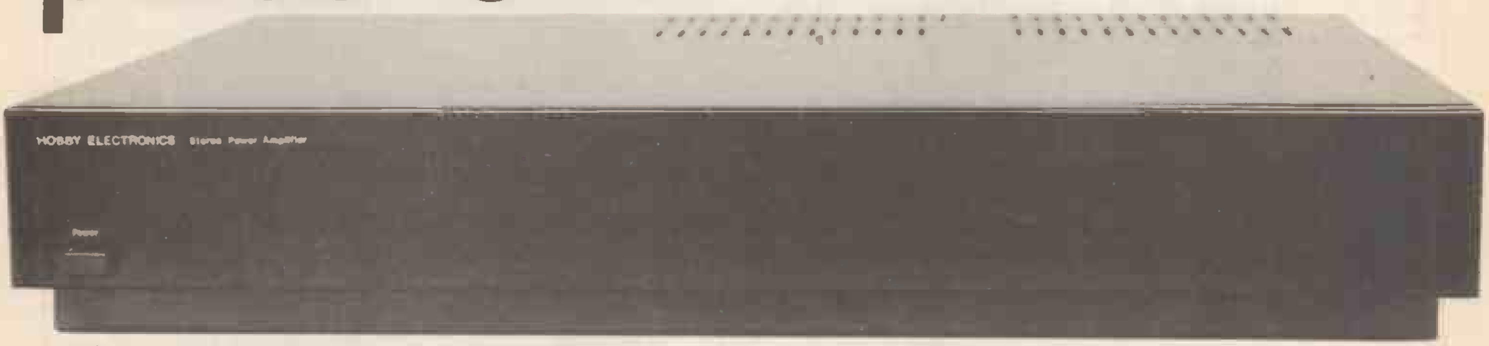
Power Amplifier part two



This month we conclude the HE Power Amplifier with details of wiring

HAVING CAREFULLY followed the contructional details of the HE Power Amplifier last month, you should have an amplifier chassis complete with all hardware including amplifier PCBs, mains transformer, bridge rectifier, capacitors and other fittings. It only remains to wire up your project.

You can see from the pictures of the inside of the amplifier that most connections are made neatly to wires contained in one main cable-form. The only wires not included in this cable-form are those associated with the 240 VAC mains. These have been kept clear for safety and to prevent the injection of any audible 'hum' into the circuit. For neatness, the mains leads should also be tied into a 'mini' cable-form.

The main cable-form consists of a collection of either heavy-guage multi-stranded wire or screened cable. The multi-stranded wire is used for all power supply and output connections — the screened cable is used purely for input connections from the input phono sockets to the PCBs.

Construction

Follow a colour-code of some sort (Table 1 shows the colour code we used) when wiring up the amplifier. This not only eases the procedure as you do it, but also makes any necessary fault-finding easier.

Start the wiring-up of your project with the mains circuitry. Follow the diagram in Fig. 1. Note that this *is* only a diagram — the actual lengths of leads should be cut to fit exactly, going around the outside, internal edge of the chassis.

Next, wire up the power supply leads from transformer to bridge rectifier, capacitors to bridge rectifier, and transformer to 5-pin DIN socket etc.

Now make all power supply connections to and from the PCBs. This stage is easier to follow if you wire one power supply rail (ie, + V, 0 V, − V) at a time and finish all connections using each separate colour before starting the next.

Make all input and output connections to the correct back panel fittings.

Finally, tie the cable-form together neatly using either lacing cord (as we used), plastic cable ties spaced at about 50 mm intervals, or simply string.

The false front panel can now be fitted, after which the case lid should be slid on from the rear and bolted on. You now have a complete and (with luck) working Power Amplifier.

Grey multi-stranded wire	—	earth (0 V)
Blue multi-stranded wire	—	output and mains neutral
Red multi-stranded wire	—	positive (+ V)
Black multi-stranded wire	—	negative (− V)
Screened cable	—	signal (input)
Brown multi-stranded wire	—	mains live
Green/yellow multi-stranded wire	—	mains earth

Table 1. Suggested colour-code for cable-form

Buylines

A complete kit of parts for the HE Power Amplifier project is available from:
Capricorn Electronics
281 Balmoral Drive
Hayes
Middlesex UB4 8HD
(Tel 01 573 1566)
for £155.

If you prefer to build the amplifier into a case of your own choice, Capricorn can supply all parts (excluding the case) for £125.

The case is also available (complete with all rear panel fittings for £35.

Complete ready-built PCBs for an amplifier are £38.50 each. Kits of all components to build your own PCBs are £28.

For those readers wishing to purchase individual items used in the Power Amplifier, the following list gives a few examples of price.

Power Amp PCB + sub-heatsink	£12.00
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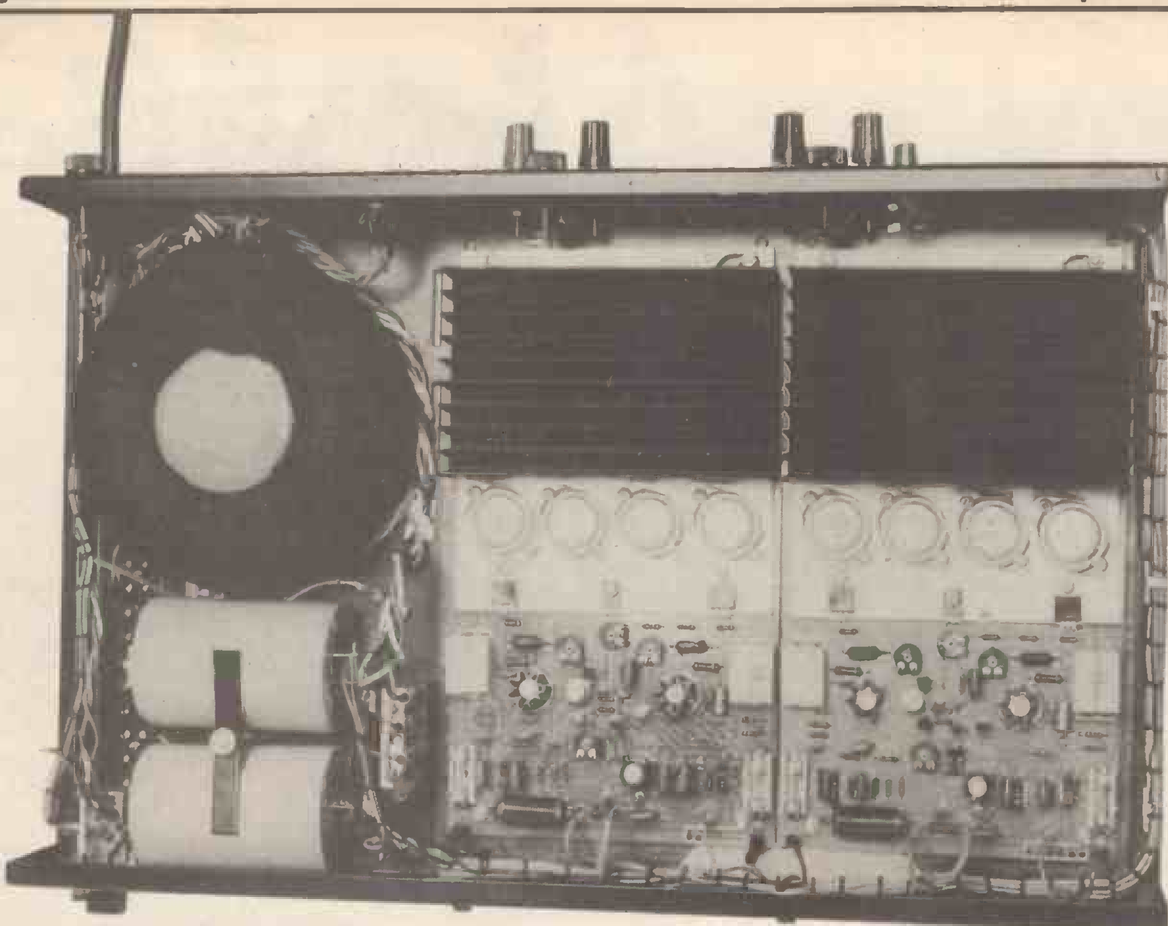
Capacitor 6800u 63 V	£4.50
Capacitor 10000u, 63 V	£5.50
Bridge rectifier 10 A, 400 V	£5.00

