

Hobby

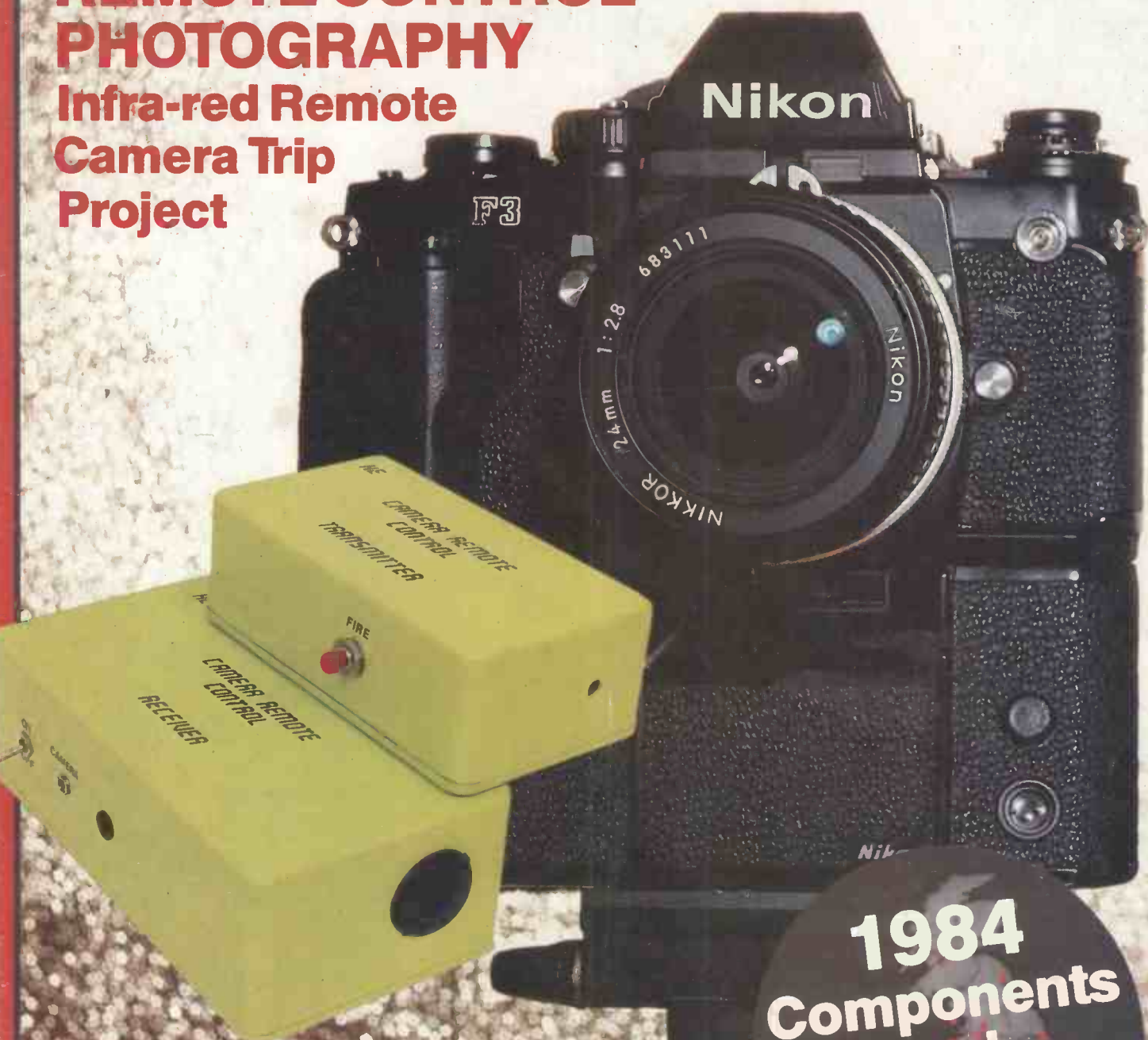
Electronics

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Hobby Electronics

FEBRUARY 1984
Vol 6 No 2

PROJECTS

- ★ INFRA RED CAMERA REMOTE CONTROL 10
Taking a long shot.
- ★ AUDIO POWER SUPPLY MODULE 20
A go-anywhere, general purpose audio PSU.
- ★ CAR TIMING STROBE 47
Tune the engine in a flash.
- ★ CB FIELD STRENGTH METER, WITH MEMORY 59
The ideal tool for aerial operation checking.

FEATURES

- ★ CAREERS IN ELECTRONICS 56
Our three-part look at the Armed Forces continues with the Royal Navy.

SPECIAL

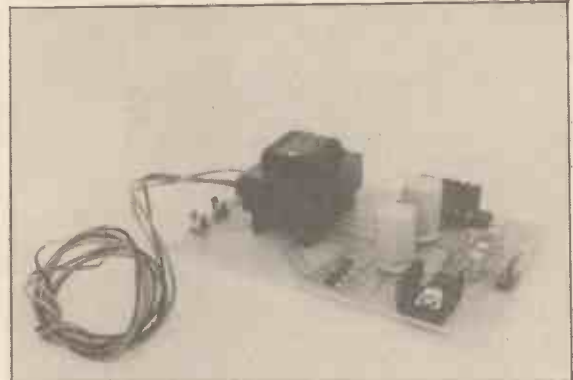
- DIRECTORY OF ELECTRONIC COMPONENTS AND HARDWARE SUPPLIERS 1984 27
A seventeen-page roundup of sources for the electronics constructor.
- HELP WANTED 65
We seek an Editorial Assistant for Digital & Micro Electronics.

REGULARS

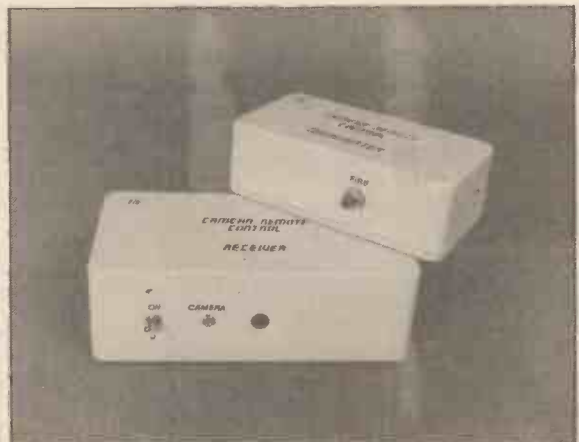
- Monitor 6
- Points Of View 16
- What's On Next 18
- HE Bookshelf 25
- Buylines 26
- Forward Bias 53
- HE PCB Service 63
- HE PCB Printout 64

ALL ABOUT ELECTRONICS has been held over this month due to lack of space, and will be back, as usual, in March.

Editor: Ron Keeley
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Managing Editor: Ron Harris BSc
Chief Executive: T. J. Connell



Audio Power Supply Module] page 20



Camera Remote Control] page 10

PLUGS AND SOCKETS	ENCLOSURES, CASES	HEAT SINKS	KNURLS, MISC. HARDWARE	CABLE AND WIRE	BREADBOARDS	TOOLS	PCBs and/or MATERIALS	CHEMICALS	CUSTOM KITS, MODULES	SURPLUS SUPPLIES	BARGAIN PACKS	BOOKS	CATALOGUE PRICE LIST	MAIL ORDER MINIMUM (6)	OVERSEAS ORDERS	CREDIT CARDS (4)	SHOPS	OTHER
													65	(5)				A.C. TOWNLEY
													N	50				WATFORD ELECTRONICS
													N	(5)	(6)			WILMSLOW AUDIO

Directory Of Components Suppliers] page 27

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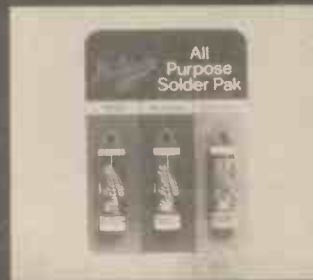


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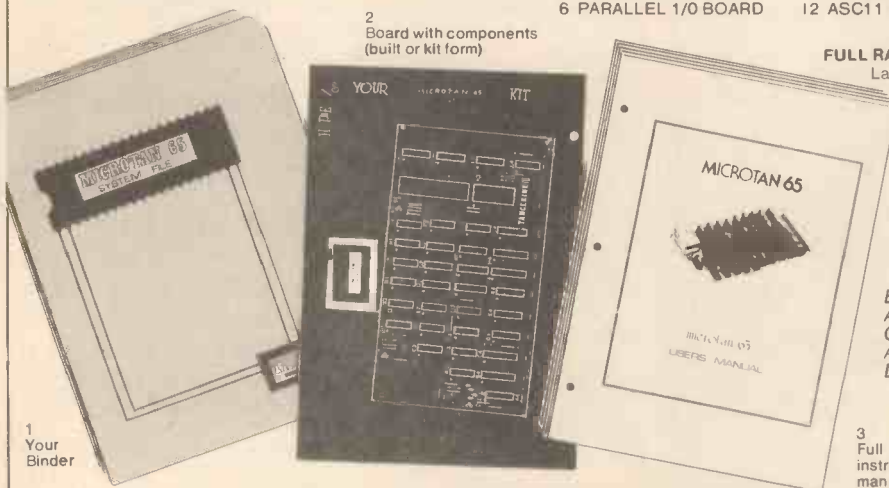
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Lynx In The Chain

Computers tell us that their Lynx microcomputer is now being stocked by Dixons, the well-known high street photographic chain. The 96K version, with software and peripherals, is available from fifty branches off the shelf, and the other branches will supply to order. The Lynx 96K is an upgrade of their 48K machine, and is said to have an unusually high resolution display and an extended 20K ROM. 37.5K of RAM is directly accessible to BASIC, with an additional 24K for machine code programs or as a data store for BASIC programs.

Owners of the 48K version can have it upgraded to 96K through their dealers for £89.95 inc. VAT. New in the shops the 96K versions costs £299 inc. VAT.

Further enquiries to **Computers, 33A Bridge St., Cambridge CB2 1UW. Tel: (0223) 315063.**

Just Your Type?

Lowe Computers of Derbyshire have signed with Brother, the typewriter giant, for major UK distribution rights of the EP-22, the world's smallest, lightest and quietest computer printer/typewriter. It incorporates an RS232 interface, which makes it a compatible printer for most popular personal computers.

At £169.95 (including VAT) from Lowe or one of their Genie Specialist dealers, the new machine will be well within the reach of every type of micro-user, from the computer whizz-kid to the accountant or businessman. The new machine is a dot matrix thermal or ribbon printer with a comprehensive QWERTY keyboard and digit calculator. The keyboard features a versatile second shift, for accents required in all Roman-script European languages and a range of signs for arithmetical or chemical formulae, including automatic superior or inferior numerals. It even makes sure you don't put an accent over the wrong letter. (How? How?) Correction facilities include a thirty two character "buffer" and a sixteen character screen display with cursor controlled insertion, deletion and overtype. A 2K continuous memory stores about a page of text with displays for corrections and remaining memory and, most important for computer users, interfacing capability with a computer's disc or tape memory.

A few touches enhance the EP-22's suitability for travelling use: cassette-loaded ribbons, full tab functions, adjustable angle-brightness in the LCD character display and a slide-out carrying handle. The whole package, which comes with batteries, three cassette ribbons, thermal and ordinary paper, weighs in at under three kilos.

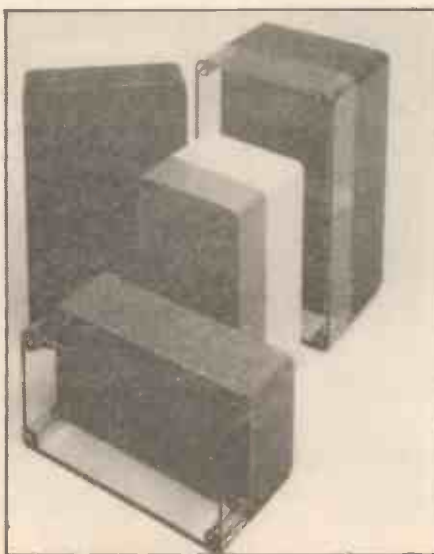
By integrating an RS 232 type serial interface into the EP-22, Brother reckon they have practically invented the personal computer printer/typewriter.



With all other printers more than twice the price, the EP-22's clear thermal or ribbon printing and interfacing memory will come as a boon to those who need an affordable first printer or an addition to either print or typewriting functions.

It sounds like a good Christmas present for the computer-buff with everything, providing a reasonably priced printout facility for computer programmes, languages, maths, scientific note-making, business and home work. The price of reasonable quality electrical typewriters has dropped like a dead crow in the last four years, much to the joy of those who type for a living or as a hobby.

Enquiries to **Lowe Computers Ltd., Chesterfield Road, Bentley Bridge, Matlock, Derbyshire DE4 5LE. Tel: (0629) 4995/4057.**



See Through Tops

Complimenting their range of tall top, clear lidded Bimboxes for applications where viewing of, but not access to, components is required, **BOSS Industrial Mouldings** are now manufacturing these versions in colours matching or contrasting with the base colour. As with all BIM 2000 Bimboxes the colour choice is black, grey, orange, white, or blue with seven sizes ranging from 100x50x25mm to 190x110x60mm. Although the clear lids are manufactured in SAN, the coloured lids as with the bases use ABS, the bases in all cases incorporating 5.08mm (0.2) spaced slots for supporting 1.5mm (0.062in) PCBs. Secured by screws running into base bosses, all lids have small peripheral flanges which sit recessed into the base providing excellent water repellent properties or, with the use of suitable mastic, a fully hermetically sealed enclosure.

More information from **BOSS Industrial Mouldings Ltd., James Carter Rd., Mildenhall, Suffolk IP28 7DE. Tel: (0638) 716101.**

A Quick Word

Cheetah Marketing's "Sweet Talker" speech synthesiser for the 16K and the 48K Spectrums and ZX81 plugs direct into the use port of the computer, draws its power from the existing supply, and has a fixed-volume built-in speaker.

The system used in the now-established allophone technique which is straightforward to use. (A certain amount of experimentation is always needed, with English, to get the sound of words correct, since they frequently

MONITOR



don't correspond very closely to the spelling) and gives an unlimited vocabulary in English. (Some other languages use a not-dissimilar allophone set.) The Sweet Talker boasts high quality speech and a very low bit rate.

A demo tape is supplied with every module to explain the system, along with a chart for easy reference. The unit is sold fully cased, tested and guaranteed, and is said to be fully compatible with all accessories. "No more lonely nights" they say. That's perhaps too much to claim, but at least you'll have something to talk to. The unit is £34.95 all inclusive.

Enquires to **Cheetah Marketing Ltd., 359 The Strand, London WC2R 0HS.**

Double Density BBC

L B Electronics of Uxbridge have produced a Double Density Disc Controller as a replacement unit for the 8271 Disc Controller usually fitted to disk driven BBC Micros.

The LB Controller is a 97 x 87mm PCB carrying the disk controller. Capable of controlling four double-sided disk drives, the adaptor is capable of true double density operation on 3in, 5in and 8in drives, single or double sided and, in the case of 5in drives, on forty or eighty tracks.

The adaptor is designed to occupy the 8271 socket on the main BBC circuit board. If two 5in or 3in drives are being used, they are controlled by the existing drive controller socket on the underneath of the BBC Micro. For 8in discs, an external converter from 34 to 50 way cable will be needed, as well as a ten way cable carrying control signals. The converter will also be needed if more than two drives are in use, and is available from LB Electronics.

BBC Micros not fitted up for disks will need three other ICs fitted.

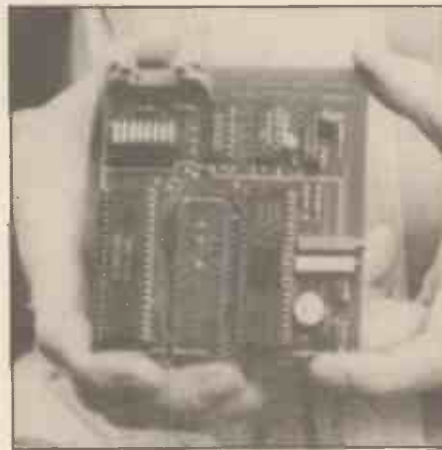
The Disk Filing System accompanying the new Disk Controller is supplied on a 2764 EPROM, with full fitting instructions. LB's disk filing system is compatible with Acorn's, and will read and write to disks formatted for use on Acorn and similar systems, without modification, provided the programs contain legal access to the filing

system as recommended by Acorn.

Additional features include the possibility of formatting disks to contain a large catalogue of up to 124 directly accessible files. The software automatically establishes which type of disk being used, and whether it is double or single sided. A utilities disk is provided with the disk formatting routines.

The controller has been optimised for use with the TEAC FD 55F, half-height, 40/80 track, double sided drive. A pair of TEACs used with the Double Density Drives gives over 1.25 Mbytes of storage.

L B is offering a complete package of one Double Density Disk Controller plus



We thought that the accompanying press photo wasn't entirely compatible with the er serious, hardworking nature of HE, so we've delegated it to what we consider a more appropriate use overleaf.

Disc Filing System, one TEAC drive, a 34 way connecting cable to connect two drives, plus a case and power supply, for £379.50 (including VAT), a saving of about £20 on the separate items.

More information and/or ordering form from **L. B. Electronics, 11 Hercies Rd., Hillingdon, Uxbridge, Middx UB10 9LS. Tel: (0895) 55399.**

Put On Your BIB

Last year **Bib Computer Care Division** launched a number of lines for computer maintenance. Bib have now introduced several new products and re-packaged some existing lines to produce a useful range for home and office users. To coincide with the introduction of this new line, Bib have produced a full colour leaflet giving comprehensive details of all the products, which are: Bib Anti-Static Cleaner BCC-3; Cassette Head Cleaner BCC-6; Computer 5¼" Disk Drive Cleaning Kit BCC-7; Computer Terminal Maintenance Kit BCC-8; Computer Care Kit BCC-9; Computer Storage Album BCC-10.

One of the most popular products is the Bib 5¼" Disk Drive Head Cleaning Kit, which is an effective method of keeping the read/write head free from dust

particles, oxides, etc. This cleaning diskette features a reinforced centre ring, which is patented, ensuring minimal wear with continual use. These products are available from **Pact International** and other distributors. In case of difficulty please contact the manufacturer at: **BIB Computer Care Division, Kelsey House, Wood Lane End, Hemel Hempstead, Herts HP2 4RQ. Tel: (0442) 61291.**

Scopex Repairs

A few eyebrows around here have been raised recently by **Scopex Instruments Ltd.**, makers of popular oscilloscopes, being taken into receivership.

Readers who have Scopex oscilloscopes and who are concerned about repairs, etc, will be glad to know that Peter Waugh, who previously designed Scopex's analogue instruments, has formed a new company, **Mendascope Ltd.**, which will provide repair and servicing facilities for Scopex scopes, including collection, and a free estimate.

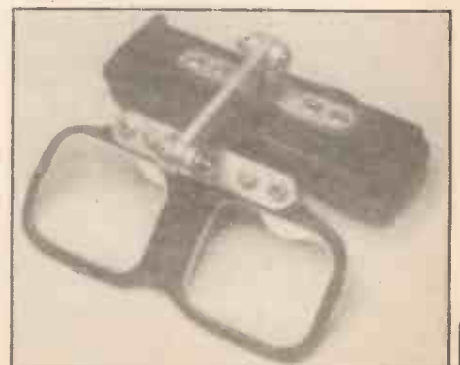
Anyone concerned should contact Mr. Waugh at **Mendascope Ltd., Otter House, Weston Underwood, Olney, Bucks MK46 5JS. Tel: (0234) 71445.**

I See

Mason and Gantlett of Norwich have produced an improved version of their **Versator** binocular magnifier. This is in effect a double-lensed magnifying glass, giving a magnification of x 2.5, which is worn round the head. It incorporates a prismatic element to help focus at short range on fine work and is designed to be worn all day if necessary without strain, with a weight of 70gm.

At £22.75 (inclusive) the **Versator Mk. 4** is a professional rather than a casual tool but anyone who tends to suffer from eye strain doing close work for long periods could consider it. Glasses can be worn at the same time. M&G don't say whether they do an approval period, but I expect they would welcome enquiries.

Mason & Gantlett Ltd., 29 Surrey St., Norwich NR1 3NX. Tel: (0603) 28101.



MONITOR

Jupiter Eclipse

Jupiter Cantab Ltd., the company which developed and launched the ACE micro, which was unusual in using FORTH instead of BASIC, have met cash flow problems like many another young company and have gone into liquidation. At the time of going to press (about four weeks ago) the business was being offered for sale by the Liquidator, J. D. Cross of Chater and Myhill, Sussex House, Hobson St., Cambridge CB1 1NJ. We have no further details at present, so watch this space.

Spectrum Program Storage

Two new products are available from Ness Micro Systems to make program storage on cassette easier and faster for Spectrum users.

The NMS Tape Control is a programmable cassette recorder which is activated by simple BASIC commands either direct from the keyboard or under program control. One or two recorders may be plugged into the controller which carries out lead switching for LOAD and SAVE and also switches the recorders on an off via their REMOTE sockets.

With one recorder set to LOAD and the other to SAVE an automatic filing and retrieval system can be set up using software such as Masterfile. A semi-automatic switch is fitted for rewind and fast-forward.

The controller plugs into Spectrum's cassette sockets leaving the expansion port free and does not use up any input/output space. It also has a built-in BEEP amplifier with volume control and is in a black, textured-plastic case measuring only 125x70x45mm. It costs £19.95, with a hobbyist kit also available for £16.95. Post and packing is £1.50. A low cost version for one recorder only and with only manual tape switching is available for £9.95 plus £1 P&P.

The NMS Speedyload software (48K only) enables users to LOAD and SAVE programs at 3000 baud thus halving the waiting time for longer programs. A 1330 byte relocatable machine-code program in ramtop allows the high-speed facility to be selected with any tape command simply by preceding the command with a `USR` statement. No extra hardware is needed and it can be used with a standard recorder. It costs £3.95 plus 40p P&P on cassette from Ness Micro Systems, 100 Drakies Avenue, Inverness IV2 3SD.

Disk Drives . . .

Advanced Memory Systems Ltd. (AMS) are producing 3in disks and disk drives based on the Hitachi system. The disks, with 100K of storage each side, are cased in strong plastic cases, which, to prove their durability, AMS drove a



car over a few times at speeds up to 60mph. They still worked afterwards. "They'll withstand anything that schools, companies or the general public hand out" say AMS. They may be right. The only other thing I know to stand up to that kind of punishment and live is my breadboard (that's breadboard, not prototype bread). The disks have automatically retracting steel shutters to project the disk surface, and overwrite switch protection. Apparently they are finding popularity in schools.

The disk drives are made by Hitachi and housed by AMS themselves in steel in a £225 single drive 100K version, or a £399 dual drive 200K version, inclusive of cables. VAT and delivery. They use the BBC micro power supply.

The 3in drives have industry standard interfaces and are electronically identical with 5¼ drives, but are much smaller, and the disks very much more durable. The drives have forty tracks with track-to-track access time of 3mS and an average access time of 55mS and an average access time of 55mS.

Enquiries via Rushworth Dales, Group, 20 Orange Street, London WC2. Tel: 01 930 1612. I don't imagine many individual users will be investing yet, but schools and colleges may want to know more.

Talkin' Bout My Generator

Dawne Instruments and Electronics have extended their range of instruments and equipment by including the IFG 422 Function Generator. This compact, rugged instrument provides sine, square, triangle, ramp and pulse waveforms over the frequency range 0Hz to 2MHz in seven decade ranges. Output is continuously variable to 20V p-p from and into 50R with switchable DC offset available to \pm Volts.

A variable duty cycle and symmetry control enables adjustment of main, square and TTL outputs to meet the requirements of digital circuitry. External sweep over 1000:1 frequency range, polarity invert and sync output, excellent accuracy, distortion, linearity, rise and fall times would seem to combine to make the IFG 422 useful for numerous applications.

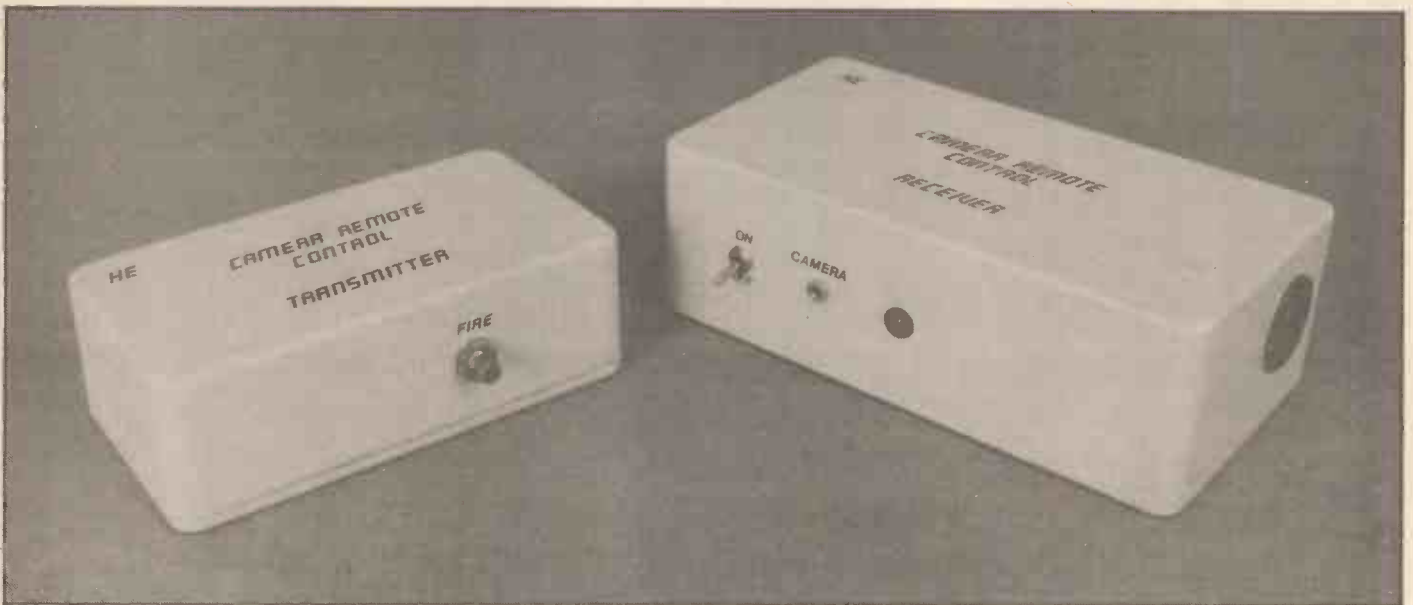
The IFG 422, manufactured by Intron, the machine measures 233 x 80 x 300mm, weighs about 1kg5 and is fully guaranteed for one year. It costs £195.00 (ex. packing, delivery and VAT). Enquires to Dawne Instruments and Electronics, Shields Road, Bill Quay, Gateshead NE10 0RS. Tel: (0632) 695117.

