Hobby Electronics

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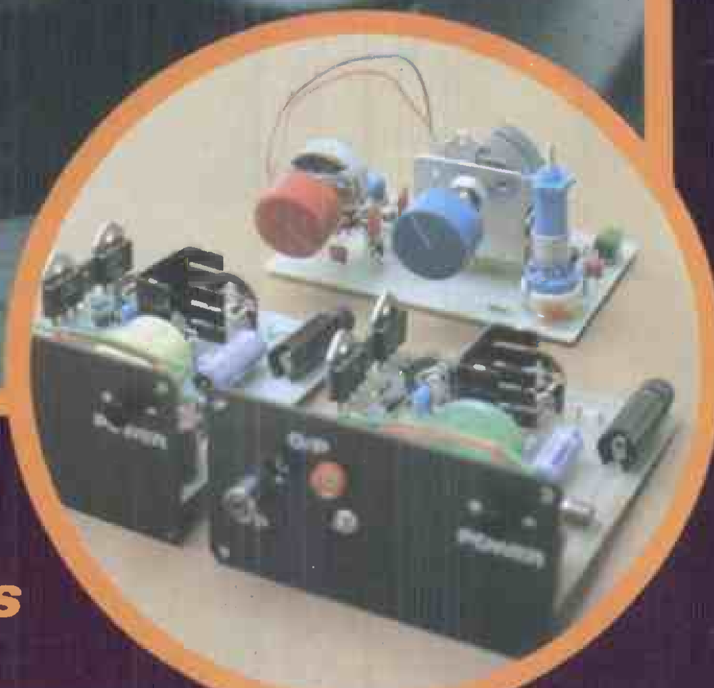
MOBILE MICROELECTRONICS



Short Wave Radio
Full Coverage Receiver

25 Watt Amplifier Modules
Sounds Good

PETting It Together
Bits And Pieces

Touch Switch
Digitally Controlled

PSU Module
Transformer Offer

Hobby Electronics

Vol. 2, No. 5 March 1980

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Simply ahead . .

ILP'S NEW GENERATION OF HIGH

I.L.P. modular units comprise five power amplifiers, pre-amp which is compatible with the whole range, and the necessary power supply units. The amplifiers are housed and sealed within heatsinks all of which will stand up to prolonged working under maximum operating conditions.

With I.L.P. performance standards and quality already so well established, any advances in I.L.P. design are bound to be of outstanding importance — and this is exactly what we have achieved in our new generation of modular units. I.L.P. professional design principles remain — the completely adequate heatsinks, protected sealed circuitry, rugged construction and excellent performance. These have stood the test of time far longer than normally expected from ordinary commercial modules. So we have concentrated on improvements whereby our products will meet even more stringent demands such, for example, as those revealed by vastly improved pick-ups, tuners, loudspeakers, etc., all of which can prove merciless to an indifferent amplifier system. I.L.P. modules are for laboratory and other specialised applications too.

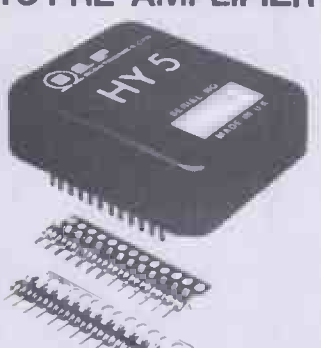
PRODUCTS OF THE WORLD'S FOREMOST SPECIALISTS IN ELECTRONIC MODULAR DESIGN

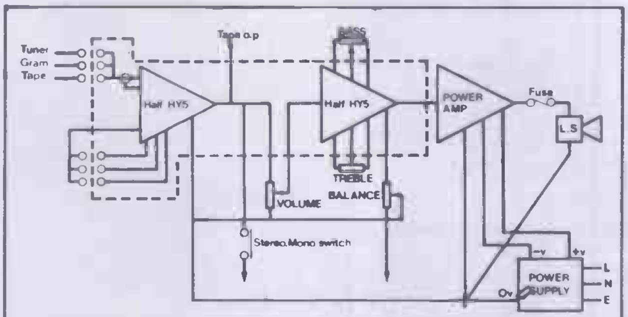
ALSO AVAILABLE FROM A NUMBER OF SELECTED APPOINTED STOCKISTS

and staying there

PERFORMANCE MODULAR UNITS

HY5 PRE-AMPLIFIER



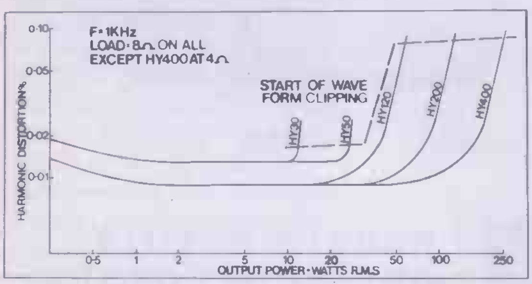


VALUES OF COMPONENTS FOR CONNECTING TO HY5
Volume — 10K Ω log.
Bass/Treble — 100K Ω linear. | Balance — 5K Ω linear.

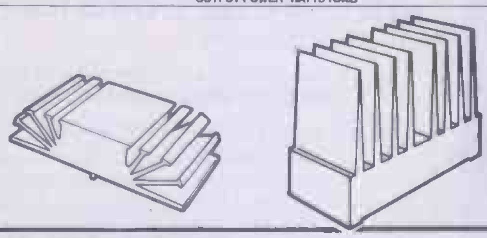
The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm. and provides multi-function equalisation for Magnetic/Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion at 1KHz—0.01%. Special strips are provided for connecting external pots and switching systems as required. Two HY5's connect easily in stereo. With easy to follow instructions.

£4.64 + 74p VAT

THE POWER AMPLIFIERS

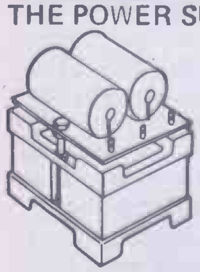


Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105x50x25	155	**£6.34** + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0 +25	105x50x25	155	**£7.24** + £1.09
HY120	60 W into 8 Ω	0.01%	100dB	-35 -0- +35	114x50x85	575	**£15.20** + £2.28
HY200	120 W into 8 Ω	0.01%	100dB	-45 -0- +45	114x50x85	575	**£18.44** + £2.77
HY400	240 W into 4 Ω	0.01%	100dB	-45 -0- +45	114x100x85	1.15Kg	**£27.68** + £4.15



Load impedance — all models 4 - 16 Ω
Input sensitivity — all models 500 mV
Input impedance — all models 100K Ω
Frequency response — all models 10Hz - 45Hz - 3dB

THE POWER SUPPLY UNITS



I.L.P. Power Supply Units are designed specifically for use with our power amplifiers and are in two basic forms — one with circuit panel mounted on conventionally styled transformer, the other with toroidal transformer, having half the weight and height of conventional laminated types.

PSU 30	±15V at 100ma to drive up to five HY5 pre-amps	£4.50 + £0.68 VAT
PSU 36	for 1 or 2 HY30's	£8.10 + £1.22 VAT
PSU 50	for 1 or 2 HY50's	£8.10 + £1.22 VAT
PSU 70	with toroidal transformer for 1 or 2 HY120's	£13.61 + £2.04 VAT
PSU 90	with toroidal transformer for 1 HY200	£13.61 + £2.04 VAT
PSU180	with toroidal transformer for 1 HY400 or 2 x HY200	£23.02 + £3.45 VAT

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FREEPOST 4, Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP.
Telephone (0227) 54778 Telex 965780

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I enclose Cheque ☐ Postal Orders ☐ International Money Order ☐
Please debit my Account/Barclaycard Account No. . . . .
. . . .
NAME . . . .
ADDRESS . . . .
. . . .
Signature . . . .

Monitor

WHATEVER NEXT?

Ignoring for a moment the young lady (if you can) let us describe to you the object of her obvious affection. It is a TR-1200G (as if you didn't know) Tele-Casseiver. (If that sounded like a new word to you, stay tuned). Panasonic, the people who make the TR etc have made up another word for your. More of that later.

The unit contains, deep breath, a 12 inch monochrome TV, FM stereo radio that will also cover MW, SW, and LW, and of course a stereo tape recorder thrown in for good measure. As you would expect the permutations of recordings are such that you can record something whilst doing something else, confusing, isn't it?

Now for new word number two, the manufacturers say that the TR . . . . . . etc is ideal for making the most of 'Simulcast' productions when the TV soundtrack is additionally transmitted on FM stereo radio. Repeat after me, Tele-casseiver, Simulcast, now on your own. Remember them because we may come round your house to test you.

Usually at this point we get to the painful bit, the price. This time, just to be different, the TR . . . . etc seems quite reasonably priced. Considering what you get, a full stereo system (5W per channel) plus a telly, £225 doesn't seem too bad. On the other hand if you're like us it could be £25 and you still couldn't afford it. Ah well, we can all dream.

By the way the young lady is not included in the price, she's an optional extra.

HALVOR GOES WEST

This is the last issue for Hobby Electronics to be edited by Halvor Moorshead. Next month he'll be in ten feet of snow publishing his own magazine in Toronto: the Canadian edition Electronics Today International.

Halvor has been with ETI (HE's big brother) in England since the days when it was a struggling one-year-old. As Editor and Publisher he has been responsible for the phenomenal growth of the magazine and the company. As well as starting the Canadian edition of ETI, back in England Halvor started Hobby Electronics and Computing Today.

Halvor's contribution to the hobby of electronics has been enormous, as any reader of HE, ETI or CT will realise. On behalf of all his friends I wish him success and happiness in North America.

HE's new Editor will be me, Steve Braidwood, currently Assistant Publisher at Modmags. I worked with Halvor on ETI in the old days, and kept in close contact as I did my bit for the colonies on the Australian and Canadian editions of ETI. I returned to London last year and was delighted to work for Halvor once again. So its goodbye Halvor and Hello HE men.

ROBOTS, ROBOTS AND MORE ROBOTS

The long-awaited Robot revolution seems to be finally taking off. First the latest news on HEBOT.

Sales of HEBOT chassis have been phenomenal, several hundred so far are running about, schools and colleges seem to be taking a particular interest. Lansing Bagnall, the fork-lift truck people, are considering using HEBOT to demonstrate their control systems. Our German and Canadian editions of ETI will be featuring HEBOT, orders for chassis are already coming in. On the home front, Nationwide, the BBC TV current affairs programme, are filming HEBOT for a feature that should be transmitted in early February, HEBOT is now a TV star. One of the more surprising aspects of HEBOT sales has been the number of Microdrives sold, almost twice as many drive units as chassis pans. How about sending us some pictures of your HEBOT and any improvements or adaptations you have made. Best pictures and suggestions will be featured in the coming months.

On a more sinister note, we've just heard that Mullard, the TV tubemakers, are to lay off 850 workers over the next two years, guess what will be replacing them? You've got it — Robots. If HEBOT gets any cleverer the next Editor of HE might just be a HEBOT, watch out Steve Braidwood.

PROJECTS SPECIAL

Dotted around the mag you will see references to our latest special. Don't miss next month's issue of HE for the full unexpurgated details!

News from the Electronics World

BASICALLY ATARI

Hot on the heels of a couple of other telly game manufacturers Atari have announced their version of the personal computer.

The Atari 400/800 series has been designed with expansion in mind. It will happily connect up to all manner of cassette decks, floppy disc and bubble memory devices. The computer comes complete with a full colour display on your own telly, four sound 'voices' and the capability for working light pens and high speed printers.

The 400 model has 8k RAM, expandable up to 48k when it becomes the 800 series. Similarly the standard 8k ROM will go up to the 40k of the 800 series given time, inclination and money. The machine works in something called Atari Basic and is based on the 6502 Microprocessor IC.

Price wise it looks most attractive, just £400 for the 400 series model and £750 for the 800. Launch date should be in June 1980. Impatient people should contact Ingersoll Electronics Ltd (the importers at 202 New North Road, London N1 7BL.

By the way, it *will* play games if fed with the appropriate programmes.

TOY CHIPS

Considering the delays we're having getting our single IC radio control system off the ground it was understandably annoying to hear of these new offerings from Plessey.

The pair of ICs in question, (SL490 transmitter and ML928 receiver) were originally developed for remote control systems in TV sets. Much of Plesseys output now ends up in R/C toys, the example shown here is made by a French company, Joustra, who have just ordered half a million of the ICs from Plessey.

These ICs, unlike our proposed system, still need quite a bit of external circuitry, in this respect they are quite versatile, finding a good home in remote control systems using anything from ultrasonics to Infra red.

We have no details of prices as yet but if you would like some more information contact Plessey at: Plessey Semiconductors Ltd, Cheney Manor, Swindon, Wiltshire.

THIMPLE THERMOMETER

Gone are the days when you were required to squint at a near-invisible line of mercury in a thin, fragile glass tube. By that we mean the electronic thermometer has arrived in all its glory. Latest model to blink its LEDs comes from Simwood Ltd. The SM1 covers the range −55 degrees C to +1250°C. The hand-held unit has a three digit display with an accuracy of ±0.15% and a resolution of 1.0°C.

A switch on the side of the unit is operated everytime a measurement is to be made, battery life is expected to ensure around 2000 operations. In the event of a low battery the display will flash.

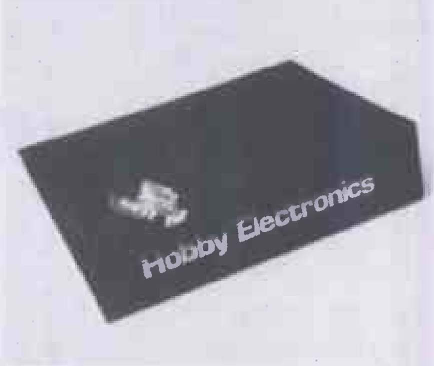
The SM1 comes complete with a carrying strap and case. Further details from Simwood Ltd., Garrett's Hall, Shalford Green, Essex.

BOOK REVIEW

Still puzzled by integrated circuits? You shouldn't be, not after reading HE all these months. If on the other hand this is your first excursion into the world of micro-electronics then you would be well advised to read a new (ish) book called Integrated Circuits, Questions and Answers. It comes from the pen of R G Hibberd and is published by Butterworth, price £1.55 (ISBN 0408004665).

This little book is probably one of the easiest to follow as it is based on a series of questions and answers. You can literally just pick it up and start anywhere. In the past Q and A books have suffered from poor indexing, a maddening aspect of any book. This one seems to have overcome this problem, making it quite suitable for quick reference. A handy book to have around.

JAWS THE JOB



Have you noticed our new Binders ad? The wording has been changed from the original because of the efforts of one D Bryant. In the original ad we said, (quite lightheartedly)

'Send your cheques, postal order's, gold sovereigns, false teeth or anything negotiable to' .....

You guessed it, D Bryant sent us his upper set. In return we have sent D Bryant an HE binder, and to discourage anyone else from trying to do the same we have kept his teeth. So if you see a man in the Britsol area walking round with an HE binder in his mouth you'll know why. No more false teeth please, just money (Gold Sovereigns are still OK).

TV EXHIBITION

50 years ago this March Logi Baird's 'Televisor' was finally on sale. The Science Museum in London are celebrating by holding an exhibition called 'The Great Optical Illusion'. It opens in March 1980. Don't miss it. (Look out for our feature on Narrow Bandwidth TV next month).

ERRATA

Now pay attention to this one as it is a bit naughty. On page 32 (Feb HE) Infra Red Remote Control, last paragraph, second column should read:—

(1) The **EARTHS** of the mains input and output .....

Not Neutrals, this would be most inadvisable, not to say dangerous. Sorry.

System 5080A

HE introduces a brand new amplifier system beginning with the 5080A POWER AMPLIFIER module.

THE HE 5080A POWER AMPLIFIER MODULE is the first part of an exciting new system in modular amplifiers, which on completion will provide the builder with a first rate stereo amplifier of 25 watts per channel into a speaker impedance of 8 ohms. Elsewhere in this issue is the 5080 PSU — the second part of the system and finally, in a couple of months' time the design will be completed with the pre-amplifier module.

The main advantage of a modular amplifier is that each module can be built separately. This suits the builder who cannot afford a complete kit of components all at once, or the builder who is not too sure of his constructional capabilities and who wishes to test each stage as he progresses. An important secondary advantage of such a method of manufacture is the reduction of interference (causing mains hum) from one device to another. The pre-amplifier in any amplifier system is particularly susceptible to pickup from the power amplifier and power supply and the only real way to eliminate this is to separate them — the HE 5080 does this.

The overall objectives of the 5080 are that each module, be self-contained, be easy to construct and look good. These aims do not, however, override the quality of the amplifier as a whole, the specifications and performance being within the criteria of "High Fidelity" audio systems.

To this end, distortion (an amount of which is inevitable in any amplifier) in the 5080A power amp module is so low as to be inaudible and the frequency response of it is well above and below the human hearing range.

To any experienced amplifier constructor, the circuit will look fairly conventional, ie the power stage is a Class AB type and the pre-driver stage is a common collector type to provide a higher input impedance to the source. This is not to say that modern techniques have not been utilised in its design. For example, "state of the art" output stage protection is provided by FS1, which prevents excessive current flow due to faults or short circuits in the speaker connections. In the past, there has been a tendency to use semiconductor type current limits which resume normal operation after the fault has

A fine pair, the 5080 Power Amplifier and PSU modules.

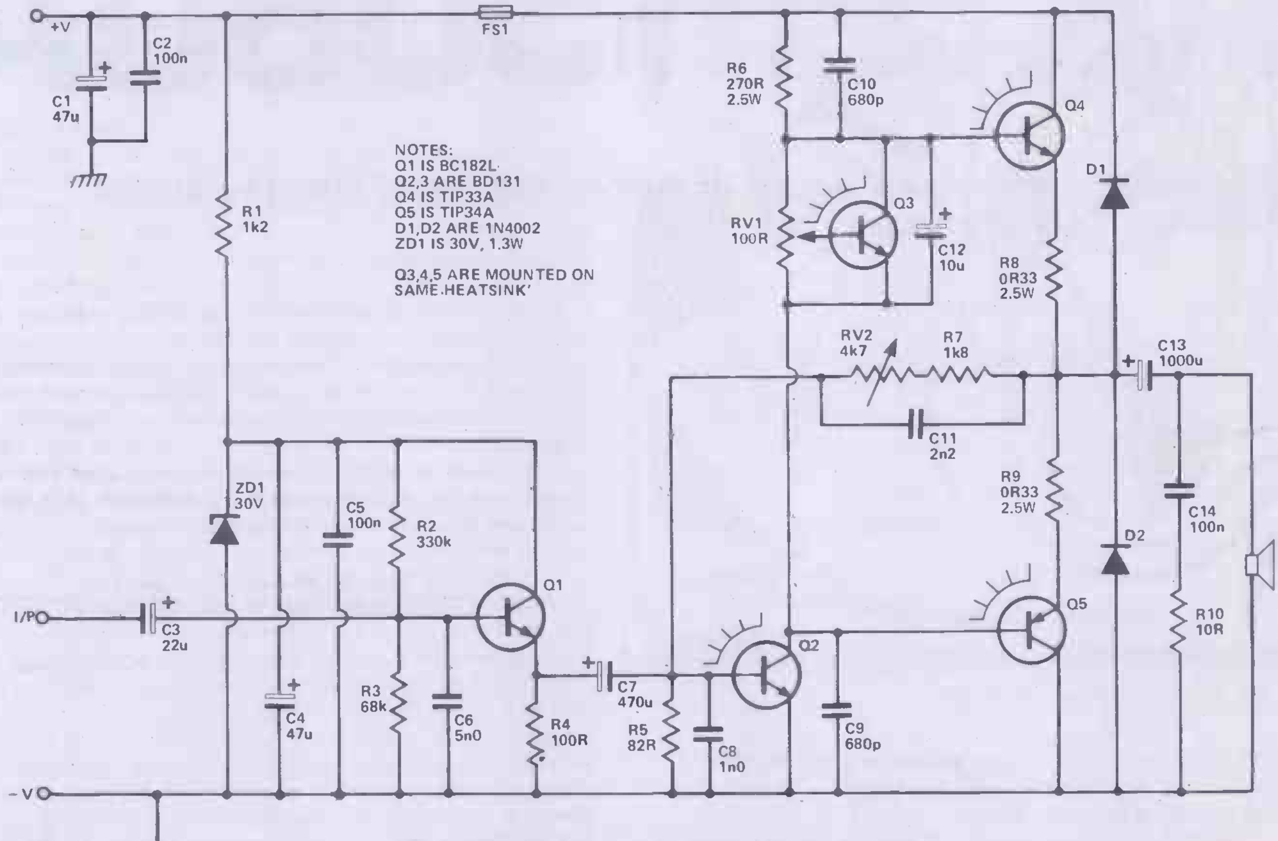
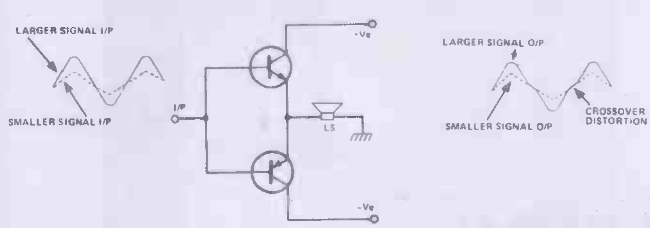


Fig. 1. Circuit diagram of the 5080A Power Amplifier

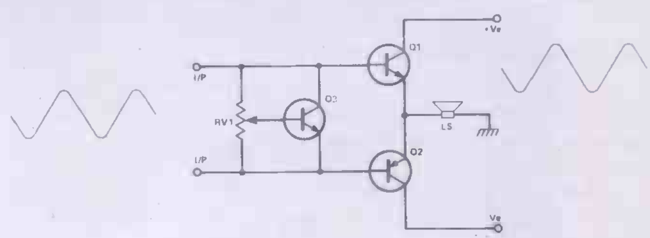
How it Works

THE 5080A power amp consists of a Class A input stage followed by a Class AB output stage. A class A transistor amplifier is shown in figure 2. As can be seen, a similar configuration is used in the circuitry around Q1 in the 5080A. The transistor is biased permanently half on so that the output waveform is identical to that at the input. Class A amplification is, however, very wasteful of power because the transistor is always conducting a certain amount of current even when there is no I/P signal, ie, under quiescent conditions. This is not normally important except in power amps, where a large amount of power stands to be lost. So, in the power O/P stage we must turn to a more efficient method of amplification.