Contact Capricorn for other details.

Please remember to add £1.50 to your order to cover p&p.



Above. Internal view of the HE Power Amplifier

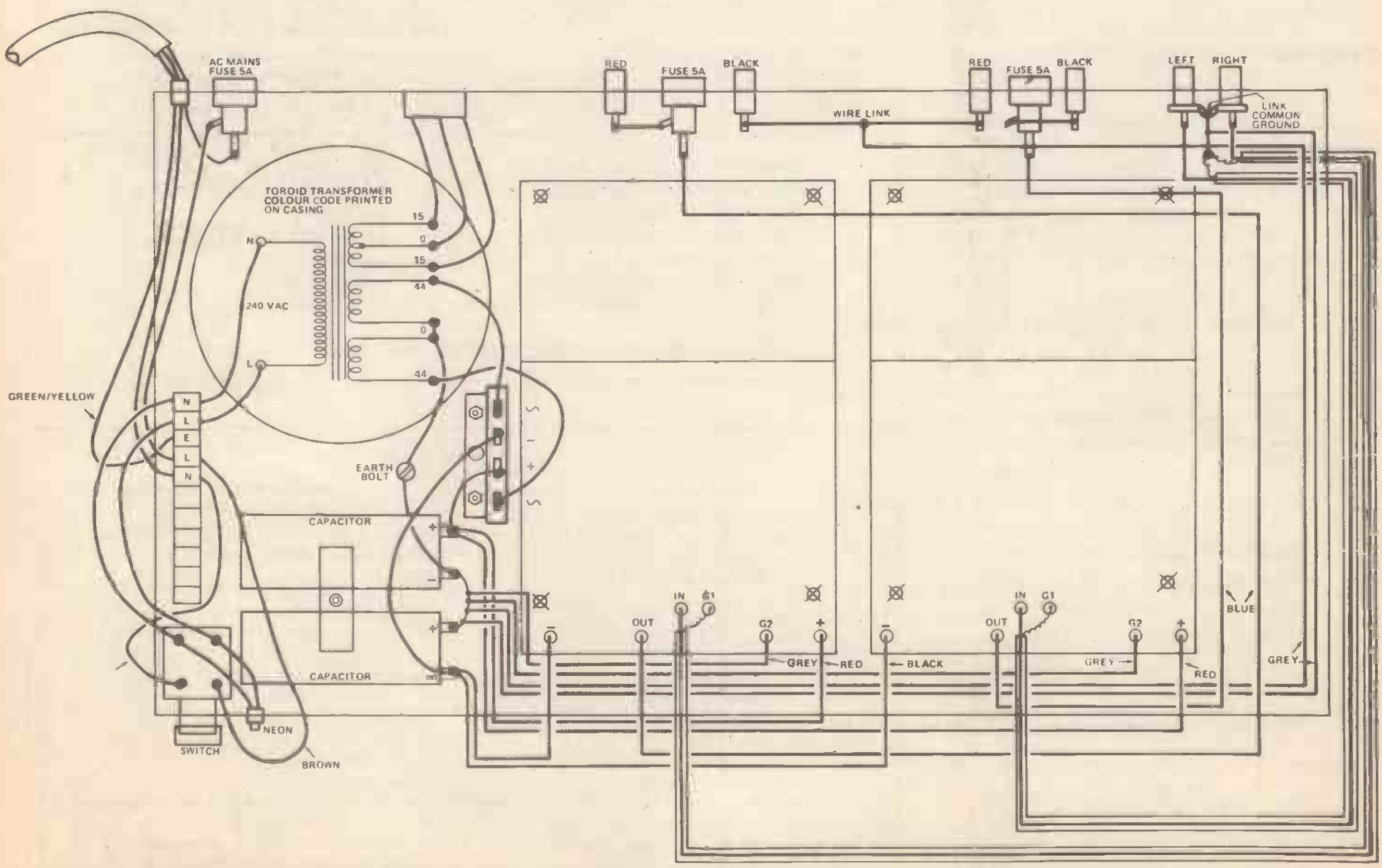


Figure 1. Wiring and connection details of the project. Use a colour code such as the one we used (Table 1) and route all the wire around the inside edge of the case

HE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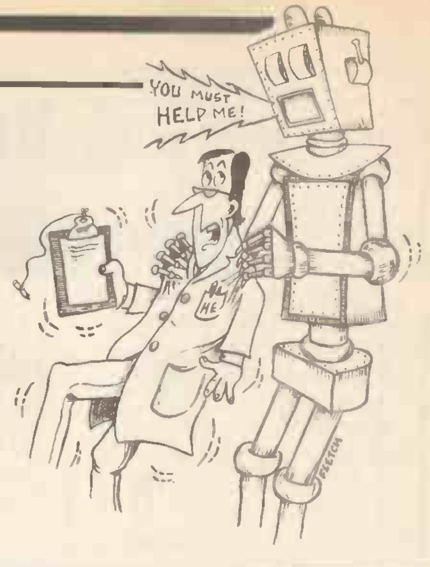


DESPITE the fact that July is printed on the cover, this CD is being compiled in May. (And just to confuse you further, the press day for this issue is in May, about a week after the *June* issue comes out.) And despite the bad weather in many parts of the country, those letters haven't stopped coming in.

On your bike for the first two.

Dear CD
I have become a regular reader of HE since December last year and am disappointed at the fact that both the digital speedometer and digital bike speedometer are both in mph. How can I convert them to kM/h?
D. Basson,
Natal, South Africa

Both of these speedos can be converted to read kMPH. Taking the Digital Speedo first, refer to the circuit in **Fig. 1** on page 14 of the December'80 issue. Increase the value of resistor R2 (you'll need to experiment with different values, starting with, say 3M3) and you should be able to calibrate the speedo in kMPH by adjusting RV1 (coarse) and RV2 (fine).