Oh yes. And here's that L.B. Electronics photo we promised you.



HE

CAMERA REMOTE CONTROL



HE's infra red remote controller gives the freedom to shoot photos from a distance, even from the other side of a window.

FOR CERTAIN types of photography, such as some wildlife and candid shots, it is advantageous to be able to operate the camera's shutter release while some distance away. The conventional method is to use an "air release", which is a simple pneumatic system having a rubber bulb, about 6 metres of rubber tube, and a simple piston mechanism which fits into the cable release socket of the camera. Squeezing the rubber bulb operates the piston mechanism which is at the opposite end of the tube, and triggers the shutter.

This system is very inexpensive and can work quite well, but there can be problems with the tube being obstructed and the system failing, or a significant delay being produced before the shutter is triggered. Many of the more recent cameras to come

onto the market have provision for an electric remote release, with the camera either being triggered direct or via an autowinder/motordrive. This type of release simply consists of a twin cable with a push button switch at one end and a plug at the other to match the camera or winder. The switch activates either the electronic shutter or an actuator in the winder. This method give excellent reliability, but it still requires a long cable to carry the signal to the camera. This can be undesirable for some types of photography, and the cable also makes an excellent trip-wire!

For many purposes it is better to use a wire-less method of control, such as an infra-red or ultrasonic system. The latter offers slightly greater range, but infra-red systems have the advantage of operating quite

well through a window, so that the camera equipment outside the house can be operated from within. The camera control system described here is of the infra-red type, operates reliably over a range of at least 6 metres, and is at least equal in this respect to the air release which it was designed to replace. It has mainly been used with a Pentax LX camera plus autowinder, but it also worked well when tried with a Minolta XD7 (which is triggered directly), and it should work with any camera which has an electric release facility. The prototype has been built as a single channel system, but the equipment could easily be modified for multichannel use with multi-camera set-ups, as will be explained in greater detail later.

Camera Remote Control

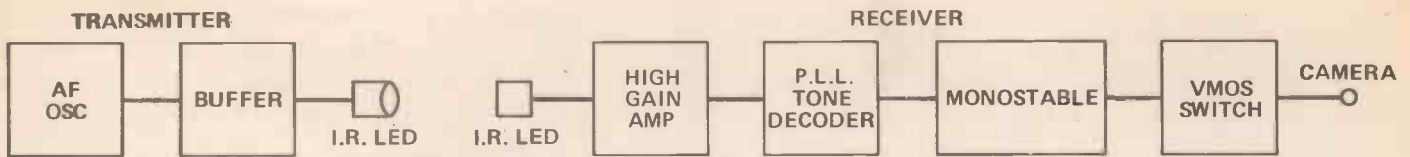


Figure 1. A block diagram of the whole remote control system.

The System

The block diagram of Figure 1 shows the arrangement used in this remote control system. As it is not practical to use a high output power from the receiver. A simple DC system is consequently impractical, as the signal received from the transmitter would often be swamped by the ambient infra-red level. Instead, an AC system is used, with the transmitter providing an amplitude modulated beam. The infra-red signal is generated using a special type of light emitting diode, and this is driven from an audio oscillator via a buffer stage which provides the fairly high drive current required. This gives a crude form of modulation with the LED simply being switched from fully on to fully off, but for this application nothing more complex is needed.

Another special type of diode is used at the receiver to produce an electrical signal from the received infra-red pulses. This is a large photodiode that gives good sensitivity, and although the diode itself is sensitive to a large part of the light spectrum, an integral infra-red filter removes light outside the infra-red range. This prevents strong light in the visible part of the spectrum from saturating the diode and preventing the system from operating properly.

The audio frequency output from the diode is not likely to be very large in practice, and would typically only be a few tens of microvolts. A high gain amplifier is therefore used to boost this signal to a high enough level to operate the following stage, which is a Phase Locked Loop tone decoder. This circuit has an electronic switch at its output, and this is turned on if an input signal at a frequency within its narrow locking range is received. The transmitter is adjusted so that its operating frequency is at the centre of the locking range, where the PLL decoder is most sensitive.

There are two reasons for the use of a PLL decoder in the circuit; one is simply that it gives almost total immunity to spurious triggering by electrical interference or noise. A second advantage is that it enables two remote control systems to be used side-by-side without one also activating the other — provided the two operate on slightly different frequencies, that is.

A monostable multivibrator is used as the next stage of the receiver, triggered by the output switch of the PLL tone decoder; the monostable drives a VMOS switching transistor which in turn controls the camera. The monostable is used to ensure that

the VMOS switch is activated for a long enough time to operate the shutter, even if only a brief input signal is received. This helps to give more reliable operation if the system is used at virtually its maximum range.

follower buffer stage to give more reliable and consistent results. Operating push-button on/off switch SW1 supplies power to the transmitter and activates the camera.

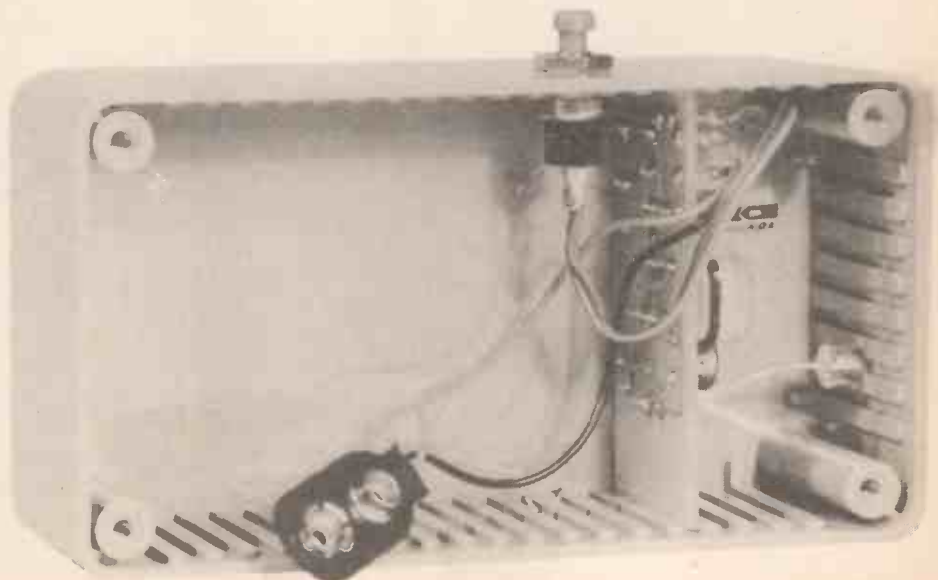
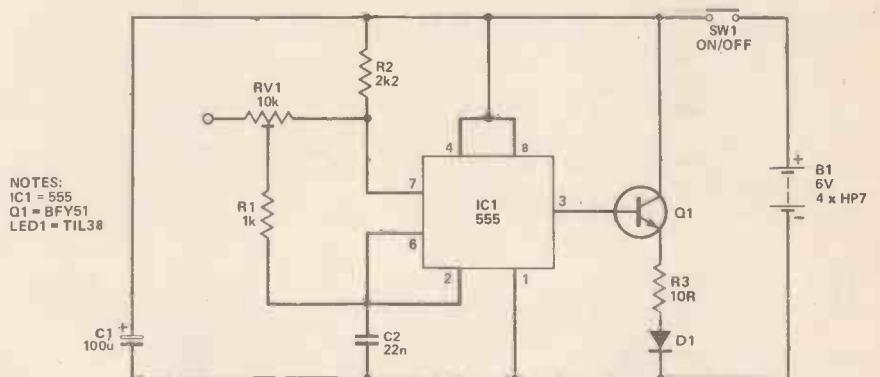
Transmitter Circuit

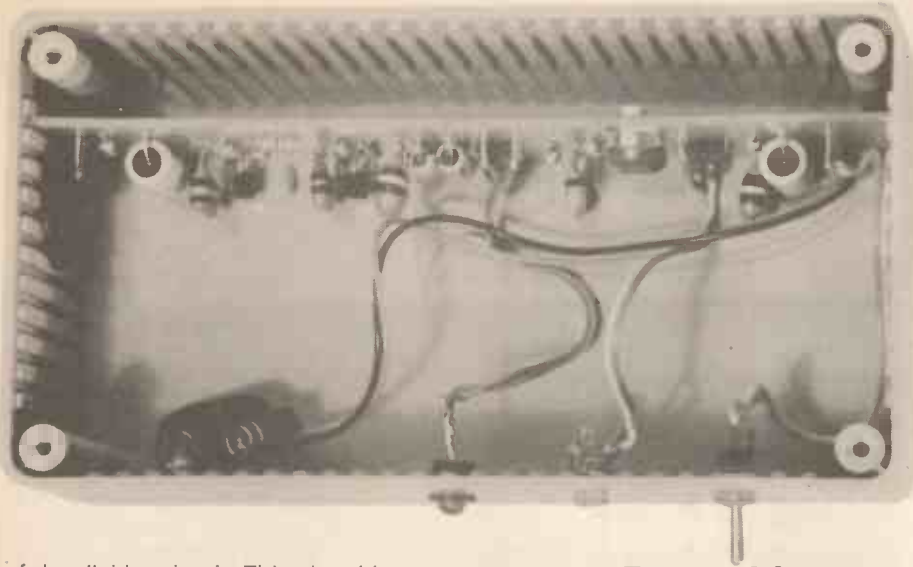
Figure 2 shows the circuit diagram of the transmitter, based on a 555 astable oscillator. This gives a roughly squarewave signal, with RV1 used to trim the output to the appropriate frequency (around 5kHz). The output stage of the 555 is barely able to provide sufficient output current to drive infra-red emitter D1 at the required current of around 150 milliamps, so Q1 is used as an emitter

Receiver Circuit

The receiver unit is a little more complex, as can be seen from the circuit diagram of Figure 3. D2 is the infra-red photo diode; this can be used as a photovoltaic cell, producing an output voltage which is roughly proportional to the received infra-red intensity, however slightly higher sensitivity is obtained by using it in a potential divider circuit, as in Figure 3. Here its reverse resistance varies with the received infra-red intensity, giving a varying voltage at the output

Figure 2. The circuit diagram of the transmitter stage.





Parts List

of the divider circuit. This signal is coupled by C4 to the input of a high gain amplifier which uses Q2 and Q3 as straight forward common emitter amplifiers. C5 rolls-off the response of the first amplifier in the radio frequency range to prevent instability. The coupling capacitors can have quite low values due to the fairly high operating frequency of the transmitter; this helps to filter out 50Hz hum received from mains powered lighting which could otherwise drive the amplifier into clipping and desensitise the circuit to the signal from the transmitter.

An NE567 (IC2) is used in the tone decoder, R11 and D3 form the collector load for its output transistor, and LED1 lights up when the tone decoder is activated. This is useful when adjusting the frequency control of the transmitter, and it also helps when setting-up the equipment ready for use.

The negative output signal from the tone decoder is used to trigger IC3, which is a 555 used in the standard monostable multivibrator configuration. Q4 is the VMOS output transistor, driven direct from the output of IC3; note that the camera or autowinder must be connected to SK1 so that Q4 is fed with a signal of the right polarity.

Transmitter

RESISTORS

- (All 1/4 watt 5% carbon)
 R1 1k
 R2 2k2
 R3 10R

POTENTIOMETERS

- RV1 10k 0.1W
 horizontal preset

CAPACITORS

- C1 100u
 10V radial electro
 C2 22n
 polyester

SEMICONDUCTORS

- IC1 555
 timer IC
 Q1 BFY51
 silicon NPN
 D1 TIL38
 high power IR emitter

MISCELLANEOUS

- SW1 Push to make
 momentary switch
 B1 Four HP7
 Battery holder and PP3 connector;
 printed circuit board; plastic case
 120 x 65 x 40mm; Veropins.

Receiver

RESISTORS

- (All 1/4 watt 5% carbon)
 R4 12k
 R5, 8 1M2
 R6, 9 4K7
 R7 390R
 R10 10k
 R11 1k2
 R12 1M

CAPACITORS

- C3, 13 100u
 10V axial electro
 C4, 6 10n
 polyester
 C5 33p
 ceramic plate
 C7, 12 100n
 polyester
 C8 22n
 ceramic
 C9 1u
 63V axial electro
 C10 22n
 polyester
 C11 2u2
 63V axial electro

SEMICONDUCTORS

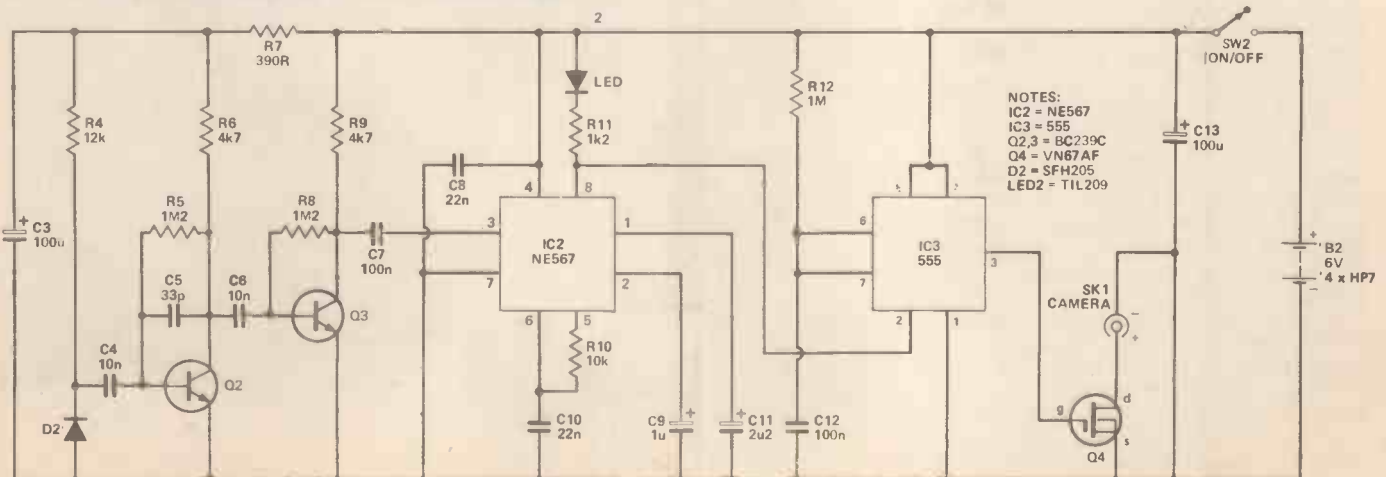
- IC1 NE567
 PLL tone decoder
 IC2 555
 timer IC
 Q2, 3 BC239C
 high gain silicon NPN
 Q4 VN67AF or VN66AF
 VMOS transistor
 D2 SFH205
 large IR detector diode
 LED1 TIL209 or similar
 panel LED

MISCELLANEOUS

- SW2 SPST
 sub-min toggle switch
 SK1 2.5mm
 jack socket
 B2 Four HP7
 Plastic case, 150 x 80 x 50mm;
 panel holder for LED1; battery
 holder for 4 x HP7 size cells and PP3
 connector; printed circuit board;
 Veropins, wire, etc.

BUYLINES page 26

Figure 3. The circuit diagram of the receiver stage.



Camera Remote Control

Construction

The printed circuit component layout for the transmitter unit is shown in Figure 4. This is quite straight forward, but be careful to mount IC1 with the correct orientation. Fit Veropins to points where connections to SW1 and the battery clip will be made, and leave D1 with long leadout wires.

A plastic case having approximate outside dimensions of 120 by 65 by 40mm is ideal for the transmitter. The printed circuit board slots into one of the vertical sets of guide rails well towards one end of the case. If a 5mm diameter hole is drilled at a suitable point in the panel at this end of the case, D1 can then be pushed into this hole. SW1 is fitted at any convenient point to the case to the rear of the printed circuit board; there is plenty of space for the batteries here as well. These are four HP7 size cells mounted in a standard square type plastic battery holder (but not the long type which will not fit into the case). The connections from the printed circuit board to the battery holder are made via an ordinary PP3 style battery connector.

If a different type of case is used it will be necessary to bolt the printed circuit board in place. There are suitable spaces on the board to accommodate mounting holes.

Construction of the receiver commences with the printed circuit board, and details of the component layout of this are given in Figure 5. Make sure that D2 is connected the right way around. If it is connected with the wrong polarity its sensitive surface (the large curved surface opposite the one carrying the type number) will be facing into the case, and it will be forward rather than reverse biased. The likely maximum range is then about 50mm!

Q2 and Q3 are specified as type BC239C, but the metal cased BC109C is a direct equivalent and is more easily obtained (although it is somewhat more expensive). Q4 can be either a VN67AF or a VN66AF, and although it is a MOS device, both these devices have a built-in 15 volt Zener protection diode, and no special handling precautions are required. It is advisable to bolt the heat-tab of Q4 to the board to improve the mechanical soundness of the board, but as it is used as a switch this device only dissipates a low level of power, and a heatsink is unnecessary.

Fit Veropins to the board at points where connections to D3, SW1, SK1, and the battery clip will be made.

A 150 by 80 by 50mm plastic case is suitable as the housing for the receiver. The printed circuit board fits into the set of horizontal guide rails nearest one side of the case. A large cutout about 12mm or so in diameter is made in the case adjacent to D2 so that the infra-red radiation from the transmitter can pass through the case to D2. It is *not* advisable to use a small cutout as this would make the

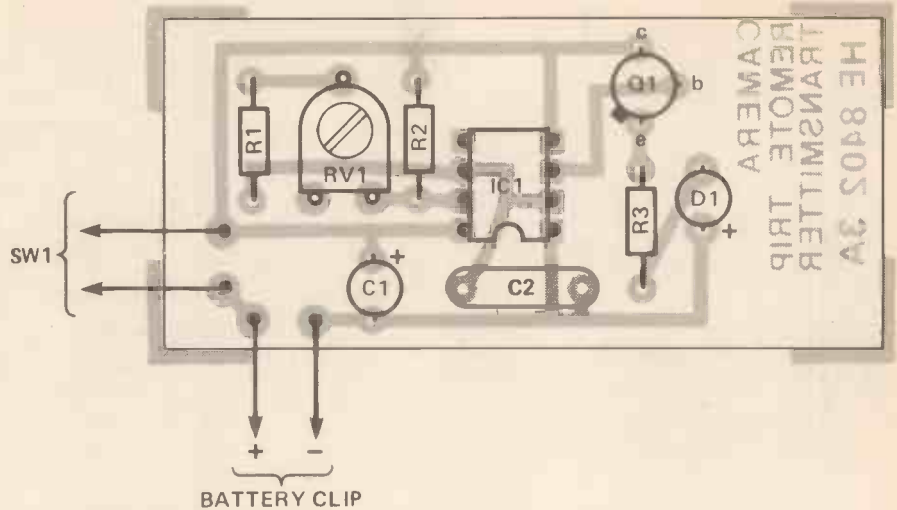


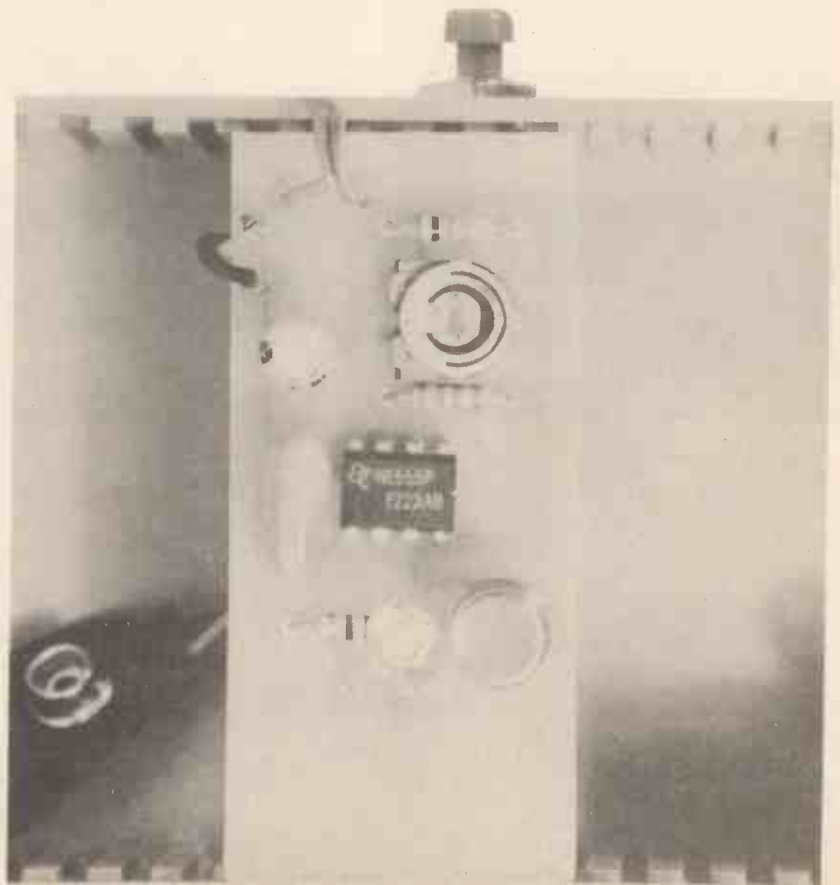
Figure 4. The PCB layout for the transmitter.

system more directional than it really needs to be!

LED1, SW2 and SK1 can be mounted at any convenient points on the case, and the final wiring can then be completed. SK1 can be any two way polarised socket; a 2.5mm jack type is used on the prototype. The connection from the camera or autowinder to the receiver is made using an electric release for the particular camera or winder you are using, and *this remote control unit can only be used if a suitable release is available*. The push-button switch on the release is removed and a plug to

match SK1 is fitted in its place. With the camera or winder connected to SK1 (and switched on where appropriate), a multimeter set to a fairly high DC volts range can be used to determine the polarity of the voltage on SK1 so that this can be correctly wired to the printed circuit board.

Like the transmitter unit, the receiver is powered from four HP7 size cells. As it is likely that the unit will be left running for long periods, NiCad rechargeable cells are probably the most practical power source, but primary cells can be used if preferred.



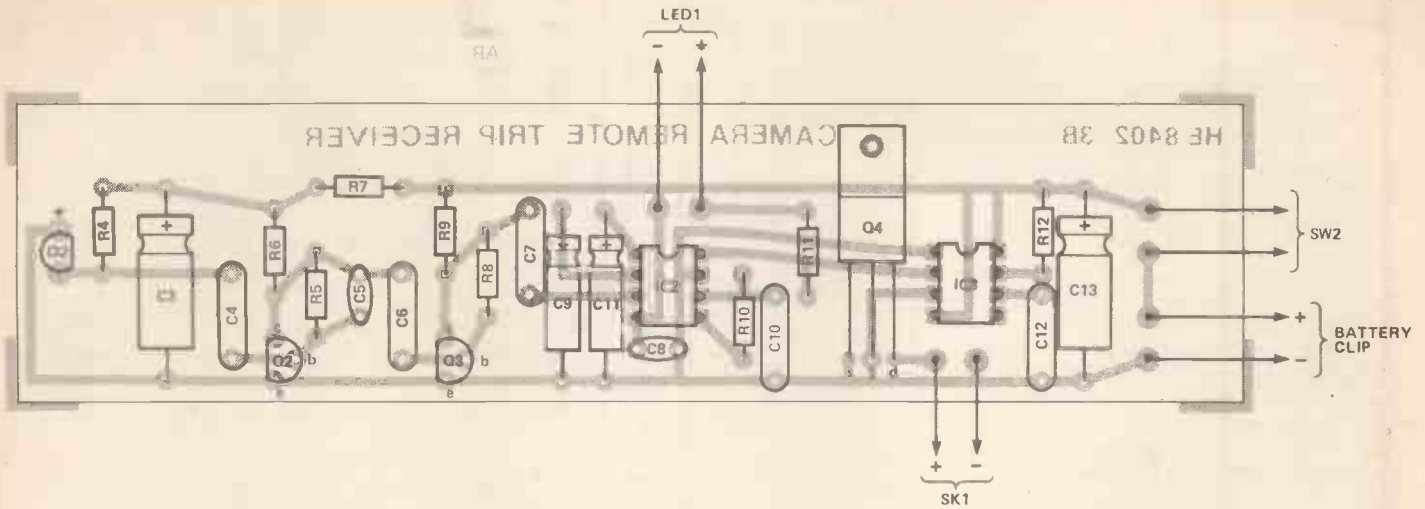


Figure 5. The PCB layout for the receiver.