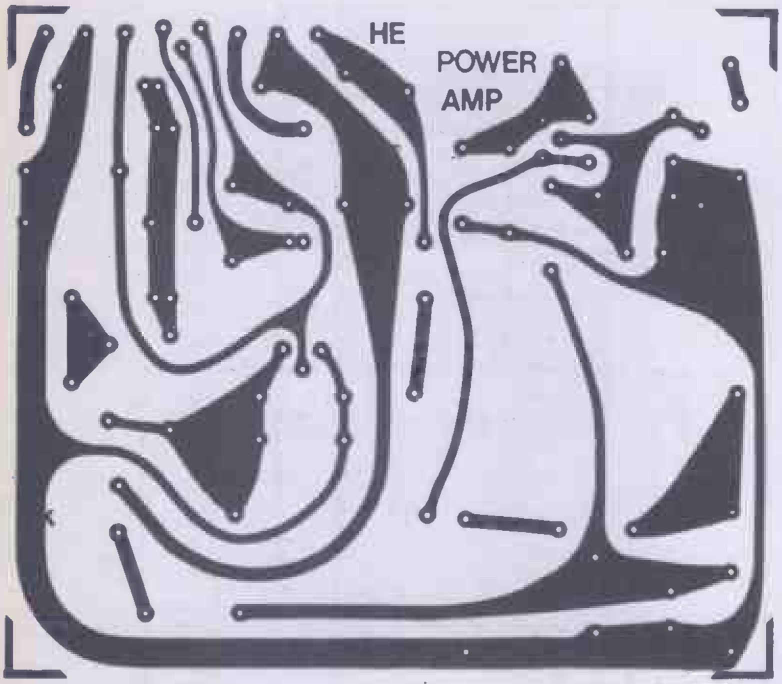
In a Class B amplifier the transistors are biased to their cut-off point so that they conduct only over one half of the signal waveform. Therefore, without an I/P signal the power loss is zero (meaning greater efficiency). Obviously one transistor is needed for each half of the waveform, as in figure 3.

But, a transistor's characteristic is not linear near the cut-off point, resulting in crossover distortion where the changeover occurs between each transistor. Moreover because the distortion stays the same size irrespective of the signal size, the relative percentage of distortion increases with a smaller signal.

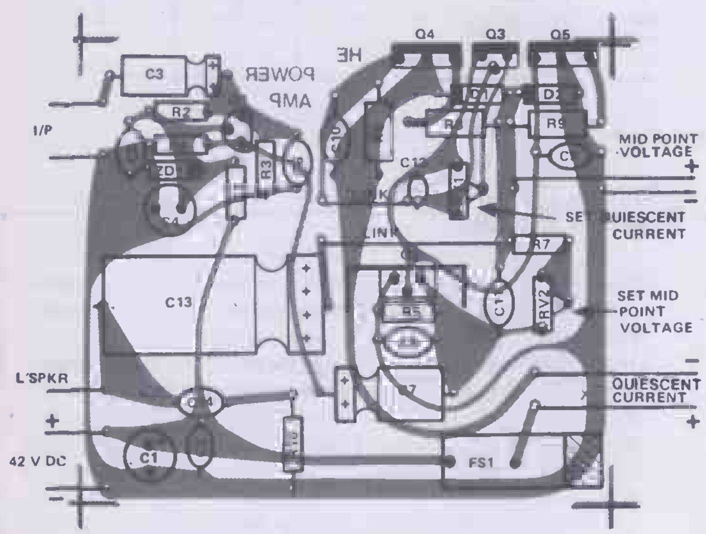


The answer to the problem is to introduce enough bias to eliminate this distortion. The overall effect is a mixture of Class A and Class B amplifications (called Class AB).

The HE 5080A power amplifier does this by means of a simple voltage regulator around Q3 and RV1. Class AB operation does mean that a certain amount of quiescent current is necessary. This is not, however, enough to represent a great heat loss and therefore this mode still maintains a high efficiency.



Above: PCB foil pattern for the 5080 PA



Above: Overlay diagram of the 5080A

been rectified, but consequently the circuit becomes increasingly more complicated. Most amplifier designers are now turning towards fuse protection as the better method.

Another ultra-modern protection technique is in the use of D1 and D2 — included to protect both the output transistors and the speaker against sharp transients. The loudspeaker being partially a reactive load can cause large back EMFs to occur around the output stage area, which these diodes eliminate.

Also, our designers' minds turned to the problem of appearance — well, what's the use of a gadget if it doesn't look good? You can't show it off to the neighbours if it looks like a tobacco tin radio, can you? And, it has got to be neat — as few wires and cables as possible hanging all over the place, tripping you up and bring the specifications down. No — a compact, good looking module is required, as good as or better than those that can be bought.

The case which we used is just the job, constructed of metal it can be used to shield the amplifier from pickup and also be used as the amplifier's own heatsink. The printed circuit board was, in fact, designed specifically for this case and it does provide the amplifier with very smart and functional protection, although it is by no means essential that the same case is used.

Buylines

First off, let's get the case out of the way. It is available from West Hyde Developments and is their "Sink Box" of length 100 mm. Their telephone number is Aylesbury (0296) 20441.

PCB mounting electrolytic capacitors are available from Electrovalue.

We cannot foresee any more problems with component supply.

Parts List

RESISTORS (All ¼W, 5% except where stated)

R1	1K2	
R2	330K	
R3	68K	
R4	100R	
R5	82R	
R6	270R	2.5W
R7	1K8	
R8,9	0R33	2.5W
R10	10R	1W

CAPACITORS

C1	47µF 63V PCB elect
C2,5,14	100n polyester
C3	22µ 25V elect
C4	47µ 40V PCB elect
C6	5n polystyrene
C7	470µ 10V elect
C8	1n polystyrene
C9,10	680p polystyrene
C11	2n2 polystyrene
C12	10µ 16V Tantalum
C13	1000µ 40V elect (see text)

SEMICONDUCTORS

Q1	BC182L
Q2,3	BD 131
Q4	TIP 33A
Q5	TIP 34A
D1,2	1N4002
ZD1	30V 1.3W

MISCELLANEOUS

Heatsink
PCB fuseholder + 1 amp quick blow fuse
Phono socket
2mm sockets — 1 black, 1 red
Rubber grommet
Case — see Buylines.

CONSTRUCTION

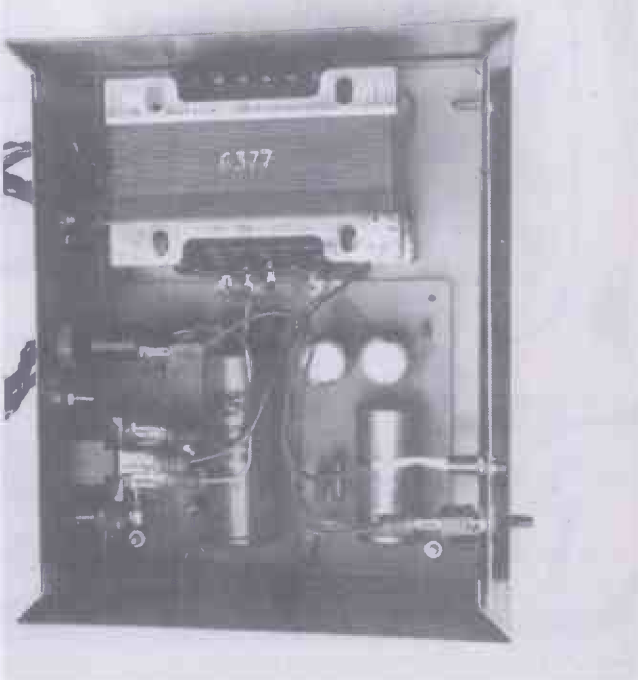
Using our design of printed circuit board, construction is straightforward. Consultation of the layout will tell you that the whole effect is one of neatness. C1 and C4 are PC mounting capacitors — if you have trouble obtaining them a suitable source is mentioned in Buylines. C13 is specified as 100 µF 40 volt electrolytic, but it does need to be quite small (a maximum of 40mm in length). Various miniature types are available, eg ITT, Plessey etc, but if you cannot obtain one small enough then buy a smaller capacitance value — 680 µF or 470 µF — do *not* be tempted to use a capacitor of lower working voltage than 40 volts. By using a smaller capacitance value the only effect will be to slightly diminish the bass response, it will probably not even be noticeable.

Q2 is mounted on its own heatsink (plastic package transistor type — see photographs).

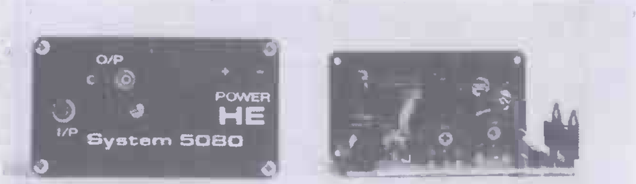
Q3, 4, 5 are all mounted on a large heatsink. If you use the same type case as you will find that the case can be used as the heatsink and does make for a good looking, neat module.

Whatever heatsink is used the transistors must be mounted using mica washers so that each transistor is electrically isolated from each other and also from the case. It is worth checking with a resistance meter that no electrical connections occur before switch on. The PCB can be bracketed to the end panel of the box and I/P phono, speaker O/P plugs and power lead can be made through this panel. Note that all external connections to the board are made from this end, meaning that all leads are kept very short, minimising the possibility of untidy flying leads and pickup. The power supply connection can be made with a small plug and socket as in our modules, or to keep cost down via a long lead with a rubber grommet in the case.

We used a PCB mounting finger release fuse-holder in order that, when the module is cased, the fuse can be removed or inserted easily. Ordinary PCB types can be used but these make the removal of fuses more awkward. Alternatively a panel mounting fuseholder can be used, connected to the board with flying leads.



Inside the 5080 PSU module. For constructional details see page 19.



Two 5080 Amplifier modules removed from their cases.

Close-up of the rear panel of one of the amplifier modules.

SETTING UP

Do *not* attempt to use the amplifier without heatsinks! A heatsink of some description must be fitted before power is applied, either the module case or any ordinary heatsink.

Turn both presets fully anti-clockwise, looking from the end away from the connection panel. Insert a 1 amp quick blow fuse in the fuse holder.

Next, connect the quiescent current test points using a short wire link. There are now two measurements to be taken:

1) The output voltage should be at about half the power supply potential. This is adjustable by RV2 and should be the first test, using a voltmeter connected to the appropriate test points.

2) The quiescent current, adjustable by RV1 and measured using an ammeter connected to the bias current test points (taking the link off first) should be set so that crossover distortion is eliminated. The current with RV1 turned fully anti-clockwise should be no more than 100 mA and is the current through the biassing chain R6, RV1, Q3 and Q2. About 50 mA of quiescent current should be added to the bias current and the final reading should therefore be about 140 to 150 mA, adjusted by RV1.

Finally resolder the link across the test points. If any audible crossover distortion occurs when an audio I/P and a loudspeaker is connected, then turn RV1 a shade further clockwise. But bear in mind that the more the quiescent current is increased the hotter the amplifier will run even with no input signal.

All of these measurements can be made with the board in its case and only the end panel taken off. **HE**

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DINDY LOW NOISE CASSETTES

SJ30	10 C30	15 min per side		£2.00
SJ55	10 C46	23 min per side (LP)		£2.50
SJ31	10 C90	45 min per side		£3.50
SJ32	10 C120	40 min per side		£4.50

ALL REDUCED!
CAPACITOR PAKS

16201	18 electrolytics	4.7uf-10uf
16202	18 electrolytics	10uf-100uf
16203	18 electrolytics	100uf-680uf

ALL 3 at SPECIAL PRICE of £1.30

16160	24 ceramic caps	22pf-82pf
16161	24 ceramic caps	100pf-390pf
16162	24 ceramic caps	470pf-3300pf
16163	24 ceramic caps	4700pf-0.047pf

ALL 4 at SPECIAL PRICE of £1.80

RESISTOR PAKS

16213	60 ¼w resistors	100ohm-820ohm
16214	60 ¼w resistors	1K-8.2K
16215	60 ¼w resistors	10K-82K
16216	60 ¼w resistors	100K-820K

ALL 4 at SPECIAL PRICE of £1.50

16217	40 ½w resistors	100ohm-820ohm
16218	40 ½w resistors	1K-8.2K
16219	40 ½w resistors	10K-82K
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SPM120/55	55v Stabilised supply — suit 2 × AL80, PA200	£5.80
SPM120/65	65v Stabilised supply — suit 2 × AL120, PA200, 1 × AL250, PA200	£5.80
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1725	150mA 15-0-15v suit SG30	£1.77

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BA173	£0.13	OA90	£0.08	IN4007	£0.09
BAX13	£0.05	OA91	£0.08	IN5400	£0.12
BAX16	£0.06	OA95	£0.08	IN5401	£0.13
OA200	£0.06	IN34	£0.06	IN5402	£0.14
OA202	£0.07	IN60	£0.07	IN5404	£0.15
BY100	£0.18	IN4148	£0.05	IN5406	£0.19
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LM381	£1.35	TAA550	£0.30	uA710	£0.25
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SJ2	200	Carbon resistor s ¼-½ watt preformed	0.50
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SJ4	60	½ watt resistors mixed values	0.50
SJ5	50	1-2 watt resistors mixed pot values	0.50
SJ6	50	Precision resistors 1-2° tol. mixed	0.50
SJ7	30	5-10 watt wirewound resistors mixed	0.50
SJ11	150	Capacitors mixed types & values	0.50
SJ12	60	Electrolytics all sorts mixed	0.50
SJ13	50	Polyester / polystyrene capacitors mixed	0.50
SJ14	50	C280 type capacitors mixed	1.00
SJ15	40	High quality electrolytics 100-470mf	1.00
SJ16	40	Low volts electrolytics mixed up to 10v	0.50
SJ17	20	Electrolytics transistor types mixed	0.50
SJ18	20	Tantalum bead capacitors mixed	0.50
SJ20	2	Large croc clips 25A rated	0.30
SJ21		Large 7½'' 'Mains Neon Tester' screwdriver	0.85
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SJ49	8	Dual gang carbon pots log & lin mixed values	1.00
SJ50	20	Assorted slider knobs — chrome/black	1.00
SJ51	1	Switchbank 5 way incl silver knobs	0.50
SJ52	1	Pak of vero board approx 50 sq. ins mixed	1.00
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SJ56	6	100K lin 40mm slider pots	0.50
SJ57	6	100K log 40mm slider pots	0.50
SJ58	6	1K lin 40mm slider pots	0.50
SJ59	6	5K lin 40mm slider pots	0.50
SJ60	4	5K log 60mm single	0.50
SJ61	4	100K log 60mm single	0.50
SJ62	5	15mm chrome knobs standard push fit	0.50
SJ63	1	Instrument knob — black winged (29 × 20mm) with pointer ¼'' standard screw fit	0.15
SJ64	1	Instrument knob — black/silver aluminium top (17 × 15mm) ¼'' standard screw fit	0.12

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SJ66		100K lin	0.25 each
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SJ70	25	BC107 NPN to 106 case perfect transistors code C1359	1.00
SJ71	25	BC177 PNP TO106 case perfect transistors code C1395	1.00
SJ72	4	ZN3055 silicon power NPN transistors TO3	1.00
SJ73	6	TO64 SCRs 5 amp assorted 50v-400v all coded	1.00
SJ74	8	Way ribbon cable — colour coded individually PVC insulated solid tinned copper conduction	0.2 metre
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SJ76	1	Board containing 2 × 5 pin DIN sockets 180° 02-2 pin DIN loudspeaker sockets	0.30
SJ77	A5	pin DIN 180° chassis/normal socket incl. DPDT switch	0.20
SJ83	6	Germ. OCP71 type photo transistors	1.00
SJ84	10	BD131 NPN transistors low Hfe rejects	0.50
SJ85	6	PNP Darlington Power Transistors TO-126	0.50
SJ86	5	PNP TO-3 germ. Power Transistors at VLTS 10-20CVCB	0.50
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SJ89	20	Mixed values 400mW zener diodes 3-10v	1.00
SJ90	20	Mixed values 400mW zener diodes 11-33v	1.00
SJ91	10	Mixed values 1W zener diodes 3-10v	0.50
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SJ95	8	Silicon Bridge Rectifiers up to 4Amp 200v + Data	1.50
SJ96	1	Battery holder to take 6 × HP7's	0.10
16168	5	Assorted ferrite rods	0.50
16169	2	Tuning gangs MW/LW	0.50
16170	50	Meters asst colours single strand wire	0.50
16171	0	Reed switches	0.50
16172	3	Micro switches	0.50
16173	15	Assorted pots	0.50
16177	1	Pack assorted hardware	0.50
16178	5	Main slider switches assorted	0.60
16179	1	Pack assorted tag strips	0.50
16180	15	Assorted control knobs	0.50
16181	3	Rotary wave change switches	0.50
16182	2	Relay 6-24v	0.60
16184	25	Assorted fuses 100mA-5A	0.50
16185		An assortment PVC sleeving markers	0.60
16186	25	Pre sets assorted types and values	0.50
16187	30	meters stranded wire mixed colours	0.50

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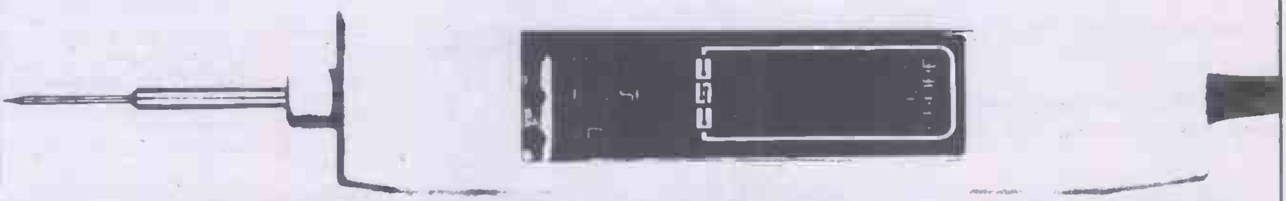

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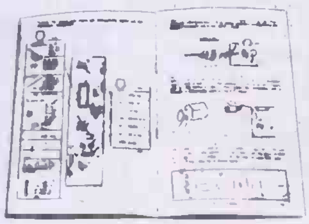

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Clever Dick

Questions from abroad this month. A prize for the correct translation. At the other end of the scale a problem concerning noisy woodworm. Where will it all end?

RIGHTY-HO, brains in top gear, eyes down for another in our series of answers to burning questions. Jonathan Hill is first away this month.

Dear CD,

As issues 1, 2, 3, 6 and 7 of HE are now unobtainable why don't you start a photocopying service for readers. Your sister magazine ETI runs such a service for around 50p per article. If you would consider this idea I am sure many readers would take advantage of this service.

Jonathan Hill,
Northampton

Actually we were considering offering a photocopying service but this was planned for next year. We have been genuinely surprised at the speed at which back numbers have sold out. In response to your request we will be offering photocopies of articles. More details next month.

A quick one from Gavin Cawley now.

Dear Dick,

Is it possible to put the Multi-Siren and R2D2 radio in the same case, sharing the same power supply and speaker?

Gavin Cawley
Coventry

A quick answer for you Gavin, yes. There will have to be a double changeover switch (DP changeover) to switch from one circuit to the other but apart from that it should be OK. By the way, it won't fit into the original R2D2 case, you'll have to find a larger model for that.

Now for something slightly different. Copies of HE reach all over the world, even Belgium. A gentleman called O. Lecoq wrote to us the other day. This is his letter, as he wrote it.

Dear Dick Clever,

In the issue HE of January p.22, you announce projects of negativ ion generators. I made one and I feel no well being, only a weight on the chest when I let it function during a night in my bedroom . . .

I think you will be interested by the article "The Invisible Enemy" I join. It was published in the Luxemburgisch newspaper "LUXEMBURGER WORT" of the 20.11.79.

O. Lecoq,
Arlon-Frassem, Belgique

Now to the problem. Mr Lecoq writes English much better than we read Luxemburgish. In fact none of us read this or any other language for that matter. (We even have difficulty with English.) The copy of the article is printed below, can any of your read it, if so could you supply us with a translation. First correct entry receives a brand new HE binder.

Incidentally, we are hoping to review a Negative Ion Generator kit in the next month or two. We'll let you know if we feel any well being . . .