Coming to the Bicycle Speedometer, refer to the circuit in **Fig. 1** on page 38 of the March '81 issue. The same operation as described above for the Digital Speedo is required here, this time with resistor Rx. Follow the instructions given in the text.

Another query on the Bicycle Speedometer came up next.

Dear CD
I am thinking about making the bike speedo in the March issue. But it says "and adjust the pot until you get the right speed reading". All very well, but how do you know what the right speed is? Unless you already have a speedo — and I haven't. Please could you help.
James Byrne
Peterborough

Someone woke up here and suggested roping your bike to the hand rail of a bus — but it's much too dangerous, illegal — and how would you know the speed of the bus anyway? Seriously, the only way to calibrate the speedometer is to compare it with the speed of another vehicle, such as a moped,travelling at a known speed. It obviously needs great care — preferably it should be done in an open space away from any vehicles or pedestrians — but once the potentiometer is set for one known speed, that's the job done. You just substitute it for an equivalent fixed value in the Rx position

---

We've got an aspiring radio ham next.

Dear CD,
Please could you tell me where I could get information about becoming an amateur radio operator and if possible a place where I could get plans from which I can make a transceiver or where I could buy one from?
Michael Nelson
Barrow-in-Furness, Cumbria

First things first: Information on becoming an amateur radio operator is available from the Radio Society of Great Britain, 35 Doughty Street, London WC1 (tel 01-837 8688). One of its publications, Beginners Handbook of Amateur Radio (£8.26 including post and packing) is worth looking at. Unless you intend operating a transceiver illegally, you will certainly have to learn about becoming a radio ham — and pass the necessary examination (the Radio Amateurs' Examination) before you can think about making or buying one.

Dear Clever Dickypoos,
I built your car booster amp but I have a problem: it will only work with about a 20R speaker. With 8 or 4R I get a continuous popping, and the output is very distorted. Please can you help?
David Harrington
Farnham, Surrey

Unfortunately, a 'bad' batch of HA1388 ICs — the device used in the project — was produced which, although the devices functioned correctly, could become unstable. First check that your wiring to the PCB is tidy, with no unnecessarily long leads. Second ensure that screened cable has been used at the input. Third make sure that the supply leads are of a heavy gauge (the peak current can be as high as 4 A). If all else fails, try adding a 100R resistor in series with capacitor C7 and one in series with C8.

The next letter must hold the record for being the shortest so far.

Dear CD,
How much is a binder?
Ben Chaston
Enfield, Middlesex

Can anyone beat that *and* make sense? A binder costs £3.95 including p&p, from Easibind Ltd, 4 Uxbridge Street, London W8 7SZ (add 30p for overseas orders).

Can anyone help this next reader?

Dear CD,
Please can anybody help me. After buying all the electronic components for your Hebot I phoned up Remcon Electronics (who produced the mechanics) only to be confronted with "Sorry — we don't do that anymore". Now I'm left with £30 worth of electronics so if anyone has any spares or ½ started ones I would be glad to hear from them.
Martin Portman
Godalming, Surrey
PS is the info. about ETI bringing out a new robot in September true and how much will it cost?

The designer of HEBOT left HE about a year ago, so we have been unable to answer any technical enquiries about it. If anyone can help Martin, drop me a line. As to a new ETI robot coming out in September, who told you that? If there *is* one coming, there's no telling when — yet.

We have some observant readers, as shown by the next letter.

Dear CD,
I think, after reading May 81 issue of Hobby Electronics I ought to point out to you and N J M Freeland that the guitar pre-amp, as in the overlay shown does have a fault. The interwiring does not show the -ve connection, that is the OV screen to anywhere along the track. This is the reason why he cannot get the pre-amp to work.
Although the circuit is supposed to be active, it lacks any real boost and cut (it sounds like a very good passive tone control network).
I would very much appreciate it if you could give some different values for the tone control network to give a good bass and treble, cut and lift.
Mark Ian Arnold
Kings Lynn, Norfolk
PS Now ain't that worth a binder!

We looked at the overlay on page 37 of the May '81 issue and saw Mark's comments to be true — the outer screen of the cable from the volume potentiometer should have been connected to the ground track (point H14). Unless this screen is grounded, the negative terminal of the battery remains unconnected to the board. Now the bad news and the good news. The bad news is that we think you've got a faulty pre-amp there, because ours has plenty of cut and lift on the bass and treble. And the good news? We'll send you a binder.

Dear Clever Dick,
Whilst idling through a pile of HEs, we decided to carry out a survey of the cost of each page in HE. From the enclosed graph you will see very varied results and the cost does not appear to be consistent. We do not feel that we are getting the greatest possible value . . . maybe there are too many pay rises in the HE office! — but nothing would stop us ordering our regular copies of HE.
Peter Durrant & Mark Hayter
Malvern, Worcestershire
PS How about slipping a couple of binders into the post to us, go-on be devils

Thanks for the survey — you must both be born statisticians. Although we haven't space to print it here, the graph shows the inevitable rise over the last two years or so — but then what hasn't suffered price increases during this time? Nice to know that despite the recession, inflation, cuts and closures we still have some loyal readers. *We'd* be slipping if we sent out binders willy-nilly.

That's the lot for another month. Watch this space in the August issue. Until then take care of yourselves. **HE**

Quick Project: Electronic Metronome

This month's Quick Project is a metronome — specially designed for all our readers who are budding musicians — to help you keep your time while playing your instrument

This simple circuit produces a tick-tock sound, through the speaker, the speed of which can be varied by adjustment of RV1.

Transistors Q1 and Q2 are connected in a standard astable multivibrator circuit. Potentiometer RV1 controls the charge rates of capacitors C1 and C2 and thus the operating frequency. Transistor Q3 amplifies the pulse produced by the astable and drives the loudspeaker.

You can build the project into any suitable metal or plastic box and power it from a PP3-sized 9 V battery. Speed control RV1 and the on/off switch SW1 should fit on the box front.

If you require an on/off indicator, a small bulb (such as an LES type) can be wired between the +9 V and 0 V power connections on the board.

Most speaker impedances will suit the circuit although higher impedance types may not give much volume. In this case reduce the value of resistor R6 to about 27 R.