Adjustment

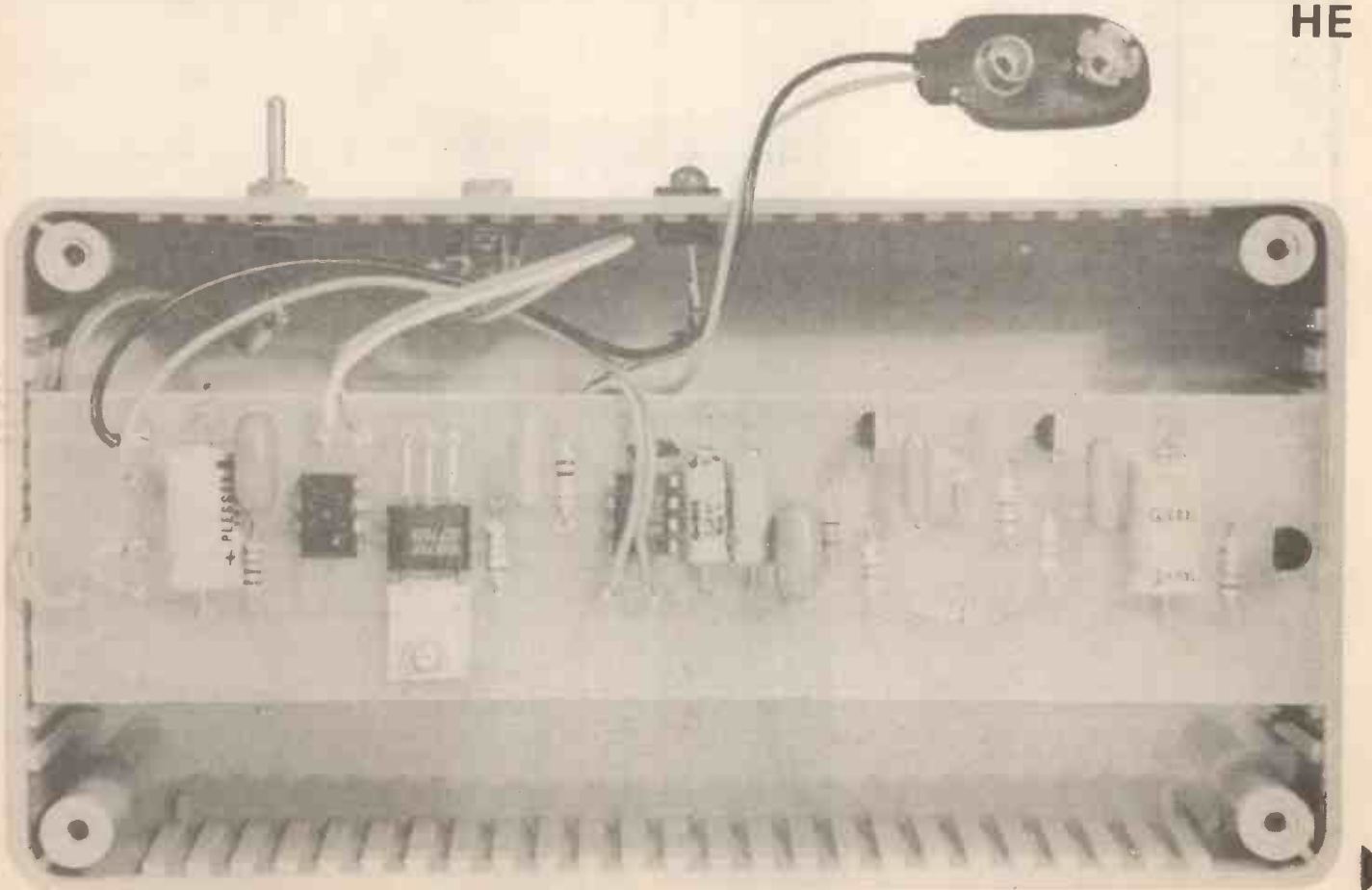
RV1 is given the correct setting by trial and error. With the output of the transmitter aimed at D2 in the receiver from a short distance away, it should be possible to get LED1 to light up by adjusting RV1. If not, switch off both units at once and thoroughly recheck them for errors. Once LED1 can be made to light up, it is a matter of gradually moving the two units further apart and readjusting RV1, as necessary, to keep LED1 alight. This is

continued until the maximum range of about seven metres is achieved.

Remember that the unit can only function properly if the infra-red radiation from the transmitter has a transparent path to D2 at the receiver. The unit is quite directional, mainly due to the the built-in lens of D1, and the output of the transmitter needs to be aimed reasonably accurately at the receiver, especially when the system is used at something approaching its maximum range.

If it is necessary to control two or three cameras, a separate receiver

unit for each one must be used. However, C10 in each unit must be given a slightly different value (15nF, 22nF, and 33nF are suitable). A separate transmitter circuit can be used for each receiver, housed in a single case and powered from the same battery. C2 in each transmitter would have the same value as C10 in the receiver unit it is to activate. It would be possible to have a single transmitter circuit with a switched operating frequency, but this would not give the option of firing two or three cameras simultaneously.



POINTS OF VIEW

Feel like sounding off?
Then write to the Editor stating your Point of View!

Sound Of Silence

Dear Sir,
With reference to an article that was published in your issue HE June '83, the Sinclair Sound Board, I have attempted this project but it doesn't seem to work.

So far I have returned the main sound generator chip 8912 as I thought this was a fault, and re-etched another board, also re-soldered another connector.

Then I have tried various interpretations of the listed poor program, finding a fault at No. 150: "GOSUB 990"? Perhaps it's "GOSUB 9990".

No matter what I do, and I think I have tried everything (including advice from the local computer club), it just doesn't seem to operate. All I get is a very low bang sound when I enter 9 into reg. 13.

Now it's on top of a pile of junk boards for breakdowns as I can't find any further use for it.

Unless . . .
Perhaps . . .
If so I would be so grateful.

Yours faithfully,
P. Allwood,
Newport,
Gwent.

Dear Hobby Electronics,
I have just completed the ZX Sound Board from HE June '83 for a technology project at school.

I have checked for any possible short circuits and that the correct components had been inserted correctly. I have also checked all the soldered joints, and assuming the sound board would work correctly, I plugged it into the back of my Sinclair Spectrum.

After restoring the power to the computer with the board plugged in, a buzzing sound was heard from the loudspeaker. Shortly after that the computer crashed and was permanently damaged. I now do not know what to do as my project has to be completed by Christmas. I would be very pleased if you could send me details on how to get the Sound Board working correctly and how to test it so that I can be sure it will not damage my computer next time. Please help me.

Yours faithfully,
C. Whitehead,
Brentwood,
Essex.

This is a pair of tragic tales, not least because both constructors have tested

their projects, and written for advice with exemplary clarity. The question is, can we help?

Firstly, there was a misprint in the program relating to the Spectrum, as Mr. Allwood suspected. The correct version is:

120 Print R: " ";
150 GOSUB 9900

This alone should be enough to make this project work, as there were no other bugs or errata. Mr. Allwood could have saved himself some trouble by writing to see if there were any errata before constructing the project.

Hint no. 1: if embarking on a complex, difficult or expensive project, anything connected to a computer or other sensitive piece of equipment, or any project at all for an examination or qualification, write to us first to check if there are any errata. Taking Murphy's Law into account, you will have enough technical problems of your own to sort out, without having to tackle ours as well.

In Mr. Allwood's case, if his project still doesn't work, then it's a mystery.

Mr. Whitehead is in deeper trouble, simply because the errata won't help him. There must be a mistake in the construction, or a malfunction in one of the components, resulting in a dead Spectrum and a useless project. The fault can only be traced by testing each component in the circuit in sequence and checking that the inputs and outputs are at the correct voltage. One of the ICs may be faulty; the edge connector may be faulty. The project needs to be looked at by someone with experience of electronics and fault-finding. Surely someone at the school could help at this stage?

Hint no. 2: when asking for errata, don't put another tricky question in the same letter, or the chances are it will sit on the enquiries file for weeks until someone has the time to work out an answer, while you sit for a lengthy period unable to proceed.

(I had better add that both these letters are models of informative conciseness).

Good luck to both constructors.

Personal Magnetism

Dear Sirs,
Could someone please supply an electronic circuit to operate a child's toy? A transmitter to activate an electromagnet which releases a catch which lets the lid of the box spring open (a clown's face is painted

on the inside of the lid. The lid is spring-hinged with a letterbox spring).

The transmitter is kept hidden from the child; the toy holds the attention of the child because he or she doesn't know when the clown will appear.

Batteries, and an on/off switch for the magnet, can be inside the box.

Sincerely,
Maurice Day,
Woodford Green,
Essex.

This is a very old letter which we have obviously failed to find a suitable answer for in the past. Can anyone come up with a neat and tidy answer? If anybody sends us a design suitable to publish, our fee for Reader's Projects (with PCB and/or Veroboard layout) is £20, and for Short Circuits (a basic circuit and diagram) is £10. Or does anyone know of a commercial remote control device that would do the job?

Clarifying The Issue

Dear Editor,
Firstly I would like to thank you for the back issue you sent me. I would very much like to obtain the other two issues, but, as you write, they are out of print. Thus I would be very much obliged if you could publish in your Points Of View department that I would like to obtain the issues of HE for November 1982 and January 1983. I would be very thankful to any reader who could sell me these issues. I will pay —2.00 for each issue.

My address is: Maksim Rudolf, Trubarjeva 79, 61000 Ljubljana, Yugoslavia.

As for you wishing me luck with the Atari 400, I would like to tell you that I have ordered and already received the computer. Thanks for enquiring for me.

Now that I have got into computers I would like also to subscribe to a magazine which deals more specifically with computers and especially software (by the way, your popular computing articles were excellent).

I have seen the ad. for Digital and Micro Electronics in your November issue. Also on HE's wrapper is a list of the mags published by Argus. I would be grateful if you could send me addresses where I could contact these magazines and subscribe to them (I don't be afraid — I have already subscribed to HE for 1984!)

Now there are a few things which I would be thankful if you could supply me with info on:

What happened to the Hobby 'Scope and the Digitester? Could you supply me with the addresses of Ferranti and Mullard (I urgently need data on some of their ICs).

Thank you very much for your help! Sorry for the long letter.

*Yours sincerely,
Maksim Rudolf,
Yugoslavia.*

The situation with November and December 1982 and January 1983 is an odd one: something mysterious happened to the order for backissues at that time, and these three issues were never stocked. A few lucky enquiries, like Mr. Rudolf, benefitted by a small cache of Decembers which we found in the office a few months ago, left over from Breadboard '82 — but the post-Breadboard '83 clearout has revealed that there are no more secret stocks, in this office at any rate. A pity, because November '82 was one of our most popular issues (it introduced HEBOT II).

So if anyone has a November '82 or a January '83 they don't mind parting with, please contact Mr. Rudolf.

The two computer magazines most likely to be of interest are *Popular Computing Today*, which concentrates mostly on games computing and includes stuff for the Atari, and *Computing Today*, which has a heavier emphasis on programming, but concentrates more on less games-oriented micros like the Spectrum, and BBC. All the magazines run from the same address, and you should write to the Circulation Manager at the new address in the front of Hobby Electronics and ask for subscription costs and advice about the contents of these and other computer magazines which Argus publishes. *Digital and Micro Electronics* is very hardware-oriented.

For information on data, write to Ferranti at Ferranti Ltd., Fields New Road, Chadderton, Oldham OL9 8NP, and Mullard at Mullard House, 1-19 Torrington Place, London WC1E 7HD.

The Digi-tester is at present being examined by our technical department, and the Hobby 'Scope is being examined by our solicitors. We do expect to conclude both series in time.

Do We Detect Problems?

Dear HE,

I wonder whether you could help me solve a problem for a friend of mine who recently purchased a video recorder. The trouble is that he lives adjacent to an airfield, and every time the radar cone is facing his flat a diagonal line coupled with an audible blip goes through his television (but only when the video is playing).

Is it possible to design a passive high pass/band pass filter to block the

interference from the radar?

*Yours faithfully,
Paul Welsh,
Hatfield,
Herts.*

There are a number of solutions to this problem. Constructing a filter yourself is one of them — but it would be quite difficult to get the filter characteristics and impedance correct without indulging in pages of mathematics, or hours of trial and error.

The VCR is sensitive to radar interference because its receiver amplifies radar signals. It is possible to buy radar filters which fit onto the antenna, but another possible solution is simply to retune the VCR to a different channel which is not adjacent to the band the radar is on.

Failing this, contact the airport authority and ask them what solution they can offer. They have probably had other enquiries of this nature. Alternatively, the Post Office Engineering department may be able to help.

Reverberations

Dear Sir,

For my 'O' level electronics examination paper project I am building an Echo Reverb unit. I am basing the design on the unit featured in the May 1982 issue of your magazine.

One of the major purposes of the practical project is to implement the circuitry and ICs encountered on the electronics course. As we have only dealt with the more simple ICs, 741, 555 timer, etc., I am trying to replace, if possible, the delay line and the pulse clock with simpler circuitry with which I am more familiar.

I think I will be able to replace the 4046 CMOS (phase locked loop) chip with a circuit involving the 555 timer, but I cannot find anything suitable to replace the expensive and complex TDA 1022 delay line.

I should be extremely grateful if you would advise me about this problem. I would also appreciate any other information which may help me in any way.

*Yours faithfully,
Martin P. Day,
Chelmsford,
Essex.*

You have grasped a can of worms here, as echo and reverb are difficult effects at the best of times, which is why they use expensive and complex parts.

There is no substitute for "bucket brigade delay line" chips such as the TDA 1022, in echo-reverb applications.

The only alternative is to go to digital delay — a technique which would be far, far more complex and costly than the lowly BBD technique, involving a high precision analogue-to-digital converter, an array of RAM, a digital-to-analogue converter, and a

CPU with ROM-based software to control everything.

We suggest you stick with the popular TDA 1002, or choose an easier project. The *Echo-Reverb*, with a series of modifications ironing out some weaknesses in the original, is featured in *Forward Bias* this month, by the way.

Not A Game Any More

Dear Modmags Ltd.,

I am writing to you to ask whether you still publish the Gadgets and Games magazine, which I never see in the shops. The last one I bought was the Winter 1980/1981 edition. If you do not publish this magazine anymore I would be interested in any other magazine that deals with handheld and table top games.

*Yours faithfully,
S. F. Richards,
Southend-on-Sea,
Essex.*

Gadgets and Games went out of publication quite a while ago, and we don't know of a similar magazine. The signs are that people are losing interest in electronic games as such, and are turning to computers for which they can buy games cartridges, with the added attraction of being able to modify the programs to suit themselves, or write their own software.

And now a public service announcement. A lot of people think that we are Modmags, but we ceased to be Modmags and became Argus Specialist Publications a couple of years ago: now we are ceasing to be 145 Charing Cross Road (that legendary address) and becoming 1, Golden Square, London WC1. See the contents page for more details.

A Reader Replies

Dear Sir,

I feel urged to write and tell you that the complaint I informed you of, re the high price which I paid for a toroidal transformer, has born fruit.

I was pleasantly surprised to be informed yesterday that my letter had been brought to the attention of the buying officer, and the prices of the transformers were being revised to fall in with those of the manufacturer's; furthermore I received a credit note for £1.36, which is the difference between the two prices.

I regard this as a very nice gesture, and the least I can do is write and thank them.

Your advice to cross-check prices is a sensible idea which I shall always carry out in the future.

*Yours sincerely,
Ronald Carter,
Crossgates,
Leeds.*

Need we say more?

COMING SOON TO . . .

Hobby Electronics

ALL ABOUT ELECTRONICS

Returning after a month's vacation, Hobby's popular back-to-basics series continues with a description of various logic chips: bistables, counters, adders, arithmetic logic units, ect.

THE HOBBIT

On the occasion of Melbourne House's innovative Spectrum adventure game is at last appearing in versions for other microcomputers. HE takes the occasion to review the game in retrospect.

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Although these articles are being prepared for the next issue, circumstances may alter the final content.

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Audio Power Supply Module

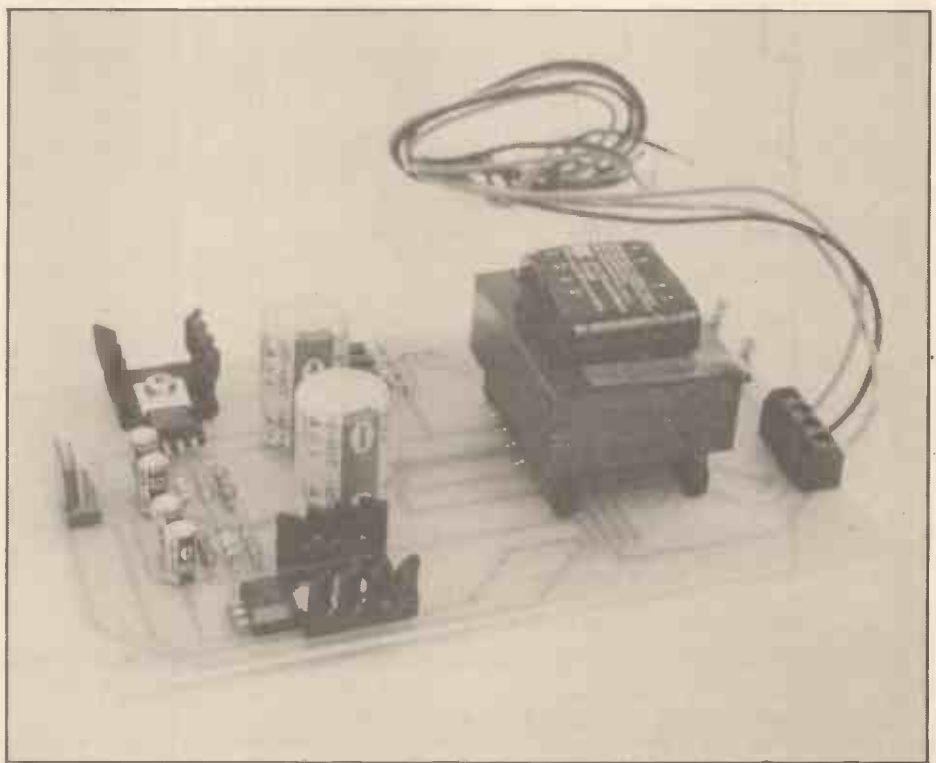
Andy Armstrong

This power supply is designed as part of a versatile audio preamp, and is also suitable for building into (or onto) other audio projects

THIS PROJECT is a general purpose power supply especially suitable for audio equipment other than power amplifiers. It may be used, for example, to power the parametric equaliser project from HE October '83.

On this versatile supply, two outputs are provided to power two separate .PC boards in the same piece of equipment, and a connection is also provided for a daughter board to customise the unit for special applications. Signals are provided so that the daughter boards may, for example, be designed to provide a mains synchronised ramp, thus making this a useful supply for phase-controlling triacs.

In addition to these special features, a couple of slightly more obvious ones are provided: first of all the PCB can accept either a 6VA PCB mounting transformer, or a 30VA toroidal transformer. Second, the type of voltage regulators used have their outputs programmed to a wide range of different voltages, thus providing for different circuit requirements. The unregulated positive DC is also available so that a +5V supply (say) could be provided using a separate regulator.



Circuit Operation

The operation of a power supply is, in principle, very straightforward. You have a transformer which cuts down the mains voltage, followed by a rectifier, a smoothing capacitor, and normally some kind of electronic voltage regulator, which gives a smooth regulated output. This particular power supply is a double rail design. It is envisaged, however,

Table 1

Transformer	R1, 4	R2, 3	R5, 6	Volts DC
0-6, 0-6	120R	390R	—	±5V
0-9, 0-9	120R	680R	—	±8V
0-12, 0-12	120R	1k2	10k	±12V
0-15, 0-15	100R	1k2	27k	±15V

Component values for output voltages from ±5V to ±15V

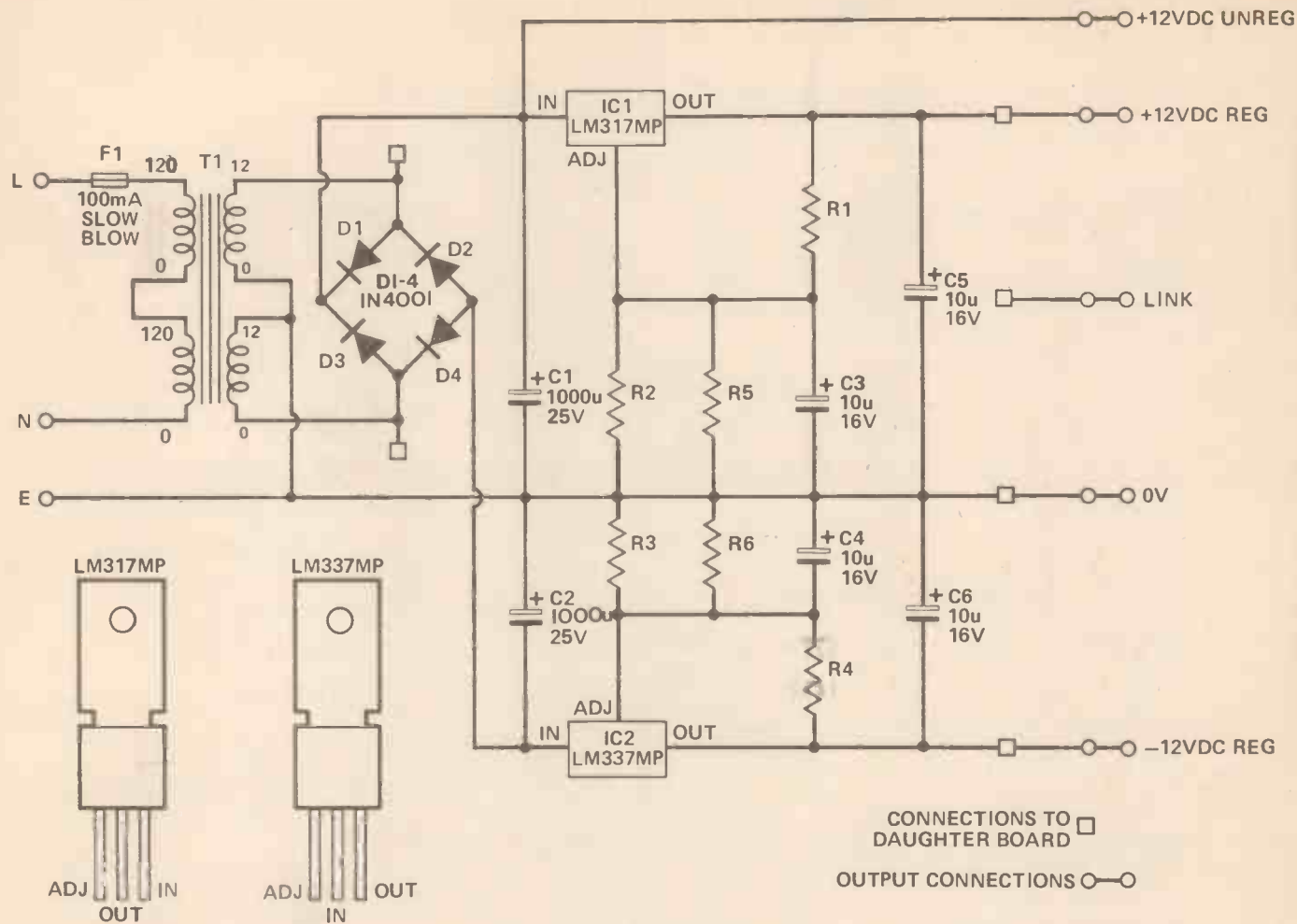


Figure 1. The circuit layout. This is one transformer you don't have to wind yourself.

that both the positive and negative supplies will normally be of the same voltage! The particular design is given for $\pm 12\text{V}$, but component values for other voltages are given in Table 1.

Close examination of the functioning of a power supply reveals that under the surface are one or two potential problem areas. The primary requirement in a regulated power supply is to make sure that the voltage regulator can always perform its job adequately. To do this, it needs an adequate voltage on its input, but not so much voltage that it will dissipate too much power at the required load current. To complicate this, most transformers sag to varying degrees under load, and also one must make allowances for the amount of ripple on the smoothing capacitors.

With a full wave rectifier system, a simplified view of the situation shows the smoothing capacitor being recharged to the peak voltage of the transformer secondary waveform every 100th of a second, and discharging steadily during intervening periods of time. In fact with any moderately low voltage system one must take account of forward drop in the rectifier diodes, and one may also take account of the fact that the capacitor voltage is

maintained over the short period of the tip of the sine waveform. These two effects almost cancel, though, so an approximation is good enough for most applications.

Since the required load current from the power supply determines both the rate of discharge from the capacitors and also the heating effect in the voltage regulators, this is the first factor which must be decided.

A Choice Of Power

This power supply is intended for small audio and other similar applications, so a heavy load current is not going to be drawn from the unit. About 100mA from each output should provide for several opamps, perhaps one or two indicator LEDs, and maybe a headphone amplifier or some other small power application.

The components and the heat sinks used for this application reflect this but, as mentioned earlier, the PCB can accommodate a much larger power transformer and with a suitable choice of capacitors and heat sinks it can then deliver a higher power.

Taking the requirement as 100mA from each of the positive and negative 12V rails, we have a total power consumption of $2\text{W}/4$. The transformer must supply this $2\text{W}/4$ max load plus the amount of power dissipated in the voltage regulators, so we can estimate the power required from the transformer as around 3W .

This does not mean, however, that a 3VA transformer would be suitable for the application, since a transformer must be derated to about $2/3$ of its specified VA rating, if used on a rectifier/capacitor load. Accordingly, a 6VA PCB mounting transformer is more suitable.

For the rectifier, four N4000 series diodes are used, since these are very commonly available — much more than any particular type of encapsulated rectifier. The choice of smoothing capacitor depends upon the type of regulator and upon the voltage of the transformer: since we require 12VDC on the output, and since a 12V RMS transformer actually gives 16V97 peak output, a 12V RMS transformer seems a reasonable choice. (Peak output = $\sqrt{2} \times \text{RMS value}$).

According to my data book, the LM317 and LM337 type regulators cannot be absolutely guaranteed to

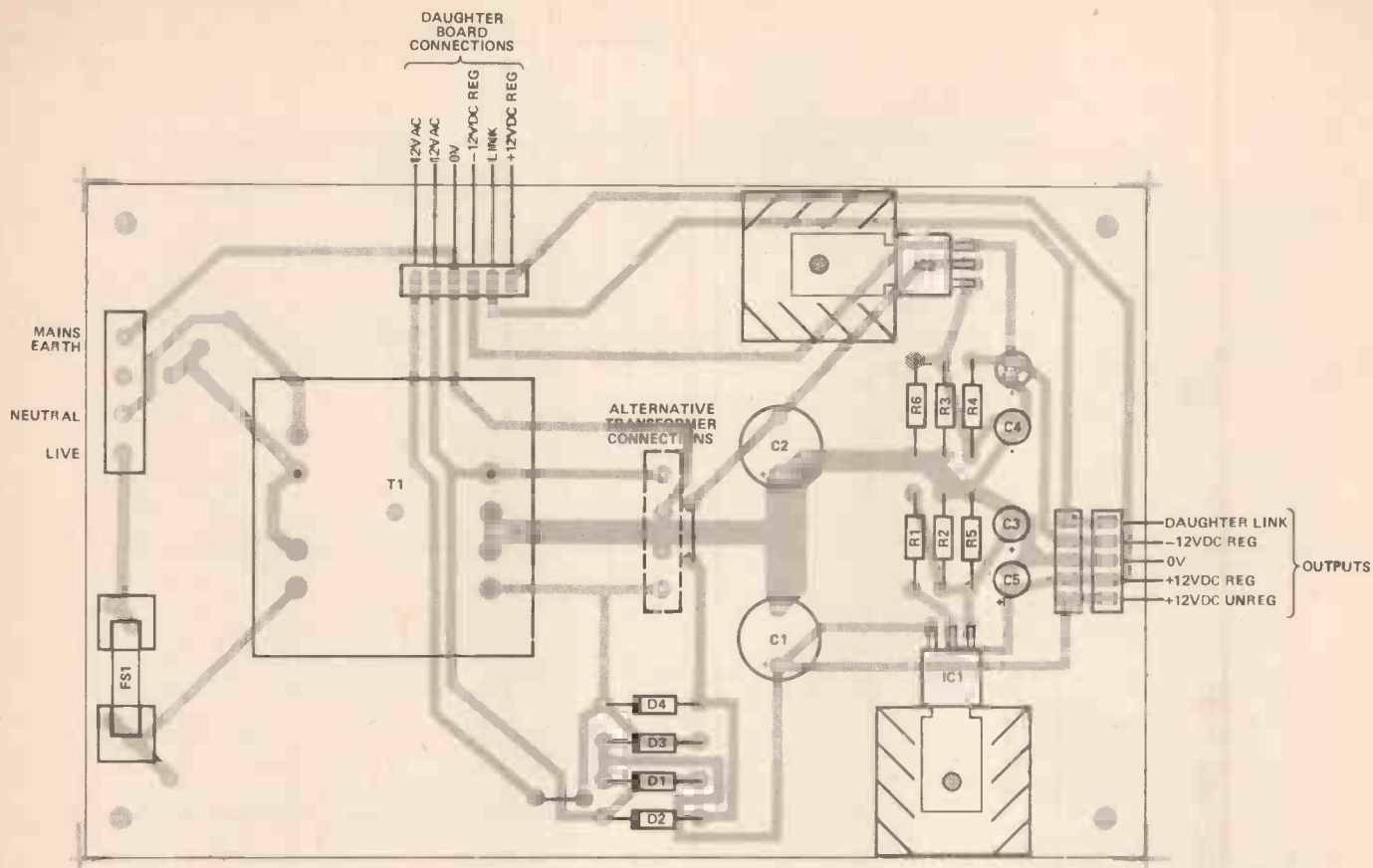


Figure 2. The PCB layout. The extra transformer connections are for use with a toroidal transformer if so desired.

work at full efficiency without about 3V between their input and output terminals. Therefore, to ensure best operation, the voltage on the smoothing capacitors must not fall below 15V in order to provide 12V regulated output. This allows us, theoretically, 1V97 of sag on the capacitors (between the peak voltages and the minimum allowed).