Der unsichtbare Feind:

Ozon ist kein Gesundbrunnen

Unter dem Titel „Ozon ist kein Gesundbrunnen" veröffentlichte die bekannte „Süddeutsche Zeitung" am 6. Oktober 1976 einen aufschlußreichen Bericht über ein Symposion, das in Dusseldorf 250 Wissenschaftler und Experten aus 10 Staaten abhielten, um die Gesundheitsrisiken des Ozons zu untersuchen und Schutzmaßnahmen auszuarbeiten.

Wir lesen: „Ozon gilt manchen Menschen noch immer als ‚Gesundbrunnen'. Ware dem so, so gäbe es für Ozon keinen MAK-Wert (maximale Arbeitsplatzkonzentration während eines achtstündigen Arbeitstages: 0,2 Milligramm im Kubikmeter Luft) und keinen MIK-Wert: Mengen von 0,15 Milligramm Ozon je Kubikmeter Luft dürfen als halbstündiger Mittelwert nicht überschritten werden."

Natürlich stellen diese Grenzwerte, vom Gesetzgeber festgelegt, keine wünschenswerten Ozonkonzentrationen dar, sondern geben an, welche Ozonmengen den Arbeitenden überhaupt zugemutet werden können.

Wir lesen weiter: „Ozon beeinträchtigt unmittelbar Mensch, Tier und Pflanze".

Da Ozon mit in der Luft enthaltenen Kohlenwasserstoffen reagiert, entstehen neue Folgeprodukte, Oxidantien genannt. Wir erfahren:

„Unter diesen (Oxidantien) sind besonders zu nennen die toxischen Stoffe PAN (Peroxyazethylnitrat) und PPN (Peroxypropionylnitrat), die unter anderem Aktivitätsstörungen bei Enzymen bewirken, das heißt das Blutbild ändern können. (. . .) Nur 0,028 Milligramm PAN im Kubikmeter (mg/cbm) Luft genügen, um Pflanzen nach zweistündiger Einwirkung zu zerstören; PPN ist fünfmal so wirksam."

„Gefährlicher aber ist die unmittelbare biologische Wirkung von Ozon, da es generell schon lange vor den Oxidantien in hohen Konzentrationen auftreten kann und zu 90 Prozent vom menschlichen Organismus aufgenommen wird: 0,16 Milligramm je Kubikmeter schwachen bereits die Infektionsabwehr, bei vorbelasteten Bronchien schadigen Ozon plus Oxidantien bereits im MIK-Wert-Bereich (= 0,15 mg/cbm) das Lungengewebe und die Lungenfunktion."

Über die Einwirkung auf gesunde Erwachsene erfahren wir: „Akute Ozonwirkungen zeigen sich allerdings beim gesunden Erwachsenen spätestens bei Mengen von 0,4 Milligramm je Kubikmeter: ‚trockener' Mund und Rachen, Atembeschwerden, Asthma und hartnäckige Kopfschmerzen sind Folgen."

„Ozon ist nicht nur giftiger als PAN, sondern im Gegensatz zu PAN greift es vor allem die tiefen Atemwege an."

Interessant ist es, zu erfahren, daß die Riesenstadt Los Angeles (USA) einen Ozonwarnplan für die Bevölkerung praktiziert: „Bei einer Konzentration von 0,2 mg/cbm (in der Außenluft) sind die Fenster zu schließen und Kinder im Haus zu behalten."

Soweit aus diesem Fachbericht.

Über Ozon erfahren wir weiter im Buch von Prof. Dr. med. Lucas: „Das Neue Große Gesundheitsbuch", Verlag „Südwest", Ausgabe 1979, Seite 73, unter dem Kapitel „Wetterfühligkeit."

„Dem Ozongehalt der Luft (Gehalt an verdichtetem Sauerstoff) besonders in Bodennähe, soll ein entscheidender Einfluß zukommen."

Die Encyclopaedia Universalis bezeichnet Ozon als giftig, selbst bei schwachen Konzentrationen. (Band 19, Seite 1434.)

Schlußfolgernd kann gesagt werden, daß Ozonproduktion in geschlossenen Räumen, besonders aber in kleinen Räumen wie Küche und Badezimmer zu vermeiden ist, da es hier besonders schnell zu hohen toxischen Konzentrationen kommen kann.

Wo Ozon unvermeidlich ist, z.B. beim elektrischen Bogenschweißen, ist für eine gute Belüftung zu sorgen G.

The article from Luxemburger Wort

To say we get some unusual requests would be something of an understatement. Take this one from Cliff Robertson for instance.

Dear Dick,

Some time ago I heard about the grubs of woodworm beetles gnawing their way through furniture until they were fat enough to emerge and start on the next lot. One can see the exit holes of the beetles on affected furniture, but there may or may not be younger members of the family still munching away inside. Could you devise a microphone / amplifier / headphone set which would enable a doubtful purchaser of a genuine antique to listen to the ravages of the creatures within? Using my tape recorder microphone and stereo headset, possibly with an adaptor to transfer the sound from the Sheraton to the microphone, or perhaps one of the advertisers in HE might like to adopt the idea!

Cliff Robinson,
Isle of Wight

What a brilliant idea! This was put to the project team who shook their wise heads in disbelief. After picking them up from the floor it transpired there may be one or two practical problems. The first would be calibration, how noisy are woodworm? Would they oblige by holding the microphone? Would they eat the microphone? We have decided to throw this knotty problem over to you. Best suggestions will be published in a month or two.

Our last letter this month comes from one J. F. Button. Getting extremely good value for money has asks three questions. This just goes to prove flattery will get you everywhere.

Dear Dick,

I am writing for three reasons:

1) To suggest that every now and then you print the names and photos of various members of the staff at HE and ETI.

2) That you design several projects which would all fit onto one big PCB and all use LEDs. (Really just a mini optical effects unit).

3) To congratulate you on running the best electronic magazines there are, namely HE and ETI, which I read and enjoy very much. Keep up the good work.

J. F. Button
Winchester

PS: I thought your stand at Breadboard '79 was the best — congratulations.

Letters of this calibre are always given priority treatment. Who can argue with the truth? Seriously though, your first request has to be denied, most of the staff at HE and ETI are either too ugly or are camera shy. You'll just have to be content with the odd pix that creep into articles and projects now and again. Number two is a little easier, we have published several projects along the lines you suggest and will be designing many more in the months to come. Although we have no definite plans for combining them all onto one PCB it is quite possible that it's something we shall consider.

Lastly, thank you very much for number three and the PS. What more can we say . . . . **HE**

PSU Module

If you haven't already got a supply for your 5080A power amp modules then you will need one! The 5080 PS is designed for the job.

THERE IS NOT AN AWFUL LOT one can say about a power supply unit. It is a pretty boring project really. Yet most electronic gadgetry just will not work without one. It actually is the work-horse of any mains powered equipment, but is generally forgotten about by most people. The HE 5080 PSU power supply, we hope, will be no exception to the rule. Designed to be trouble free and easy to build, the supply can be built, tested and used without much fuss.

The 5080 PSU features a dual regulated voltage output of 42 volts DC and 24 volts DC so that it can power two of the 5080A power amplifier modules along with the 5080 Pre-Amplifier module which is still in design stages and will follow in a couple of months time.

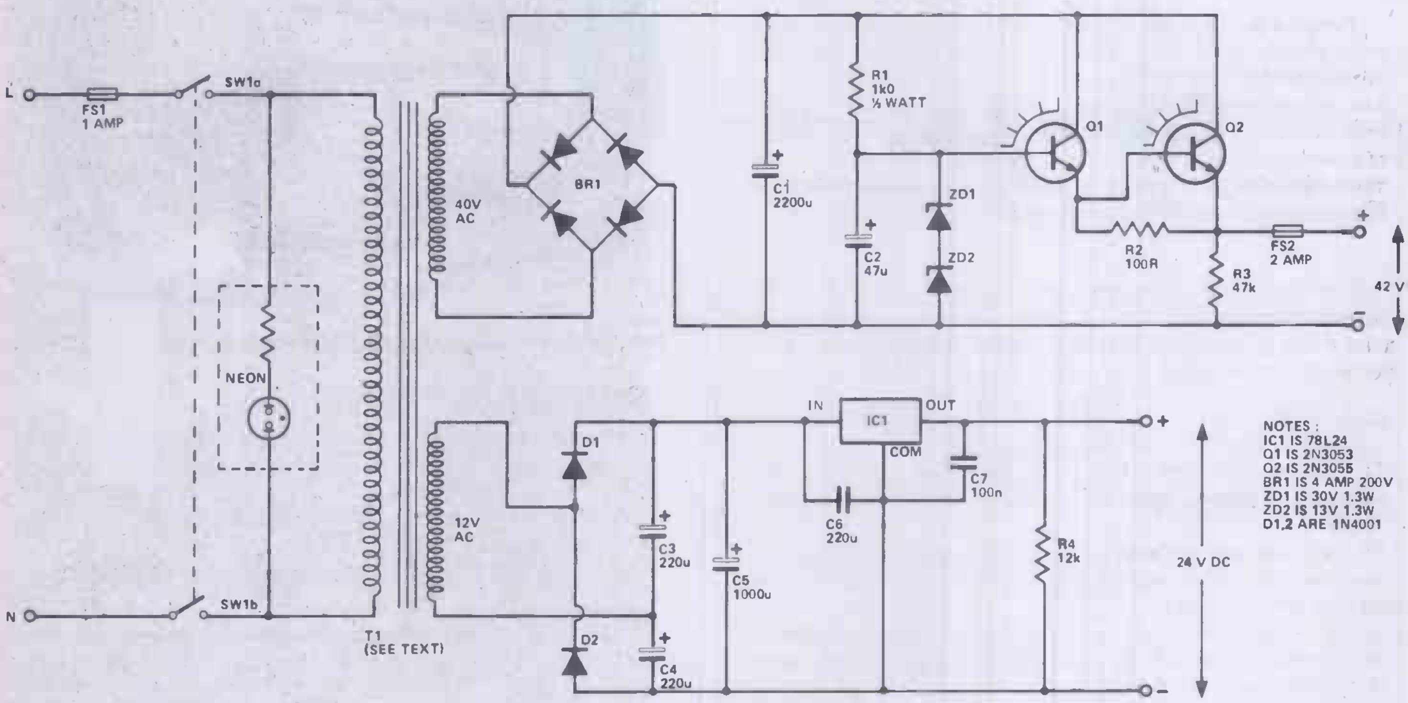


Fig. 1. Circuit diagram of the system 5080 PSU module. Photographs of the module are featured in the 8080 Power Amplifier project on page 11

How it Works

The circuit can be divided into two main parts — the 45 volt DC supply, which is a fairly standard transistorised voltage regulator providing a stable supply for up to two 5080A Power Amplifier modules — and the 24 volt DC supply providing a very stable supply for the future pre-amplifier module in the 5080 system.

The 42 volt supply consists of the usual bridge rectifier and smoothing capacitor. A stable 43 volts is given by the series combination of ZD1 and ZD2. Q1 and 2 form a Darlington pair in a series pass regulator configuration to allow the high current output necessary with power amps.

The 24 volt supply is somewhat more unusual in that a voltage doubler rectifying stage is used around D1, 2 and C3, 4 so that over 24 volts DC is available from 12 volts AC.ICI is a 24 volt regulator providing up to 100 mA at that voltage — quite ample for most pre-amplifier applications.

FS2 is quoted as a 2 amp fuse — this is essential when the PSU is to supply two power amplifier modules of the 5080A type. If only one power amplifier is to be run, then lower the fuse rating of the power supply to 1 amp.

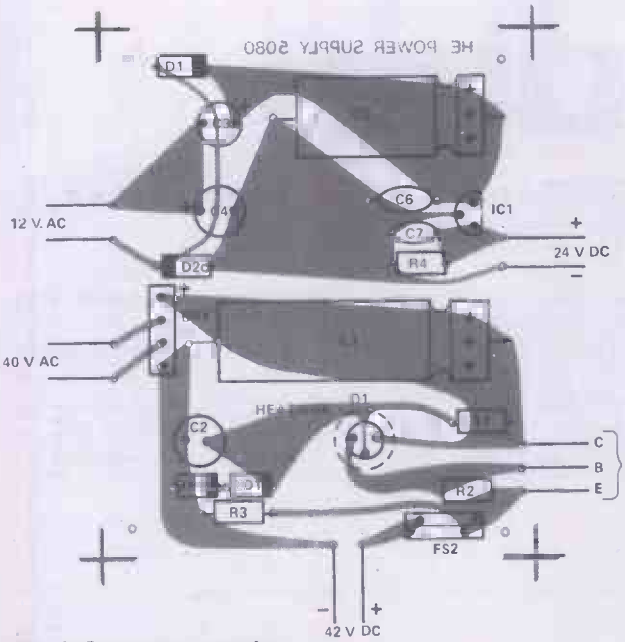


Fig. 2. Component overlay

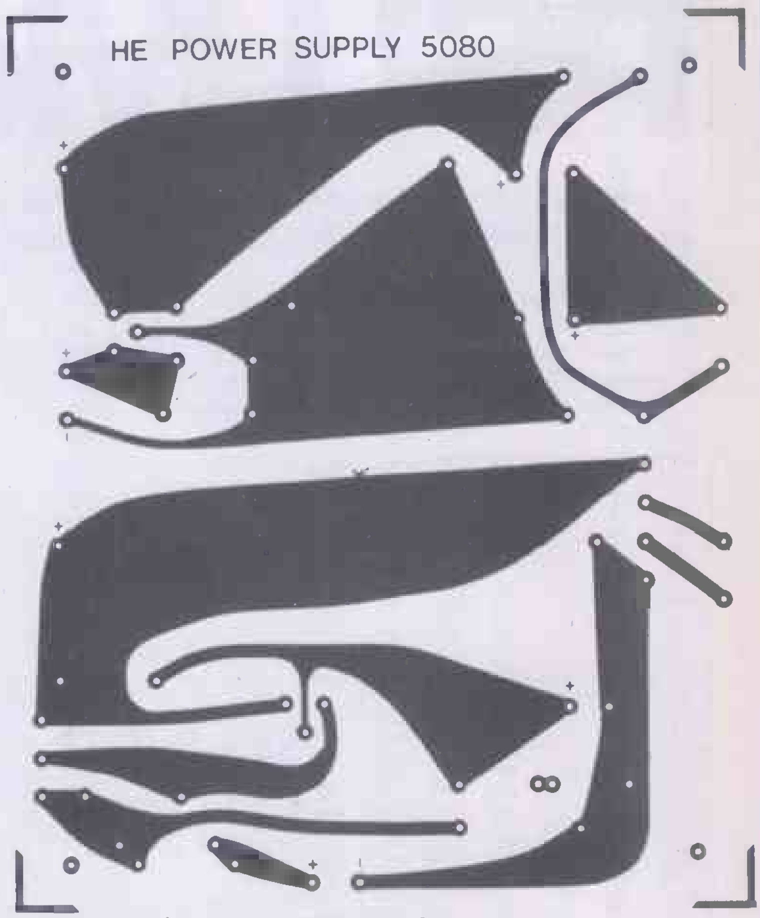


Fig. 3. PCB foil pattern for PSU Module.

Parts List

RESISTORS (All ¼W, 5% unless otherwise stated)

R1	1KO ½W
R2	100R
R3	47K
R4	12K
CAPACITORS	
C1	2200 u 63 volt Elect.
C2	47 u 63 volt PCB Elect.
C3, 4	220 u 25 volt PCB Elect.
C5	1000 u 40 volt Elect.
C6	220 n polyester
C7	100 n polyester
SEMICONDUCTORS	
IC1	78L24
BR1	4Amp 200V bridge rectifier
Q1	2N3053
Q2	2N3055
ZD1	30 V 1.3Watt zener
ZD2	13 V 1.3Watt zener
D1, 2	1N4001

MISCELLANEOUS
Panel mounting fuseholder + 1 amp fuse
PCB mounting fuseholder + 2 amp fuse
Neon mains indicator
Radiating fin heatsink for TO5 transistor
Case (see Buylines)
T1 50 VA or 100 VA mains transformer with 40 volt AC and 12 volt AC windings. (See buylines).

CONSTRUCTION

The main construction work concerns the building up of the circuit board, which is fairly spacious and therefore shouldn't be too difficult. C2, 3 and 4 are P.C.B. mounting capacitors and a suitable source in case of difficulty is given in Buylines.

Q1 heatsink is a radiating fin type, to fit a TO5 transistor.

Q2 is mounted on to the metal chassis of the case using the usual mica washer and heat sink compound to provide electrical isolation — check that this is so before you wsitch on.

SW2 is mounted on the circuit board in fuse clips FS1 however, should be panel mounted on the case, along with SW1 and the neon indicator.

Finally as with any mains powered device, make sure that the chassis case of the power supply is taken to mains earth, with bolt on connection. This is a safety measure in case of any fault. **HE**

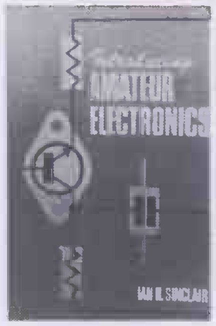
Buylines

If printed circuit board mounting capacitors are hard to come by, you might try Electrovalue. All other components should be easy to obtain.

Our case was type FP 1B. This is available from Watford Electronics. This case was found to be ideal when a 50 VA transformer was used. If a 100 VA transformer is used, the next case up in the range might be necessary.

Transformer T1, although easily obtainable, may present some cost problems to your pocket. If this is the case (and even if this is not the case) look at the ad on page 23 of this issue of Hobby Electronics, where lo and behold you will come across the answer to your dreams. Either of these transformers can be used in the 5080 PSU. It would appear that these transformers were purpose-built for the power supply (the truth is that we designed the PSU to suit the transformers).

Hobby Electronics Book Service



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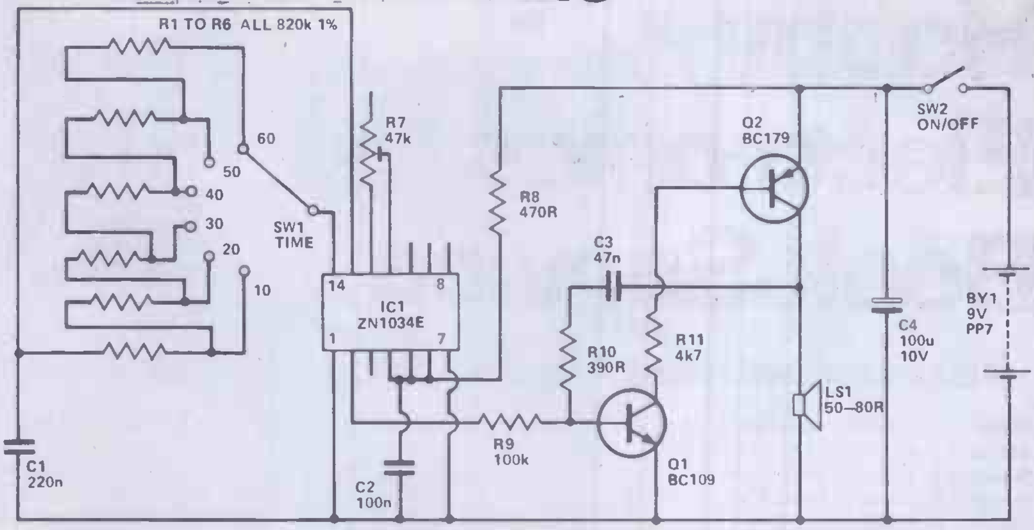
ZN1034E TIMER



Long timing periods are difficult or even impossible to obtain using most simple timing circuits, such as those using the well-known 555 timer IC. The problem is that such circuits usually provide a timing period of only about 1CR seconds, and times of more than a very few minutes require unrealistically high values for the time resistor and capacitor. The ZN1034E device is specifically intended for aplications where long times are required, and using an oscillator, a 14 stage binary divider (divide by 4,096 circuit), and a logic control section, an output time of between about 2,700 and 7,500CR seconds can be attained! This enables times of hours or even days to be obtained, and times of a few minutes to a few hours can be obtained without having to use an electrolytic timing capacitor, giving excellent reliability and accuracy.

This simple timer circuit provides an audible alarm at the end of the timing period which can be varied from 10 to 60 minutes in 10 minute increments. C1 is the timing capacitor, and the timing resistance is formed by whichever of the series of resistors (R1 to R6) is switched into circuit using SW1. The timing resistors all have the same value, and so if one resistor gives a time of 10 minutes, two produce a time of 20 minutes, three give 30 minutes, and so on. The timing period can be varied from about 2,700CR to 4,100CR seconds using R7, and in practice this is adjusted by trial and error to give a suitability high level of time accuracy.

The ZN1034E has an internal 5 V. shunt regulator, and R8 is the load resistor for this. The trigger input (pin 1) is connected to the negative supply so that circuit is triggered at switch on. The not Q output at pin 2 goes low during the timing period, cutting off both Q1 and Q2. These two devices, which form the basis of an audio oscillator driving LS1, are biased into operation at the end of the timing period when pin 2 goes high, causing the alarm to sound.

The circuit consumes about 8 mA under quiescent conditions, rising to about 16 mA when the alarm is operating. The times provided by the unit can be varied to suit individual requirements by changing the timing component values, but the timing resistance should be no more than about 10 megohms, and the timing capacitance should not be less than 3.3nf.