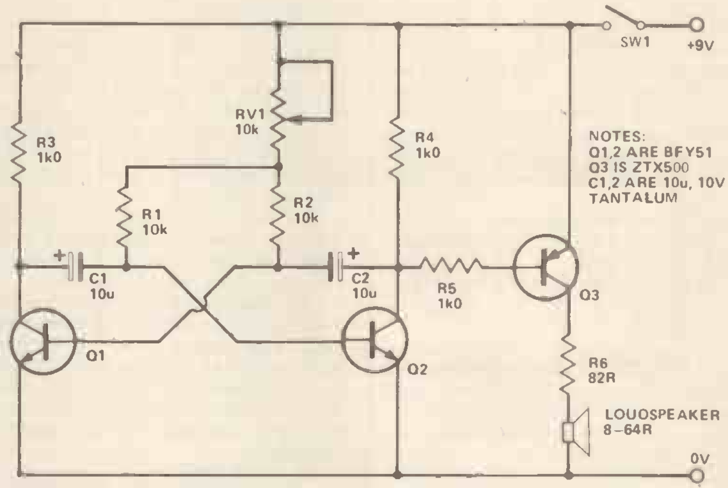


Figure 1. Circuit diagram

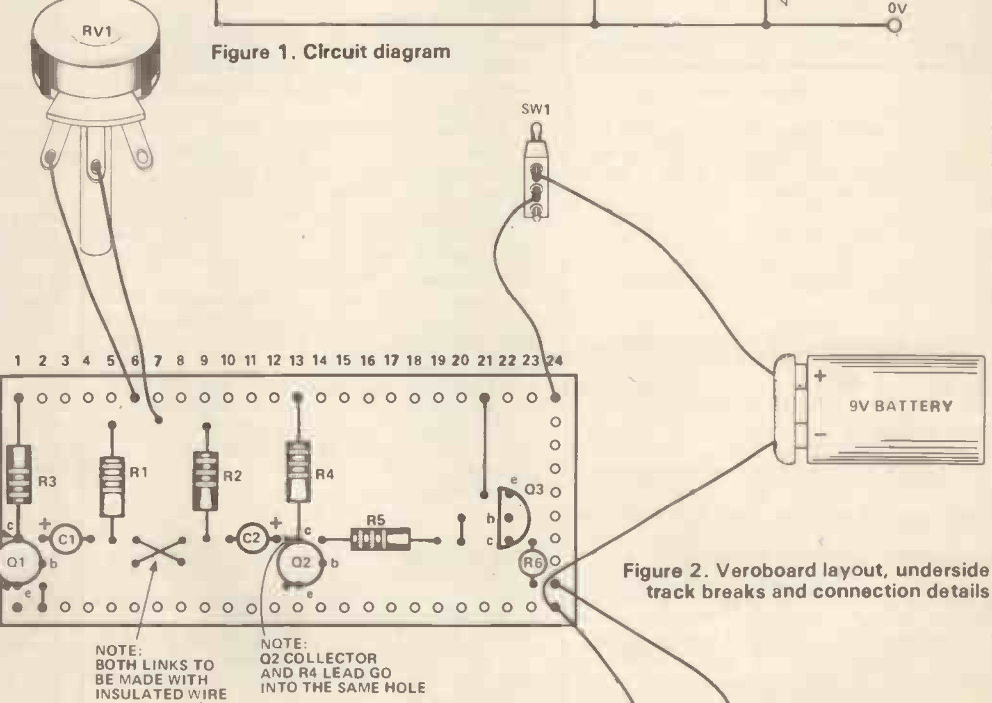
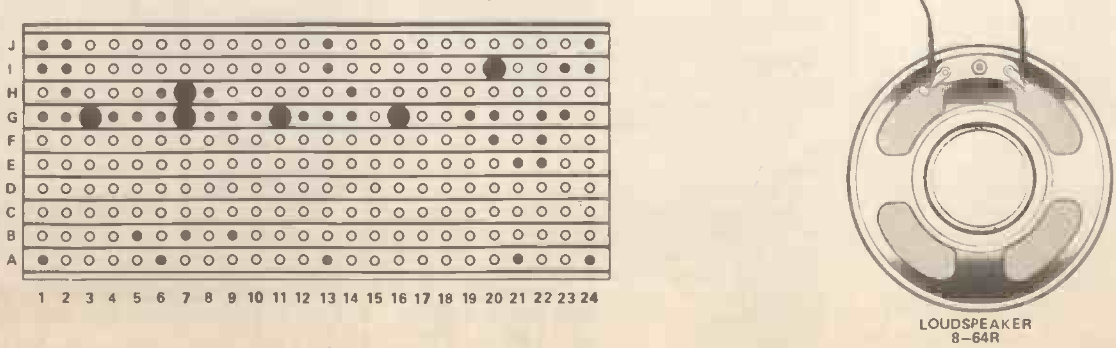


Figure 2. Veroboard layout, underside track breaks and connection details



HE

Your Letters

A selection of your letters to the Editor

BOTH THE YOUR LETTERS page and Clever Dick's page can provide a useful means of exchanging your views. This first letter should help to answer J.A.Pearson's plea under Your Letters in the May '81 issue of HE.

Dear Mr Davies,
I was interested to read the letter from Mr Pearson concerning old television receivers.

I thought you might be interested in seeing an article I wrote which appeared in February Scottish Field, about Benjamin Clapp, who was chief assistant to John Logie Baird. I have sent a copy of Mr Pearson's letter and the article to which he refers, to Mr Clapp.

I suggest your reader contacts Wireless World at Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

I hope this letter might be of some help.
Janet Thomas
Coulsdon, Surrey

Thanks for taking the trouble to forward Mr Pearson's letter and for the information. I will send a copy of your article to Mr Pearson.

Dear ED or C Dick
Looking through the 'Your Letters page' I was stunned at R Sawyer's letter. ED said try the Doorbell monitor (in the) March issue. What Doorbell monitor? I am only twelve — don't I deserve a binder?

I've been trying the Chuffer project for weeks (January) and I've checked all the wiring and components. Where have I gone wrong? Was there a fault?
P. Prodromov
Southgate, London N14
PS Don't I deserve a binder?
PPS I think your mag should have something about computers in it.

It was my mistake — the Doorbell Monitor project was on pages 32-33 of the *April* '81 issue.

The only error we have on file for the Chuffer project was a misprint on the overlay shown on page 56 of the January '81 issue. In the lower right-hand corner of the overlay, the electrolytic capacitor is numbered C9 — it should have been numbered C8. Otherwise it's difficult to say where you could have gone wrong. (Faulty component perhaps?)

We're not offering binders on this page yet but we'll consider your request for something about computers. (See the review of the Sinclair ZX81 — in kit form — in the Gadgets, Games & Kits supplement on page 31).

I'll let this next letter speak for itself.

Dear Sirs,
May I start by congratulating you on a magazine that brings electronics within everybody's reach.

That is the praise, the rest isn't.

If you are passing my way do drop in and see the pile of scrap that is all that is left of a model plane that took me weeks to build, cover etc. It took time to save for the radio equipment and it has now been all ruined by some B------ with a CB set.

My monitor showed that this 'accident' was not pilot error.

How can you possibly justify trying to promote something that is both illegal and causes so much damage to other people's property? Your Article in May 1981 issue is proud of the 20,000 turn out at Donington and amused at the trader selling "straight 40-channel AM rigs for £120".

Every one sold is illegal and that should be made quite clear. Every one used is illegal and that should be made quite clear. Every one sold will have a good chance of affecting a legal radio modeller and that is not funny and that should be made quite clear.

You should not compare whether AM or FM is better or worse for service . . . there is NO choice. FM will be legal, AM will not.