If we are drawing a steady 100mA from the supply then the discharge of the capacitor will be linear (this is the simplest case). The change in the voltage across a capacitor (ΔV) over a period of time t (seconds), when charged or discharged at a steady current in amps, is $\Delta V = IT/C$. If we know the value of ΔV (in this case the maximum allowed ripple) we can rearrange the equation to calculate C:

$$C \text{ (in farads)} = IT/\Delta V$$

$$= \frac{(0.1)(0.001)}{1.97}$$

$$= 5.07 \cdot 10^{-4} \text{ farads} =$$

$$507\mu\text{F}$$

Since this is only an approximate calculation, we cannot hope to get away with a 50uF capacitor with all its tolerance variations, under all conditions, but a 100uF capacitor should be more than adequate! Since the peak voltage somewhat exceeds

Parts List

<p>RESISTORS (All $\frac{1}{4}$W 5% carbon unless noted) R1, 4 100R 2% R2, 3 1k2 2% R5, 6 10k</p> <p>CAPACITORS C1, 2 1000u 25V radial electro C3, 4, 5, 6 10u 16V radial electro</p>	<p>SEMICONDUCTORS IC1 LM317MP IC2 LM337MP D1-4 IN4001</p> <p>MISCELLANEOUS T1 6VA 12V Case; heatsinks; one or two Molex connectors, 6-pin 0.1in; 4-way PCB mount screw connector; two fuse clips, 100MA slow blow fuse; PCB, solder, M3 nuts and bolts, wire, etc.</p>
<p>BUYLINES page 26</p>	

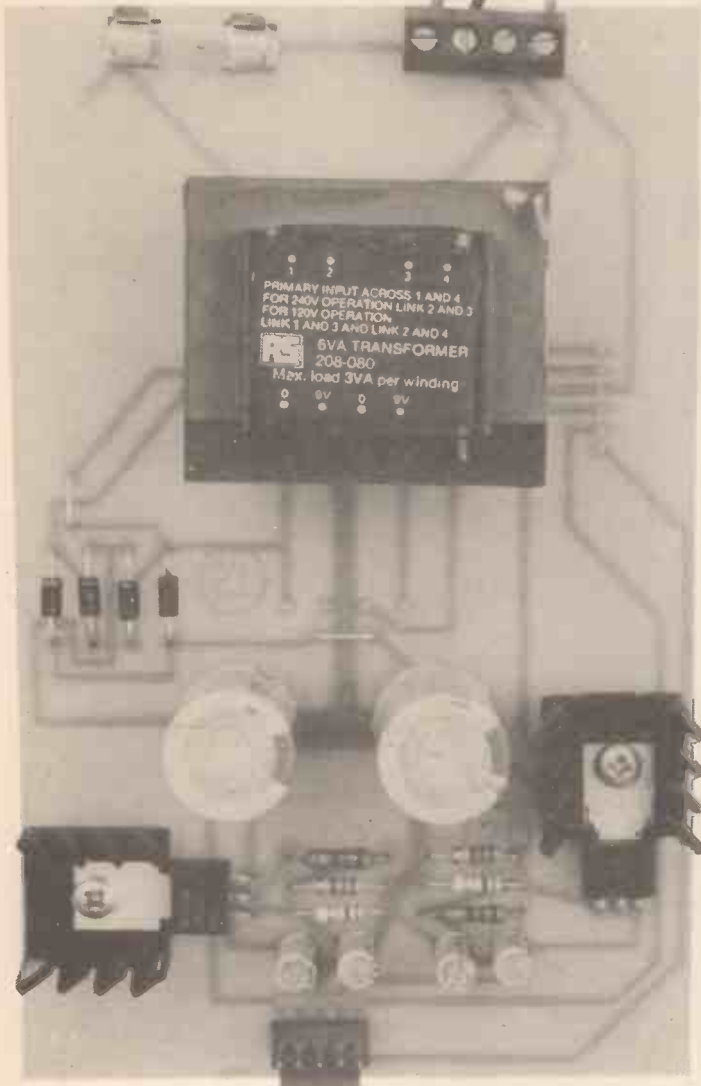
16V, we take the next highest rating which is 25V. The voltage regulators will dissipate about 0W4 max (typically 4V across the regulators at 100mA). Therefore the 21°C-per-watt heatsinks chosen should handle the heat. For experimentors wishing to use higher currents, a 17°C per watt is available.

The type of voltage regulator used here is more advanced, in many ways, than the 7800 series regulators. It works by maintaining a constant 1V2 between its output terminal and its adjustment terminal. If, therefore, a certain value of resistance is placed between those two terminals and a

further resistance is connected to earth, a constant current will flow in the chain, since a constant voltage across a fixed resistor will produce a constant current between output and adjustment terminal; the current flowing into or out of the adjustment terminal itself is very, very small.

Thus, by selecting the ratio of two resistors, any output voltage greater than 1V2, up to the maximum rating of the regulator, can be programmed. A decoupling capacitor on this point completes the system, providing regulation with a much lower degree of ripple than that able to be achieved by 7800-style regulators.

This prototype board was built using a 6VA, 9V transformer; this gives sufficient power for some applications, but for several purposes a 12V transformer should be used as specified.



There is also a capacitor between the output terminal of the regulator and OV. This capacitor is required by virtually any type of electronic voltage regulator, since the electronics can, load current. This output capacitor fills in the gap until the regulator can take over. by its very nature, only respond at a relatively slow speed and thus may fail to meet very sudden surges of

Resistor Calculations

To calculate the required resistor values to set the output voltage, the technique is first to choose a

convenient value for the resistor between output terminal and adjustment terminal (resistors R1 and R4 on the circuit diagram) subtract 1.2 from the required output voltage, multiply the value of R1 by the remaining voltage and divide by 1.2. In this case $10V8/1.2 = 9R1$, to give the value for R2. If, as will typically happen the first time, the value for R2 turns out *not* to be very near a preferred value, a different value for R1 can be chosen and the process repeated.

The value for R1 should be fairly low, in order that any current that does flow out of the adjustment terminal can be ignored. Sometimes, as in this particular case, the required

value for R2 does not come out as an E12 value resistor for any E12 choice of R1. One can then make up required values using series or parallel combinations, or alternatively find an E24 resistor. For accuracy, high tolerance resistors should be used. For this reason extra resistors in parallel with R2 and R3, designated R5 and R6 respectively, have been included.

One final note should be made about the design of the power supply: great care has been taken over the layout of the PCB to avoid the pulse charging current of the smoothing capacitors from modulating the output voltage, due to resistive drops in the PCB tracks affecting the adjustment terminals of the regulators. This is a point which should be borne in mind by any constructors choosing to do their own PCB layout or Veroboard construction.

Construction

The construction of this unit is very straightforward. A few points need to be made however. It is always best to solder down resistors before other components, as resistors are the least expensive and least destructible circuit elements. Also, it is wise to bolt down the regulators securely before soldering their pins; this will avoid straining the soldered joint.

The preferred order of construction is, in fact, to insert the resistors first, followed by the diodes, the main smoothing capacitors C1 and C2, and the transformer and also, of course, the mains fuse. Before any further work is attempted it is advisable, at this stage, to check that when mains is applied to the input of the transformer the capacitors take up voltages of approximately 17V positive and negative with respect to OV, and that they are the right way round!

Assuming this to be the case, the mains should be disconnected and the rest of the power supply assembled. The final test before connecting to any equipment is to check that the output voltages really are plus and minus 12V. The power supply is then ready for use.

As previously mentioned, this power supply is suitable for the parametric equaliser must be built to a slightly fit into the original case of that project; so either the parametric equaliser must be built into a slightly larger and more accommodating case; or maybe the power supply can be mounted from the top of the case by using four bolts; or finally a separate box may be built to house this unit, which may be used with a number of different projects.

The primary intention, however, is that this power supply may be built into the cases of other projects which have not already got their own power supplies; quite possibly in the future several such projects will be forthcoming!

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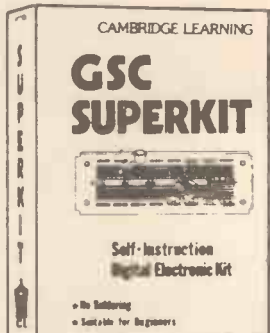
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74LS05	20p	74LS160	50p	BC177	18p	280S10	910p	CA3059	285p
74LS06	20p	74LS161	50p	BC178	20p	6802	238p	CA3060	250p
74LS09	20p	74LS162	45p	BC192L	10p	6821	100p	CA3080	72p
74LS10	20p	74LS163	45p	BC194	10p	6840	375p	CA3086	68p
74LS11	20p	74LS164	45p	BC212L	10p	8850	110p	CA3130E	90p
74LS12	20p	74LS165	60p	BC213L	10p	8852	250p	CA3130T	110p
74LS13	25p	74LS166	90p	BC214L	10p	8854	850p	CA3140C	90p
74LS14	34p	74LS168	110p	BC214L	10p	8856	450p	CA3140E	90p
74LS15	20p	74LS169	110p	BC247	12p	8184	850p	CA3140E	90p
74LS20	20p	74LS170	100p	BC248	12p	8184	850p	CA3189E	300p
74LS21	20p	74LS171	95p	BC249C	14p	8226	270p	CA3240E	110p
74LS22	20p	74LS172	45p	BC251	18p	8250	850p	CA3240E	110p
74LS24	20p	74LS175	45p	BC252	18p	8253	300p	LF347	150p
74LS27	20p	74LS181	120p	BC258	18p	8255	288p	LF351	48p
74LS28	20p	74LS183	120p	BC259	18p	8259	400p	LF353	85p
74LS30	20p	74LS190	60p	BF400	20p			LF355	85p
74LS32	25p	74LS191	60p	BFV81	23p			LF358	85p
74LS33	20p	74LS192	60p	BFV82	23p			LF357	110p
74LS37	20p	74LS193	60p	TP292A	38p			LM300A	22p
74LS38	20p	74LS194	60p	TP30A	38p			LM310	120p
74LS40	20p	74LS195	60p	TP30A	38p			LM310	120p
74LS42	38p	74LS196	60p	TP32A	38p			LM310	120p
74LS47	40p	74LS197	54p	TP32A	38p			LM310	120p
74LS48	40p	74LS221	60p	TP32A	38p			LM310	120p
74LS51	20p	74LS240	70p	TP32A	38p			LM310	120p
74LS54	20p	74LS241	70p	TP32A	38p			LM310	120p
74LS55	20p	74LS242	60p	TP32A	38p			LM310	120p
74LS73	20p	74LS243	60p	TP32A	38p			LM310	120p
74LS74	30p	74LS244	100p	TP32A	38p			LM310	120p
74LS75	30p	74LS245	140p	TP32A	38p			LM310	120p
74LS76	27p	74LS247	70p	TP32A	38p			LM310	120p
74LS83	40p	74LS249	70p	TP32A	38p			LM310	120p
74LS85	40p	74LS251	45p	TP32A	38p			LM310	120p
74LS86	25p	74LS252	45p	TP32A	38p			LM310	120p
74LS90	30p	74LS253	45p	TP32A	38p			LM310	120p
74LS91	60p	74LS256	200p	TP32A	38p			LM310	120p
74LS92	60p	74LS257	45p	TP32A	38p			LM310	120p
74LS93	40p	74LS258	45p	TP32A	38p			LM310	120p
74LS95	80p	74LS259	80p	TP32A	38p			LM310	120p
74LS96	90p	74LS260	35p	TP32A	38p			LM310	120p
74LS107	33p	74LS271	100p	TP32A	38p			LM310	120p
74LS109	33p	74LS272	25p	TP32A	38p			LM310	120p
74LS110	33p	74LS273	100p	TP32A	38p			LM310	120p
74LS113	30p	74LS275	175p	TP32A	38p			LM310	120p
74LS114	32p	74LS279	50p	TP32A	38p			LM310	120p
74LS122	60p	74LS281	60p	TP32A	38p			LM310	120p
74LS123	90p	74LS283	50p	TP32A	38p			LM310	120p
74LS124	150p	74LS290	55p	TP32A	38p			LM310	120p
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Camera Remote

Equivalents may be required for some of the components used in this project. A TIL100 IR detector diode will comfortably substitute for the specified SFH205, and BC109C or BC549 types can be used in place of the somewhat hard-to-find BC239C.

Several suppliers stock all the parts, or their equivalents — try **Maplin, Watford or Cricklewood Electronics**, for example.

The cost for both transmitter and receiver sections is estimated at around £11.00, excluding the case as usual. PCBs are available through HE's own PCB service, or make your own from the pattern reproduced on page 64.

Field Strength Memory Meter

The tuning capacitor, C4, is listed as a 39pf polystyrene type, and may not be stocked by some suppliers. A 39p

silvered mica type, although more expensive, is a suitable substitute where stability is the most important factor. Alternatively either a 33p or 47p polystyrene type would be acceptable, since the tuning can be 'pulled in' by adjusting the coil L1.

The former for L1, and the dust core are available, separately, from **Maplin Electronics**, who also stock the remaining components.

It's definitely worth shopping around for some of the other parts for the Meter. For example telescopic aerials can be picked up quite cheaply, and the price of a panel meter varies considerably (you can save even more if you are willing to settle for a physically smaller, but harder to read, meter). Excluding these components, the case (which is not critical) and the PCB, the other components should cost in the region of —5.00.

Audio PSU

The author has offered a choice of transformers for this project: either a 12-0-12 volt 6VA PCB mounting type (which should have split bobbin construction for optimum isolation between primary and secondary) or an identically rated toroidal transformer.

Techomatic stock an appropriate toroidal transformer, and the regulator ICs. The other components, including PCB-mount transformers, are standard and easily obtainable from a number of sources.

Timing Strobe

A number of components are difficult — probably impossible — to find, unless you know someone with a particularly well stocked junk box.

For a start, use a 22u 450 electrolytic instead of the specified 16u 500V type. It should be able to cope with the voltage developed by the circuit, as quoted by the author. Both C2 and C3 will probably have to be specially ordered; a 1u 400VDC type will be OK for C2.

The other components are all available from **Maplin**, including the FX2240 pot core, the pulse transformer and the Xenon tube itself.

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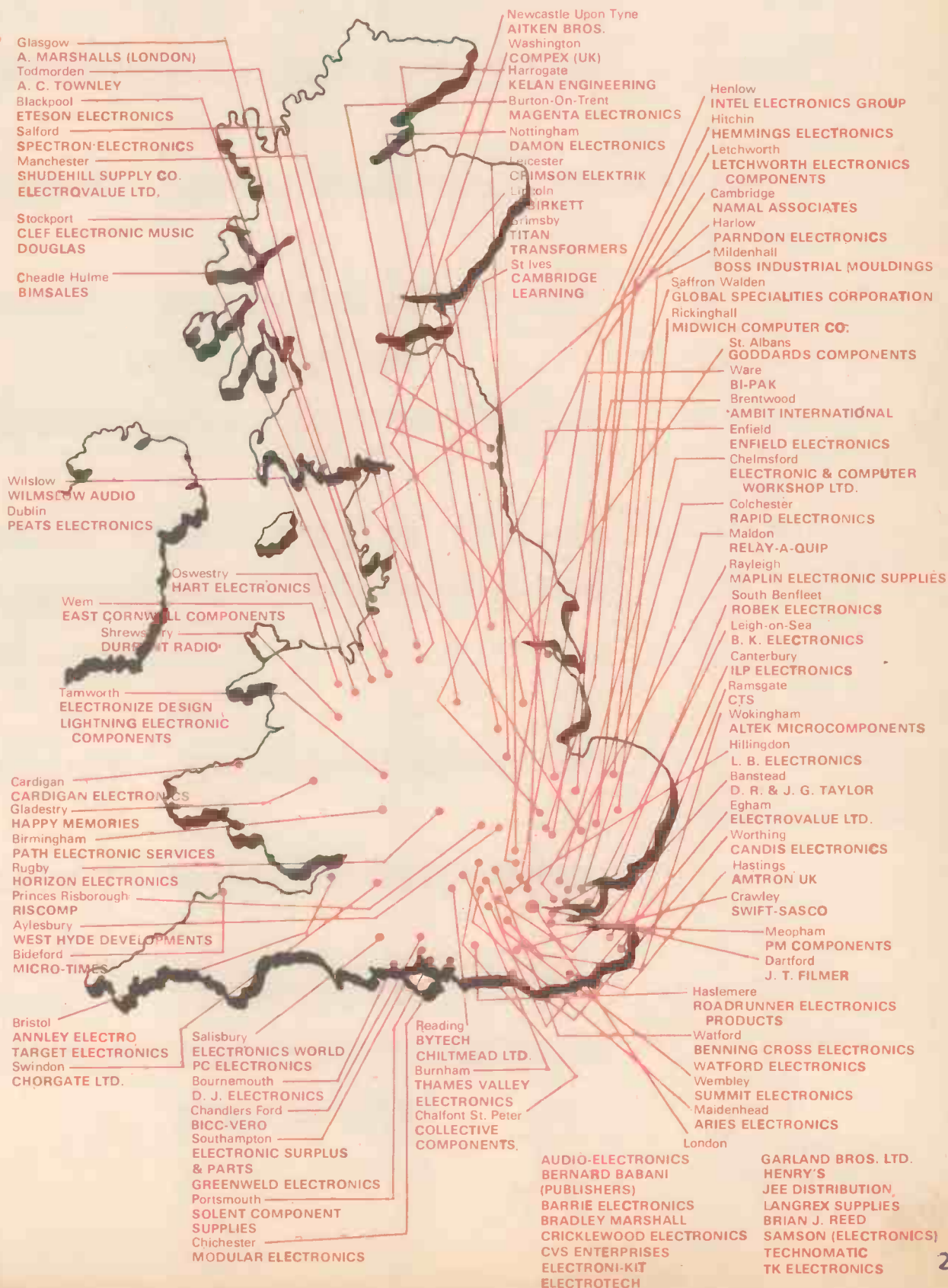
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PLUGS AND SOCKETS	ENCLOSURES, CASES	HEATSINKS	KNOBS, MISC. HARDWARE	CABLE AND WIRE	BREADBOARDS	TOOLS	PCBs and/or MATERIALS	CHEMICALS	CUSTOM KITS, MODULES	SURPLUS SUPPLIES	BARGAIN PACKS	BOOKS	CATALOGUE/PRICE LIST	MAIL ORDER MINIMUM (6)	P&P (6)	OVERSEAS ORDERS	CREDIT CARDS (4)	SHOPS	OTHER	
													(5)	£5		(5)				KELAN ENGINEERING LTD.
														£1	50					LANGREX SUPPLIES LTD.
														N	(5)					L B ELECTRONICS
														65						LETCHWORTH ELECTRONIC COMPONENTS
														N	(5)					LIGHTNING ELECTRONIC COMPONENTS
														N	50	(5)				MAGENTA ELECTRONICS LTD.
														(5)	(5)					MAPLIN ELECTRONIC SUPPLIES LTD
														N	35					MARCO TRADING
														N	60	(5)				A. MARSHALL LTD.
														N	50					MICRO-TIMES
														N	(5)					MIDWICH COMPUTER CO.
														175	50					MODULAR ELECTRONICS
														N	N					MS COMPONENTS LTD.
														£3	60					MYERS ELECTRONICS
														£10	£1	(5)				NAMAL ASSOCIATES
														£1	N					PARNDON ELECTRONICS LTD.
														N	80					PATH ELECTRONICS LTD.
														£10	£1					PC ELECTRONICS
															50					PEATS ELECTRONICS
														N	50					PM COMPONENTS LTD.

Directory Of Components Suppliers

NOTES:

- (1) Including ferrites, RF chokes, etc.
- (2) Discrete devices.
- (3) Other than optoelectronic.
- (4) Access and Barclaycard (Visa).
- (5) See company listings overleaf.
- (6) In pence unless otherwise noted. N = No minimum. SAE = Please send a stamped, self-addressed envelope.

	RESISTORS	CAPACITORS	POTENTIOMETERS	TRANSFORMERS	INDUCTORS (1)	DIODES, SCRs TRIACS	TRANSISTORS (2)	LINEAR ICs	DIGITAL ICs	LINEAR MSI/LSI	DIGITAL MSI/LSI	OPTOELECTRONICS	VALVES	RELAYS	SWITCHES	FUSES AND PROTECTION	BATTERIES AND PSUs	ANALOGUE PANEL METERS	TRANSDUCERS (3)	PCB HARDWARE
T POWELL																				
RAPID ELECTRONICS LTD.																				
BRIAN J REED																				
RELAY-A-QUIP																				
RISCOMP LTD.																				
ROADRUNNER ELECTRONIC PRODUCTS LTD.																				
ROBEK ELECTRONICS																				
SAMSONS (ELECTRONICS) LTD.																				
SHUDEHILL SUPPLY CO. LTD.																				
SPECTRON ELECTRONICS LTD.																				
SUMMIT ELECTRONICS																				
SWIFT-SASCO LTD.																				
TARGET ELECTRONICS																				
D R & J G TAYLOR																				
TECHNOMATIC LTD.																				
TENNCO DISTRIBUTION																				
THAMES VALLEY ELECTRONICS LTD.																				
TITAN TRANSFORMERS																				
TK ELECTRONICS																				
A C TOWNLEY LTD.																				

Directory Of Components Suppliers

PLUGS AND SOCKETS	ENCLOSURES, CASES	HEATSINKS	KNOBS, MISC. HARDWARE	CABLE AND WIRE	BREADBOARDS	TOOLS	PCBs and/or MATERIALS	CHEMICALS	CUSTOM KITS, MODULES	SURPLUS SUPPLIES	BARGAIN PACKS	BOOKS	CATALOGUE/PRICE LIST	MAIL ORDER MINIMUM (6)	P&P (6)	OVERSEAS ORDERS	CREDIT CARDS (4)	SHOPS	OTHER
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- NOTES:**
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														£1	50				T POWELL
														£1	(5)				RAPID ELECTRONICS LTD.
														N	(5)				BRIAN J REED
														N	(5)				RELAY-A-QUIP
														N	50	(5)			RISCOMP LTD.
													SAE	(5)	(5)	(5)			ROADRUNNER ELECTRONIC PRODUCTS LTD
													SAE	200	35				ROBEK ELECTRONICS
														£2					SAMSONS (ELECTRONICS) LTD.
															(5)				SHUDEHILL SUPPLY CO. LTD.
													SAE	(5)	(5)				SPECTRON ELECTRONICS LTD.
														N	40				SUMMIT ELECTRONICS
														25	£2				SWIFT-SASCO LTD.
														25	(5)				TARGET ELECTRONICS
														N	N	N			D R & J G TAYLOR
														N	40				TECHNOMATIC LTD.
														£10	£1				TENNCO DISTRIBUTION
														N	45				THAMES VALLEY ELECTRONICS LTD.
																			TITAN TRANSFORMERS
														N	55				TK ELECTRONICS
														£5	(5)				A C TOWNLEY LTD.

Directory Of Components Suppliers

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	RESISTORS	CAPACITORS	POTENTIOMETERS	TRANSFORMERS	INDUCTORS (1)	DIODES, SCRs TRIACS	TRANSISTORS (2)	LINEAR ICs	DIGITAL ICs	LINEAR MSI/LSI	DIGITAL MSI/LSI	OPTOELECTRONICS	VALVES	RELAYS	SWITCHES	FUSES AND PROTECTION	BATTERIES AND PSUs	ANALOGUE PANEL METERS	TRANSDUCERS (3)	PCB HARDWARE
VINTAGE WIRELESS CO.																				
WATFORD ELECTRONICS																				
WEST HYDE DEVELOPMENTS LTD.																				
WILMSLOW AUDIO																				

DIRECTORY OF ELECTRONIC

Listing over 60 companies supplying electronic components

If the name of your favourite component supplier does not appear in these pages, please write and tell us about him.

Aitken Bros. and Co.,

35, High Bridge, Newcastle on Tyne, NE1 1EW. Tel: (0632) 326729
 Aitken Bros. can also supply schools, colleges and other companies, and can quote special prices for larger quantities. They also sell a good range of test equipment: analogue and digital multimeters, frequency meters, function generators, pulse generators, signal generators and oscilloscopes.

The shop is in Newcastle upon Tyne, at the above address. Post and packaging charges are 75p for orders under £10.

Altek Microcomponents Ltd.,

22, Market Place, Wokingham, Berks RG11 1AP. Tel: (0734) 791579.

Distributors of disk drives and LSI from Mitsubishi, Sharp and others. Post and packaging is charged pro-rata.

Ambit International,

200, North Service Road, Brentwood, Essex CM14 4SG. Tel: (0277) 230909; Ambit International (Retail Sales), Park Lane, Broxbourne, Herts EN10 7NQ;

Solent Component Supplies, 53 Burrfields Road, Portsmouth, Hants PO3 5EB. Tel: (0705) 669021. Specialists in inductors, ferrites etc., but, "it's all a bargain at Ambit". See for yourself at their Brentwood headquarters or at the franchised shop in Acton.