TRANSFORMER OFFER (PSU)

If you are contemplating building the 25 watt amplifer and PSU modules in this month's HE (page 19) then you may be interested in our special Readers Offer this month. We have a fairly limited supply of transformers suitable for the PSU module. These are the same types as used on our prototype. We have two types on offer, the larger of the two is a 100 VA device, it has two 12 V windings and one 40 V winding. The primaries are both rated at 240 V AC. (The smaller model also has a 220 V tapping on the primary).
Both types are available for just £6, that includes VAT and postage and packing. (Postage on the larger one is nearly £1.50!) so as you can see it is a very good deal indeed.

When ordering please specify which type you need (S or L). As stocks may be limited we reserve the right to send you the alternative model, so order early.

Personal callers to the HE offices can purchase the transformers for just £4.50 (inc VAT)

Send cheques, postal orders or gold (not less than 1oz please) to:
HE TRANSFORMER OFFER.
Hobby Electronics,
145 Charing Cross Road,
London WC2H 0EE.

PETting It Together

If you think PETs are small furry animals, then read on. Rick Maybury has been looking around the Commodore factory in California where PETs are made.

SILICON VALLEY: that conjures up all sorts of images. What the papers and TV programmes fail to tell you is that it is an area some 200 miles long. To locate one particular place requires a little more than a vague map and a tentative invitation.

Heedless of these 'minor' problems HE went in search of the Mecca of microcomputers, that well known manufacturer of watches, calculators and of course PET computers, Commodore.

Commodore, or at least, the place where they make PET are to be found in what might be called the heart of Silicon Valley, Santa Clara. Santa Clara, and particularly the Commodore complex is about as easy to find as a proper English chip (potato that is) in the USA.

Having finally arrived we were greeted by our genial host Neil McElwee who conducted our visit.

Before we launch into graphic descriptions of how PETs get put together some information on other Commodore products. The watch and calculators bearing Commodore badges are mostly built in the Far East, however, LCD displays for which Commodore are justly renowned are put together in their Texas plant. Right, back to sunny California.

PET, or Personal Electronic Transactor, (not sure what it means either) has become synonomous with home computing. They first sprang upon the unsuspecting world during 1977, bringing computing in real terms into the home. During these past two or three years Commodore have managed to knock out something like 80,000 PETs, surpassed only by the amazing Radio Shack (Tandy to us limeys) who claim an impressive 100,000 TRS 80s on the streets.

SOLAR POWERED

The PET is a rather unholy mixture of modern and 'ancient' technology. On the one hand we have the relatively old fashioned monitor, the telly bit on the top coupled up to the very latest (well, pretty new considering) IC microprocessor technology. Just to complicate matters, a mechanical tape deck is thrown in for good measure. To date the PET is still the only all-in-one computer system on the market. This curious combination is reflected in the factory complex.

The Commodore factory boast one of the most advanced solar heating and air conditioning systems in the world. (Why they should need any kind of heating in California must remain a mystery). Within this ultra-modern complex the PET computers are virtually assembled by hand. In fairness though they hope to be using automatic insertion machines for the main PCBs in the very near future.

From beginning to end a PET takes about three days to come together, a bit slow when you consider the average family car is built in just a few hours. Much of the three days period is taken up by what the Americans call 'burn time'. We call it 'soaking', it involves putting the various assembled PCBs through a continuous test cycle for up to 36-hours.

BIG SCREEN

Looking round the factory it's surprising to see how many varieties of PET there are. Apart from the various permutations of memory size, 8k, 16k and 32k they also have an intruiging machine called Teachers PET. Far from being designed for whiskey manufacturers it is specifically intended for schools and colleges. To look at it is pretty much the same as a standard PET. Though we're told it has a couple of features that will make teaching the intricacies of computer programming a lot easier. (Classrooms full of sceptical students, we wish them luck). Most of the PETs under construction now sport the green screen, this is the 9 inch, 40 column item. Commodore are currently introducing a 12 inch screen model, capable of displaying 80 columns and supporting up to 64k of memory. That means it will be even smarter. Fascinating as this doubtless is, we tend only to be interested in how good the games are.

Apart from the PET, Commodore also assemble a noisy device called a line printer. In reality they only manufacture the electronics, the mechanics are off-the-shelf items. The same goes for the Floppy Disk units, only the electronics are assembled on-site.

It was interesting to see the PETs undergoing their final checks before packing. A test involves a programme being loaded into the machine from a floppy disk and a trained operator looking at the results on the screen. This must be one of the most boring jobs imaginable, peering day in, day out at rows of meaningless alphanumeric and graphic characters flashing on the screen. Boring or not, their rejection rate and after sales failure rates are impressively low. There is a chance for us humans yet.

The entire factory (the Americans call it a 'facility') is staffed by only 300 people, most of them concerned with PET manufacture. Whilst we were there a lorryload of PETs was being packed up for the UK market, though informed sources at Commodore now predict the next big market to be in Germany.

Commodore are basically a hardware manufacturer, that is to say they have very little interest in the software side, the programmes written for PET. However, at the time of our visit the Gentlemen at the facility were taking great pains to impress us with their new Word Processor package, and most interesting it sounded too. This

Below. The Commodore factory. The sloping roof acts as a solar collector. Inside much of the air-conditioning and heating is also solar-powered. The entire complex is staffed by only 300 employees, most of the component parts of the PET. i.e. metal work is fabricated in other plants.

preoccupation with business use emphasised the current US trends in microcomputing and doubtless the way, we in Europe will be going in the next year or so.

BUSINESS USERS

When PET first came onto the scene most of them went to what we would call the hobbyist market. That is the chap (and probably a good few ladies too) who sit at home writing and running programmes purely for personal use. Today we have the situation where the majority of machines are being brought for business use. Many small companies unable to justify spending thousands of dollars on time sharing or a mainframe system are turning to devices like PET to solve all their paperwork and financial problems. For a very modest outlay a small company can buy a complete package of hardware and software capable of dealing with such diverse subjects as payroll, stock control and invoicing yet still play a creditable game of Star Trek, all at the flip of a cassette tape or floppy disk. Commodore confidently predict this will be the way of minicomputers in the next few years. To this end they are preparing to tool up for the CBM Business system a somewhat serious version of the ordinary PET.

Naturally everyone at Commodore were a little reticent (to say the least) to discussing the future but one helpful gentleman steered us towards a shiny booklet, Commodore's annual report. Without committing himself too heavily he pointed out three very interesting paragraphs which he assured us might answer one or two burning questions. The first states;

". . . and work is moving forward on a large area LCD (Liquid Crystal Display) to be employed in computers and selected consumer products".

Could this be a thin screen TV?

The second paragraph is a little more down to earth.

"Other computer enhancements under development during fiscal 1980 will expand the capability of PET systems to a point where they will be able to talk, listen and draw. Development of a next generation computer is scheduled for completion during 1979-80 and introduction by the end of the fiscal year".

Whatever next? A talking PET. Our office PET could tell a tale or two.

Our last clue to the future is a little more concrete,, PET owners will be delighted/frustrated to know that;

". . . a low cost colour controller to be introduced in fiscal 1980 with the PET system and available for sale to outside customers by the Electronic Components Division".

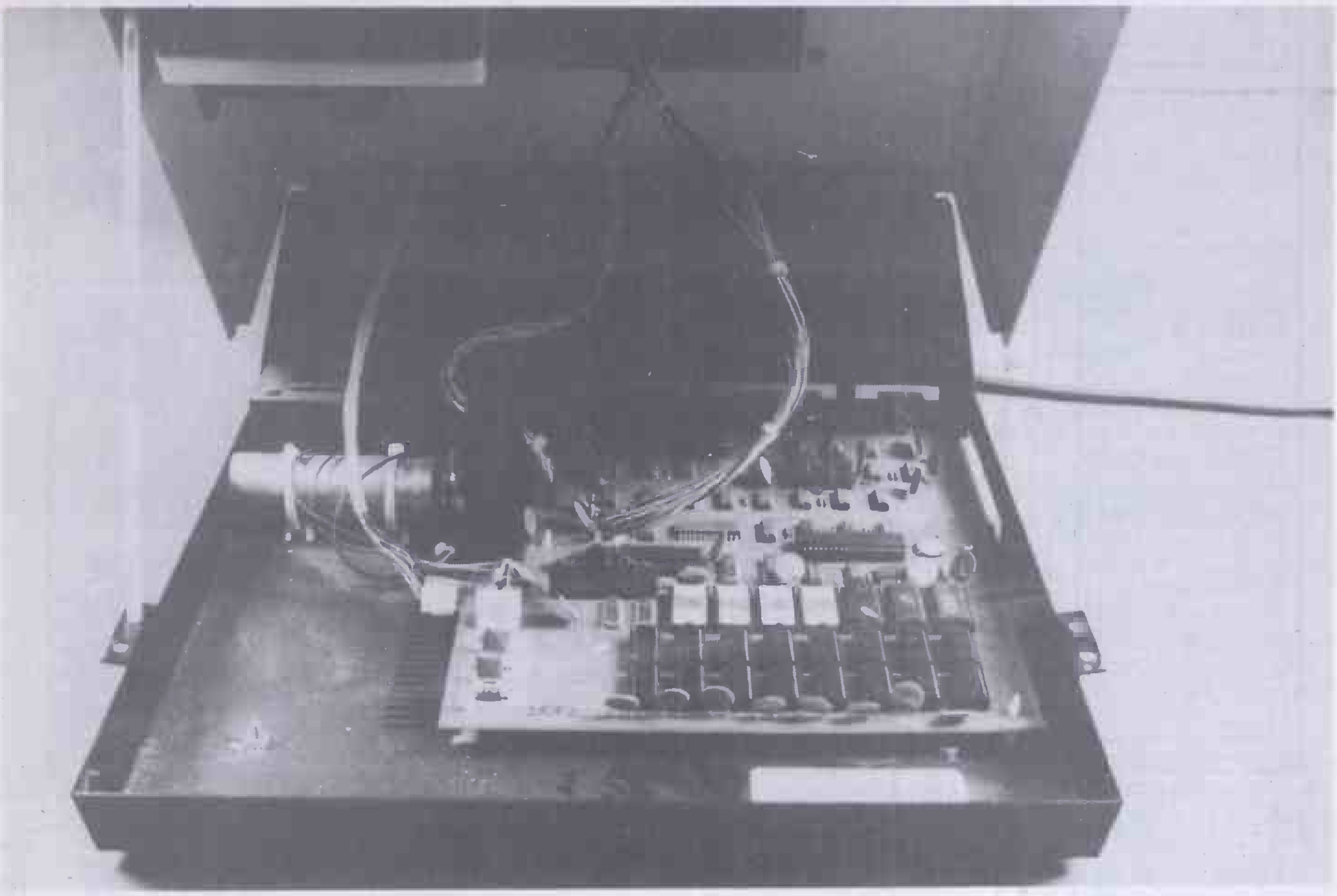
We are tempted to ask whether combining all of these features, speech, etc, will produce a PET with an LCD display and some very colourful language. Watch this space.

Above. The sloping roof of the factory acts as a solar collector.

Left. Inside the reception area. The area is space-heated and air-conditioned by the solar system.

Right. Inside one of the assembly shops. The PET's are built on an assembly-line though much of the work is still completed by hand.

PETting It Together



Inside a typical PET. The main processor board can be seen on the right hand side of the cabinet. The rows of ICs at the front are the RAMs. The hefty power supply can be seen on the rear, right hand side. The large smoothing capacitor is just below the mains transformer.

All of the current range of PETs share a common chassis. The case is fabricated from mild steel, making it very robust and unfortunately quite heavy.

The electronics are divided into three sections. The main board, that does all of the clever stuff. It sits in the bottom part of the case. This board holds all of the digital bits, an array of large and small ICs in neat rows just beneath the keyboard.

Sitting next to this is the mains power transformer. The incoming mains is stepped down to the various supply levels needed to drive the electronics. The supply for the monitor circuitry also originates here, so it is a pretty hefty device.

The final section is the monitor. This is housed well away from delicate ICs in the top section of the case. It gives an interesting contrast to the neat digital stuff below, looking somewhat similar to a birds nest, made by a blind bird.

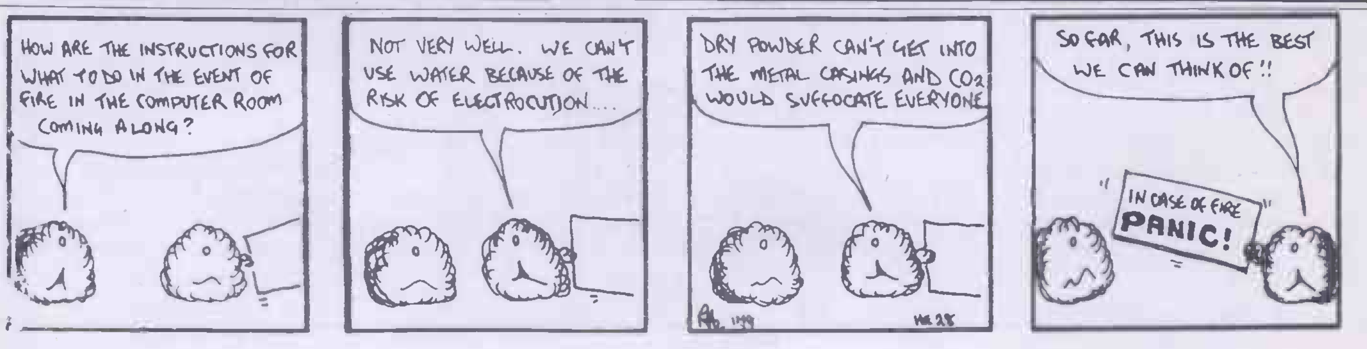
We were interested to ask why Commodore opted for the all-in-one concept. The answer came as something of a surprise. In the US the controls over using UHF modulators are very strict. So rather than running foul of the all powerful FCC they decided to supply a monitor built in. Incidentally this has a number benefits. Fewer problems arise as a result of poor interconnections between computer and display and the character definition is much better.

As it turned out the in-built monitor was a wise choice. Texas lost several months in getting their computer on the market, purely as a result of having to obtain FCC approval for their modulator.

Another aspect of this unconventional design is the ease of service. Literally everything is readily accessible. The top half of the cabinet tips up into the service position, a very good idea.

It is difficult to comment upon the PETs design, after all 80,000 people can't be wrong. Many lesser computer companies have gone bust building machines with extravagant claims.

The durability of PET is unquestionable though this may work to Commodre's detriment. Newer designs appear almost daily, hopefully PET will also move with the times and a new model should be appearing soon.



HOW ARE THE INSTRUCTIONS FOR WHAT TO DO IN THE EVENT OF FIRE IN THE COMPUTER ROOM COMING ALONG?
NOT VERY WELL. WE CAN'T USE WATER BECAUSE OF THE RISK OF ELECTROCUTION....
DRY POWDER CAN'T GET INTO THE METAL CASINGS AND CO2 WOULD SUFFOCATE EVERYONE
SO FAR, THIS IS THE BEST WE CAN THINK OF !!
IN CASE OF FIRE
PANIC!

Kit Review

INTEGREX 2020 TA

Without doubt the most ambitious and one-of the most expensive kits we've ever reviewed. Was it worth it? Read on and find out.

QUITE POSSIBLY the most rewarding kit we've ever built, extravagant claims? We think not, after soldering up some two hundred or so components and to have said kit work first time, how satisfying can you get?

The kit in question is the Integrex S2020 TA Stereo Amplifier Tuner. Integrex are past masters at audio kits, specialising in designs published in a certain 'venerable' electronics journal. Our kit was chosen carefully from their range, taking into consideration cost, specifications and apparent ease of construction. Obviously we had to avoid any previously published designs so we settled for the 2020. The kit will arrive on your doorstep for just £59.95, not bad at all.

BEGINNER BEWARE

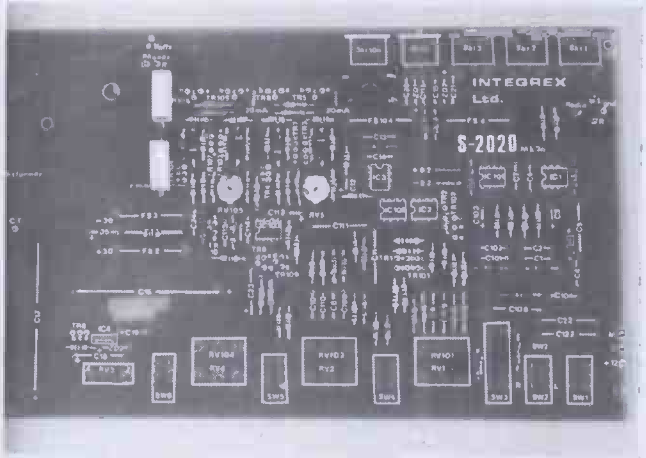
From the outset it must be said this kit is not for the faint-hearted or clumsy solderers. It is a kit on the grand scale. The instructions assume a basic familiarity with electronics, quite the opposite philosophy to Heathkit who reckon that if you can read you can build their kits. (And rightly so for their instruction manuals are the best we've ever seen.)

Now for the gripes, the kit arrives carefully boxed, all of the electronic components neatly packaged in the obligatory plastic bag. Unfortunately none of the dozen or so bags bore any identification labels, confusion reigned. Worse was to come. Having warmed up the HE soldering iron and selecting what seemed to be the appropriate plastic bag, construction commenced. About half way through the first hundred or so resistors it appeared that the bag being used had more bits than was necessary for the first stage, indeed several bits did not seem to belong anywhere. We still have a couple of resistors, three transistors and good few nuts, bolts and round things left over. We've often discovered things missing in the past but never a surplus, even allowing for the modifications Integrex suggest for the unit they still remain a mystery. Perhaps they are spares, if this is so then this is a trend we shall encourage.

As it arrives. Unfortunately none of the plastic bags bear any labels, confusing isn't it?

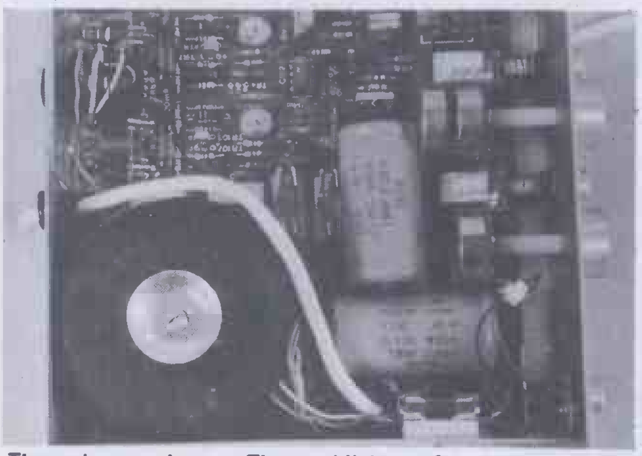
THE ELECTRONICS

Back to business, the electronics are all built up onto two glass fibre PCBs, one for the main amplifier and a much smaller one for the tuner. (Incidentally the amplifier is available as a kit on its own). The PCBs deserve a mention, they are plated, screened and a component legent printed on the topside. All this makes them a positive delight to work with. Construction of the electronics is to work with. Construction of the electronics is the longest job, allow two or three evenings for this and don't forget to tick the bits off as you go along.



The PCB with the first batch of resistors soldered down. Note the excellent component legend.

One or two comments about the electronics before we get to the metal work. The toroidal transformer, a splendidly made device, was just a touch too big, probably this was only the thickness of the covering material but it did necessitate making the mounting hole a shade larger. Secondly, Integrex would be well advised to supply some IC holders in the kit, they would add pennies to the cost but might save hours fault-finding. Lastly the holes for the PCB mounting pots were too small, they had to be opened out at quite a late stage making life a bit difficult. Small points but they are so easily remedied.



The mains supply area. The toroidial transformer was a slightly 'snug' fit.

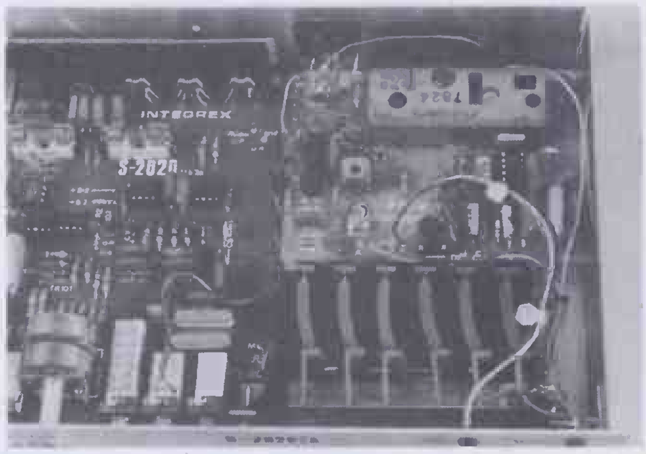
BOLT UP

On the home stretch now, the well made aluminium chassis pan accepts all of the various bits and pieces. The channel selector assembly is a trifle fiddly to bolt up and align with the front panel. Apart from that everything just falls together. Integrex suggest that when mounting the pots the front panel should be used to ensure that everything lines up properly, we didn't, and suffered the consequences accordingly.

Once assembled, and before the tuner section is connected the amplifier is set up. This could not be easier, consisting of about four current and voltage readings and two preset pot twiddlings. Everything checked out OK first time. How about a fault check-list for the not-so-fortunate Integrex?