At the top of the page you cover yourselves by pointing out the 1949 Wireless Act and then in the last line you congratulate the organisers.

Let me make it clear I am not anti-CB and when it is legal I will have a set but the children using it (children in mentality at least) give the whole thing a bad name.

My monitor has picked up conversations treating the damage to radio modellers as a joke. How funny would it be if someone destroyed their property? Another conversation wondered what the buzzing noise was on their set. Are they that daft not to know when they are interfering with a totally legal radio modeller?

You and other electronic magazines have been a powerful force in making CB legal, commendable I agree, but understand the power you have and the damage you do and have done.

The whole frequency system is cockeyed but 'facts is facts' and I and thousands of others either have to write off hundreds of pounds worth of planes, motors, servos etc, sell our transmitters and receivers and knock down prices as nearly obsolete to buy new equipment for the new frequency allocated to aero-modellers. What a Catch-22.

I hope the government choosing the frequency and you for lobbying for it are pleased with the damage and cost you have put thousands of people to.

I doubt writing this will have any effect or you will risk publishing it but looking at a pile of scrap balsa, cracked receivers and a pile of wires I felt someone should know.
D. Reed
Leatherhead, Surrey

I had received similar reports of sabotage to model aircraft by irresponsible (and illegal) CBers . . . but I doubted whether *thousands* of RC modellers had been affected.

I spoke to Pete Christy, technical consultant to a radio control equipment manufacturer, who said: "It's difficult to put an actual number on it. A thousand or so might be a reasonable estimate for the last year."

He considered that the problem of CB interference to radio modellers was usually restricted to major urban areas or city centres. To give some idea of the potential targets for such interference, he said that up to the time that radio model licences were suspended in January 1981, about 100,000 licences had been issued.

Items published under Breaker One Four in HE contain the personal views of Rick Maybury, who is the Editor of Citizens' Band magazine. I share Rick's opinion that if successive governments over the last 10 years had not stalled in the allocation of different frequencies for CB and radio-controlled models, we would not have had the present chaos on 27 MHz and other bands.

Dear Sir,
I have recently constructed the Public Address Amplifier from your March issue and at long last got it to work.

I am appalled at the mistakes, both in the layout and method of construction, it could never be made to work from your published article.

First corrections to the layout:
Move the top end of R5, C3 and R6 up one hole from K to J.
Move the top end of R4 and the bottom end of C2 from J to I.
Move the lead from the centre of the Mic Vol on/off control and the top end of R8 from H to G.

Having corrected the above errors the output waveform distortion (due to incipient instability) was completely unacceptable. Investigation showed that the Veroboard tracks are not capable of carrying the circulating earth currents present and it was necessary to re-inforce these with soldered-on heavy gauge copper wire, the holes for the wire links were drilled out and these also replaced with heavy gauge wire.

I might add that two samples were constructed, both showed the same faults and both responded to the same cures.
A.D. Poupard
Edenbridge, Kent

We agree with the errors listed in your letter, and these apply to the Veroboard layout shown in Fig. 2 on page 14 of the March '81 issue. We cannot, however, agree with your comments about the method of construction and the 'incipient instability'. The project was designed to avoid large currents passing through the Veroboard tracks, and if you refer to Fig.2 you will see that the 0 V supply lead goes directly to one of the solder tags on IC1. Thus the supply current to the board is only a few milliamperes.

Thanks for pointing out the layout errors.

Dear Sir,
Referring to page 16 of the May issue of Hobby Electronics, what technique of playing is required with regard to the annotation of the notes from the tone generators and the keyboard adjacent?

As a professional (retired) arranger and pianist etc (I was at one time staff arranger with Francis, Day and Hunter in Charing Cross Road) I would love to hear what would come out of the instrument played normally but connected as annotated.

Of course it is a slip but how it could get past so many people I cannot understand. (I had a few years correcting printers errors etc.)
Ivan E. Gray
Bidlington, East Yorks
PS I enjoy reading HE — it is my favourite.

We discussed your letter in the HE office and came to the conclusion that you had misunderstood the drawing under How It Works on page 16 of the May '81 issue. Here the dividers have been shown linked to the note outputs from the top octave generator IC, but *not in chromatic order*. In the final wiring up, the correct notes are coupled to the correct outputs from each divider IC. To show this in the drawing on page 16 would have meant showing a lot of wires crossing over each other.

And that's the last letter of the month. **HE**

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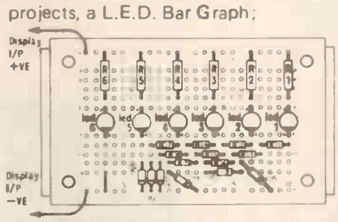

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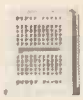

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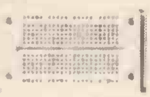

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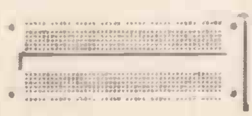

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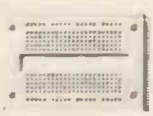

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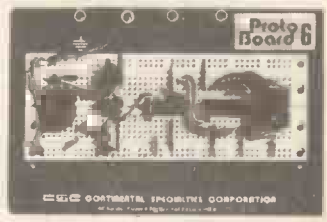

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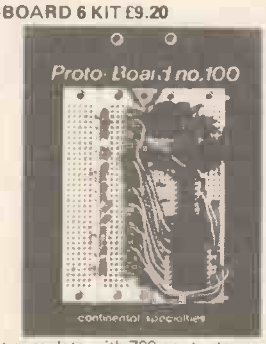

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Treble Booster

Another design in our range of musical effects. This project lets you boost your guitar's high notes by two different amounts

WITH THE AID of our Treble Booster you can liven up the sound of your electric guitar and obtain what guitarists call a 'brighter' sound. Conventional treble boost circuits are readily obtainable and most guitarists who play electric guitars will have used the effect at some time or another. The standard effect relies on amplification of frequencies around 4 kHz much more than those frequencies below and above this point. Our treble booster does this, of course, and the response of this 'normal' booster mode of the circuit 'peaks' at approximately 4 kHz with a maximum boost of 25 dB (a gain of about 18). However, in 'superboost' mode the circuit can be used to provide a more extreme effect, with a peak of around 40 dB (a gain of 100) at 10 kHz, for those who do not believe in doing things by halves! Figure 1 shows the two responses that are available. When not required, the frequency boost can be completely removed (ie, for a flat response) so that the guitar sound is unaffected.

The booster is completely self-contained, and is connected between the guitar and amplifier using a standard guitar lead terminating in a ¼" jack plug. Regular readers will recognise the case we have used as being of the same type housing the HE Fuzzbox in the March issue and the HE Envelope Generator in the June issue — it's such an ideal case for a guitar effects pedal that we couldn't resist using it yet again.

Construction

Make all necessary breaks in the copper tracks of the board, as indicated in the underside view in Fig. 3. These can be done with either the specially designed tool from Vero, or a small hand-held drill bit (about ⅛" is ideal). Press the cutting edge onto the hole in question and twist clockwise until the copper breaks away in a clean circle. Make sure no loose swarf bridges across to adjacent tracks.