Amtron UK Ltd.,

7 Hughenden Rd., Hastings, Sussex TN34 3TG. Tel: (0424) 436004. Over 150 electronic kits in our range, as well as 22 different types of metal and plastic cabinets.

For post and packing charges, see Price List. Overseas buyers please write for postal charges.

Annley Electro,

190, Bedminster Down Road, Bristol BS13 7AF. Tel: (0272) 632622.

"We are a stockist of Velleman kits, Wood and Douglas radio kits, and RF components. The bulk of our business is concerned with electronic design and industrial supplies. We are also rare in as much as we are always happy to make the effort to obtain obscure parts for our customers."

Mail order post free over £10.00.

Aries Electronics Ltd.,

159 Boyn Valley Road, Maidenhead, Berks SL6 4DT. Tel: (0628) 37431. "Specialists in optoelectronic devices and power diodes".

Audio-Electronics (Cubegate Ltd.)

301 Edgware Road, London W2 1BN. Tel: 01 724 3564. (See Henry's.)

Bernard Babani (publishing) Ltd.,

The Grampians, Shepherds Bush Road, London W6 7NF. Tel: 01 603 2581.

Write for a current catalogue, post free. Postal charges on orders are 35p a book.

Barrie Electronics,

3, The Minorities, London EC3. Tel: (01) 488 3316.

Specialists in transformers; p&p charges are cost.

Benning Cross Electronics,

67, Vicarage Road, Watford, Herts. Tel: (0923) 36234.

PLUGS AND SOCKETS	ENCLOSURES, CASES	HEATSINKS	KNOBS, MISC. HARDWARE	CABLE AND WIRE	BREADBOARDS	TOOLS	PCBs and/or MATERIALS	CHEMICALS	CUSTOM KITS, MODULES	SURPLUS SUPPLIES	BARGAIN PACKS	BOOKS	CATALOGUE/PRICE LIST	MAIL ORDER MINIMUM (6)	P&P (6)	OVERSEAS ORDERS	CREDIT CARDS (4)	SHOPS	OTHER	
														(5)	150	85				VINTAGE WIRELESS CO.
														N	60					WATFORD ELECTRONICS
													£2	(5)	N			(5)		WEST HYDE DEVELOPMENTS LTD.
														N	(5)		(5)			WILMSLOW AUDIO

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COMPONENT AND HARDWARE SUPPLIERS

and hardware to the electronics enthusiast.

RETAILERS! If your company is not included, please write and tell us about yourself, in time for the next edition of this Directory.

"All brand new, full-spec components, manufacturers guaranteed". Other items stocked include test equipment, hand-held CB gear, headphones, aerials and audio tapes.

BICC-VERO Electronics Ltd.,

The Retail Department, School Close, Industrial Estate, Chandlers Ford, Hants SO5 3ZR. Tel: (04215) 62829.

"The professional company with the personal touch!"

Vero are well known for their breadboarding systems, eg Verobloc and Veroboard, and their range of enclosures and cases. Send for the new catalogue containing over 100 new products including connectors and cases. Vero products are available world-wide from retail stockist and mail-order companies.

Bimsales,

48, Station Road, Cheadle Hulme, Cheadle, Cheshire SK8 7AB. Tel: 061 485 6667.

Bimsales are distributors for Boss Industrial Mouldings.

Postal and packing charges depend on the items bought.

BI-PAK,

The Maltings, 63a High Street,

Ware, Herts SG12 9AD. Tel: (0920) 61593.

"BI-PAK have now been serving the public for 18 years, and the range of products over the years have ever increased — and continues to do so". From their shop in Ware, BI-PAK also supply CB accessories, radio aerials, leads, styli and cartridges, cassettes and hifi accessories, headphones and multitestors. They are a specialist supplier of many components (see main listings).

B.K. Electronics,

Electronic Components and Equipment, Unit 5, Comet Way, Southend on Sea, Essex SS2 6PR. 37, Whitehouse Meadows, Eastwood, Leigh-on-Sea, Essex SS9 5TY. Tel: (0702) 527272.

"B.K. Electronics specialise in:
 1. Loudspeakers and tweeters from 3" to 15", up to 150 watts RMS, with some speaker cabinet designs available in kit form; power amplifiers up to 300 watts RMS.
 2. Test equipment, ie, oscilloscopes, signal generators, pulse generators, frequency meters, digital and analog multimeters, digital thermometers etc." Turntables and cassette decks, in chassis form, are also stocked at their shop in Southend, Essex. Post and packaging charges for mail order transactions range from 50p to £3.

J. Birkett,

25, The Strait, Lincoln LN2 1JF. Tel: (0522) 20767.

Shop open Monday to Saturday 9am to 5.30pm, closed Wednesday. Postage = 50p on orders under £5.00.

Boss Industrial Mouldings Ltd.,

(David George Sales Ltd.), James Carter Road, Mildenhall, Suffolk. Tel: (0638) 716101.

"We service the electronics industry mainly through a network of distributors, but we are also happy to accommodate the hobbyist".

B.I.M. also carry a very large range of filament and neon indicators.

Bradley Marshall,

325, Edgeware Road, London W2 1BN. Tel: 01 723 4242.

This well known London firm, operating from their shop in Edgeware Road (where else?), also stock test equipment and can supply most data sheets. In addition to Barclaycard and Access, American Express and Diner's Club cards are accepted.

S & R Brewster Ltd.,

86-88, Union Street, Plymouth, Devon. Tel: (0752) 665011.

Directory Of Components Suppliers

"We are soldering specialists, manufacturing our own range, and we can offer advice on any soldering problems. We are also the main specialist retailer of electronic components in the locality". All components in the RS catalogue can be despatched by S & R Brewster within 48 hours of ordering; there is a 15% handling charge on this service. Normal P&P is charged at cost. 20% handling charge is made on RS components.

Bytech Ltd.,

57, Suttons Industrial Park, Reading, Berks. Tel: (0734) 61031. Bytech are franchised distributors of Fairchild components, Intel systems, single-board computers and components, Hitachi colour monitors and DEC, QUME and Centronics printers.

Cambridge Learning Ltd.,

Rivermill Lodge, St. Ives, Huntingdon, Cambs PE17 4EP. Tel: (0480) 67446. Self-instruction books, and kits.

Candis Electronics Ltd.,

Highdown Works, Highdown Avenue, Worthing, W. Sussex BN13 1PU. Tel: (0903) 690750. Specialists in temperature sensing equipment of all kinds, including thermocouples, digital thermometers, resistance and thermistor sensors. Postage = £1.50 minimum.

Cardigan Electronics,

Chancery Lane, Cardigan, Wales. Tel: (0239) 614483. Cardigan also stock BBC, Acorn and Sinclair computers, televisions and general electronics. Opening: 10am to 5pm Monday to Saturday, closed Wednesday. Cardigan don't generally do mail order business but will accept enquiries.

Chiltmead Ltd.,

Norwood Road, Reading, Berks. Tel: (0734) 669656. Specialists in surplus electronic equipment and components.

Chordgate Ltd.,

75, Farringdon Road, Swindon, Wilts. Tel: (0793) 33877. Their retail shops in Swindon and Deptford (London) carry a changing stock of new and surplus material. Mail order charges are dependent on the weight of the package, and Chordgate welcome official orders from schools, colleges, etc.

Clef Electronic Music,

44A, Bramhall Lane South, Bramhall, Stockport, Cheshire SK7 1AH. Tel: (061) 439 3297. Although we started out as custom kit suppliers, most of our products are now available as manufactured goods, too".

Collective Components,

Churchfield House, Churchfield Road, Chalfont St. Peter, Bucks. Tel: (02813) 89191. Collective components supply by mail order only; p&p charges are 25p for orders under £10.

Compex (UK) Ltd.,

66, J. F. Kennedy Estate, Washington, Tyne & Wear NE38 7AJ. Tel: (091) 416 7814. Télex: 537681. "Our main role is that of an importer from France, Germany, Italy, Japan, Taiwan and the USA."

Over 7500 items and million individual components are stocked. Our specialist items are capacitors, ICs, transistors and Ni Cad batteries with chargers capable of taking sizes between D and AA as well as PP3. Post and packaging charges are 50p for within the UK and 90p for overseas orders. Delivery is immediate and everything ordered is supplied. A stock/price list is available only for 100+ quantities, and Access is the only credit card accepted.

Comtech Electronics,

205, Sturdee Rd., Leicester LE2 9FY. Tel: (0533) 779578. Comtech can supply low-priced semiconductors and passive components by return. Callers by arrangement, trade enquiries welcome. Postage = 30p on orders less than £10.00.

Cricklewood Electronics,

40, Cricklewood Broadway, London NW2 3ET. Tel: (01) 452 0161. "Formerly a branch of A. Marshall (London) Ltd., we stock one of the widest ranges of components in the country".

A range of test equipment is also carried and American Express cards are accepted.

Crimson Elektrik,

9, Clayville Road, Leicester LE4 7JJ. Tel: (0533) 761920. "We specialise primarily in high quality hi-fi equipment, custom built amplification and active cross-over networks". P&P is charged at cost.

CTS,

20, Chatham St., Ramsgate, Kent CT11 7PP. Tel: (0843) 54072. "The best little component shop in Kent" — no mail order. Closed Thursdays.

CVS Enterprises,

21-23 Bell Street, London NW1. Tel: 01 723 8545. "We specialise in video game hardware and software. We can supply all parts for building video games, including logic, PCBs and programs to run in them, also push-buttons, four and eight-way joysticks, etc".

Damon Electronics,

99, Carrington Street, Nottingham. Tel: (0602) 53880. P&P charges are by weight; TV, FM and CB aeriels are also stocked.

D.J. Electronics,

64, Ensbury Park Road, Bournemouth, Dorset. Tel: (0202) 515703. Mail order enquiries are welcomed.

Douglas,

90, Wellington St., Stockport, Cheshire SK1 3AO. Tel: 061 480 8971. Also main stockists for Wharfedale speakers; do crossover networks, etc. Open 10am to 5pm Monday to Saturday, closed Thursday. No postal charges on orders over £5.00, otherwise by weight. Overseas customers write for quote. Credit = Access only.

Durrent Radio,

9, St. Mary's Street, Shrewsbury. Tel: (0743) 61239. "We always have a large quantity of surplus test equipment, components and hardware in stock".

East Cornwall Components,

119, High Street, Wem, Shropshire SY4 5TT. Tel: (0939) 32689. "We offer a very comprehensive range of components not only to the more professional hobbyist but to the TV repair man, also".

Electronic & Computer Workshop Ltd.,

171, Broomfield Road, Chelmsford, Essex CM1 1RY. Tel: (0245) 262149.

"Our company has a wide range of test equipment, tools, and microelectronic components, ideal for the hobbyist and professional user."

Credit cards: Access only.

Electronic Surplus & Parts,

147, Foundry Road, Southampton, Hants.

"Our company specialises in surplus electronic parts and as such we do not stock a complete range of components, although various transistors, pots, transformers, meters etc are listed in our updated news/bargain sheets".

Electronics World,

1A, Daws Road, Salisbury, Wilts. Tel: (0722) 21262.

"The only shop in Salisbury with a *comprehensive* range of components". A surplus list will be supplied free on receipt of an SAE. Catalogue 50p.

Credit Cards: Access only.

Electroni-Kit,

388, St John Street, London EC1 4NN. Tel: (01) 278 0109.

"We are aiming at people who are just beginning in electronics. Our kits are complete in every way; nothing else is required."

Electroni-Kits are available from most High St. hobby shops. P&P charges are approximately 10% of the order value.

Electronize Design,

Magnus Road, Wilnecote, Tamworth, B77 5BY. Tel: (0827) 281000.

Electrotech,

394, Edgware Road, London W2 1SD. Tel: (01) 923 8189.

Suppliers to the public of general electronics components. Handling charges are inclusive.

Electrovalue Ltd.,

28, St Judes Road, Englefield Green, Egham, Surrey TW20 0HB. Tel: Egham 33603 (STD (0784), London (87)).

680 Burnage Lane, Manchester M19 1NA. Tel: 061 432 4945.

"Established 1965, produced catalogue from 1967. Also sell computers and related products. Main franchises are Siemens, Radiohm, Nascom, Gemini, and Vero. Discounts based on order value have been operated since 1967. Our latest price list is available on request, post free.

Other items available from Electrovalue include aerials, buzzers,

crystals and thermistors. Their shops are in Egham, Surrey, and Manchester (Burnage).

Enfield Electronics,

208, Baker Street, Enfield, Middx. Tel: 01 366 1873.

"We specialise in mail order, and we have a retail counter."

Post and packing 50p under £10 order value, free above.

Etson Electronics,

15B, Lower Green, Poulton-le-Fylde, Blackpool, Lancs FY6 7JL. Tel: (0253) 885107.

"We also stock Vero boxes and boards, and the full range of RS components is available to order."

J. T. Filmer,

82, Dartford Rd., Kent DA1 3ER. Tel: (0322) 24057.

Established 30 years. Shop open Tuesday to Saturday 9am to 5.30pm, Monday 9am to 5pm, closed 1-2 except Saturdays, closed all day Wednesday.

Garland Bros. Ltd.,

Chesham House, Deptford Broadway, London SE8 4QN. Tel: 01 692 4412.

"Established over 20 years, we specialise in loudspeakers, audio equipment, in-car entertainment, alarms for cars and electronic components. We also do audio and CB repairs."

Global Specialities Corporation,

G.S.C. (UK) Ltd., Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ. Tel: (0799) 21682.

Well known for their extensive range of instruments and test equipment, GSC have retail outlets all over the UK. Post and packaging charges are to scale and American Express cards are accepted.

Goddards Components,

110, London Road, St. Albans AL1 1NX. Tel: (0727) 64162.

"We also sell a large range of aerials, hi-fi accessories, and spares, test equipment, loudspeaker chassis, and have just opened a music department with everything for the modern musician."

Personal shoppers only.

Greenbank Electronics,

92, New Chester Road, New Ferry, Wirral, Merseyside L62 5AG. Tel: 051 645 3391.

Greenbank also supply modular computer kits and are sole suppliers of the "Interak 1" modular Z80-based rack mounting computer.

A single 50p charge covers all orders regardless of size.

Greenweld Electronics Ltd.,

443, Millbrook Road, Southampton SO1 0HX. Tel: (0703) 772501.

"As well as one-off component supply for hobbyists, we also supply components in bulk — 100 off, 1000 off, etc — at very competitive prices. The catalogue also comes with a wholesale discount list, with discounts on every item from 5% to 66%, depending on part and quantity."

Greenweld's catalogue costs £1.00 including postage, and contains £2.00 worth of discount vouchers.

They accept orders from overseas, but prefer them to be accompanied by either local currency or a bank draft. Local postal orders or cheques are not acceptable.

As well as items mentioned in the main listings, Greenweld also supply speakers, headphones, mics, buzzers and bells, morse keys, multimeters, and storage containers. See the full range at their shop, in Southampton!

Happy Memories Ltd.,

Gladestry, Kinston, Herefordshire HR5 3NY. Tel: (054 422) 618 or 628.

Computer specialists. No shop as such, but callers are welcome. Mostly mail order; postage = 50p on orders under £5.00.

Hart Electronics Kits Ltd.,

Penylan Mill, Oswestry, Shropshire SY10 9AF. Tel: (0690) 6528.

"Hart Electronics are specialists in kits to the highest professional standards, which are easy even for complete beginners to assemble."

They also stock tape heads, mechanisms and test cassettes. P&P charges are based on a sliding scale.

Hemmings Electronics,

16, Brand Street, Hitchin, Herts. Tel: (0462) 3303.

Also suppliers of microcomputers, printers, mono and colour monitors, computer consumables (floppy discs, paper, ribbons etc), and software. P&P charges are 60p on orders under £10.

■ Directory Of Components Suppliers

Henry's (Cubegate Ltd.),

404, Edgware Road, London W2 1ED. Tel: 01 723 1008.

Henry's carry large stocks at competitive prices . . . and also test equipment, leads, speakers chassis from 1½" to 15", microphones, CB and Ham equipment and accessories, calculators, microcomputer kits and accessories, telephone equipment, security equipment ultrasonics and digital watches!

Post and packaging is charged by weight, with a minimum of 65p. Overseas buyers please phone or write for quote.

Horizon Electronics,

Charlotte Street, Rugby, Warwick. Tel: (0788) 78138.

Horizon stock an extensive range of transistors and linear ICs.

Credit: Access only.

ILP Electronics Ltd.,

Graham Bell House, Roper Close, Canterbury CT2 7EP. Tel: (0227) 54778.

Their products are sold by Watford Electronics, Maplin, Audio Electronics, Electrovalue, Farnell and RSC Components. ILP will also make one-off toroidal transformers for a nominal charge.

Intel Electronics Group Limited,

Henlow Trading Estate, Henlow, Beds SG16 6DS. Tel: (0462) 812505.

Post and packaging charges are at cost.

Jee Distribution,

43, Strathville Rd., London SW18. Tel: 01 870 0075.

"We are originally industrial suppliers who opened a shop for hobby buyers six months ago. Please drop in. "Shop hours 9am to 5pm weekdays. Orders (and postage) will be invoiced.

Kelan Engineering Ltd.,

North Works, Hookstone Road, Harrogate, North Yorkshire HG2 7BU. Tel: (0423) 883672.

The price of Kelan's catalogue is refundable on first order, and any overpayment sent (for instance, from overseas) is credited or refunded (please state). Access accepted.

Langrex Supplies Ltd.,

Climax House, Fallsbrook Road,

Streatham, London SW16 6ED. Tel: (01) 677 2424.

"Langrex supplies specialise in electronic valves, tubes and semiconductors and carry over £1M worth of stock from all leading UK and USA manufacturers. Obsolete and hard to get types are a speciality. Orders despatched day of receipt."

L.B. Electronics,

11, Hercies Road, Hillingdon, Middx. Tel: (0895) 55399.

Post and packaging on mail orders is 50p minimum.

Letchworth Electronics Components,

25, Ridge Rd., Letchworth, Herts SG6 1PW. Tel: (04626) 79681.

Specialists in valves, as well as general components; can get old valves to order. Mail order only. Postage = 57p minimum.

Lightning Electronic Components,

18, Victoria Road, Tamworth, Staffs. Tel: (0827) 65767.

"Lightning Electronic Components specialise in fast turn around of mail order — and personal service for callers at the showroom. Telephone orders by credit card also accepted."

A range of test equipment is also available; post and packaging charges are 50p for orders under £10.

Magenta Electronics Ltd.,

135, Hunter Street, Burton-on-Trent, Staffs DE14 2ST. Tel: (0283) 65435.

"Magenta Electronics is an established company which has specialised in the mail-order supply of components and kits etc to readers of Hobby Electronics. New kits are added each month. We are happy to supply either individual parts or complete kits.

All orders receive careful and prompt attention and all parts are, of course, new and full specification. P&P is a single standard charge and all prices include VAT. Our price list is free with orders or on receipt of an SAE. The illustrated catalogue is 80p, in stamps or added on to your order."

"We don't claim to be perfect, but we do try!"

There is no surcharge or minimum order on credit cards.

Maplin Electronic Supplies Ltd.,

PO Box 3, Rayleigh, Essex SS6 8LR. Mail order sales Tel: (0702) 552911.

"Orders are despatched on the day of receipt. A price list/project book is

published every three months and a brand new catalogue will be available in November."

Maplin also sell: aerials, car accessories, microcomputers and software, electrical accessories, mics, headphones, musical effects units, organ components, record and tape accessories and parts, loudspeakers and test equipment. They are also sole distributors for Heath Kit products in UK.

Shops at: 159-161 King Street, Hammersmith, London, (Tel: 01 748 0926); 284 London Road, Westcliffe-on-Sea, Essex, (Tel: (0702) 554000); Lynton Square, Perry Bar, Birmingham (Tel: 021 356 7292); 8 Oxford Road, Manchester (Tel: 061 236 0281); 46-48 Bevois Valley Road, Southampton (Tel: (0703) 25831).

Marco Trading,

The Maltings, Wem, Shropshire. Tel: (0939) 32763.

"We supply electronic components to the public via our ever-growing mail order service, and also we offer wholesale and quantity terms to schools, universities and, of course, the trade; we believe we offer competitive prices and services"

Marco Trading's 109-page catalogue is available for 35p. A retail shop has just opened in a 6000 sq ft renovated Mill; telephone for opening times.

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"All items stocked by Marshalls are top quality branded products which carry full manufacturer's guarantees."

Marshall's offer trade, retail, export and quantity discounts, and stock the extensive range of Leader and Thandar test equipment. In addition to Barclaycard and Access, credit cards from American Express, Diner's Club and Tricity Finance are also accepted.

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"All brand new, full-spec devices"

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Chichester, Sussex. Tel: (024361)
2916.

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signal VHF/UHF devices, and
associated components.

MS Components Ltd.,

Zephyr House, Waring Street, West
Norwood, London SE27 9LH. Tel:
01 670 4466.

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power supplies soldering equipment
and suppressors, and offer a prototype
transformer service.

Myers Electronics,

12-14 Harper Street, Leeds 2. Tel:
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CM18 7RR. Tel: (0279) 32700.

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time."

P.A.T.H. Electronic Services.

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PC Electronics,

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extremely low prices"

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PM Components Ltd.,

Selectron House, Wrotham Road,
Meopham Green, Meopham, Kent
DA13 0QY. Tel: (0474) 813225.
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output transformers, wirewound
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hours of receipt. There is a carriage
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minimum order charge.

T. Powell

311, Edgware Road, London W2.
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"Specialists in electronic kits,
especially ioniser kits".

Rapid Electronics Ltd.,

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Colchester, Essex CO4 5RD. Tel:
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prices! Because we have depth of
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161, St Johns Hill, Battersea,
London SW11 1TQ. Tel: 01 223
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bushes, grommets, cartridges, stylii,
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loudspeakers, earphones, transistor
arrays, suppressors, EHT trays,
crystals, counters, bulbs,
programmer/timers, solenoids and
motors, . . . amongst other things.

Their catalogue costs 75p plus 25p
post and packaging. On goods, post
and packaging charges are inclusive,
other than 16p SAE or label.

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Moat Lodge, Stock Chase, Maldon,
Essex. Tel: 0621 58686.

"We can supply any component in
quantity and we manufacture
enclosures and cases to customers
specifications. Trade price lists are
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order are 50p for orders under £5.
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Risborough, Bucks HP17 0AT. Tel:
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"In addition to supplying the usual
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to construct security equipment to
their own requirements. Full details
are supplied with each module, most
of which are on demonstration at the
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kinds of components to hobbyists; also
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"Swift-Sasco are broadline distributors of electronic components. Based at Crawley, we service the whole of the UK".

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The car won't start . . . your engine stalls suddenly just as the red light goes green . . . you're making a cool 20 miles to the gallon . . . your car needs tuning, and here to do it is the

Car Timing Strobe

G. V. Whitney, G8RSI

IN the great majority of car timing strobe lamps, particularly the cheaper ones, a direct connection is required between the high tension lead of the first cylinder and it's associated spark plug. In this design however, no physical connection exists between the device and the metal parts of the HT cable or the plug; instead a capacitive connection is made to the outside of the cable using a simple clip.

Circuit Description

The full circuit is shown in **Figure 1**. Q1 and Q2 operate in conjunction with transformer T1 to form an

inverter which is powered by the vehicle's battery. Base bias for Q1-2 is provided by the potential divider R1 and R2; the circuit is fairly efficient and has good self-starting ability.

The operation of the inverter is a fairly straightforward process, and eagle-eyed readers may have already spotted the similarity to a simple multivibrator. This is in fact the case, but where, in a normal astable circuit, you would have capacitors to provide the necessary feedback path from the base of one transistor to the collector of it's "mate" and vice-versa, these have been replaced by the windings of T1. Feedback, in this case, is inductive.

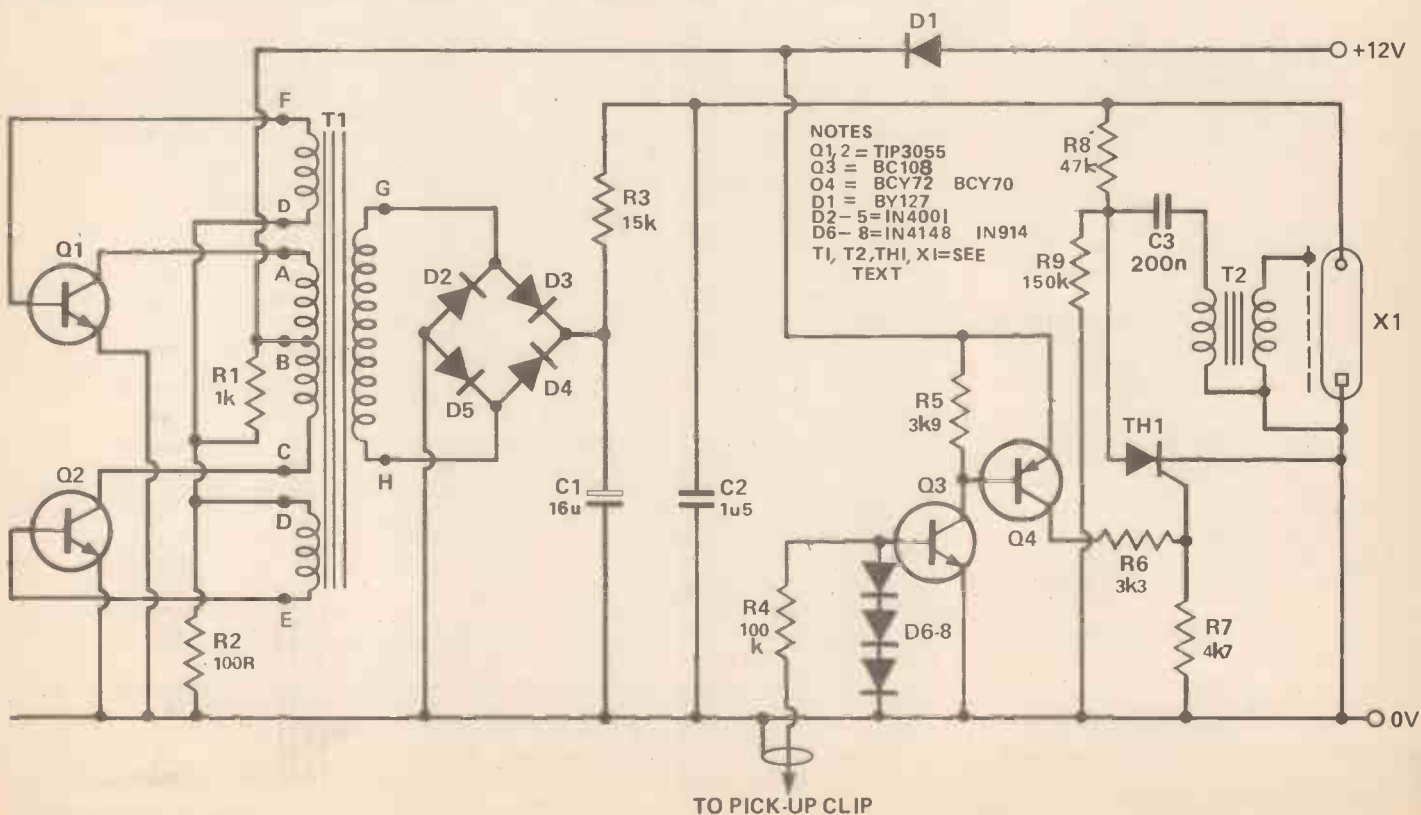
As in the normal astable circuit, the start-up relies on the spread in

component tolerances; one side of the circuit will always switch on first the moment power is applied, and the resultant current pulse "kicks" the whole thing into continuous oscillation.