Next, the tuner section is connected, this is based on a pre-aligned tuner head, the only adjustments to be made are for AFC and background noise. Both are made by ear so no problems here, again a first time success.

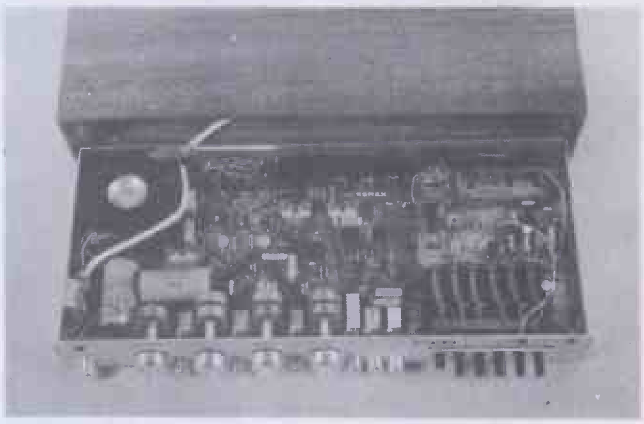
All that remains is to bolt up the front panel and slide the whole unit into its attractive solid mahogany case. Our front panel was just a little too long for a comfortable fit, a couple of strokes with a file soon cured that.



The tuner area. The pre-aligned tuner head saves a lot of trouble.

VALUE FOR MONEY

So, to the important bit. It works extremely well, concensus in the office was most favourable, the claimed 20 watts per channel all seemed to be doing their stuff. Generally it seemed to live up to its



The completed amplifier/tuner prior to sliding into its case.

specifications and produced a very pleasing sound. The tuner section was comparable with any other set we have heard, costing up to three or four times as much. The use of a varicap tuner makes it very convenient to use. How about a little light behind the tuning scale Integrex?

Conclusion? The kit represents very good value for money, if you are in the market for a stereo tuner amplifier look no further. One or two little things outlined earlier need to be looked at by the manufacturers but apart from that we have no hesitation in recommending it. Remember though, it is not for the absolute beginner you at least need to know how to solder. All of the components supplied are of the highest quality and should give years of trouble-free service. In case of problems Integrex offer a repair service. The amplifier specifications are given below. Integrex can be found at: Portwood Industrial Estate, Church Gresley, Burton on Trent.

SPECIFICATIONS

Amplifier Specification
Sensitivity to give 20 watts into 8Ω
Magnetic pick up 2.5mV
Tape input 130mV
Radio 130mV
Input impedance 47k @ 1kHz

Tape output (low level output) 130mV via 4.7kΩ unaffected by tone or volume controls

Tone controls
Treble + 10-12dB at 15kHz
Bass ± 16dB at 30Hz

Balance ± 8dB one channel relative to other

Unweighted signal-to-noise of complete amplifier with full amplifier bandwidth
—60dB magnetic pickup
—72dB radio

Power Output (both channels)
>20+20 watts into 8Ω intermittent sine wave
16+16 watts into 8Ω continuous sine wave
15+15 watts into 15Ω continuous sine wave

Harmonic distortion
15 watts into 15Ω 0.05% at 1kHz
20 watts into 8Ω 0.09% at 1kHz

Low level distortion
0.16% at 1kHz 50mW into 15Ω
0.07% at 1kHz 50mW into 8Ω

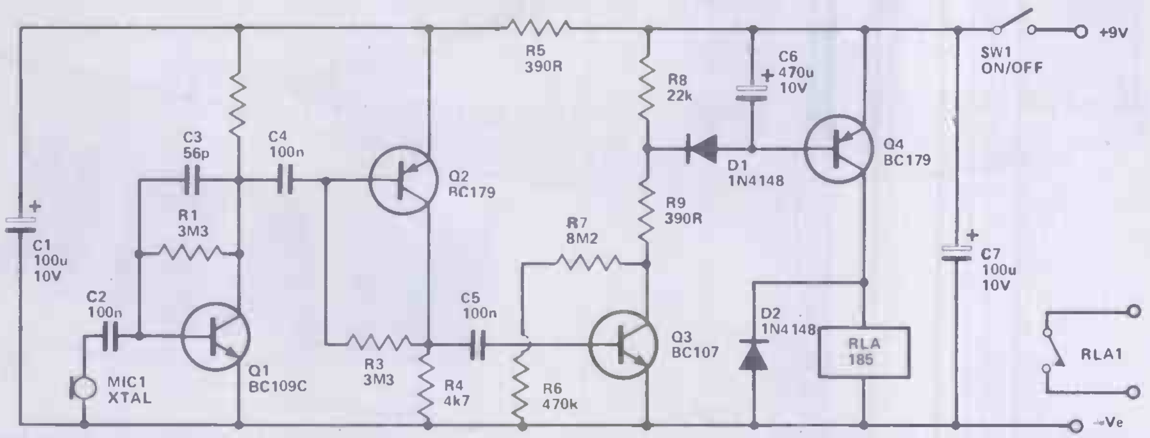
Frequency response (16+16 watts into 8Ω)
—1dB14Hz to 22kHz
—3dB less than 7Hz to 35kHz

Stability — will drive electrostatic loudspeakers

Output impedance less than 1 milli ohm

Dimensions (sleeve)
Width 391mm 15.4in
Height 69mm 2.7in
Depth 170mm 6.7in

HE



SOUND OPERATED SWITCH

Sound activated switches are used in many applications, some typical examples being voice operated tape recorders, baby alarms, burglar alarm systems, and VOX (voice operated switching) systems of radio transmitting / receiving installations. The simple circuit shown here will operate at a distance of up to about 2 or 3 metres from a voice of average volume (slightly less if the xtal microphone insert is replaced by a medium or high impedance dynamic type).

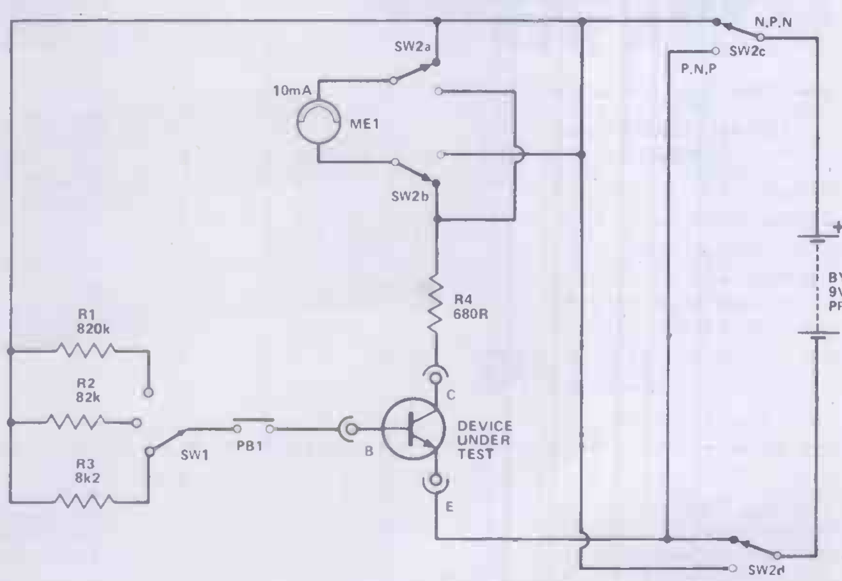
Signals produced by the microphone are amplified by a high gain amplifier which uses two stages of common emitter amplification. These two stages are based on Q1 and Q2 and use a straight forward capacitively coupled arrangement. Both transistors are operated at low collector currents in order to give a low noise level and quiescent current consumption. C3 rolls off the high frequency response of the circuit and aids good stability.

The output from Q2 is coupled to a third common emitter stage by C5. This third stage is based on Q3, and is biased by R6 and R7 to a point where Q3 is virtually cut off. There is thus very little voltage developed across load resistor R8, and the input voltage fed to Q4 via D1 is insufficient to switch on this device and activate the relay which forms its collector load. However, when sounds are received by the microphone, a strong signal is received at Q3's base, causing it to conduct heavily on positive going input half cycles. This produces a series of strong negative pulses across C4, charging up this component to an adequate level to switch on Q4 and the relay. A pair of relay contacts are used to control the supply to the slave equipment.

C4 charges via the fairly low impedance of Q3 and R9, giving the circuit a fairly fast attack time. C4's discharge path is through the relatively high impedance of Q4's base emitter junction giving a decay time of a second or two. Thus the circuit responds rapidly when a signal is initially received, but the relay does not cut out during the brief pauses that occur during normal speech.

The quiescent current consumption of the circuit is only about 250 μA, but this rises to about 35 mA when the relay is activated.

TRANSISTOR TESTER



This very simple transistor tester measures DC current gain in three ranges, with full scale values of 10, 100 and 1,000. It will also show whether or not the device under test has a high leakage current.

The basic tests for a transistor are very simple and in order to test for high leakage, it is merely necessary to connect a voltage across the emitter and collector terminals of the test device, and then measure the current flow. In this circuit BY1 is the voltage source, and ME1 registers the current flow. R4 is a current limiting resistor which protects ME1 and the test device from passing an excessive current.

Silicon devices have extremely low leakage currents, and if there is any deflection of ME1 when testing a silicon transistor it certainly means that device is not functional (or is connected incorrectly). Germanium devices have somewhat higher leakage currents, and a very small deflection of ME1 is acceptable when testing this type of transistor.

The test for DC current gain (Hfe) is basically the same as for leakage testing, except that a current is fed into the base terminal of the test device. This causes a larger current to flow in the collector circuit of the transistor, and the current gain is equal to the collector current divided by the base current. If SW2 is depressed, a base current will be provided to the test device by whichever resistor (R1 to R3) is selected by SW1. With SW1 in the "10" position, a nominal base current of 1 mA is fed to the test device, and it must have a current gain of 10 in order to produce a collector current of 10 mA and give full scale deflection of ME1. Lower levels of current gain give a proportionately lower meter reading. With SW1 in the "100" and "1,000" positions, the base current is reduced to 100 uA and 10 uA respectively, giving the correspondingly higher full scale gain values.

PNP and NPN transistors require opposite supply polarities, and SW3 is used to switch the supply polarity to suit the type being tested and to connect ME1 with the correct polarity.

HE MARKET

LCD CHRONO

We feel we've got to tell you carefully about this offer. Why? Because our price is so enormously lower than anywhere else you may suspect the quality.

The display is LCD and shows the seconds as well as the hours — and minutes — press a button and you'll get the date and the day of the week.

Press another button for a couple of seconds and you have a highly accurate stopwatch and hundredths of a second displayed and giving the time up to an hour. There is a lap time facility as well — and of course a back light.

Our Chrono comes complete with a high grade adjustable metal strap and is fully guaranteed.

£11.95

ALARM-CHRONO LCD

This new addition to our unbeatable selection of bargains is no ordinary LCD watch. It's a slim, multi-function, dual time chronograph alarm watch, no less.

This model will show hours, minutes, seconds, date, day of the week, stop watch, split time, alarm and alternate dual time zone — not all at once, of course. There is also a night light.

Hours, minutes, seconds and day of the week are displayed continuously, while the date will appear at the touch of a button. The day of the week is indicated by a flag. When used as a stopwatch, the maximum count is 0.1 secs. short of thirteen hours.

£19.95

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....

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Please allow 28 days for delivery

PLACE

DIGITAL ALARM CLOCK RADIO

THIS IS THE THIRD digital alarm clock that we are offering (we regret the earlier versions are no longer available). We have sold thousands and thousands of these and our buying power enables us to offer a first rate branded product at a really excellent price.

The Hanimex HC-1100 is designed for mains operation only (240V/50Hz) with a 12 hour display, AM/PM and Alarm Set indicators incorporated in the large display. A switch on the top controls a Dim-Bright display function.

Setting up both the time and alarm is simplicity itself as buttons are provided for both fast and slow setting and there's no problem about knocking these accidentally as a 'locking' switch is provided under the clock. A 9-minute 'snooze' switch is located at the top.

An example of this clock can be seen and examined at our Charing Cross Road offices.

£10.60

You probably won't believe us as we're selling the goods but we're going to tell you anyway! We have *rejected* eight clock radios for Marketplace, they were all cheap enough but the quality was so poor that we couldn't have lent our name to them. However, we are now able to offer another portable LCD Clock Radio to you which meets our standards.

The clock is a 12-hour one with AM/PM indicated and a back light. The radio is Medium Wave with very nice quality for a small speaker. The alarm can be either a beep-beep type or the radio, there's also a snooze facility.

The cylindrical construction is in keeping with the very modern styling. The tuning dial is actually incorporated into one of the end caps!

We won't even mention the RRP — but just check on comparable prices — you'll find ours a bargain.

An example of this Clock Radio can be seen and examined at our Charing Cross Road offices.

£17.95

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CLOCK RADIO Offer
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Popular Electronic Projects £1.75
R. A. Penfold. A collection of the most popular types of circuits and projects using modern, inexpensive and freely available components.

Digital IC Equivalents and Pin Connections . . . £2.85
Adrian Michaels. Covers most popular types and gives details of packaging, families, functions, country of origin and manufacturer.

Radio Stations Guide £1.75
B. Babani and M. Jay. An invaluable aid to everyone with a radio receiver helping them to obtain maximum entertainment, value and enjoyment from their set.

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R. A. Penfold. Full of constructional circuits covering the most basic security systems to the Ultrasonic and Doppler Shift systems.

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F. G. Rayer. The book contains concise practical instructions so that even an inexperienced hobbyist can construct a fairly sophisticated instrument with the minimum of difficulty and expense.

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Note that all prices include postage and packing. Please make cheques etc. payable to Hobby Electronics Book Service (in Sterling only please) and send to:

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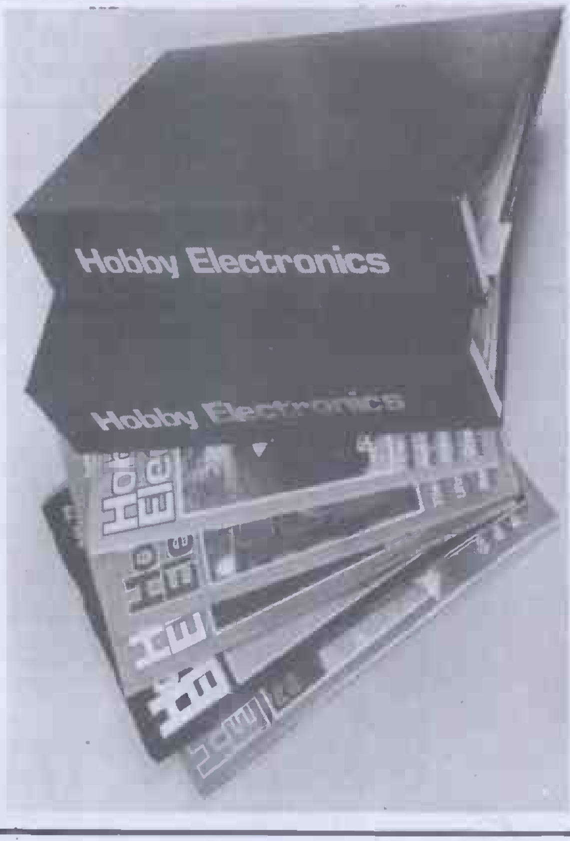
HE Binders



Now that Hobby Electronics is in to its second volume the need for a good strong binder is greater than ever.

In line with our policy of value for money, we will outline some of the alternative uses an HE binder can be put to.

(1) Blocking cat-flaps to prevent stray cats from entering your kitchen.
(2) Blocking off car radiators during cold weather.
(3) Temporary bridges for model train layouts.
(4) Emergency umbrellas.
(5) A hat for HEBOT.

Of course, you could use them for keeping those valuable copies of HE in pristine condition, but that's up to you.

To become the proud owner of these blue bound, gold embossed works of art just send us £3.20 without delay.

Send your cheque, postal order, pools win or gold fillings (to the value of £3.20) to;

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Next Month

Hobby Electronics

DIGITAL FREQUENCY METER

The most sophisticated piece of test gear to appear in HE so far! Don't let that put you off, our main project next month will be very simple to build and will cost a fraction of a commercially made unit. Once calibrated (that's a doddle too) it will accurately measure frequencies up to 10 MHz in a series of switched ranges. Now you will be able to measure the output of those oscillators, calibrate test gear, even use it to indicate frequency on Long Wave and Medium Wave radios. Why wait any longer? This one is for you.

RADIO CONTROL SPEED CONTROLLER

Don't worry. The radio control system is coming, meanwhile, how about this neat and simple solid-state motor speed controller for existing systems. If you've got an R/C car with electric motor drive this will be just what you're waiting for.

PROJECTS SPECIAL

Next month we hope to bring you news of the Hobby Electronics Projects Special — Volume 1. After months of research we have come up with what we believe will be the last word in specials, and all for just £1.25.

INTERCOM

Until CB gets legalised you will have to content yourself with this really superb intercom. Practise your 10 code, try some slang, we gaurantee it will not contravene any Post Office regulations. Seriously though, a really good two-wire design that will not leave you so poor trhat you can't afford the batteries. It features a calling facility and a massive 2 watt audio output. Perhaps we should have called it a PA system!

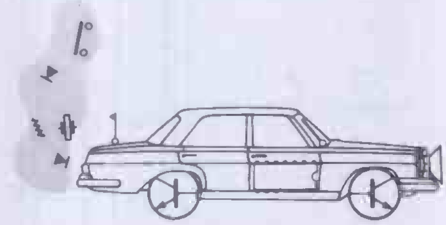
SLOW SCAN TV

Almost exactly 50 years ago a new invention was demonstrated for the first time. It consisted of an unweildy mixture of bits and pieces that would not have looked out of place in a scrapyard.

This invention was called a 'Televisor' and by now you may have guessed the inventor's name, Logi Baird. His system for transmitting moving pictures unfortunately lost the race for commercial success to the all-electronic system, the forerunner of our present system.

If you thought the Baird system is now little more than a historical curiosity you would be sadly wrong. Unbeknown to most of us development of the Baird system has been plodding along steadily these past fifty years. The improvement in available technology has made further investigation very worthwhile and we're sure you'll find next month's feature on Slow Scan Television very interesting. It is one of the few fields where the amateur can still make an important contribution.

ELECTRONIC IGNITION



After this month's feature on automotive electronics we are following it up with a really professional design for an electronic ignition system. We won't make any extravagant claims for this unit, we don't have to, it will speak for itself.

NEGATIVE IONS

Next month we go into the health business, with a review of a kit that will change your life.

We've had a steady stream of inquiries about negative ion generators in recent months. So, by popular request, before your very eyes, we will review the latest in personal negative ionisers. Called the 'Fusion', the ioniser is available both in kit form and ready built. It's a compact (4½inx2½inx1¼in), battery operated unit complete with a magnetic fixing pad, so you can even use it in your car.

The claims of the effects of negative ions are many and various. Once we've got our soldering iron out of hock and built the box of tricks, we'll see how many of these claims we can verify.

It's well known that increasing the density of negative ions hurtling around your ears can make you feel more awake and alert and dispell the gloom of a smoky atmosphere. They have to be negative, mind you. Positive ions have the opposite effect.

It is also claimed that negative ions can, in some cases, alleviate asthma, allergies and migraine. We have our doubts, but we're going to try it out anyway. By inhibiting the growth of bacteria, they are also supposed to cut down infections caused by air-borne germs. Well, that's a lot to live up to, but watch this space next month (give or take a few pages) for our findings on this new kit.

The April issue will be on sale March 14th

The items mentioned here are those planned but circumstances may affect the actual contents

Electronics On Wheels

The basic concepts of the internal combustion engine have changed very little in the past 80 years. Today, however, electronics are beginning to make considerable inroads into the car industry. Motoring journalist Tony Bentley looks at some of the latest developments.

AS AN INDUSTRY, the world's car manufacturers have always been a pretty conservative bunch. That's not to say that they don't expend a great deal of money and effort on research and development, but the fact is that the nature of their market makes them extremely reluctant to take any risks in terms of putting untried innovations into production. Mud sticks in the automotive business, and a reputation for unreliability due to malfunction of some insufficiently tested piece of equipment would be as easy to acquire as it would be hard to shake off. With very few exceptions, then, the motor industry prefers to tread a safe path and use only technology that has been proven in practice over a long period.

The potential for the utilisation of electronics in motor vehicles is enormous. In all probability, but for the caution and reticence of the major auto makers, many of the possibilities could have been realised in practical use sooner than they have been. Both specialist electronics companies and 'in-house' research departments of the car firms have devised numerous auto-related applications for microprocessors and other types of electronic components, in some instances replacing conventional systems but in others creating entirely new functions. Only in the last few years have these ideas filtered through on to the production line, and then mainly due to outside influences.