Insert and solder the 8-pin DIL (dual-in-line) IC socket where shown and also solder in Veropins where external component-to-board connections are to be made.

Next, the link, resistors and capacitors should all be inserted and soldered. Make sure you have positioned all polarised capacitors the right way round. Push the IC into its socket, checking first that it is correctly aligned.

Now, mark and drill the case to take the input jack socket and SW1, and then mount them both into their places.

Wire up your project, carefully following the connection details in Fig. 3, using screened cable for input and output leads to reduce the chance of interference. All other connections are made with thin multi-strand wire.

Finally, screw on the bottom of the case, plug in your guitar — and boost.

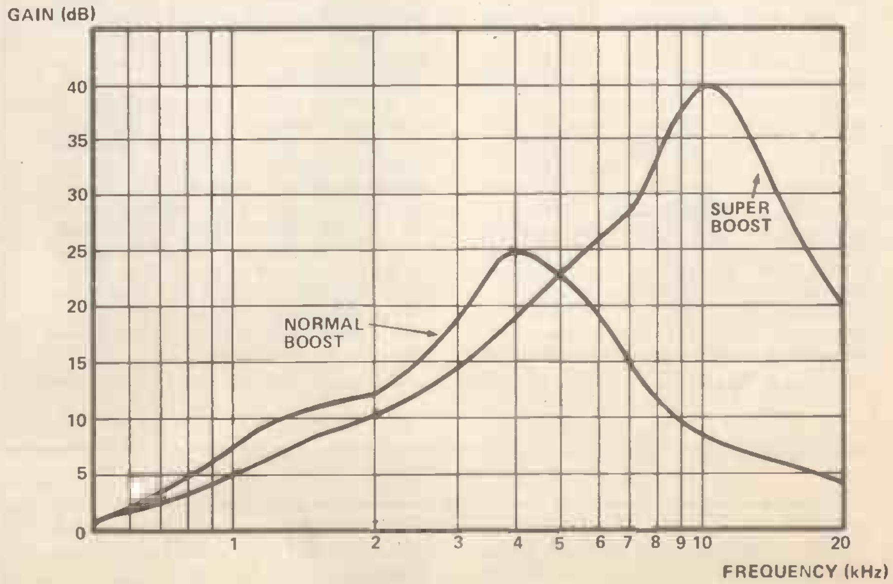


Figure 1. Measured frequency responses of our prototype Treble Booster. Switch SW1 allows you to choose the response required

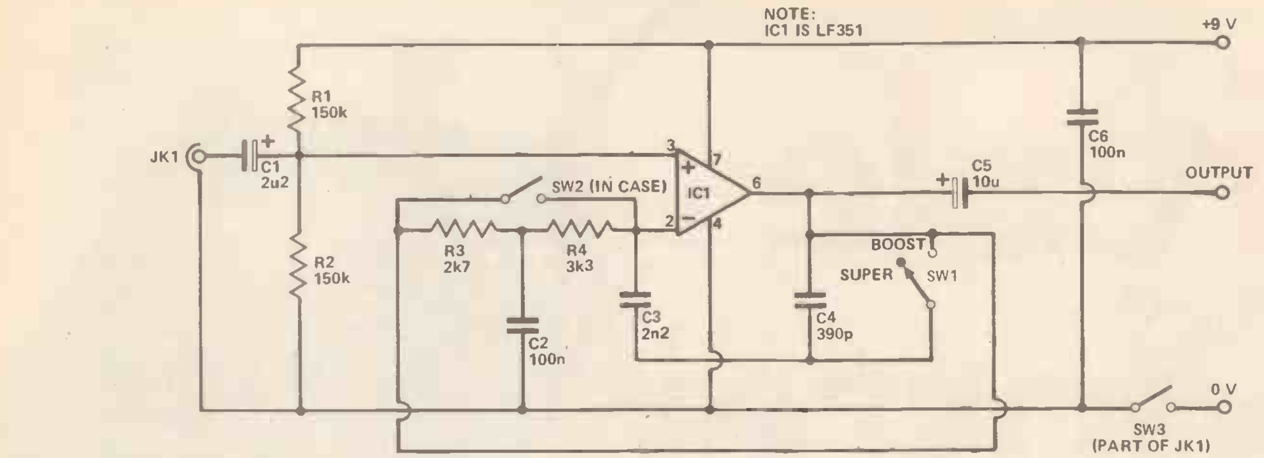


Figure 2. Complete circuit of an HE Treble Booster·

How It Works

Without the capacitor shown connected by broken lines, the circuit basically consists of an amplifier whose response is flat.

In this circuit, by inserting the capacitor into a positive feedback loop around the amplifier the response can be changed. As the reactance (you can think of reactance merely as AC resistance) of the capacitor falls at higher frequencies, more signal is fed back and is thus re-amplified. The gain of the system therefore increases as the frequency goes up.

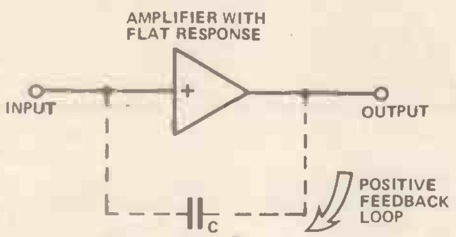


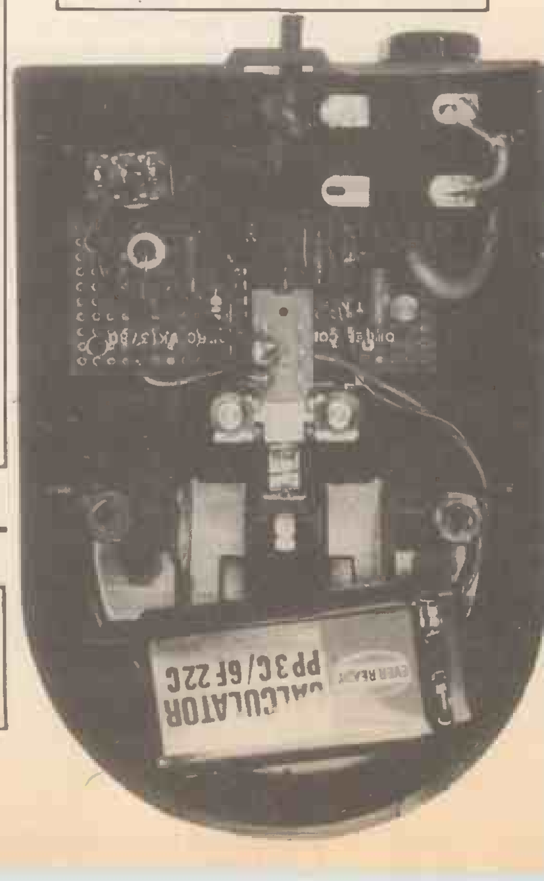
Figure 2 shows the circuit of the treble booster, and it is based on an LF351 or similar (TL071CP, TL081CP, etc) low-noise, JFET operational amplifier. Integrated circuit IC1 is used in the non-inverting mode, and has its non-inverting input biased to half the supply potential by R1 and R2. Capacitor C1 couples the signal from the guitar to the non-inverting input of IC1.