Also, in common with the "standard" astable, is the shape of the output waveform; it is a rather rough squarewave. A marked disadvantage of this is the tendency for the ferrite core of the transformer to approach saturation point on current peaks, due to the DC component (the flat bits) of the square wave. To improve efficiency, an air gap is included in between the cores (see winding details).

Purists would say that, because of this waveform, fast recovery rectifiers

Figure 1. The circuit. T1 is hand-wound with 30 and 40 SWG insulated wire (see text).



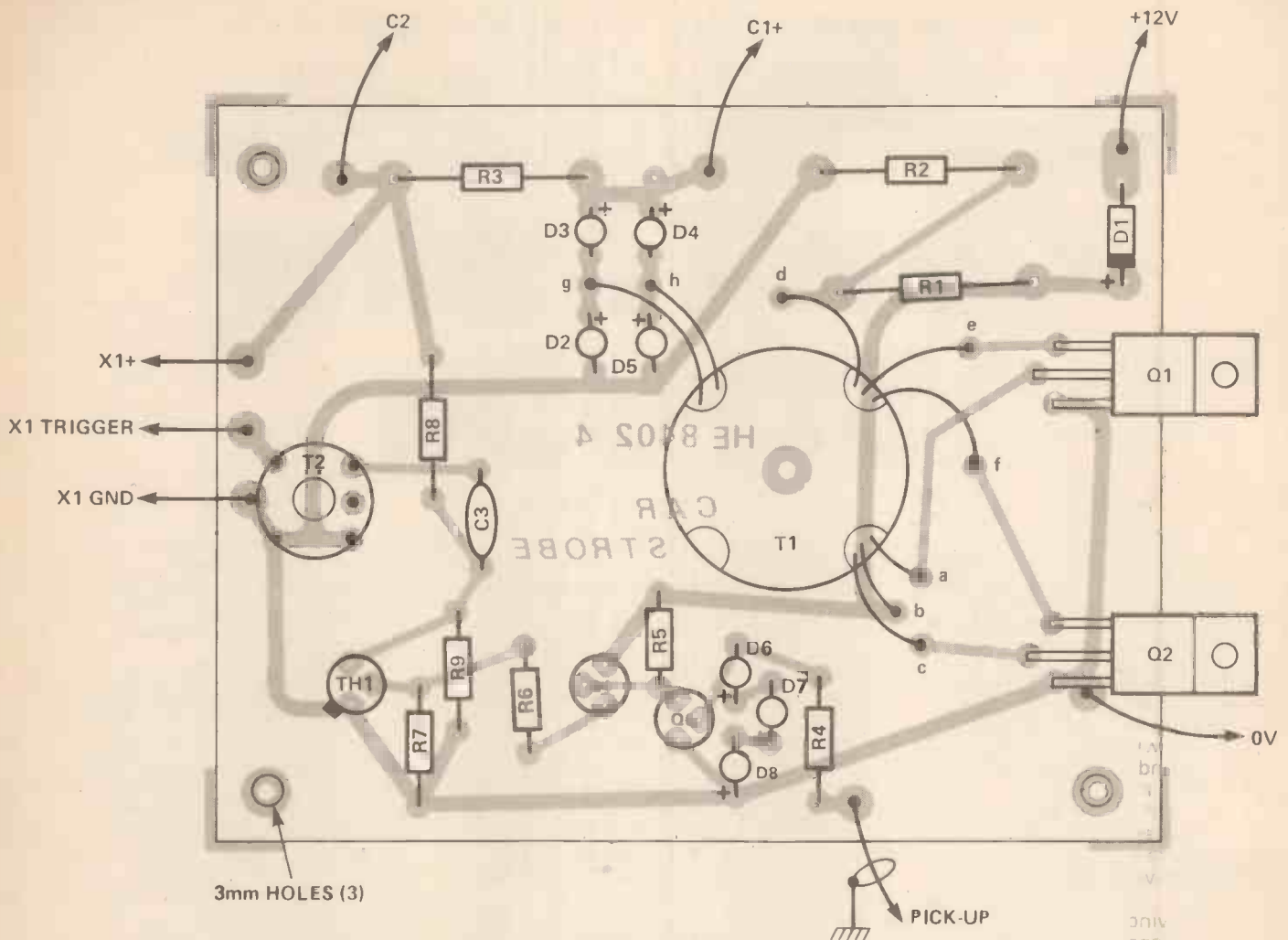


Figure 2. The PCB overlay. The construction and mounting of T1, although not difficult, needs patience and care to avoid damaging it in the process.

should be incorporated in the output, and this is quite true! However the types used here are more generally available than faster varieties and in any case the extra efficiency is negligible.

Despite this slight drawback, it does have the previously stated advantage of good starting characteristics, and due to the "hard" switching action of the transistors, it's difficult to stall.

It should be noted that the output of the transformer is at a low impedance and because of this, and the almost silent running of the circuit, there does exist a risk of shock from the high voltage on C1 and C2. Although probably non-lethal, shocks are an unpleasant experience, so care should be taken when testing!

As an "optional extra", a mains voltage (240V) type neon lamp, plus a 100k 1/2 watt series resistor can be added across C1.

The output of the inverter is applied to a bridge rectifier formed by D2-D5. Because of the high operating frequency of T1, a large degree of smoothing is unnecessary, and a value of 16u was found to be quite adequate for C1.

From C1, current is fed to R3 and

C2, which is the component that will provide the power to produce a flash in the Xenon tube, X1. This capacitor is a compromise; a larger value will produce a brighter flash, but will be greater in physical size. It should also be noted that the greater the energy created in the tube, the shorter its life will be, so after careful consideration it was decided that an upper limit of 2u would be best. As a small paper capacitor was available at 1u5, this was used with acceptable results.

The type of capacitor used is not really critical, providing it can stand the large discharge currents involved (the tube constitutes a shortcircuit when the Xenon gas is fully ionized) and has an adequate voltage rating. For example as the inverter is supplying 350 volts, a 400V component could be used, whereas a capacitor rated at 350V would leave no margin of safety (suitable types are mentioned in *Buylines*).

If a capacitor of the required rating is not available, it would be quite in order to place larger values in series. Using two 4u 250V in this way would, in effect, produce 2u 500V. If this is done, a resistor of about 1MR should

be placed across each capacitor to prevent unequal charges from developing.

To trigger the tube, pulses are picked up from the HT cable on the vehicle using a simple "bulldog" type paper-clip, these are fed to RA by a length of screened lead. R4, along with D6-8, serve to limit voltage and so prevent damage to the amplifier formed by Q3-4. A potential divider in the collector of Q4 is used to ensure clean triggering of the thyristor TH1.

C3 is charged to approximately 260V from the junction of R8-9; the ground return path for this action is provided by the low resistance primary of T2. When the thyristor is triggered, C3 is discharged across the primary winding, and generates a pulse of over 4kV in the secondary winding to trigger the Xenon tube.

Construction Of T1

Transformer T1 is constructed on a pair of FX 2240 ferrite pot cores. Having obtained your cores (see *Buylines*), you can then spend an evening indoors winding the bobbin! The first winding to go on is the

Parts List

RESISTORS

(All 1/4 watt 5% carbon unless noted)

R1	1k 3W
	5% wirewound
R2	100R 3W
	5% wirewound
R3	15k 1W
R4	100k
R5	3k9
R6	3k3
R7	4k7
R8	4.7k
R9	150k

CAPACITORS

(See Buylines for details)

C1	16u
	500V electro
C2	1u5 500V
C3	200n 500V

SEMICONDUCTORS

Q1, 2	2N3055
Q3	BC108
Q4	BCY72, BCY70
TH1	600V/1A SCR
D1	BY127
D2-5	1N4001
D6-8	1N4148

INDUCTORS

T1	"home wound" on FX2240 pot core
T2	pulse transformer

MISCELLANEOUS

X1 Xenon tube
Metal box; FX2240 pot core; 50R screened cable; nylon nuts and bolts; insulating kits for Q1, 2; bulldog clip; wire, cable, mounting nuts and bolts etc.

BUYLINESpage 26

collector winding; start off by sleeving the end of the wire (30 or 32 SWG insulated wire) and then tie the wire to the bobbin with cotton thread, wind on 14 turns and bring out the wire in a loop to form the centre-tap. Cut the loop sleeve and tie the ends and then wind on another 14 turns, and again sleeve the wire end. (Strip lengths of 30 SWG wire-wrap wire to obtain the sleeving).

Cover the winding with a single layer of PVC tape and then start the base windings (from the same end as the first, and in the same direction), winding on four turns, a tap, then another four turns. Finish the winding with a layer of tape as before.

Now the really boring bit; wind on approximately 400 turns of 40 SWG from the 'start' end and direction in the same as the other windings. I

used a hand drill for this, with a large nut and bolt mounted in the chuck to hold the bobbin. The accuracy of the windings is not that important, but try to aim for 400-500 turns, ie on the high side. Finish as before.

Before assembling the cores a small washer cut from PVC insulation tape should be placed over the centre limb of one core half, to provide an air gap between the core halves when they are bolted together.

When mounting the transformer on the circuit board, use a nylon or brass bolt, and use the *minimum* amount of force; these ferrite cores are *very* fragile. You can lock the bolt using paint or glue, but gluing the cores together is *Not* recommended.

I used a pressed aluminium box to mount the board in, but a die-cast box is to be preferred, in case you try

to park your car on it one day!

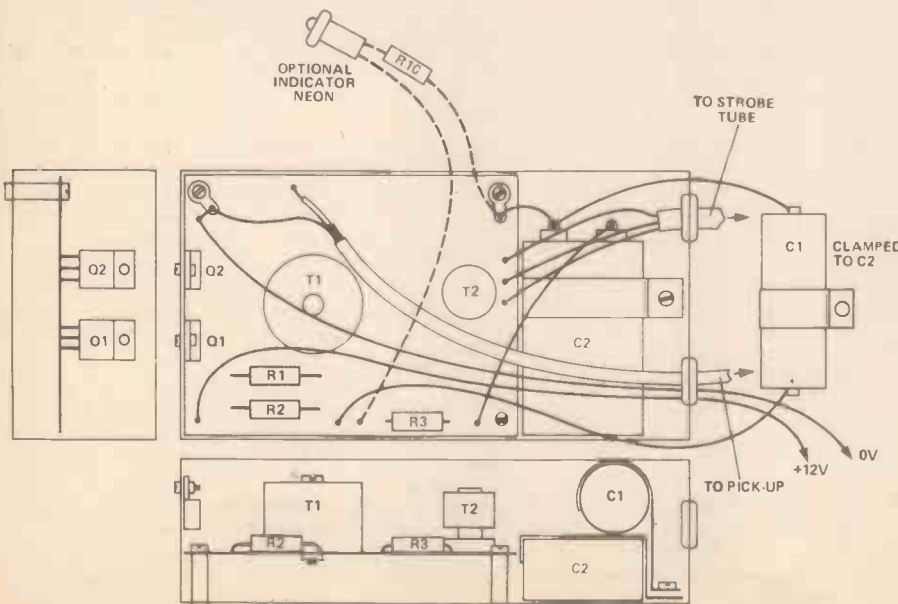
Q1-Q2 are mounted on the box using insulated bushes and mica washers; again, nylon bolts are to be preferred. Input and output cables are best fed through grommets and clamped down using "P" type clips. I mounted the strobe tube in the wide end of the discarded soldering iron handle, and connected it to the box using good quality three-core mains cable. A well insulated torch casing would make an excellent substitute, using the reflector to increase flash intensity! The pick-up lead uses screened 50 ohms CB cable (or amateur radio cable if you prefer!) of about 5mm diameter. Make sure the screen is earthed at the board end, only, and that the board is earthed to the box. The screen is earthed at the board end, only, and that the board is earthed to the box.

In Use

It is unlikely that this device will turn your average Ford Cortina into a Ferrari (we're still working on that!) but what it *will* do is ensure that the sparks are appearing at the right time, and allow the timing to be checked and corrected with the engine running; this is by far the most accurate method. As the position of the strobe marks on the engine casing vary from engine to engine, prospective car tuners should obtain a copy of the service notes or manual for their particular vehicle; these usually outline the methods very clearly.

Cautionary Note: Strobe timing involves leaning over a running engine; in these circumstances loose clothing, particularly ties and shirt cuffs, are a hazard to health. Reading a magazine is difficult if you lose your fingers, so take care!

Figure 3. The wiring connections.



Modifications

Some specimens of Q3 may have a tendency towards self-oscillation; this can be cured by placing a 150p disc capacitor between base and emitter, on the track side of the board.


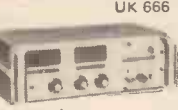


Finally, concerning the Xenon tube itself, some tubes appear to suffer from intermittent triggering as they get older. The best cure for this is to wind about four turns of ordinary 5A fuse wire, or a strand from a length of hook-up wire, around the length of the tube, and connect one end to the trigger terminal.



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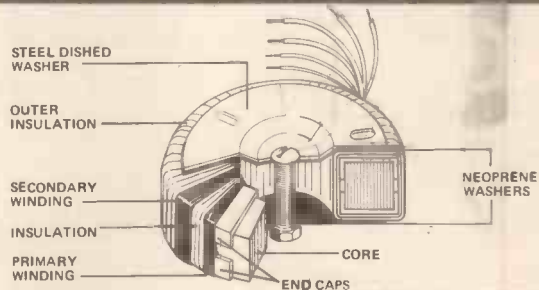
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19 x 3.5	17 x 3 x 10	24.09	20.09
19 x 3	17 x 2.5 x 10	24.09	—
19 x 2.5	17 x 2 x 10	22.94	18.94
19 x 6	17 x 5.5 x 12	28.69	24.69
19 x 5	17 x 4.5 x 12	27.54	23.54
19 x 4	17 x 3.5 x 12	25.24	21.24
19 x 3.5	17 x 3 x 12	24.09	20.09
17 x 3.5	15.5 x 3 x 9	21.79	17.79
17 x 2.5	15.5 x 2 x 9	20.64	16.64
17 x 4	15.5 x 3.5 x 12	25.24	21.24
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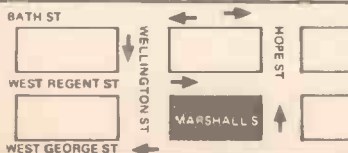
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FORWARD BIAS

Questions, answers and errata from readers and writers.

Echo Reverb Error Error

With any luck all this will be the end of the Echo Reverb Saga. This project appeared just over a year ago, and has been the subject of considerable dissent ever since!

First, there are admitted typographical errors and misprints in the diagrams: these have been corrected in Hobby Electronics (several times) but for the sake of completeness, here they are again!

In Figure 1, the circuit diagram, the unlabelled pin of IC5, which is connected to the wiper of RV2, is pin 9; the PCB layout was correct in this regard.

Again in Figure 1, D2 was shown inverted; the cathode should go to the OV rail and, again, the PCB layout showed this component correctly.

In Figure 2, the PCB layout on page 36, the connections to the end tags of RV2 were not indicated; they should go to the +15V and OV rails as shown in the circuit diagram. This error has been corrected in the new layout, Figure 2, on this page.

In the Parts List on page 37, RV1 and RV3 are incorrectly specified as linear types: both should be

logarithmic. In the old circuit RV4 should also have been a log pot, but as modified (Figure 1, this page) it stays as a linear type.

The worst fault lay in the PCB track design for the power supply circuit; as originally published the circuit indicated a single 15V secondary winding, but the layout connected two windings of a centre-tapped transformer in series. Thus a 15V transformer installed onto the PCB would have produced an output well above the rated input voltage of the regulator IC.

This error may be corrected by one of two options: either replace the transformer with a 9-0-9V type, or undertake track surgery shown in Figure 3.

The second list of complaints about this project are essentially of the "it doesn't work . . ." variety. Again, these fall into two groups: those who cannot get the beast to work, and those who have a working Echo/Reverb but are dissatisfied with the results; the "it doesn't work properly . . ." subset.

Without going into specific fault-finding detail, it is impossible to answer all the complaints of those who cannot get any useful output

from the unit: check your construction, components, wiring and so on, and if that doesn't turn up an obvious fault (assuming you've made all the corrections published so far), write to us again and we'll do our level best to help. The complaints of the second group are somewhat harder to satisfy. In part the answer is not to expect too much from a simple circuit which was, after all, designed to minimise cost rather than to maximise performance.

Also a good deal of experiment with the many controls is required to get the most out of this project! However, there were design faults in the project too, and these have been eliminated, as far as possible, without a total re-working of the project, in the circuit diagram and new PCB overlay printed in these pages.

Many readers complained of a low-level 50/100Hz hum in the background. This is caused by the PCB track layout, in part; the charging current for C1 flowed through a fairly thin length of copper so that, due to track resistance, the earth track of most of the circuit hummed with respect to the regulator earth point. The correction of this fault involves some minor track surgery, ie the track

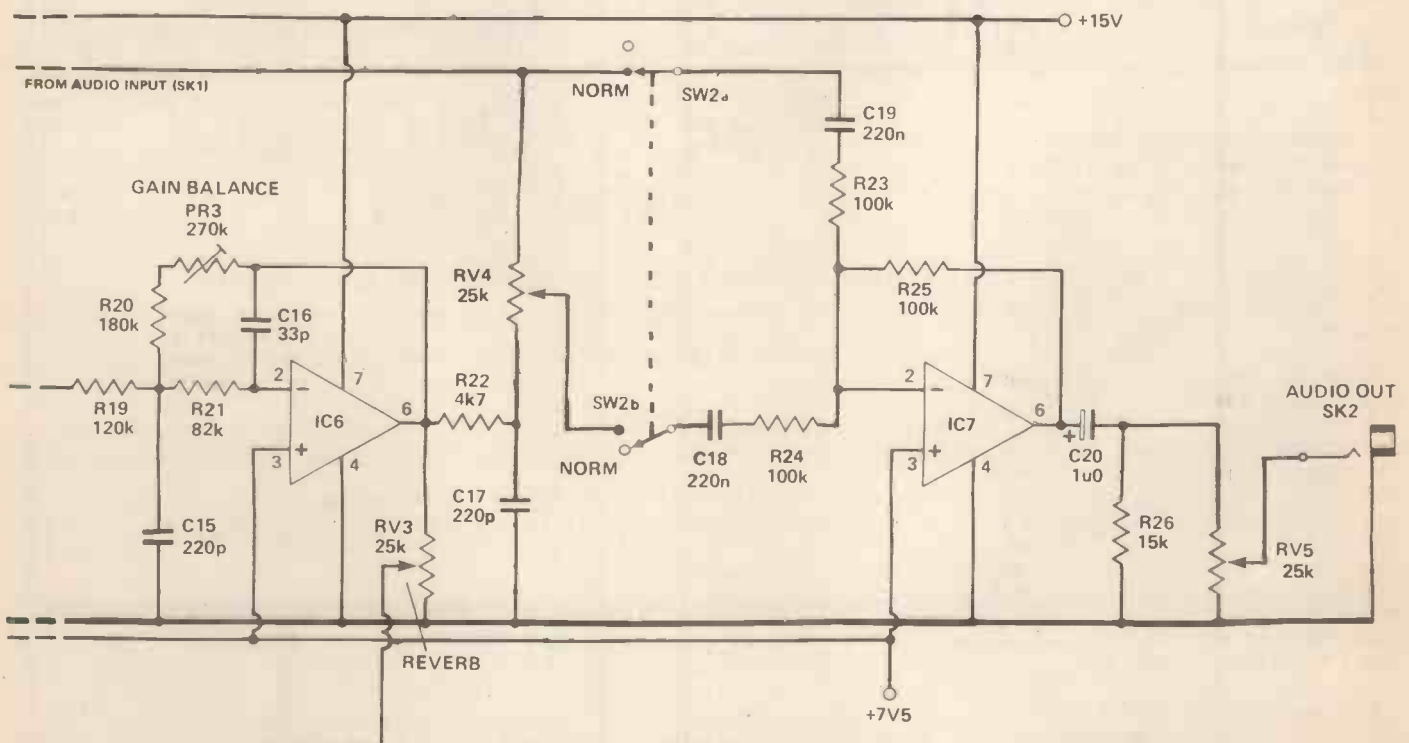


Figure 1. Most of the circuit modifications to improve performance are shown on this diagram. Note that the direct input to C19 (via SW2a) now comes from SK1, not RV1.

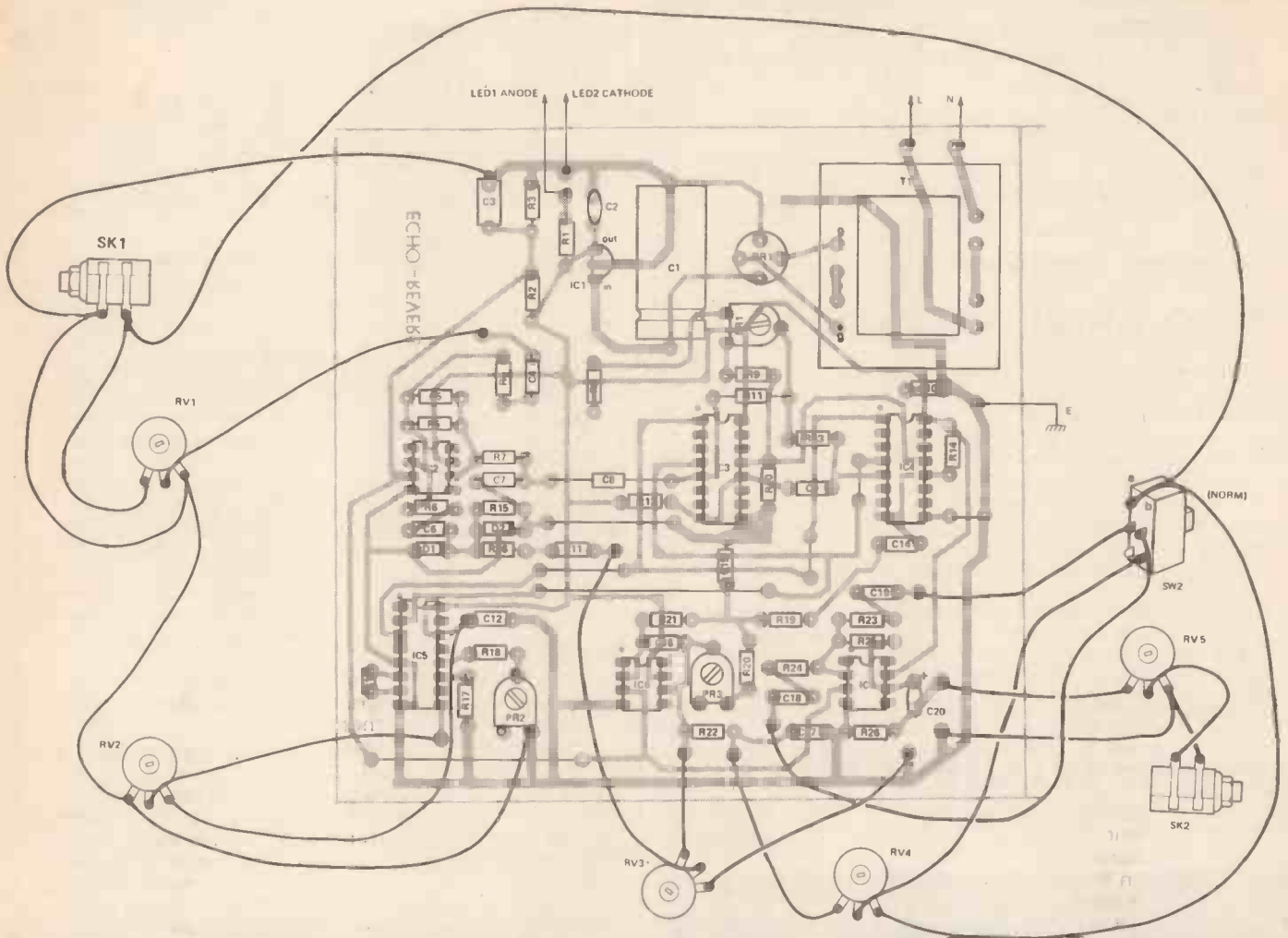


Figure 2. The revised component layout shows all the off-board connections. This PCB should be used with a 9-0-9 volt transformer as indicated; the track cut near the (-) terminal of BR1 is to reduce the hum level, but the earth rail has to be re-connected via the off-board components (see text).

joining the 0V side of C10 and the (-) terminal of the bridge rectifier must be cut; a suitable point is close by where the track from C10 joins the link from (-) to the earthy side of C1, as shown in the new overlay diagram, (Figure 2). However, a new link must be supplied to connect up the earth rails, and in the layout of Figure 2 this goes from the OV side of PR2 to the OV side of C3, via RV2, RV1 and SK1.

The other solution to the general problem of hum and noise is to use screened cable for all off-board wiring, but particularly for the input and output leads.

Another design fault concerned the wiring of SW2, which was supposed to switch between 'Normal' and 'Echo'; in fact the connections around the switch were such that it was impossible to switch the delay effect out of circuit; another difficulty was that the level of 'straight' signal in the output mix could never be more than that of the delayed signal, ie a 1:1 mix was the best that could be obtained.

Both problems have been eliminated in the new circuit of Figure 1, and the full wiring details are given in Figure 2. No track modifications are required, as all connections are made off the PCB.