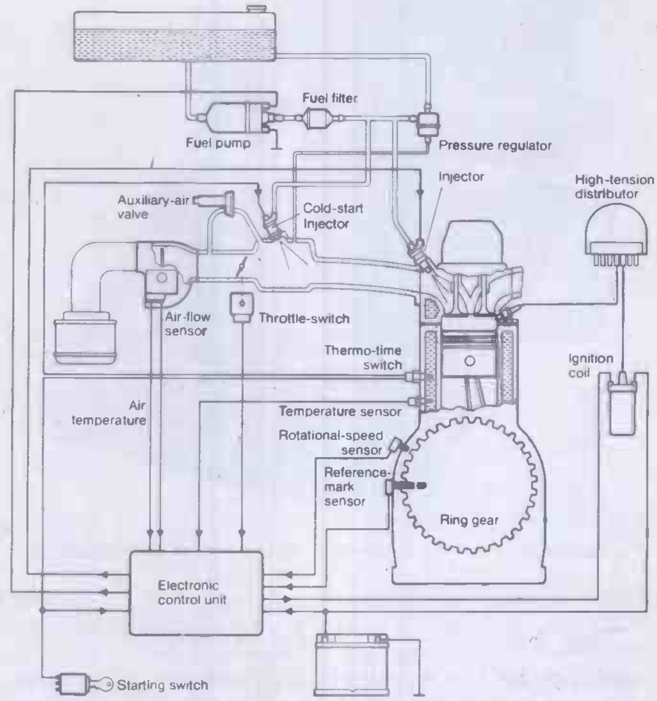
Taking a broad view, development has been going on in all three of the world's main motor production centres — the USA, Europe and Japan — but local conditions and pressures have tended to concentrate efforts in differing directions. For instance, due to more congested roads and higher fuel prices, European and Japanese cars have always been designed in a way which makes them much more fuel-efficient than their American counterparts. Oil shortages and ever tightening engine emission controls in the last few years have left the Stateside giants frantically scrabbling for radical alternatives to keep their own products viable in the face of competition from the imports. Along with lighter, smaller, aerodynamically cleaner bodies and advances in mechanical engine design, electronic ignition and fuel control systems offer them salvation. In Japan, even more stringent emissions regulations have preoccupied the local manufacturers. In Europe, by comparison, much less outside pressure has been brought to bear, certainly in terms of governmental legislation, although of course the overall energy situation has been just as prominent in the designers' minds. Consequently, implementation of electronic options has been more selective and deliberate. A further difference between Europe and the US is that few European car companies have extensive in-house electrical and electronics departments, unlike their American counterparts, though major independent electronics firms have divisions specifically given over to automotive work.

HISTORY

The history of electronics in cars goes back to the late Fifties, when the old DC dynamo-type generator began to be replaced by the alternator, which incorporated at least a semiconductor rectifier, if not at first an integral electronic voltage regulator. Alternators caught on in an increasingly big way, but nothing else of note happened until 1967 when the first electronically controlled fuel injection system went into mass production. Bendix in America had patented the idea in the mid-Fifties but it was the German company Bosch who put theory into practice.

Electronic ignition was the next major development. Transistor ignition systems using an induction pulse generator had been introduced as early as 1959 but it was the end of the next decade before any entered series production, and then to begin with only 'transistor-assisted' types retaining the mechanical contact-breaker points. Contactless designs came next and many kinds of both inductive and capacitive discharge variants proliferated on the accessory market. As original equipment, contactless transistor ignition became almost universal on the US scene by 1975 but is still only slowly infiltrating the European assembly lines.

Alongside the primary components in the late Sixties and early Seventies came a sprinkling of ancillary devices — electronic turn signal flasher units, windscreen wiper intermittent switching systems and quartz clocks, for instance — but the widely predicted electronic revolution did not materialise. There was a steady trickle of electronic gadgetry on to the accessory sidelines but, until very recently, no large-scale breakthrough in the OE field.



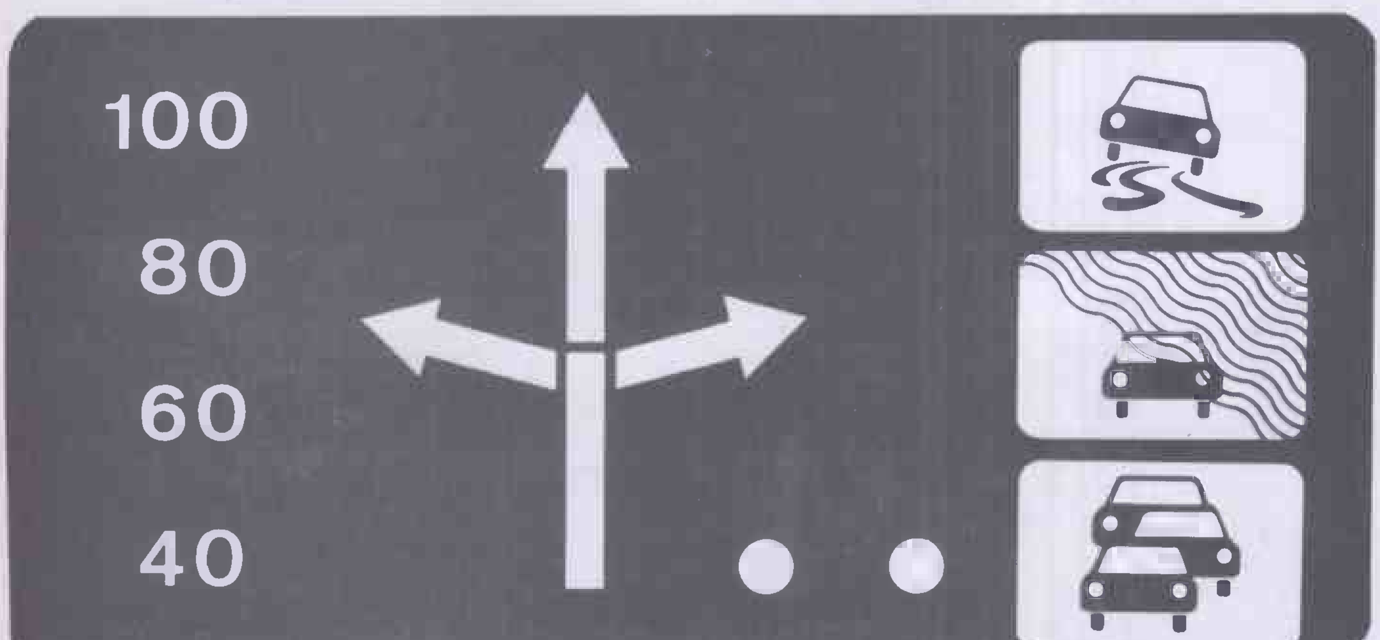
Simplified diagram of the Bosch 'Motronic' system.

ENVIRONMENTAL PRESSURE

The last couple of years have brought far-reaching and dramatic changes, particularly on the other side of the Atlantic. Environmentalist pressures, and those of rapidly increasing petrol scarcity and price, have made electronically governed fuel injection systems such as Bosch's several 'Jetronic' variations more and more attractive to designers of spark-ignition engines. Such set-ups enable very precise and effective control of a petrol engine's fuel supply. In conjunction with devices which monitor exhaust gas content, closed-loop feedback can be established so that an engine's fuel/air mixture can continuously be regulated at the optimum point for emissions and economy. On the ignition front, too, a major transition is in progress — from merely contactless ignition to a much more sophisticated type which, as well as creating and supplying a powerful spark, replaces conventional mechanical timing adjustment by a fully self-governing electronic timing system.

ENGINE MANAGEMENT

Partly thanks to technology derived from the US space programme, there is now a sufficiently strong electronic armoury to deal with the difficulties of in-car service. The



The prototype display for ALI. It shows both directional instructions and pictorial warnings of potential road hazards.

The control box for the Lucas electronic Fuel Injection system.

motor vehicle environment puts relatively tough demands on semiconductors, and perhaps one reason for the delay in introduction of major systems was the former dearth of reasonably-priced and dependable parts. Such components are now available and, together with the perfection of LSI (large-scale integration) circuitry, they have made viable the installation of an on-board microprocessor, so designed as to regulate both the fuel/air and ignition systems simultaneously and in complementary fashion. This is the 'electronic engine management system' or 'integrated engine control', which will be seen on increasing numbers of European cars in the next few years.

If a vehicle has engine management plus other, subsidiary electronic components, the idea of combining all together in a 'central electronic system' is attractive, for reasons of both cost-effectiveness and function. Where a number of information inputs from various points on the engine and running gear of a vehicle are required by different systems, feeding them all into a central electronic processor obviates the need for wasteful duplication of individual sensors and connections. For example, an input for engine speed is required not only for ignition timing but also for fuel injection, as well as automatic transmission if the vehicle is so equipped.

Taking the idea a step further, intermediate information from the electronic data-processing of one subsystem may be utilised as the input for others. Dividing the inlet airflow by the engine speed, for instance, gives data about engine load, which may be usefully employed as an input signal for electronic ignition and an electronically-controlled automatic transmission. The central electronic system will enable many functions to be dealt with in more sophisticated ways than at present. Common use of housings, connectors and even complete functional 'blocks' will yield not only cost reductions but increased reliability.

The possibilities are exciting. A variety of separate functions (e.g. anti-lock braking, cruise control) can be handled by a central system. So too can all the information currently given by conventional instrumentation, plus additional computations outside the scope of normal gauges. Vehicle speed, engine speed, water temperature, oil pressure and temperature, distance travelled and so on can easily be derived and displayed, and only simple computations are necessary to produce further data such as ETA at a given destination, fuel consumption at any instant or projected quantity of fuel necessary to complete a journey. Additional sensors can add warning capability for things like incorrect level of fuel, oil, coolant, brake fluid, etc, brake lining wear and even tyre pressure; monitoring operation of all bulbs and lamps is equally simple. A check can be fed into a central electronic system of virtually every sub-system and function on the vehicle. To avoid baffling the driver with too much information at once, a single panel display can group the various items of feedback according to relative significance or potential danger and suppress those not wanted for normal driving, only displaying them when a malfunction arises in the relevant area or when requested to do by the driver.

COMPUTER CONTROL

Until recently, the circuitry used in car electronics was largely analogue type. Increasing use will be made of digital circuits, as in modern computer equipment, facilitated by LSI. Currently, two distinct methods of realising the central electronic system concept are being explored, termed a) 'single purpose computer' and b) 'microprocessor' systems. Both consist of MOS (metal oxide semiconductor) based LSI components and so-called 'peripherals' (pick-ups, sensors, etc).

In the single purpose computer system, each individual function has a separate computer circuit, while a central storage element holds only the data for the specific vehicle along with certain fundamental functions which bring about effective interaction of the various individual data processors. The whole system can be built from standardised parts and be expanded without difficulty.

The microprocessor system uses one central computer for all its range of component systems: this holds not just the vehicle data but programmes for each of the individual functions. The main benefit of this type of design is one of economy both of cost and space when a large number of sub-systems are required; it is also highly flexible, as the programme can be altered by a simple change in the central element.

HERE TODAY

There you have an overall view of trends and likely developments. Much has already been achieved, and some of the specific points mentioned deserve a closer look. The name 'Bosch' has already cropped up once or twice, and certainly this firm is in the forefront of the European, if not world, scene. Two of their most interesting projects that have reached production are 'Motronic' and 'ABS'.

Motronic is already in service on the BMW 723i. It is an integrated engine control system consisting of a microprocessor, data and programme memory and input/output circuit. Sensors provide it with information on inlet airflow, engine speed, crankshaft position, and engine and intake air temperatures: it then interprets these data and continually, at minute intervals, regulates the quantity of fuel being injected and the point in the combustion cycle at which ignition is taking place, by reference to predetermined programmes. In other words it provides highly accurate and stable management of the two essential engine processes.

Advantages to the driver stem from Motronic's ability to distinguish particular engine conditions — idling, cold-running, over-running and accelerating — from 'normal' running, and compensate accordingly. In practice this means instant starting and totally smooth running during warm-up, regardless of changes in load, circumstances or ambient conditions, the engine operates without any 'flat spots' or hesitation immediately it is set in motion, in winter and summer. Advantages to everyone include impressive reductions in fuel consumption and pollution.

The Motronic system is designed to match the life of the engine, and needs no servicing whatsoever. In fact the only maintenance requirement left on the electrical side of the engine is routine renewal of spark plugs. Motronic additionally makes it possible to adapt engine control to deal with possible future requirements, such as use of alternative fuels or compliance with revised exhaust emission standards.

ABS means, if you untangle the German initials, anti-skid braking. Under development since 1970 in conjunction with BMW and Mercedes-Benz, it utilises sensors to measure the speed of wheel revolutions and send signals to an electronic control unit, which distinguishes whether the wheels are tending to lock as the brakes are applied or are still turning. In the light of this information, the appropriate amount of braking force is then applied or removed from the relevant wheels by a hydraulic unit.

On the road, ABS shows to greatest advantage under wet conditions, when stopping distances are often greatly improved. The system is especially useful in compensating for clumsy or unskilled driving, as it helps maintain directional stability even if the brakes are applied whilst cornering. Technically the circuitry is fail-safe: if a fault in the electronics should by some chance occur this is detected before the brakes are applied, a warning light is activated and the brakes revert to full normal operation. Bosch claim that, in safety terms, ABS is 'the most important development since the seat belt'.

ALI

Another Bosch project which is still at the research stage but could rapidly be put into operation if given the nod by government is known as ALI. Don't ask what the initials stand for this time, but the concept is of a driver aid that gives up-to-the-minute traffic reports and information about weather conditions on the roads ahead. The computers this time are not in the car but are linked to series of inductive loops set into the surfaces of major roads. As an ALI-equipped car passes over each of these loops, a bleep from its information receiver alerts the driver and reminds him to check his ALI screen for updated information — it may, for instance, advise him to turn off at the next junction. All the driver has to do to get continual route guidance is, when commencing his trip, to switch on the device and key in numbers corresponding with his destination.

Installation of ALI would, its makers estimate, cost about £30,000 per mile on the current motorway and major road network, or about 1% of the cost of road-building (only a fraction of which would be accounted for by the actual electronic hardware). The on-vehicle equipment should cost between £70-100 on a mass-produced basis, and in view of impressive-sounding estimates of an up to 10% overall fuel saving on a motorway network, plus a reduction in both driver frustration and accidents, the whole system ought to pay for itself within a few years.

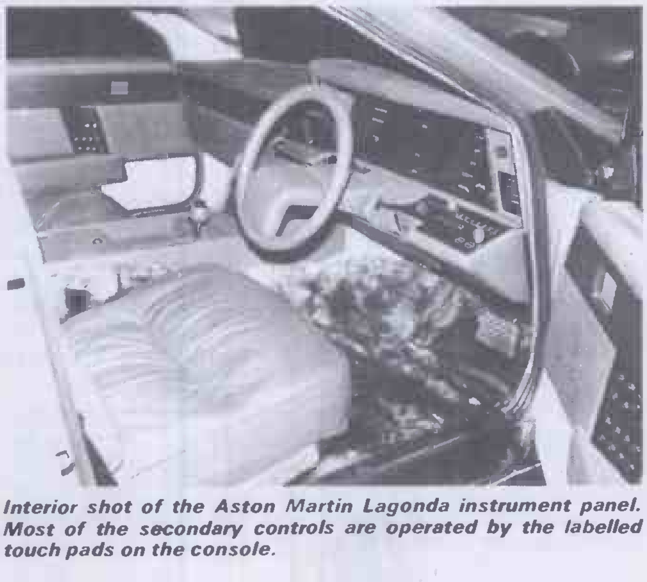
HOME GROWN

The leading British auto-electrical company is, without a doubt, Lucas. They, too, have extensive past experience with electronic ignition and petrol injection systems including a joint project with Bosch, the L-Jetronic fuel injection. Foremost among their own current developments is their latest microprocessor controlled injection system which is based on digital circuitry of the type mentioned earlier, rather than analogue as on previous variants. The control unit incorporates the latest LSI techniques, using just two chips to contain all the main fuelling functions. The digital design, Lucas claim, provides more precise control of the fuel supplied to each engine cylinder than was previously attainable. The new system is already in production for Jaguar XJ12 and XJS models, in which applications it has met with a warm reception from the motoring press, and is also being fitted to SD1 Rovers for the US market.

In the near future Lucas propose their own version of the total 'engine management' package, combining ignition control with the injection on one microprocessor. They point out the comprehensive diagnostic facility this will allow, and make the bold prediction of fuel consumption gains of as much as 25%. They emphasise that to make optimum use of the instantaneous logic available, adjustments based on it must be made as quickly as possible — to this end, they have developed a solenoid with an operation time of well under half a millisecond, which they expect to play a big part in actuating engine control functions in the future.

STILL TO COME

A couple of more mundane applications of electronics are also just around the corner. Lucas are at present working on electronic control of conventional carburettors to bring some of the benefits of the more sophisticated fuel systems to cheaper cars. Vehicle Condition Monitoring ('VCM') will be available for smaller cars within the next year or so; this will provide an illuminated readout for such things as fluid levels and brake lining wear, and give a check on correct operation of bulbs.



Interior shot of the Aston Martin Lagonda instrument panel. Most of the secondary controls are operated by the labelled touch pads on the console.

ASTON MARTIN

Aside from the work being performed by the big auto-electronics specialists, some car firms in Europe have already taken an initiative by buying-in electronic systems from elsewhere. First, and most brave, were Aston Martin Lagonda. Their unique Lagonda — the world's most sporting limousine or most luxurious sports car, depending on which way you look at it — has featured a fully electronic instrumentation system right from the start. (When the car was initially announced it was intended to incorporate a trip information computer too, but problems in those early days with electromagnetic interference caused that idea to be shelved; now, with the available improved technology, it could be reinstated.)

The Lagonda's instrumentation package was designed exclusively for AML by a small firm in the USA. It uses a single PCB mounting all instruments and warning lights: these include speedometer, tachometer, clock, total and trip odometers, along with readouts for battery voltage, fuel level, water temperature, oil pressure, oil temperature, plus both internal and external air temperature. The speedometer and odometer readings may be selected in miles or kilometres per hour at will. Two binnacles house touch-sensitive switchgear.

The display panel is blank when switched off, lighting up with red LEDs when in operation. Instead of facing the whole gamut of data all the time, the driver can touch a switch to select 'essential instruments' only, reducing the information in front of him/her to speed, time and fuel tank contents. In this mode, the rest of the display only makes itself visible if a problem arises, in the event of which the relevant readout flashes to attract attention.

AML use Lucas Opus electronic ignition at the moment, and, regarding integrated engine control systems and the like, take the view that they will adopt what their suppliers develop. One thing they do predict is the use of LCDs in instrumentation.

EUROPEAN ELECTRONICS

Talbot (ex-Chrysler Europe) were in a good position while they were still a subsidiary of the American parent Chrysler Corporation to keep tabs on what was going on in the Stateside industry. Their Alpine models were among the first in the popular mass market to feature contactless ignition as standard, and now the SX versions of Horizons and Alpines are equipped with electronic trip computers which, at the touch of a button, give readouts for journey time elapsed, distance covered, fuel consumed, average speed and average rate of fuel consumption.

By contrast, Citroen had no transatlantic connection. The totally electronic completely distributorless ignition system fitted to the downmarket Visa and LN twin-cylinder models was conceived entirely within France, in collaboration with the Thomson company. It consists merely of two proximity detectors, a vacuum sensor, a coil and — the important bit — a computer. This proximity detectors respond to the passing of a metallic 'slug' attached to the engine flywheel, sending a pulse to the microprocessor with each revolution. The vacuum sensor signals the varying state of engine load. The electronic control centre then chooses the appropriate timing, according to engine speed and inlet manifold depression, for the coil to send HT current to the spark plugs, at the same time ensuring that it (the coil) is fed sufficient primary current to produce the desired secondary voltage. The system is cheap, absolutely maintenance-free, and produces improvements in almost all aspects of engine behaviour: fuel consumption, exhaust pollution, low-speed torque and acceleration, and cold starting (even with a partially discharged battery for it needs to be cranked at only 20rpm to produce a spark). Work is continuing on versions for larger engines.

CRYSTAL CONTROL

Other ideas being muttered about on the European scene at the moment include piezo-electric actuation of the injector valves in fuel injection systems, and replacement of the conventional wiring harness or loom with a single feeder wire, multiplexed signals and a decoder at each 'service' point. For instrument displays, electroluminescence seems likely to be the in-vogue medium, with digital circuitry but analogue-type visual presentation. Talking gauges will surely come — Texas Instruments are already developing them in the States.

As repeatedly hinted at, the Americans are ahead of us at least in implementation of a number of the possibilities. Right now a wide range of electronic add-on toys is available for fitment to their cars. If you happen to live on this side of the big pond but find the lure of accessories such as electronic combined analogue/digital display instruments and trip computers irresistable, don't despair. At least one British concern is importing them: Hatton Enterprises, of Langwood House, Epsom Road, Ashtead, Surrey, who handle 'Avatar' instruments and 'Prince On-Board Computers'. Thanks to the conservation-orientated pressures existing in the USA, virtually every car emerging from Detroit in 1980 has (as well as transistor ignition) some kind of electronic fuel metering device, from a basic 'feedback' carburettor system to full analogue or digital electronic fuel injection. Other electronics applications proliferate — electronic level control, electronically tuned radios, electronic speedometers, electronically coded door and boot locks are just a selection of the stock and optional equipment available on vehicles in dealer showrooms this year. Ford give the value of all the electronic components on a 1980 Lincoln Continental Mark VI as around $1800 or nearly 10% of its retail price.

The trend can only continue upwards. Another authoritative American source estimates that the world automotive industry will use about $600 million-worth of semiconductor devices in the 1981 model year, rising to $1 billion-worth per year by 1985 — a compound annual growth rate of close to 30%. European crystal-gazers are hardly more cautious: Volkswagen, for instance, talk in terms of electronics constituting about 7% of the average car's manufacturing cost by 1988, compared to around 2% today.