The voltage gain of IC1 is controlled by the amount of *negative* feedback from the output to the inverting input. At DC and low frequencies there is virtually 100% negative feedback through R3 and R4 due to the very high input impedance of IC1, and the circuit therefore has unity voltage gain. At higher frequencies the impedance of C2 becomes significant and it tends to decouple some of the feedback, giving the circuit a response which steadily rises with increased signal frequency. It is normal to tame the high frequency response somewhat to prevent excessive boost at the highest audio frequencies and to reduce the risk of instability. With SW1 in the 'normal' position C3 is shunted across R3 and R4, and its fairly low impedance at high frequencies gives increased feedback at frequencies above about 4 kHz, with a consequent 'rolling off' of the response. If SW1 is set to the 'high' position C4 is added in series with C3 giving reduced capacitance and higher boost at frequencies above approximately 5 kHz.

If SW2 is closed the output of IC1 is connected directly to the inverting input, giving 100% negative feedback and unity voltage gain. Switch SW2 can therefore be used to switch out the treble boost and give a flat response when the boost is not required. On/off switching is provided by SW3, which is part of the input jack socket. The treble booster is turned on by insertion of a jack plug. Total current consumption is less than 2 mA so long battery life can be expected from this project.

Parts List

RESISTORS (All ¼ W, 5%)	
R1, 2	150k
R3	2k7
R4	3k3
CAPACITORS	
C1	2u2,16 V electrolytic
C2,6	100n polyester
C3	2n2 polystyrene
C4	390p ceramic
C5	10u,16 V electrolytic
SEMICONDUCTOR	
IC1	LF351 JFET operational amplifier
MISCELLANEOUS	
SW1	single-pole, single-throw latching push-button switch
Case to suit	(includes SW2 — see Buylines)
SK1	¼" jack socket (with SW3)
PP3-size battery + clip	
Veroboard, 10 strip x 24 hole, 0.1" matrix	



Buylines

A full kit of parts for this project, including foot pedal and Veroboard, has been produced by Magenta Electronics for £9.94. This price includes VAT but not p&p.

Magenta can also supply the stylish foot pedal case separately, for £5.65 including VAT but not p&p.

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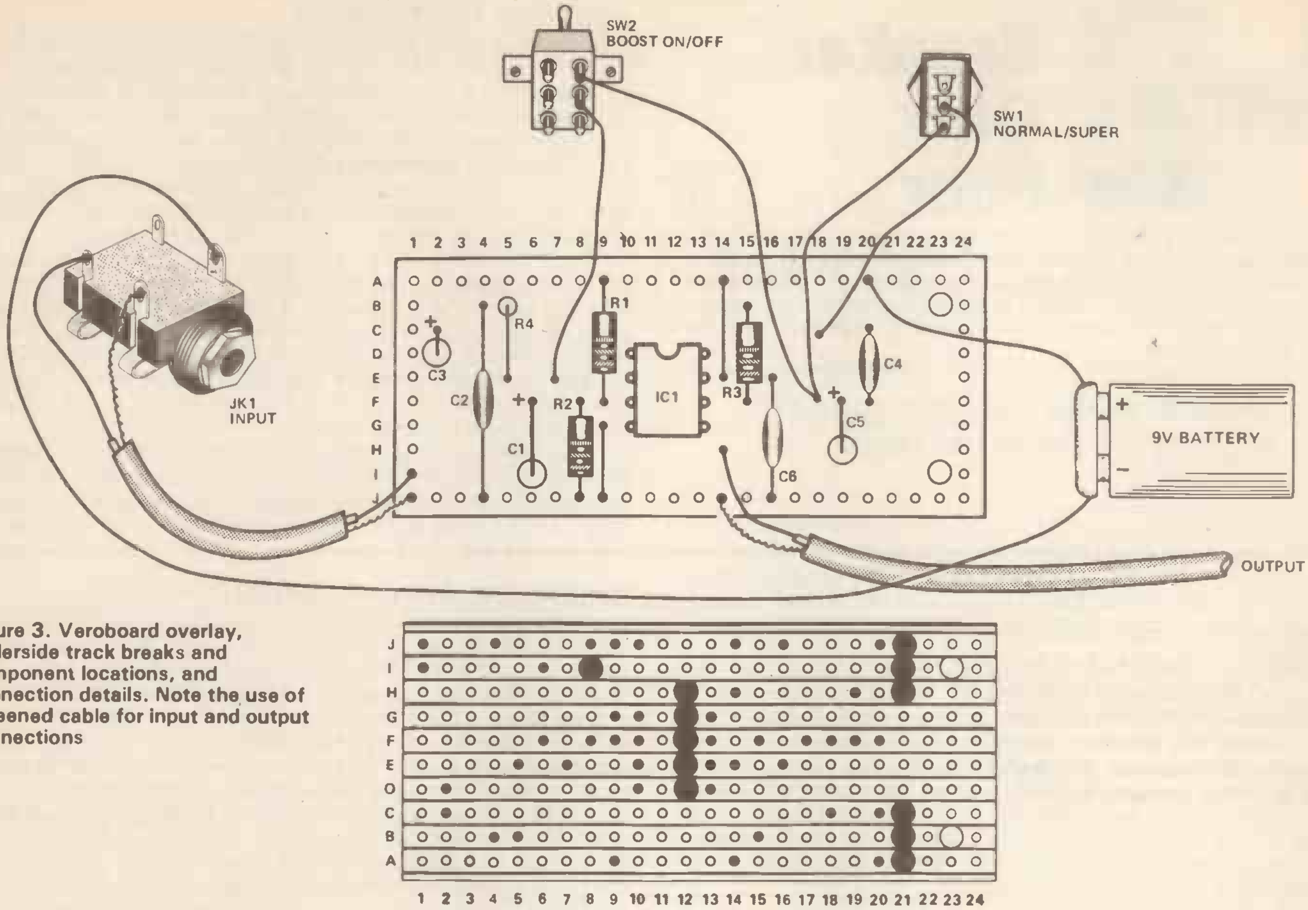

Figure 3. Veroboard overlay, underside track breaks and component locations, and connection details. Note the use of screened cable for input and output connections

HE

CB Breaker One Four

The publishers of HOBBY ELECTRONICS would like to point out that it is at present a contravention of the Wireless Telegraphy Act of 1949 and 1968 to use, manufacture, install or import CB transmitting equipment. It is not the intention of Modmags Ltd to incite, encourage or condone the use of such equipment.

The battle over the FM spec goes on. Rick Maybury looks at the latest developments

IT WILL COME as no surprise to learn that within three weeks of the UK CB draft specifications being published at least one Japanese manufacturer had working examples of their wares in the country. On the other side of the coin, all the various legalisation groups are running around doing their utmost to get the spec changed.