Component changes to note are that SW2 is now a double-pole double-throw type, and that an extra potentiometer, RV5, has been included in the output signal line. The other important change is that the 'straight' signal to C19 is now taken direct from the input jack, not from the wiper of the input level control RV1. Thus RV5 can be used to set the level of the output signal for both 'straight' and 'effect' conditions; the gain balance preset PR3 should be adjusted to ensure that the 'effect' level matches that of the straight through signal.

The modification also allows the proportions of straight to delayed signal to be varied continuously from 1:0 to 0:1; in view of this RV4 should be re-labelled 'MIX', rather than 'Echo Level', and the pot should be a linear type as originally specified.

A couple of general points are worth noting: the Echo/Reverb will not work reliably (or very well) from a low-level input signal, so some form of preamplification will probably be necessary to boost the signal to around 1V at the input. The other point concerns the difference between echo and reverb: an echo is a clearly defined repetition or series of repetitions of a single sound, whereas for reverberation the repetitions are

not separate — they overlap and produce continuously.

In circuit terms, the difference is a function of the delay introduced into the signal path. This unit produces a maximum of 30ms delay, with the clock set to minimum, and this is just enough to produce an echo from short sharp, input sounds; in other words the usefulness of the effect depends to an extent on instrumental technique — thrashing away at a three-chord Status Quo number will not yield the expected result!

The delay can be extended, as mentioned in the text, by further reducing the clock frequency; (the ultimate maximum delay is 50ms), but this will produce an audible whistle in the output because the clock then falls inside the output filter cut-off, at 15kHz.

Finally a word to those readers who have written to say that the unit does not produce the stated effects, but a kind of 'pitch change' instead. Gentlemen, it is physically impossible for the Echo/Reverb to give a pitch change, except briefly as the delay control is rapidly rotated. True pitch change is only available with high quality digital delay systems.

The 15-0-15 volt PCB pattern, Figure 3, has been moved to the PCB Printout page, page 64.

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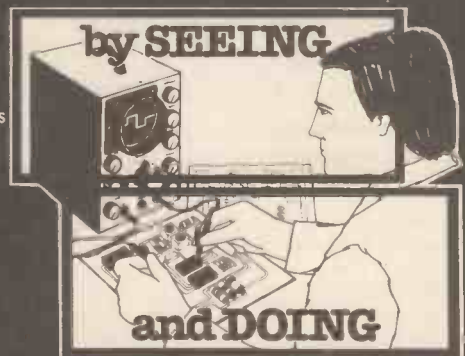
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CAREERS IN ELECTRONICS



In our second article on the Armed Forces we look at the Royal Navy.

Helen Armstrong

In the ROYAL NAVY there are again three main engineering categories: Weapons Engineering, Marine Engineering and Air Engineering.

Weapons Engineers deal with the weapons and communications systems on ships and shore bases. The field is divided into Ordnance — dealing primarily with the weapons systems — and Radio — dealing with the communications, including satellite communications, coded communications and data handling equipment.

At *HMS Raleigh*, a shore station at Torpoint, near Plymouth, training begins with six weeks of general naval training, where you learn about the service and its procedures and what is expected from you as a seaman. The training base for weapons is *HMS Collingwood*, another shore base (the Navy names many of its shore bases as if they were ships) at Fareham in Hampshire. After eight weeks training here you will be categorised into Ordnance or Radio; most trainees get the allocation of their choice, but the Navy has the final word. After three or four months, further training you will be sent to a ship as an operational mechanic.

There is room for career advancement through extra qualifications (GECs as well as technical qualifications) and interviews. You can progress from Mechanic to Technician and thence to Petty Officer and on up according to ability.

Weapons engineering probably has the greatest number of options to attract someone with an interest in electronics, Air Engineering with the Fleet Air Arm also has options relating to weapons and radio. The training centre for Air Engineering is at *HMS Daedalus* at Lee-On-Solent, and after six weeks basic training at *HMS Raleigh* and three months at *HMS Daedalus* you will spend about eighteen months at a Naval air station getting practical experience before you join a seagoing squadron.

Marine engineers, who deal with the mechanical and heavy electrical equipment on ship, undergo a parallel course of training at their own establishment.

Apprenticeships

More highly qualified aspirants can be accepted for an Artificer Apprentice scheme lasting five years. This is a high-

powered technical apprenticeship which qualifies the successful artificer with a BTEC award and BTEC Diploma, with some specialisations earning the TEC Higher Certificate. Entrants are between 16 and 21 and must have, basically, good passes at GCE 'O' level or CSE in Maths, a physics-based subject, and English Language, or similar first year course units in a BTEC Certificate or Diploma, or equivalent qualifications. Alternatively, they sit a qualifying examination, and in any case undergo interviews, aptitude tests and the regulation medical.

Men and women (WRNS, colloquially known as Wrens) who come into the Navy as mechanics can become Artificer Candidates.

The fourteen week introductory term at *HMS Raleigh* includes technical training and general naval training, which includes all the basics of dress, kit care, drill and procedure. You can leave after four weeks if you feel unsuited. The Technical Educational Training covers maths, mechanical engineering science, electrical engineering science and English, with an emphasis on traditional maths. And it is worth noting that, unlike most schools and colleges, the Navy has a vested interest in making sure that its trainees get the best from their education, so that there is individual attention to all students. In the twelfth week you will choose your specialisation. About 85% of candidates get the specialisation they opt for.

Going To Sea

Weapons Engineering training at *HMS Collingwood* comprises five terms of craft workshops, maths and electronics, starting with intense groundwork and then branching out into computers and microprocessors (including programming), communications, navigation aids and control engineering along with other craft basics and naval techniques such as survival at sea. After this there is a period at sea — and why opt for the Navy if not to go to sea? — there is a period at sea learning all about the ship, putting techniques into practice, spending a little time on all sections of the ship and keeping a regular journal of observations on your work, which contributes to your qualifications and future promotions. This phase is followed up by four weeks of revision and consolidation at *HMS Collingwood*. At this stage you attain the BTEC Diploma, and subsequent work is towards the BTEC Higher Certificate.

This is followed by a term of Specialist Technical Training, in which apprentices opt either for Action Data and Communications, or Weapon Data and Ordnance. This is the stage at which mechanic Artificer Candidates join the course. The final term is Deep Specialist Training, in which the options are broken down still further into half a dozen possibilities. At the end of the course, the apprentice becomes an Acting Petty Officer Weapon Engineering Artificer.

Air Engineers and Marine Engineers follow parallel courses at their own training establishments. Although Marine Engineers deal much less with electronics than Weapons Engineers, and Air Engineers somewhat less so (although some electrical/avionics specialisations do require good electronics training) the continual advance in engineering techniques is moving all the time towards more electronics, more digital electronics and more computer control, so it is worth asking detailed questions if you are inclined towards a discipline which does not otherwise seem as electronically-inclined as you would like, to get a clear idea of exactly what the job will allow you to do.

You can enter the Navy between the ages of 16 and 33, and as an Artificer Apprentice between 16 and 21. The basic term of service is again 22 years from age 18, but ratings (seamen without specialist training or officer standing) can leave at 18 months notice after their initial term of service, which is normally two years and six months after the age of 18. There are a number of other career options, and most seamen who leave before their 22 years is up are liable for three years on call to the Royal Fleet Reserve.

Officer Opportunities

Engineering Officers are divided into the same three specialisations, and can begin their career either by reading for a degree at the Royal Naval Engineering College and Manadon, by entering as a Direct Graduate Entry after reading at a civil University, or via a University Cadetship Entry.

You can also apply for a Naval Bursary in addition to your LEA grant while studying at a civil university: you are then required to serve the minimum of a Short Career Commission in return. Alternatively, a few candidates are given the opportunity to join the Navy first and then go on to study at the University or Polytechnic which they have already arranged to attend. This (University Cadetship Entry) requires you to serve for at least five years after completion of training, and you do a certain amount of Naval training during vacations.

Naval College and Direct graduates do a period of general naval training at the Britannia Royal Naval College at Dartmouth and at sea. They can go on to Manadon for Application courses for twelve to eighteen months, specifically related to the engineering branch the graduate has chosen; then there is a period learning about the equipment; then to sea, as a Lieutenant (just for the record that's Leff-tenant, in the Royal Navy — Loo-tenants are American).

It is also possible to join the Navy on a Short Career Commission as an Instructor Officer specifically to teach other Naval entrants. This is the Navy's equivalent of Teacher Training, and they have their own Royal Naval School of Education and Training Technology at



A computer laboratory in the Data Processing Division at RN Portland Bill.

Portsmouth. The basic course is six months, with nine weeks teaching practice; you can enter this course with or without prior teacher training, and with or without a degree, so long as you have qualified in the subjects you are to teach, which comprise a Higher National Certificate or Diploma in Engineering for engineering courses. Like all would-be officers you would be selected by the Admiralty Interview Board at *HMS Sultan* in Gosport.

Going back to the Naval Engineering degree at Manadon (the college is called, in the Naval tradition, *HMS Thunderer*), the BSc and MSc courses, while tailored to Naval requirement, are validated by the council for National Academic Awards, and the course of education are directed so that they can become Chartered Engineers of the professional bodies of their specialisation. The degree is system-orientated, fitting out the engineering officer for responsibility for one part of the Navy's overall engineering structure. However, the first two years of the course include electrical and mechanical subjects to give an integrated basis, with general basics such as mathematics and engineering drawing, plus non-engineering subjects. Workshop technology is also covered, as a Naval engineer must above all be practical, much according to the equation "It don't go = Make it go".

Computer Control

The College makes special mention of its Control Engineering and Computation course, since so many weapon systems are now computer-controlled in one form or another.

As stated before, although electronics

is a basic of engineering in the navy, the option which is most concerned with electronics *per se* is Weapons Engineering, and some aspects of Air Engineering. Specialist study is undertaken in the third year of the degree course, and includes individual projects which are an important part of the graduate officer's assessment.

Training does not stop after a three-year degree: then follows application training, where everything learned so far is applied to the specific equipment which the officer will be responsible for on board his ship. This part of the course includes management and administration, applied with the same rigour to the actual situations in which the officer will be serving. There is also project design and building in small groups as the Naval engineer needs to be able to work as part of a closely knit team.

As we saw with the Army, earlier on, a very important part of the officer's role is the organisation, supervision and leadership of ratings and other seamen working with him, as well as being able to work accurately and harmoniously with officers above him. There is less emphasis on personal combat training and survival training in the Navy, as the whole purpose of the service is to man and operate the massive machines — the ships — which do the actual fighting (They do have a combat branch, the Royal Marines, and a Fleet Air Arm which runs its own combat planes, so that the Navy is a little like all three services rolled into one.)

There are some opportunities for women in the Air Engineering Branch, both as a mechanics, servicing and repairing aircraft, and also as Aeronautical Engineering graduates.

Careers In Electronics continues next month with the Royal Air Force and a round up of addresses to contact.

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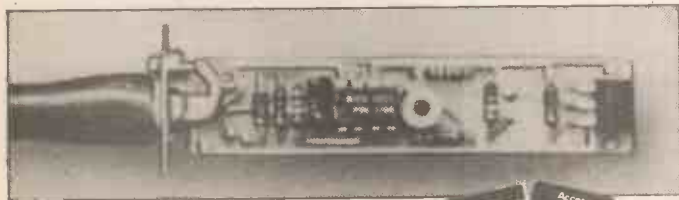


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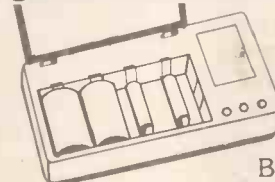
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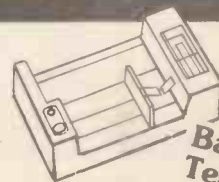
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A FIELD STRENGTH METER is used to give a relative indication of the signal intensity radiated by a transmitter, and units of this type are very useful when optimizing transmitter and (or) aerial performance. The Field Strength Monitor featured in this article is primarily intended for use with 27MHz citizens band equipment, but it can be adjusted for use on the 27MHz radio control band and could probably be adapted for amateur band use.

A problem when making field strength checks is that it is usually necessary to have the field strength meter close at hand so that it can be read easily, and it is also necessary to operate the transmitter. Unless a helper can be found, this means that the meter has to be placed close to the transmitter, rather than where the most meaningful results will be obtained: in general, readings are likely to be most reliable if the meter is placed a few metres or more away for the aerial. In practice field strength readings are often taken practically underneath the aerial, where the readings obtained may be of little value.

A novel feature of this field strength meter is its simple memory circuit which enables readings to be held for a minute or so. This makes it possible to position the meter in the most favourable position, go to the transmitter and activate it briefly, and then return to the field strength meter to take the reading (which will be held for some time after the transmitter has been switched off). This system overcomes the problem of reading the meter from a distance, but does not impair the accuracy. The unit can also operate as a conventional field strength meter, incidentally.

Block Diagram

The system used in the unit is shown in the block diagram of Figure 1. A short aerial picks up the radio signal from the transmitter, and a bandpass filter is used to remove any signals on other bands. A buffer amplifier enables the high impedance aerial signal to efficiently drive the next stage, which is a straightforward diode detector. This simply gives a DC output level which is roughly proportional to the strength of the received signal. A storage capacitor is charged by the output of the detector, and this remains charged even when the signal from the transmitter ceases. The voltage on the capacitor

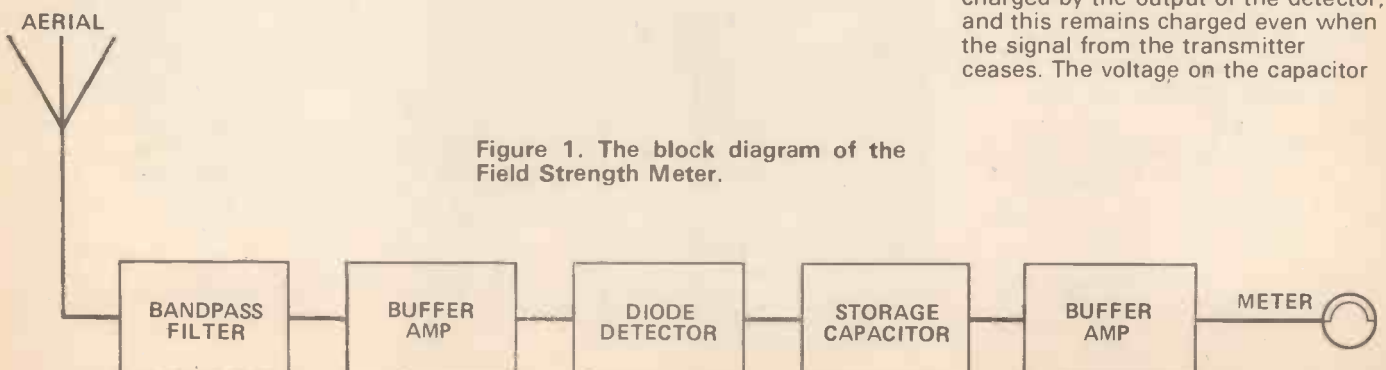


Figure 1. The block diagram of the Field Strength Meter.

CB Field Strength Meter

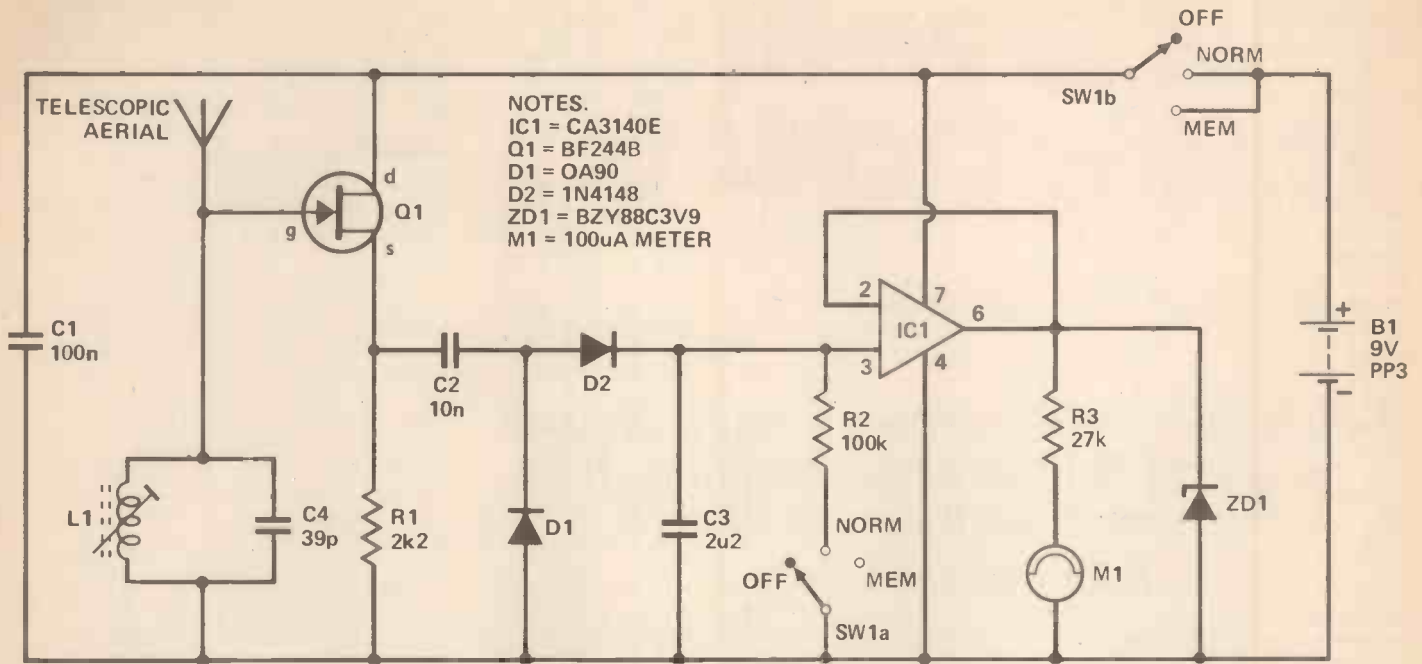


Figure 2. The field strength meter circuit, with a single tuned circuit.

is fed to the meter circuit by way of a buffer stage which has an extremely high impedance so that it does not discharge C3; the reading on the meter therefore remains unchanged when the input signal ends, giving the required memory action.

The Circuit

Field strength meters are almost invariably very simple pieces of equipment and, as can be seen from the circuit diagram of Figure 2, this one is no exception.

With this type of circuit a reasonable amount of selectivity is required, otherwise there is a likelihood of strong transmissions on other bands giving a significant reading on the meter. On the other hand, a high degree of selectivity would be undesirable as it would give large variations in sensitivity over the operating frequency range of the unit.

In practice a single tuned circuit gives adequate selectivity, and in this case the tuned circuit is comprised of L1 and C4. A telescopic aerial is used, coupled direct into the tuned circuit; this loads the tuned circuit and increases its bandwidth, but this leaves an adequate level of performance in this respect. In fact the passband might well be a little narrow without this loading by the aerial.

Q1 is used as a source follower buffer stage between the tuned circuit and the detector stage. The latter is almost a conventional two diode type, but the RF filter capacitor (C3) is larger than normal, and there is no load resistor. The only discharge path for C3 is through the very high reverse resistance of D2, or the even higher input resistance of IC1. C3 therefore charges up to the peak input

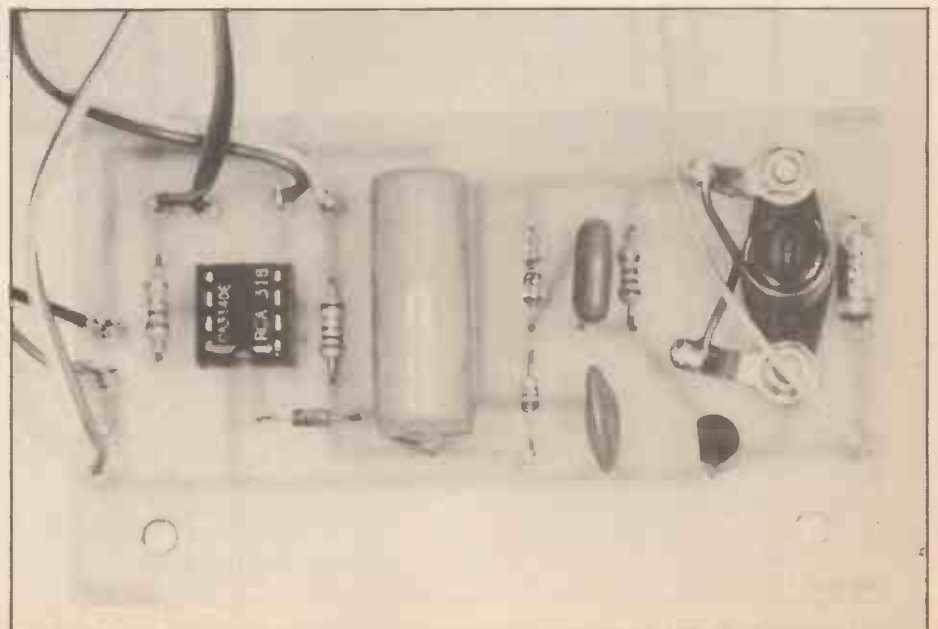
potential from D2, but discharges only very slowly when the signal from D2 ceases. C3 has been given a fairly high value and D2 has been made a silicon rather than a germanium diode, so that the discharge rate is so slow that there is no significant change in voltage over a period of about one minute or so. A germanium diode would be preferable for D2 in that it would give a lower forward voltage drop with slightly improved sensitivity and linearity, however in this application it is relative rather than absolute field strength values that are required, and the linearity (or lack of it) is not of great importance. The sensitivity of the circuit is perfectly adequate using a silicon diode for D2.

IC1 is used as a unity voltage gain buffer stage. The CA3140E device is a

MOS type which provides an ultra-high input impedance, so that no significant input current is drawn from C3. The output of IC1 drives a simple voltmeter circuit using R3 and M1. ZD1 is a Zener protection diode with ensures that no more than a marginal overload of the meter can occur.

SW1 is the mode switch, and in the first position the unit is switched off. In the next position R2 is connected to across C3, so that the detector circuit works conventionally and the unit functions as a normal field strength meter. R2 is switched out in the third position, and the memory action is then produced. A reading in the "memory" mode can be cancelled by switching the unit briefly to the "normal" mode so that the C3 discharges through R2.

Power is obtained from a small (PP3



size) 9 volt battery, and this has a long operating life as the current consumption of the circuit is only 3.5 milliamps.

Construction

A plastic case having approximate outside dimensions of 150 x 80 x 50mm will comfortably accommodate all the components. M1 is mounted on the right hand side of the front panel, and a standard 60 x 45mm panel meter requires a main 38mm diameter cutout. This can be made using a miniature round file or a fretsaw. Four 3.2mm diameter mounting holes are then required for the fixing screws, and the positions of these can be marked using the meter as a template.

Any meter having a full scale deflection of about 1 milliamp or less can be used, and inexpensive types are perfectly adequate for this application. However, the value of R3 must be decreased proportionally if a meter having a full scale sensitivity greater than 100 microamps is used, otherwise the circuit will be unable to fully drive the meter. Inexpensive meters often have no provision for screw fixing, and there is then little choice but to glue it in place using a good quality general purpose adhesive.

SW1 is mounted to the right of M1, and requires a standard 10mm diameter mounting hole. Ideally the telescope aerial should be about 1 metre or so in length, but smaller types just about give an adequate level of performance. Most types have a threaded base which accepts a mounting bold (usually an M3 type these days), and the aerial can therefore be mounted through a hole drilled in the top of the case, fixed in place using a screw taken through a hole drilled at a suitable position in the base panel. A soldertag should be fitted on the fixing screw so that it is easy to make a connection to the aerial.

Details of the printed circuit board and wiring are provided in Figure 3. L1 is home-wound on a standard 7mm coil former fitted with a adjustable dust-iron core. The winding consists of 8 turns of 20 SWG enamelled copper wire with closely spaced turns. The coil is mounted on the board using two 8BA fixing screws and an 8BA soldertag is mounted on each of these. The soldertags provided two convenient fixing points for the ends of the winding, and the connections from the winding to the board are carried by the soldertags and fixing screws. Reasonable care should be taken when winding L1, but construction of this component is not too critical since the core gives a wide turning range.

IC1 is a MOS device and requires the appropriate handling precautions to be observed. Mount this component in an 8 pin DIL IC socket,

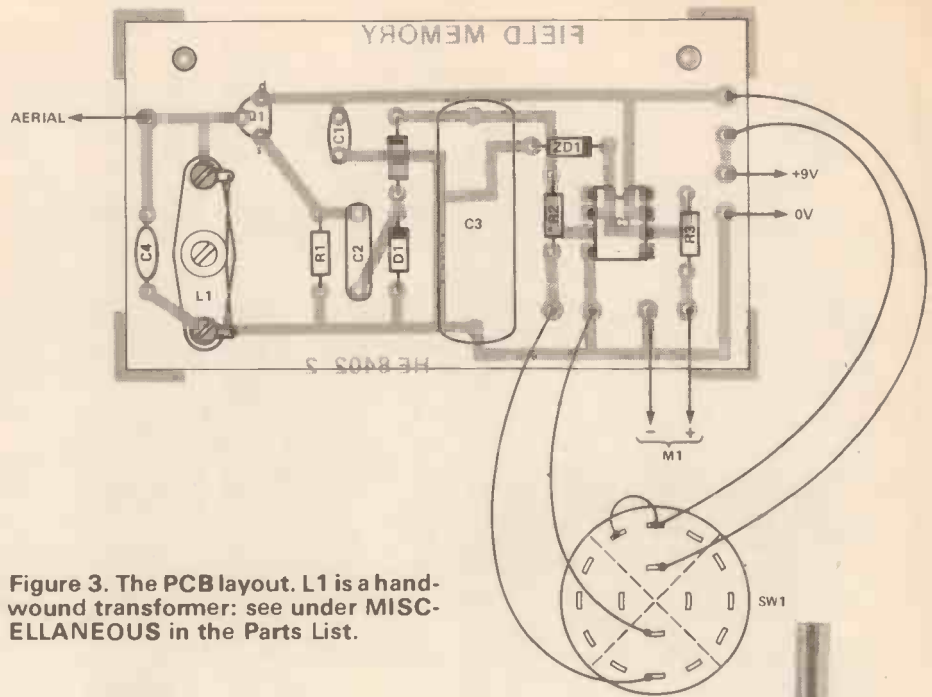
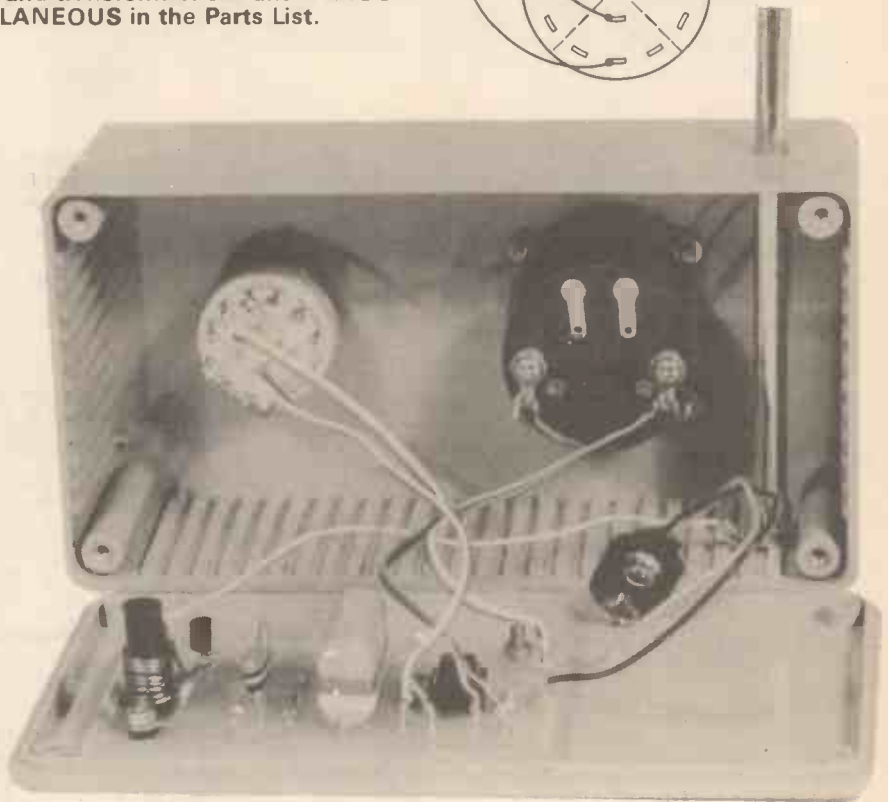


Figure 3. The PCB layout. L1 is a hand-wound transformer: see under MISCELLANEOUS in the Parts List.