I started this article by talking about the car industry's early reluctance to accept electronics. I'll finish by saying that today it couldn't do without them. Computers are now extensively used in designing new models. They're even running the assembly lines (you must have seen Fiat's brilliant 'Hand-built by Robots' advertising campaign). If there's any way to solve the automotive problems of the next two or three decades, electronics will be the key. **HE**

Electronic Circuit Design
No. 1
Selected Reprints from electronics today
Introduction
Since ETI was originally launched in Britain in April 1972 we have published nearly 5000 pages of editorial matter: much of this has been devoted to electronic projects of course. In our history we have republished the best of these projects in Top Projects No 1-No 7, we have also reprinted the Tech-Tips and other circuits in Circuits Book No 1 and No 2 and our beginners series Electronics-It's-Easy is now on its third reprint.
We have not however, until now, brought together the best features dealing with electronic design. Nearly 1500 pages have been devoted to this in recent years and this special is the first of a series of three which will bring together the best 250-300 of these.
Although some features are from quite early issues they have only been included because we feel that 'age has not withered them'.
We hope that the contents help the reader understand at least some of the aspects of electronic circuit design.
Halvor Moorshead
Editorial Director — ETI
Contents
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Touch Switch

Bet you'll think this project's a touch of genius. Ten sequential outputs, or build it like a bistable. All under perfect, personal, fingertip control.

TOUCH SWITCHES have begun to appear in all kinds of places . . . lifts have them, TVs have them; even personal computers have them. Well, now you can have one too, for the price of a couple of chips and a handful of discrete components.

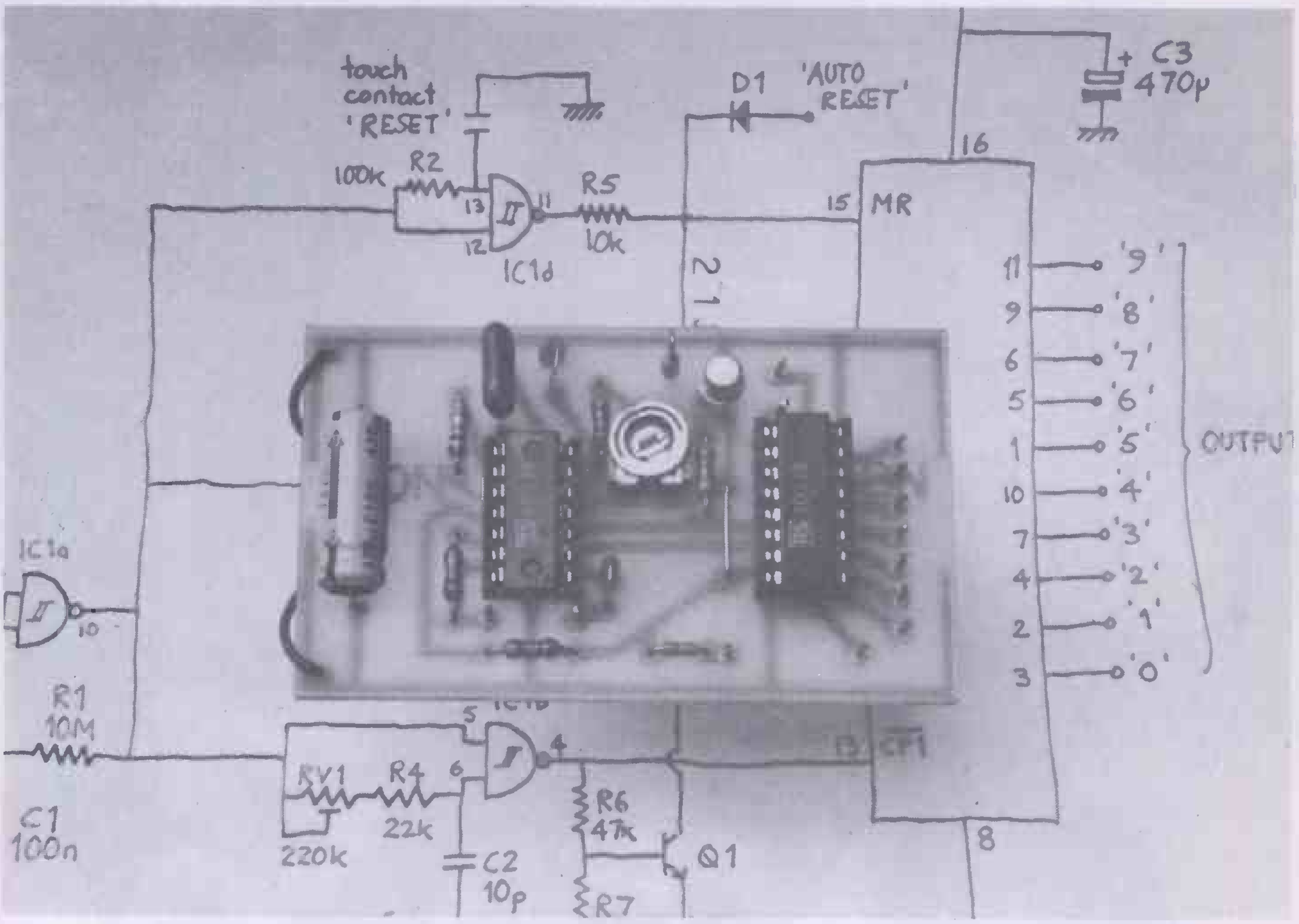
Now is your chance to get the world under your thumb. Featuring up to ten sequentially selected outputs and an overiding reset input, the project is a cinch to build. Make one for fun or control your radio, Hi-Fi, goldfish, etc.

Many commercial touch sensors rely on the electrical mains for an energising field. This circuit can be powered from a single nine volt battery, a PP3 will do, has low current consumption, uses only a few cheap components and is simple to construct. Also, above all, it is safe.

CONSTRUCTION

To avoid the introduction of stray circuit capacitances and ensure reliable and repeatable operation, we strongly recommend that our PCB design is used. It is very small and should be quite easy to make or cheap to buy. There is only one link to make on the board. Make sure you get the diode and electrolytic capacitor the right way round. That goes for the integrated circuits too. It is quite okay to use sockets, in fact we would recommend it. That way you can always use the chips again and anyway, sockets make substitution easy if (horror of horrors!) the project fails to work first time.

You can try different layouts for the touch sensors. We made up a special board. At its simplest, a touch sensor could consists of a piece of unetched PCB split



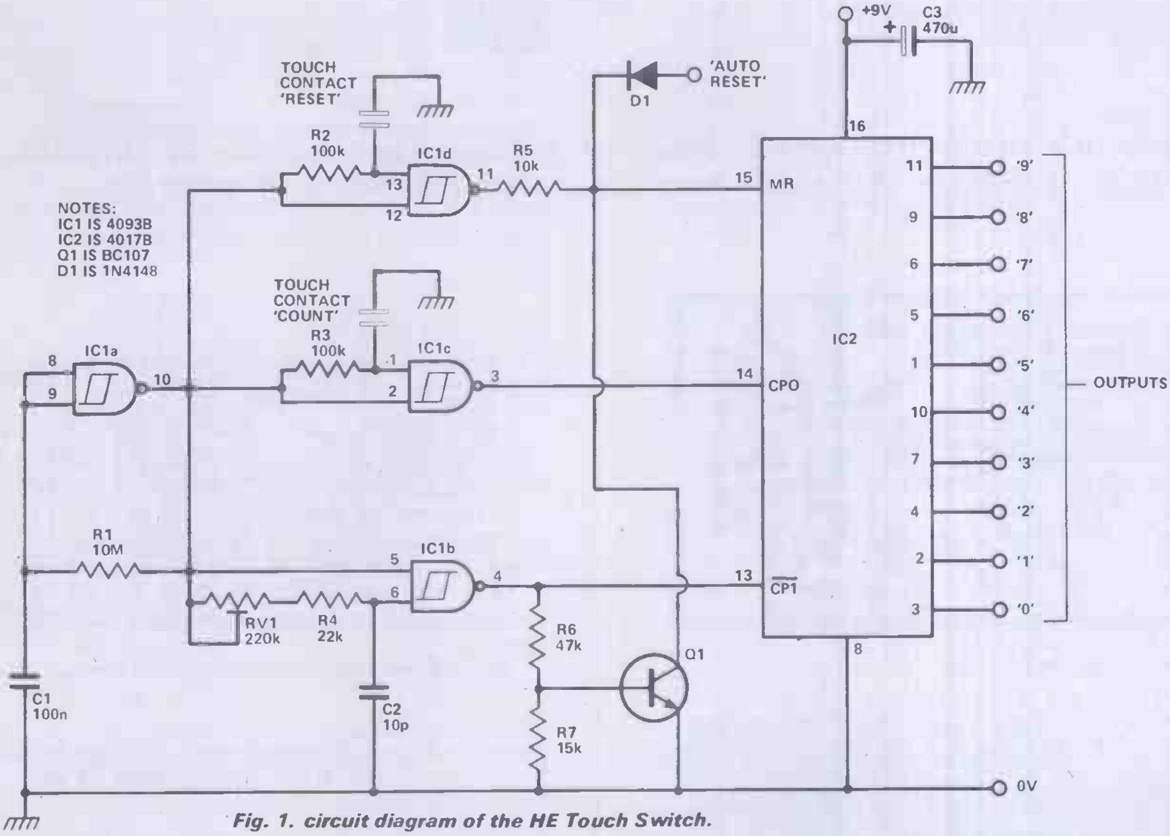


Fig. 1. circuit diagram of the HE Touch Switch.

How it Works

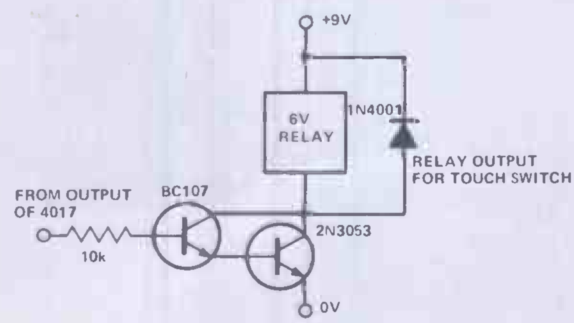
The circuit operates by using the hand as part of a capacitor in a critical timing circuit. When the detector contacts are touched, the extra capacitance introduced has the effect of delaying the transmission of a clock edge. The circuitry is driven by one single phase clock generated by IC1a whose output consists of a continuous stream of pulses at about one Hertz with a nominal fifty percent duty cycle. A delayed and inverted clock is generated from this signal by IC1b whose output drives one of the clock inputs of decade counter-decoder IC2.

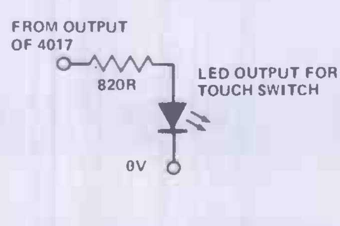
This chip does all the work of decoding the clock signals and provides a reset input which can be controlled from the touch circuitry or driven directly by one of the outputs of the chip. For example, to reset to zero after the 'fifth' count has been reached, just connect output 'six' (pin 5, IC2) to the 'auto reset' input at the anode of D1. If no connection is made to D1 then the circuit will cycle through all ten outputs. By connecting output 'two' (pin 4, IC2) to 'auto reset' and taking an output from 'one' or 'zero' (pins 2, 3 IC2), the circuit will operate as a bistable: one touch turning the output on; another touch resetting the output to off. The 'reset' touch contact may be left disconnected in this case.

A certain delay will always be introduced by IC1c, d owing to stray capacitance from the circuit board and connecting leads. This may be nulled out by adjustment of RV1 which should be set to minimum resistance consistent with reliable operation.

Two suggested output circuits are shown. The first lights a LED when the appropriate output is selected, the other circuit will drive a small relay whose contacts may be used to switch more power.

The touch 'reset' circuit operates in a similar manner to the 'count' circuit. A glance at the timing diagram should make things clear.





into two copper lands by scoring or filing a line down the middle breaking the copper, but leaving the insulating board intact. Make sure no copper whiskers remain to bridge the copper lands as these would prevent the circuit from working at all. Sensitivity will depend to an extent on the physical size of the touch contacts and the area covered by, for example, the thumb or palm. Reliable operation was obtained using the prototype with the touch contacts covered by a layer of adhesive plastic film. Use of a coloured film like the sort used to cover books could make an attractive addition to the project. Use your imagination and do not be afraid to experiment. Finally, a word of caution to anyone thinking of controlling mains powered equipment. This is okay so long as you make sure you use a relay whose contacts are rated for the job and keep all mains wiring away from the rest of the project. Build one now and give your projects a little touch of class!

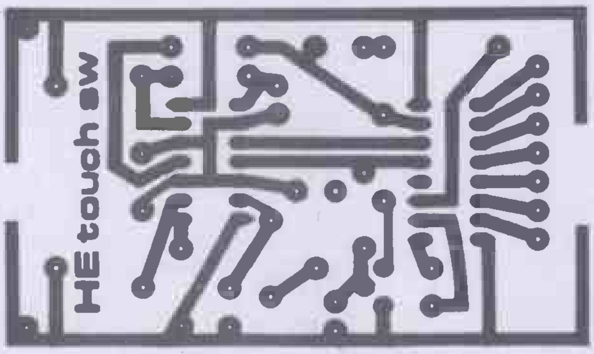


Fig. 2. PCB for the Touch Switch

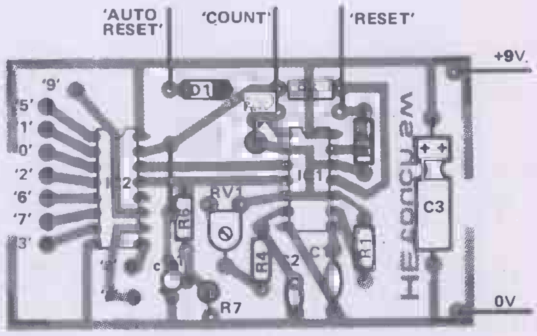
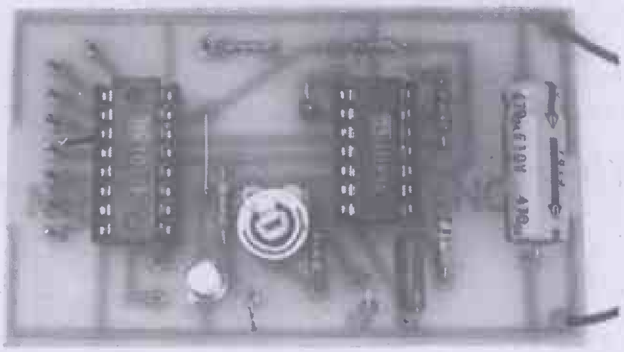
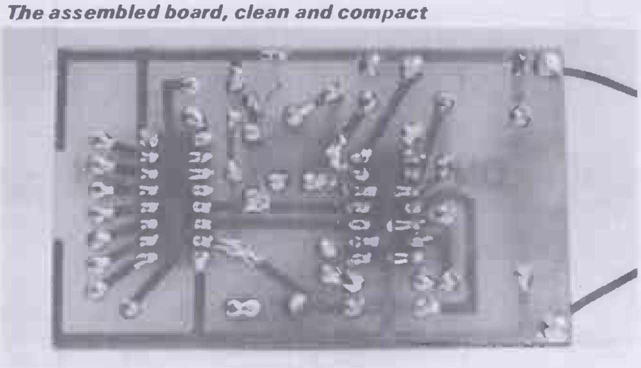


Fig. 3. Overlay diagram for the Touch Switch.



The assembled board, clean and compact



Good soldering pays off. Practice makes perfect

Use of a PCB makes construction a snap!

Parts List

RESISTORS (All ¼W, 5%)

R1	10M
R2, 3	100k
R4	22k
R5	10k
R6	47k
R7	15k

POTENTIOMETER

RV1	220k submin. horiz. preset

CAPACITORS

C1	100n polyester
C2	10p polystyrene
C3	470μ electrolytic

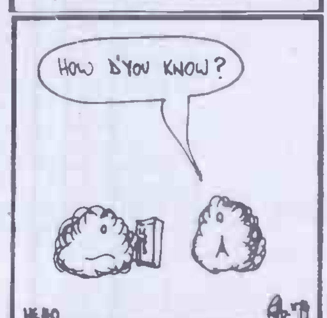
SEMICONDUCTORS

Q1	BC107
IC1	4093B
IC2	4017B

Buylines

All the components for this project should be readily available from the larger mail-order suppliers.


THIS THING MUST BE REALLY OLD!


HOW D'YOU KNOW?
HE40


ALL THE I.C.'s ARE LABELLED IN LATIN!!

electronics today international

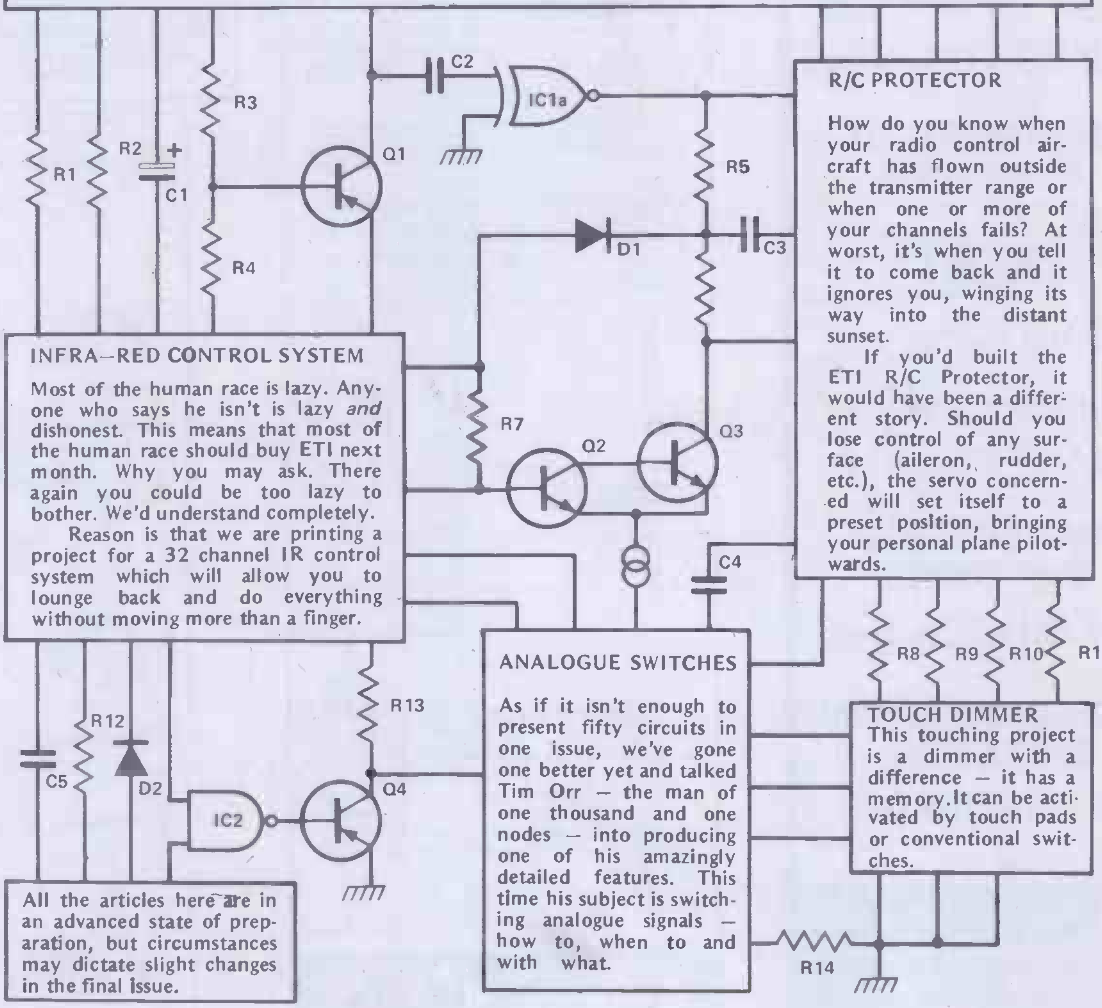
What to look for in the April issue: on sale March 7th

CIRCUIT SUPPLEMENT

Next months ETI carries something really special — a SIXTEEN PAGE circuit supplement for the experimenter. All the circuits have been tried and tested by us, making this the most reliable reference yet. If there is anything you need a circuit for or any circuits you need something for this is the place to find it. No less than 50 in all. Half a hundred of the best you'll find anywhere.

Well worth keeping for that inevitable future time when you'll NEED ONE or more of the priceless little gems lying amid these pages.

50 TESTED CIRCUITS TO BUILD



R/C PROTECTOR

How do you know when your radio control aircraft has flown outside the transmitter range or when one or more of your channels fails? At worst, it's when you tell it to come back and it ignores you, winging its way into the distant sunset.

If you'd built the ETI R/C Protector, it would have been a different story. Should you lose control of any surface (aileron, rudder, etc.), the servo concerned will set itself to a preset position, bringing your personal plane pilotwards.

INFRA—RED CONTROL SYSTEM

Most of the human race is lazy. Anyone who says he isn't is lazy *and* dishonest. This means that most of the human race should buy ETI next month. Why you may ask. There again you could be too lazy to bother. We'd understand completely.