At the epicentre of the discontent is the new frequency and the use of FM instead of good old AM. Without wishing to be a bore, we have had the opportunity to try out the new equipment and I can confirm, whether you like it or not, that the range is just as good and the quality of speech several times removed from what we are accustomed to. As reported last month, the equipment cost, a very touchy subject at the best of times, will at worst be the same as that already on the black market and at best, less than we are used to. To date the cheapest basic 40-channel 4 W FM mobile rig will cost under £50.

Antenna Restrictions

However, it's not all smooth sailing. There is one area of contention: the ERP (effective radiated power) of the new equipment is likely to cause a few problems with antennas. A spokesman at the Home Office has told me that it is almost certain that it will only permit one type of antenna. It looks as though the standard CB antenna will consist of a stainless steel whip with a loading coil at the bottom of the whip. Sounds familiar? It should do, as it will look like the radio telephone antenna used by cab companies and by those rich enough to afford radio telephones.

There's more to come, though. It looks as though legislation will be introduced to specifically outlaw helically-wound antennas (just like DV27s, Firestiks, Roadhogs, etc) and as for base stations, well you can forget beams, gain antennas, or in fact anything that would transgress the 2 W ERP rule. All is not lost though, as steady pressure from NATCOLCIBAR and several other groups has been bending the ears of the Home Office in order to get this ruling changed.

This rather shortsighted legislation could make the difference between a workable system and a poor alternative to the illegal system already in use. I'll be reporting on the outcome of a very important meeting at the Home Office next month, hopefully with some good news.

Important Announcement

Just a couple of weeks before the legislation date good old Modmags will be organising the most important CB exhibition of the whole year. Already several very large importers and manufacturers of CB equipment will be exhibiting their wares. We plan to allow visitors to the show to purchase rigs but we can't say too much until our plans are finalised. In the meantime, if you want to see what the new system is all about, see the very latest equipment, eyeball all the CB personalities or just ratchet with the dozens of accessory dealers who will be there, get yourself along to the Horticultural Hall in London on the 11th, 12th and 13th September. We at CB will be there to answer your questions and sell you magazines, etc so come along and make a day of it. **HE**

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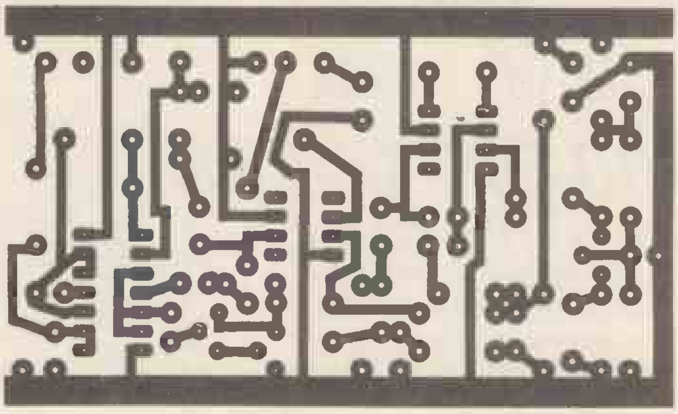
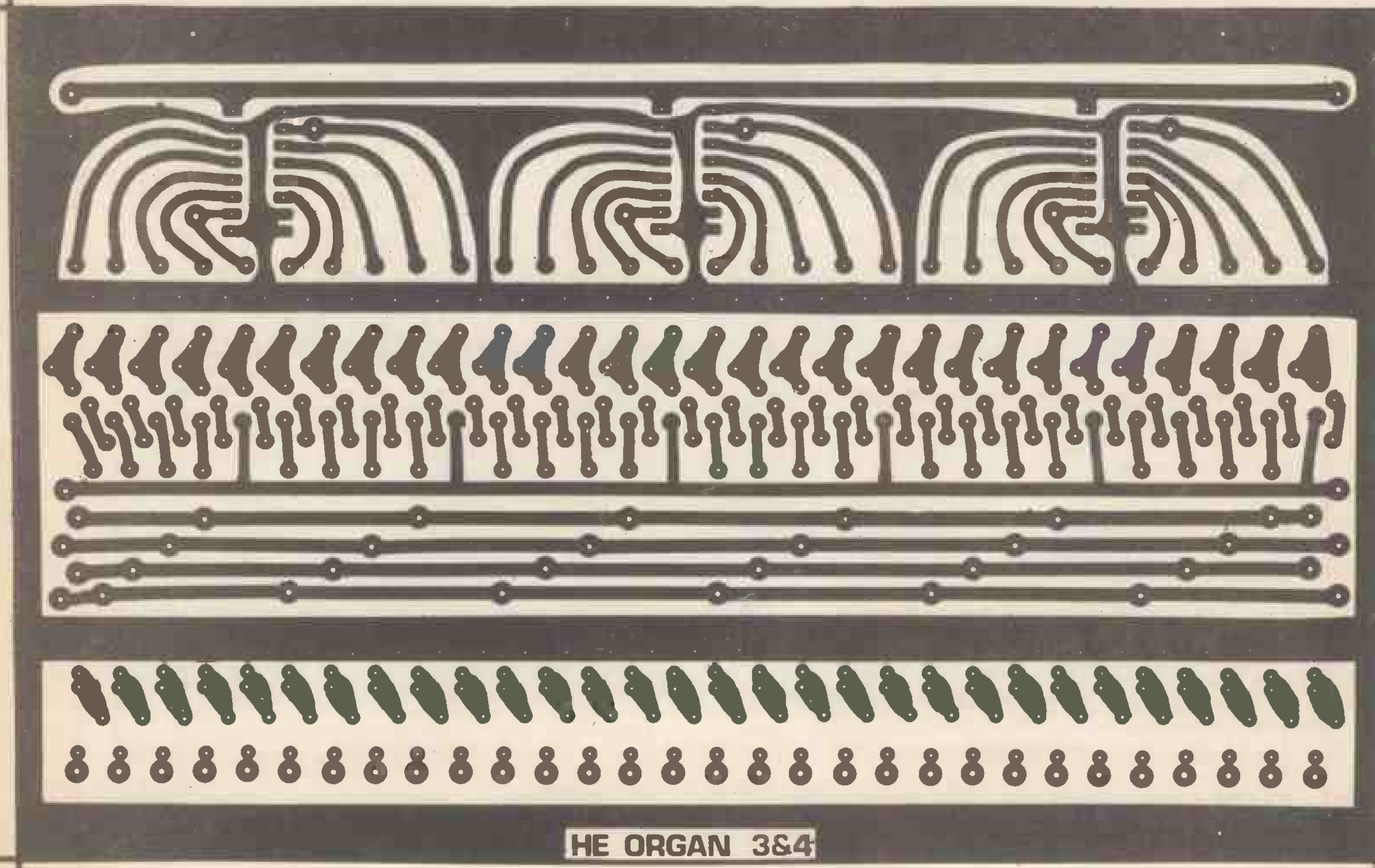


PCB foil pattern of the HE Ultrasound Alarm



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