Parts List

RESISTORS

- (All 1/4 watt 5% carbon)
 R1 2k2
 R2 100k
 R3 27k

CAPACITORS

- C1 100n ceramic
 C2 10n polyester
 C3 2u2 polyester
 C4 39p polystyrene

SEMICONDUCTORS

- IC1 CA3140E
 D1 0A90

- D2 1N4148
 ZD1 BZY88C3V9
 Q1 BF244B

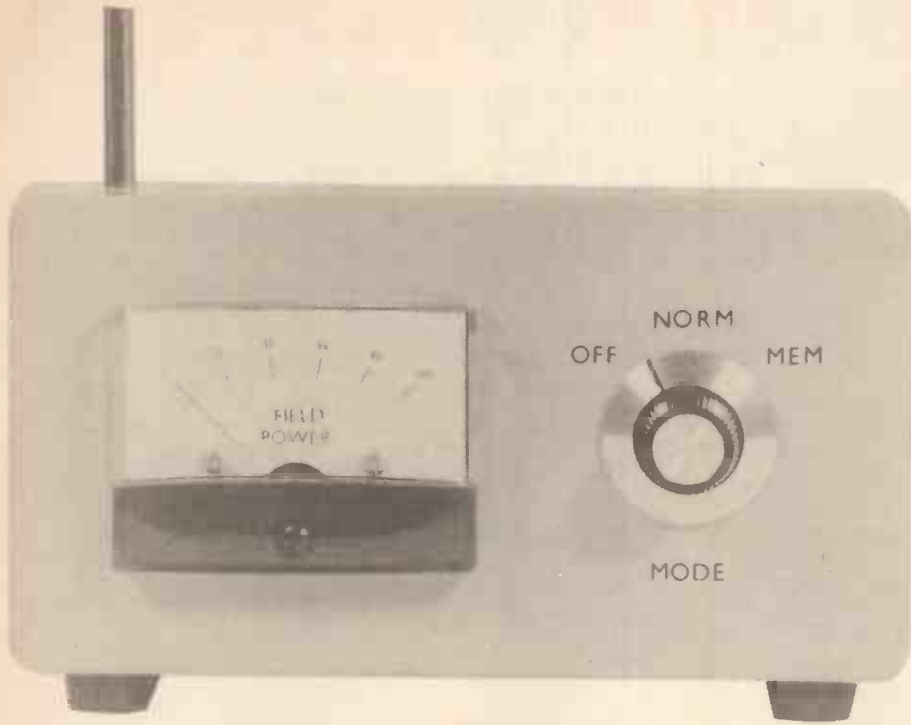
MISCELLANEOUS

- M1 100uA, 60 x 45mm moving coil panel meter
 B1 9 volt, PP3 size
 SW1 3 way 4 pole rotary

Telescopic aerial; printed circuit board; plastic case, 150 x 80 x 50mm; control knob; PP3 battery and connector; 81 pin DIL IC socket; 7mm coil former, dust-iron core, and 20 swg enamelled copper wire for L1; wire, etc.

BUYLINES page 26

CB Field Strength Meter



The finished Field Strength Meter front panel, showing the normal position for bench testing, and the memory position to enable tests to be made some distance from the transmitter.

handle it as little as possible, and do not plug it in until all the other wiring has been completed.

Once the board and wiring have been completed the board is mounted at any convenient position on the rear panel of the case.

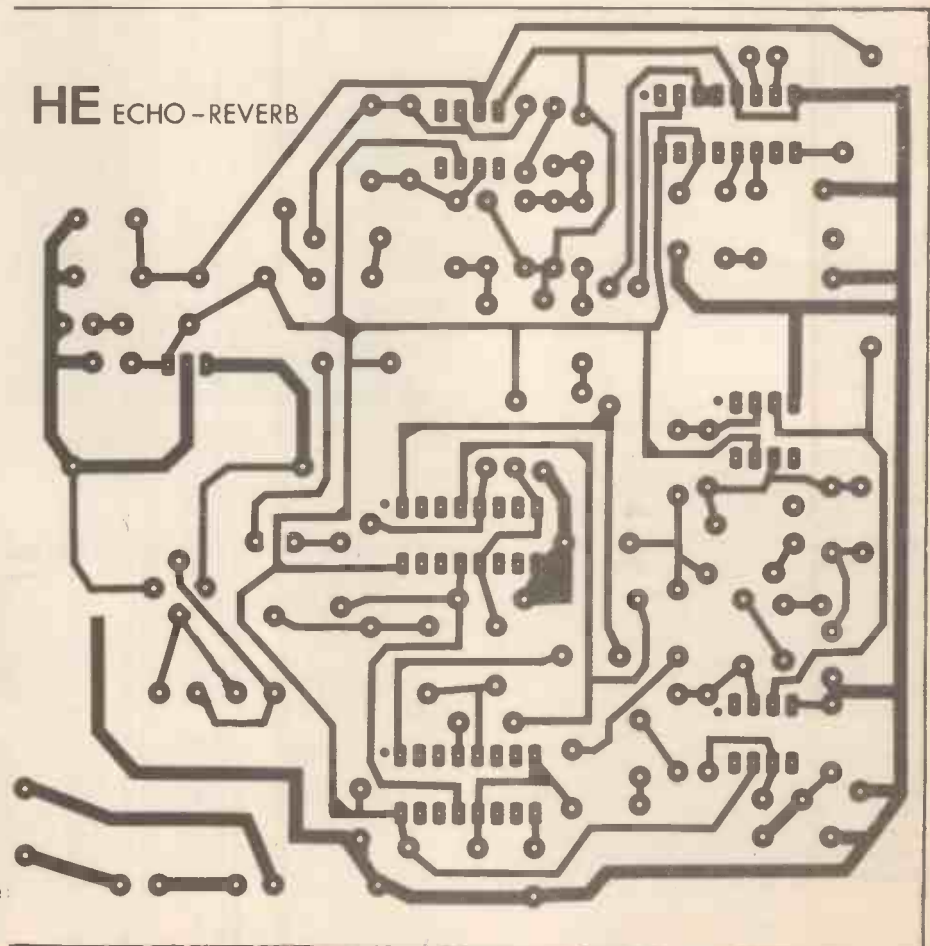
Adjustment

Before the unit is ready for use the core of L1 must be set to peak sensitivity at the centre of the 27MHz band. With the aerial fully extended, the back of the case temporarily removed to give access to the core of L1 and the unit switched to the "normal" mode, it should be placed within a few metres of a CB rig operating on a channel near to the middle of the band — in other words, around channel 19 to 22 — but obviously a clear channel should be utilized! Next, the core of L1 is adjusted to obtain a deflection of M1, and then to peak the reading: the unit is then ready for use. It is advisable to use a plastic trimming tool when adjusting L1, rather than an ordinary screwdriver which could damage the core and produce detuning. If overloading should ever prove to be a problem a simple solution is to retract the aerial slightly!

HE

PCB PRINTOUT (continued)

HE ECHO-REVERB PCB MODIFICATION



This foil pattern has been modified for correct operation with a 15-0-15 volt transformer as originally specified. The windings are now connected in parallel, rather than in series.

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Apart from the PCBs for this month's projects, we are making available some of the popular designs from earlier issues. See below for details. *Please note that only boards for projects listed below are available: if it isn't listed we can't supply it.*

February 82 HE/8202/1 HE/8202/2	Relay Driver Mast-Head Amp	£2.38 £1.24	October 82 HE/8210/1 HE/8210/2	Flash Point Alarm Negative Voltage Generator	£2.45 £1.71	HE/8306/2 HE/8306/3	CB Rap Latch Bat Light (Car battery monitor)	£1.90 £2.59
March 82 HE/8203/1	Digital Dice	£1.61	HE/8210/3	Squelch Unit	£2.90	HE/8306/4	Traffic Light Toy	£2.94
April 82 HE/8204/1	Digital Capacitance Meter	£4.62	November 82 HE/8211/1	Pedometer/ Odometer	£2.45	July 83 HE/8307/1	Soft Fuzz	£3.19
HE/8204/2 HE/8204/3	Dual Engine Driver Bike Alarm	£3.76 £2.82	December 82 HE/8212/1 HE/8212/2 HE/8212/3&4	Phase Four Microlog Tape/Slide (Set of Two)	£3.25 £4.58 £6.05	August 83 HE/8308/1 HE/8308/2 HE/8308/3 HE/8308/4	Whistle Switch Ace Interface Enlarger Timer Auto-Winder	£5.06 £4.05 £3.36 £3.43
May 82 HE/8205/1&2	Digital Thermometer (Set of two)	£5.31	HE/8212/5 HE/8212/6 HE/8212/7 HE/8212/8	TV Amp Lofty Noise Gate Low Cost Alarm	£6.56 £3.00 £4.14 £2.65	September 83 HE/8309/1 HE/8309/2	Tremoleko SPL Meter	£3.61 £4.85
HE/8205/3 HE/8205/4	Echo-Reverb Cable Tracker	£6.47 £2.13	January 83 HE/8301/1 HE/8301/2	Chip Probe Switched Mode Regulator	£2.09 £2.25	October 83 HE/8310/1 HE/8310/2 HE/8310/3	Ultrasonic Alarm Audio Level Meter High Voltage Meter	£3.67 £3.55 £3.99
June 82 HE/8206/1	Power Supply Design	£2.85	HE/8302/1 HE/8302/2	Incremental Timer DigiTester PSU	£8.20 £7.71	November 83 HE/8311/1 HE/8311/2	Wiper Delay Light Delay	£3.22 £3.21
HE/8206/2 HE/8206/3	Auto-Wah Auto Greenhouse Sprinkler	£3.54 £3.97	March 83 HE/8303/1	Loudspeaker Protector	£2.89	December 83 HE/8312/1 HE/8312/2 HE/8312/3 HE/8312/4	Damp Meter Continuity Tester Light Meter Bassman	£3.32 £1.39 £3.63 £2.75
HE/8206/4&5	Telephone Timer (Set of two)	£7.48	HE/8303/2	Overvolt Cutout	£2.59	January 84 HE/8401/1 HE/8401/2 HE/8401/3	Power Reducer Lap Counter Quizmaster	£3.69 £7.00 £3.23
July 82 HE/8207/1 HE/8207/2 HE/8207/3 HE/8207/4	Tanover TVI Filter Computer PSU Solar Radio	£2.45 £2.05 £8.83 £2.28	April 83 HE/8304/1 HE/8304/2&3	6502 EPROMMER Ducker Main Board Preamp Board Power Down	£8.26 £4.09 £2.66 £2.42	February 84 HE/8402/1 HE/8402/2 HE/8402/3	Audio PSU Field Memory Camera Remote Transmitter Receiver	£5.62 £3.23 £2.67 £3.48
August 82 HE/8208/1&2 HE/8208/3&4	Digital Millivoltmeter (Set of two) Audio-Analyser (Set of two)	£4.99 £13.28	HE/8304/4			HE/8402/4	Timing Strobe	£3.61
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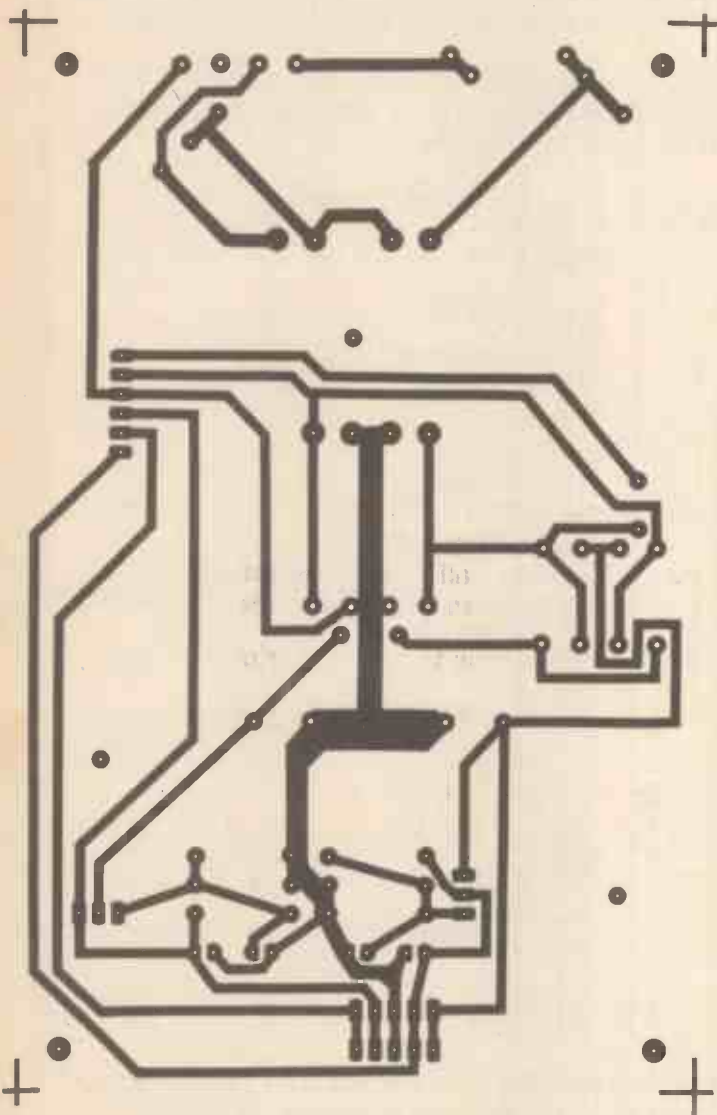
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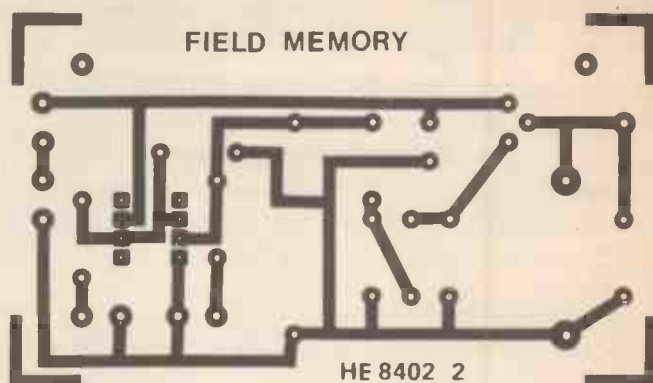
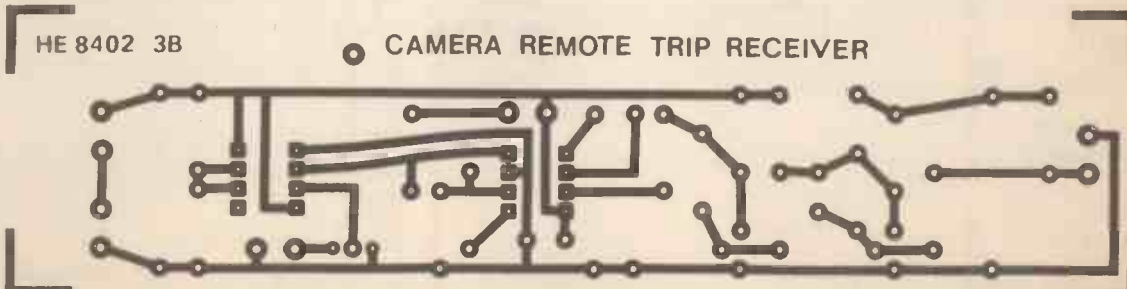
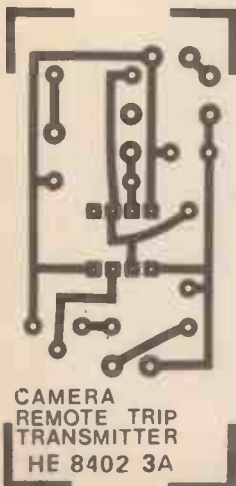
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PCB FOIL PATTERNS



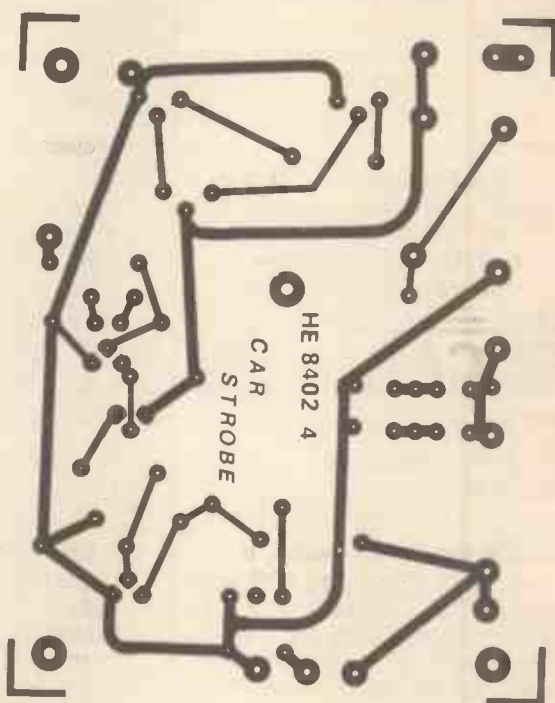
Above: The PCB foil for the Audio Power Supply Module. Note the alternative positions to allow a standard or a toroidal transformer to be used.

A pair of PCB layouts for the Camera Remote Control. Below: the Receiver; left: the Transmitter.



Above: The PCB foil for the CB Field Strength Meter.

NB: The modified foil pattern for the HE Echo-Reverb is now on page 62.



Above: The PCB mask for the Car Timing Strobe.

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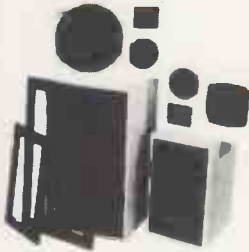
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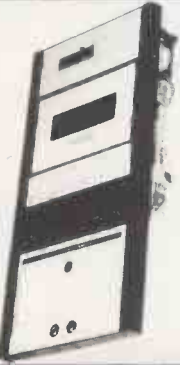
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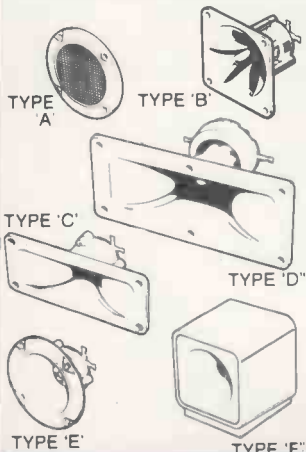
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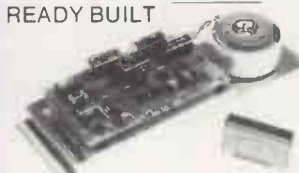
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Price £31.35 each. £2.50 P&P



OMP POWER AMPLIFIER MODULE READY BUILT



New model.
Improved specification

MOSFET versions available up to 300W. R.M.S.

NEW OMP100 Mk.II POWER AMPLIFIER MODULE Power Amplifier Module complete with integral heat sink, toroidal transformer power supply and glass fibre p.c.b. assembly. Incorporates drive circuit to power a compatible Vu meter. New improved specification makes this amplifier ideal for P.A., Instrumental and Hi-Fi applications.

SPECIFICATION
Output Power:— 110 watts R.M.S.
Loads:— Open and short circuit proof 4/16 ohms.
Frequency Response:— 15Hz - 30KHz -3dB. T.H.D.:— 0.01%
S.N.R. (Unweighted):— -118dB ±3.5dB
Sensitivity for Max Output:— 500mV @ 10K. Size:— 360 x 115 x 72 mm Price:— £31.99 + £2.00 P&P. Vu Meter Price:— £7.00 + 50p P&P.

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Better to be 'Alarmed' than terrified. Thandar's famous 'Minder' Burglar Alarm System. Superior microwave principle. Supplied as three units, complete with interconnection cable. FULLY GUARANTEED.

Control Unit — Houses microwave radar unit, range up to 15 metres adjustable by sensitivity control. Three position, key operated fascia switch — off — test — armed. 30 second exit and entry delay.

Indoor alarm — Electronic swept freq. siren. 104dB output.

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SAVE £128 Usual price £228.85

BKE's PRICE £99.p&p£4

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MIXERS DISCO

OMP PRO MIX MONO

OMP PROMIX MONO DISCO MIXER (As illustrated), 4 Inputs: — 2 Mag. Disc. 1 Aux. plus Mic. with override. Active bass and treble tone cont's. Individual level controls plus master volume. Monitor output (headphone) for all Inputs. Output: 775mV Supply 240Vac. Size: 19" x 5 1/2" x 2 1/2". Price: £49.99 + £2.00 P&P

ALSO Stereo Version as above price £69.99 + £2 p&p



READY BUILT & TESTED.

B.K. ELECTRONICS

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Step-by-step fully illustrated assembly and fitting instructions are included together with circuit descriptions. Highest quality components are used throughout.

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PRICES REDUCED ON SUPER SAVE D.I.Y. KITS



SX 1000 Electronic Ignition

- Inductive Discharge ● Extended dwell circuit stores greater energy in coil ● Three position changeover switch ● Patented clip-to-coil fitting ● Easy to assemble, easy to fit ● Contact breaker triggered - includes bounce suppression circuit.

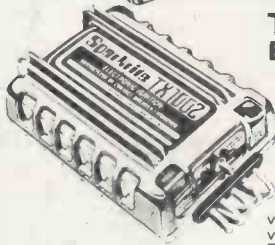
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SX 2000 Electronic Ignition

- Reactive Discharge ● Combines inductive & capacitive energy storage ● Gives highest possible spark energy ● Patented clip-to-coil fitting ● Easy assembly sequence ● Contact breaker triggered - includes bounce suppression circuit.



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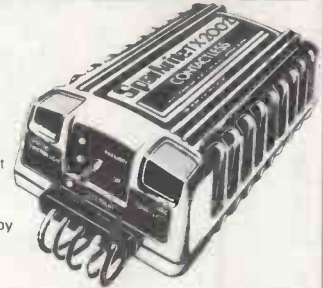


TX 1002 Electronic Ignition

- Inductive discharge ● Extended dwell circuit stores greater energy in coil ● Three position changeover switch ● Contactless or contact breaker triggered ● Clip-to-coil or remote mounting ● Rugged die-cast case ● Contactless adaptors included for majority of 4 & 6 cylinder vehicles ● Easy to build ● For details of vehicles fitted by contactless trigger, ring Technical Service Dept on (0922) 611338-9.

TX2002 Electronic Ignition

- Two separate systems in one unit! ● Reactive Discharge OR Inductive Discharge, with three position changeover switch ● Gives highest possible spark energy ● Clip-to-coil or remote mounting ● Rugged die-cast case ● Contactless or contact breaker triggered ● Contactless adaptors included for majority of 4 & 6 cylinder vehicles ● For details of vehicles fitted by contactless trigger, ring Technical Service Dept on (0922) 611338-9.



AT-40 Electronic Car Alarm

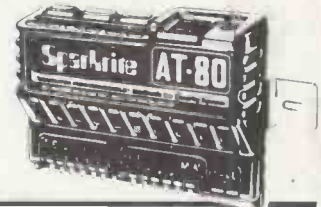
- Guards doors, boot, bonnet from unauthorised entry ● Armed/disarmed using concealed switch ● 30 second delay-to-arm, 7 second entry delay ● Can alternatively be wired to exterior key switch ● Flashes headlights & sounds horn intermittently for 60 seconds when activated ● Security loop protects accessories ● Low consumption C-MOS circuitry.



NEW

AT-80 Electronic Car Security System

- Guards doors, boot, bonnet from unauthorised entry ● Armed/disarmed from outside vehicle by magnetic key fob passed across windscreen ● Individually programmable code ● 30 second delay-to-arm ● Flashes headlights and sounds horn intermittently for 60 seconds when activated ● Security loop protects accessories ● Function lights to assist setting-up ● Low consumption C-MOS circuitry.



SUPER SAVE

ULTRASONIC Intruder Detector

- Supplementary to AT 40 & AT-80 ● Will work in conjunction with any door switch input or voltage sensing alarm ● Detects attempted break-in and movement within passenger compartment & triggers alarm ● Includes high efficiency ultrasonic transducers ● Crystal controlled for low drift ● Ingenious sensitivity control allows freedom from false alarms ● Low current consumption



NEW

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- Triggered by waving hand over dice ● Completely random selection ● Bleeps & flashes during 4 sec tumble ● Throw displayed for 10 seconds then flashes to conserve battery ● Low consumption C-MOS circuitry.

SUPER SAVE

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TX 1002	£22.95	£22.95
TX 2002	£32.95	£32.95
AT-40		£9.95
AT-80	£32.95	£24.95
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