Reason is that we are printing a project for a 32 channel IR control system which will allow you to lounge back and do everything without moving more than a finger.

ANALOGUE SWITCHES

As if it isn't enough to present fifty circuits in one issue, we've gone one better yet and talked Tim Orr — the man of one thousand and one nodes — into producing one of his amazingly detailed features. This time his subject is switching analogue signals — how to, when to and with what.

TOUCH DIMMER

This touching project is a dimmer with a difference — it has a memory. It can be activated by touch pads or conventional switches.

All the articles here are in an advanced state of preparation, but circumstances may dictate slight changes in the final issue.

Hobby Chit~Chat

As a follow-up to last month's 'Chit-Chat', we look now at alarm-call generator circuits and methods of connecting them up to self-latching burglar alarms.

IF YOU BUILT or intend to build any of the relay-output burglar alarm circuits described in last month's 'Chit-Chat' feature, you'll need to couple your circuit up to a suitable alarm-call generator (a bell, siren or electronic siren) in order to make a working burglar alarm system. This month's 'Chit-Chat' tells you how to make those connections and describes some practical 'electronic siren' circuits that you can build.

An alarm-call generator may use the same battery supply as the actual burglar alarm (see Fig 1a) or may be powered from it's own supply battery (Fig 1b). The rules for deciding which alternative to use are quite simple. First, if the burglar alarm and the generator voltages are not the same, you must obviously use individual supplies for each. Second, if the burglar alarm is NOT self-latching via a pair of relay circuits, you should use separate supplies: the reason for this is that the alarm-call generator impresses a lot of 'noise' on it's battery supply and this noise may cause malfunctioning of a non relay-latching burglar alarm that uses the same supply.

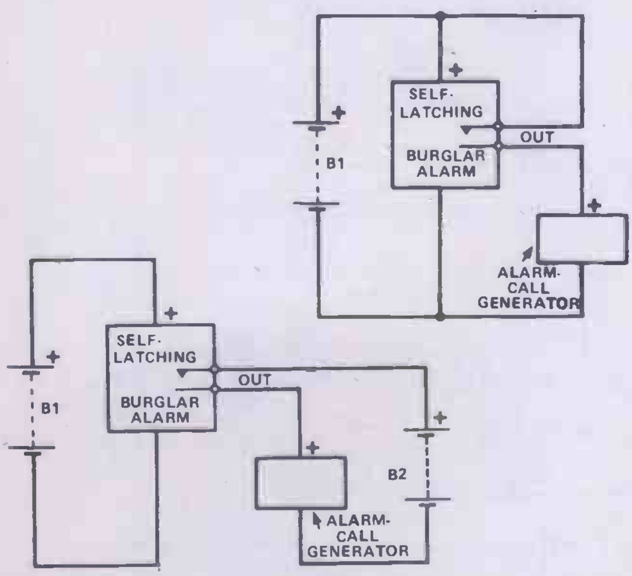


Fig. 1. Interfacing a direct-action alarm call generator (bell, siren etc) to a self-latching burgular alarm using (a) common or (b) individual supply batteries.

Thus, you can safely use a common supply only if the burglar alarm is self-latching via a relay contacts and if it has the same voltage rating as the alarm-call generator. Four of the burglar alarm circuits described in last month's 'Chit-Chat' were of the self-latching 'relay' type, so from this point on we'll confine the discussion to this type of alarm circuit.

AUTO-TURN-OFF ALARM ACTION.

Once a self-latching alarm has been activated it sounds the generator until the systems batteries run flat if the connections of Fig 1 are used. An alternative action, in which the generator sounds for only a pre-set period (typically 5 to 15 minutes) can be obtained by interposing an auto-turn-off unit between the burglar alarm and the alarm-call generator, as shown in Fig 2. This unit incorporates a relay that closes and completes the generator circuit as soon as the burglar alarm activates, but then automatically turns off and disables the generator after some pre-set period. Fig 2 shows alternative ways of interconnecting the three units when (a) common or (b) dual supply batteries are used.

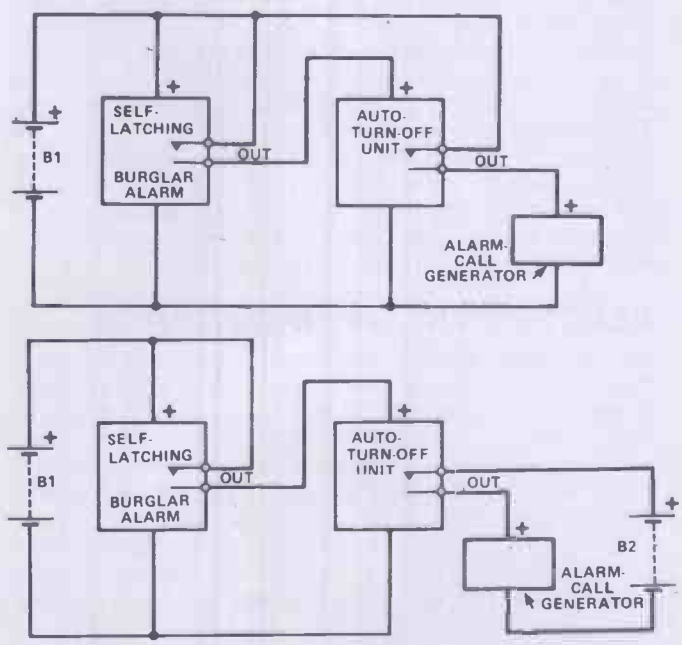


Fig. 2. Interfacing an alarm call generator to a self-latching burgular alarm via an auto-turn-off unit, using (a) common or (b) individual batteries.

Figure 3 shows the practical circuit of an auto-turn-off unit that gives a basic timing period of 8 minutes: the period is proportional to the CI value and can be doubled (for example) by giving CI a value of 200n.

The operating principle of the Fig 3 circuit is quite simple. ICI is a 555 'clock' generator and IC2 is a 14-stage binary counter which changes state on the arrival of each 8192nd clock pulse. When power is first applied to the circuit the output of IC2 is set to the 'low' state via C2. As the output goes low the relay is driven on via Q1 and contacts RLA/1 close and complete the

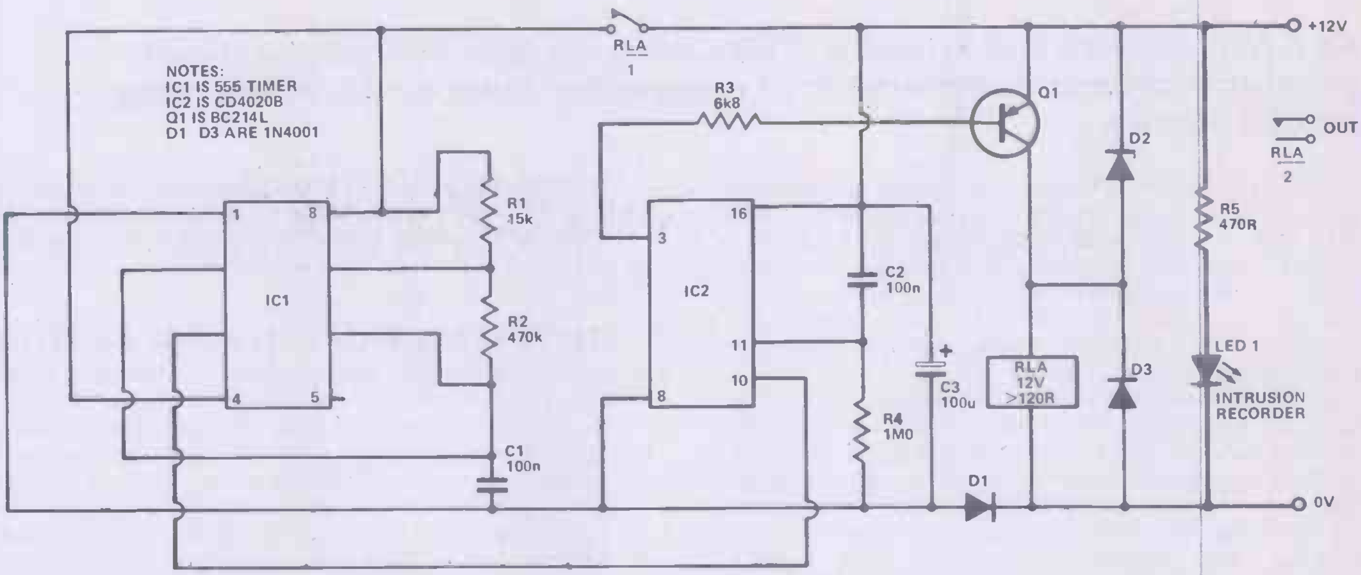


Fig. 3. A practical auto-turn-off unit giving a delay of about 8 minutes. The delay can be increased by using a larger value for CI.

supply connections to the IC1 clock generator, which then starts operating. On the arrival of the 8192nd clock pulse (after roughly 8 minutes with the component values shown) the output of IC2 flips high and turns the relay off via Q1, thereby opening contacts RLA/1 and breaking the supply connections to the clock generator. The operating sequence is then complete.

Note in this circuit that LED1 illuminates so long as a voltage supply is connected from the output of the self-latching burglar alarm. The LED thus acts as a visual 'Intrusion Recorder' which continues to glow even when the alarm-call generator has switched off.

ELECTRONIC SIREN CIRCUITS

An alarm-call generator can take the form of an electro-mechanical bell or siren or of an electronic siren or sound generator. In some cases it may be an advantage to use two types of generator, either operating directly in parallel or operated simultaneously via a multi-contact relay. An electronic siren may, for example, be used to sound inside a house while an alarm bell sounds outside.

Electronic 'sirens' can take a number of different forms and may be designed to generate quite distinctive sounds. Figures 4 to 8 show five useful designs that can easily be built by the electronics hobbyist.

The Fig 4 circuit generates a 'bleep-pause-bleep-pause' pulsed tone signal. IC1a-IC1b form a 1Hz astable multivibrator which alternately gates the IC1c-IC1d 1kHz oscillator on and off. The resulting pulsed tone signal is amplified by Q1 and Q2 and reproduced at a level of several watts in the speaker. The available power output of this circuit is limited by the '18 volts maximum' of the supply line.

The permissable maximum voltage (and thus the available power output) of the above circuit can be increased by modifying the circuit so that the supply to IC1 is limited to 12 volts by a resistor and zener diode, as shown by R4 and ZD1 in Fig 5. This particular circuit generates a 'dee-dah' warble-tone alarm, similar to a

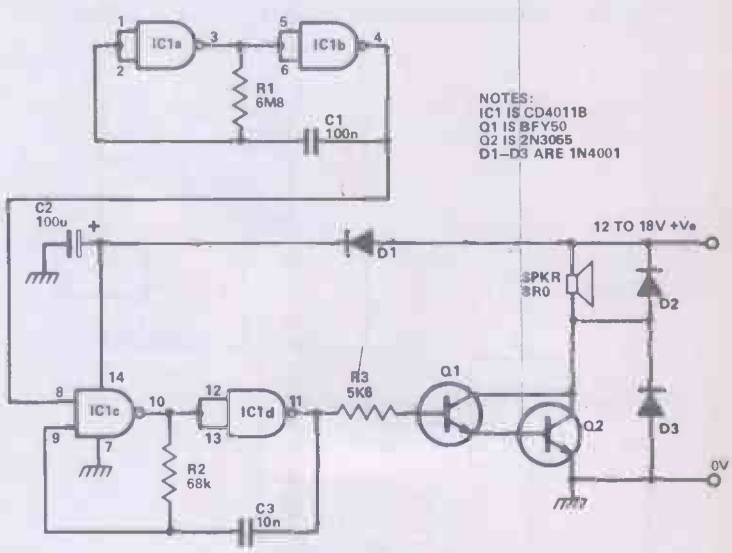


Fig 4. Higher power pulsed-tone alarm call generator.

British police car siren. The circuit is similar to that of Fig 4, except that the 1hz astable is used to frequency-shift the IC1c-IC1d oscillator.

The frequency-shift 'symmetry' of the circuit

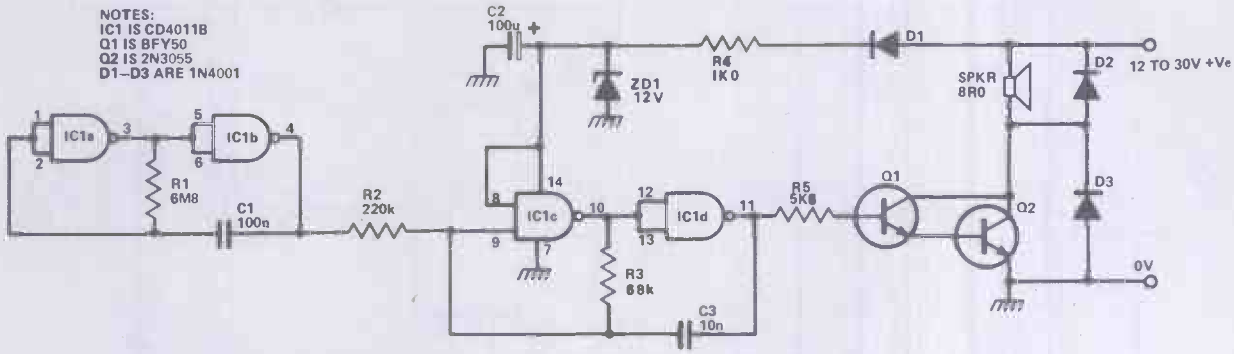


Fig. 5. High-power warble-tone alarm call generator.

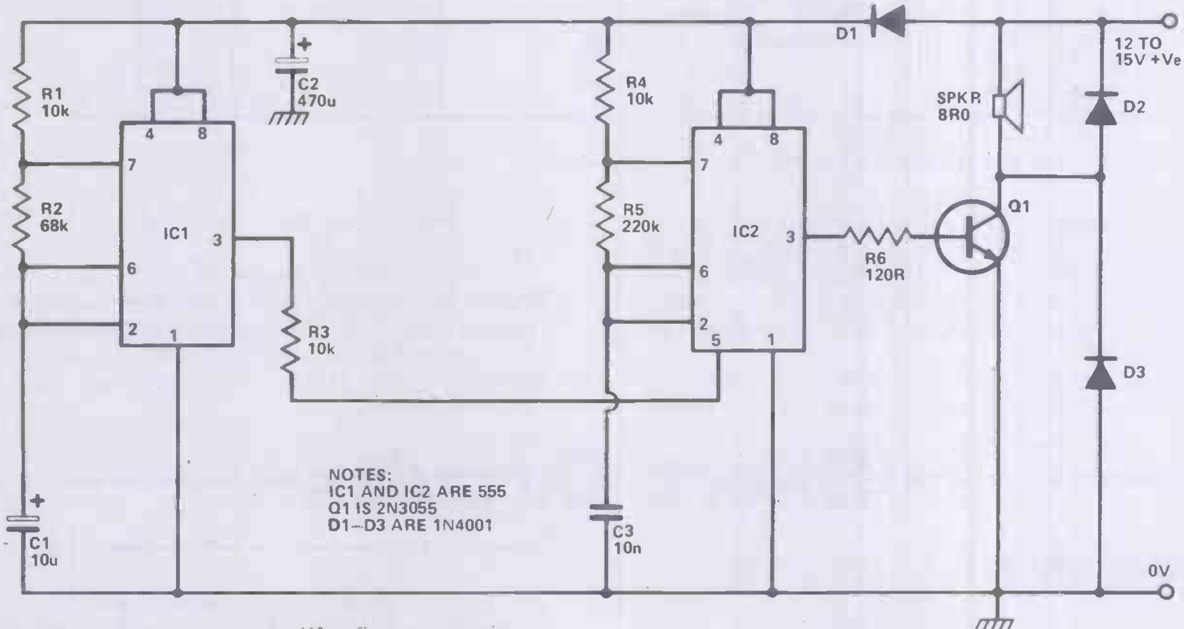


Fig. 6. Alternative warble-tone alarm call generator simulates a British police car siren.

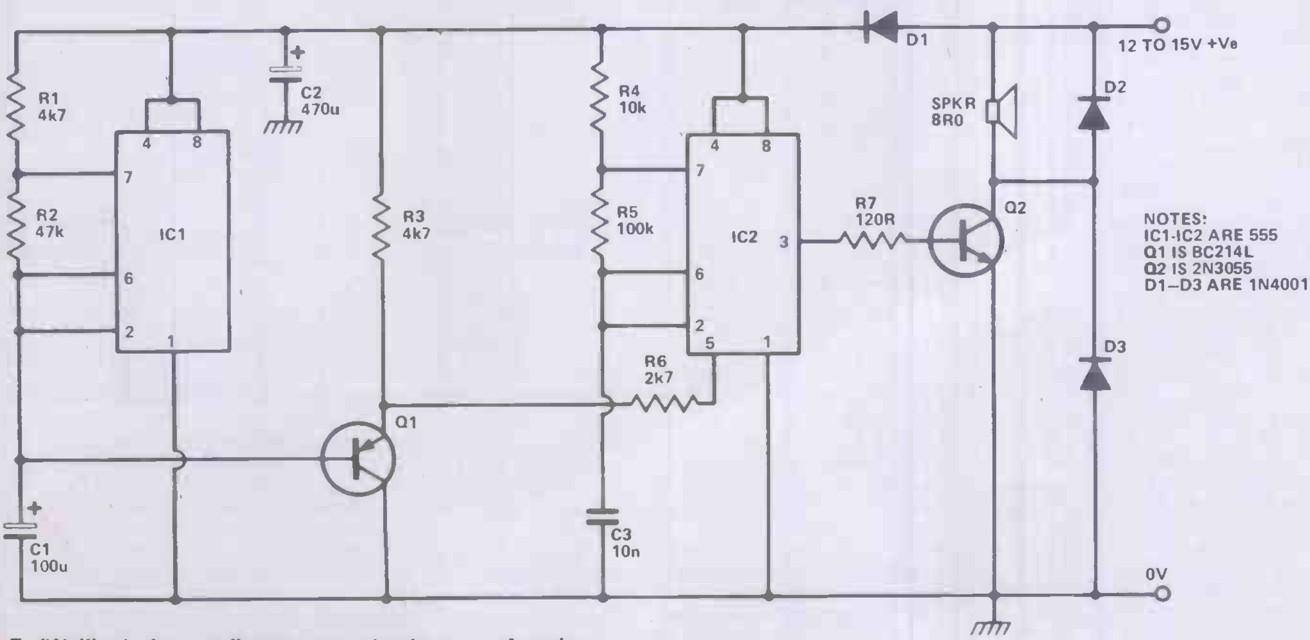


Fig. 7. 'Wailing' alarm call generator simulates an American police siren.

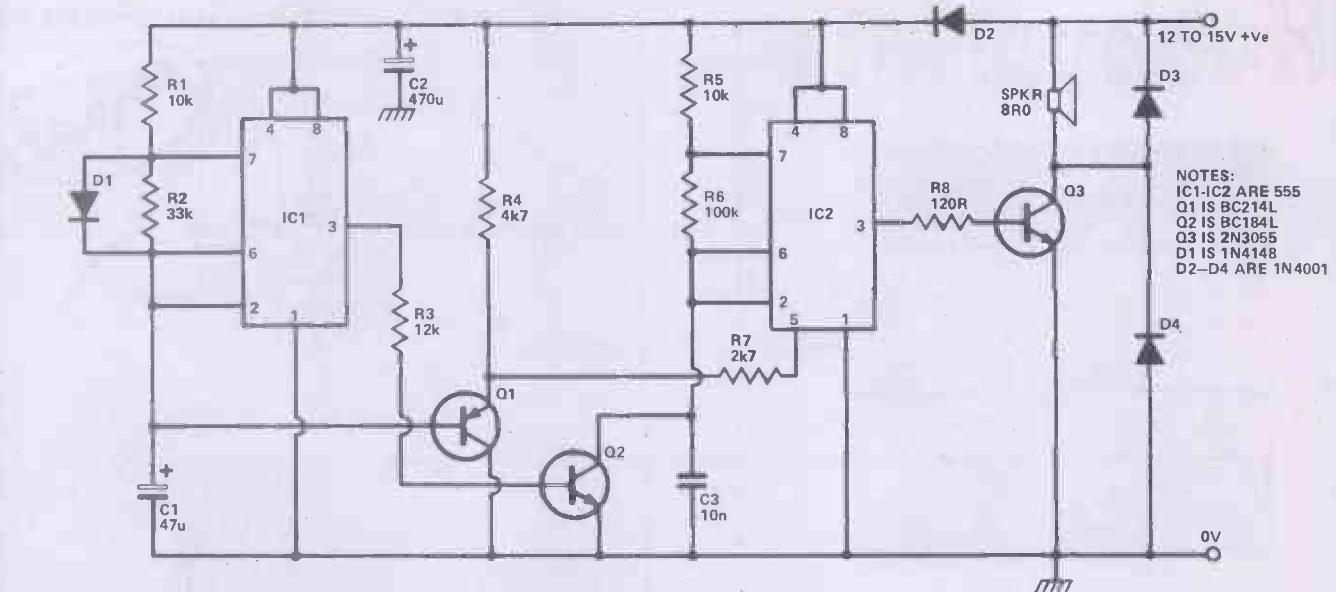


Fig. 8. 'Red-Alert' alarm call generator simulates 'Star Trek' alarm signal.

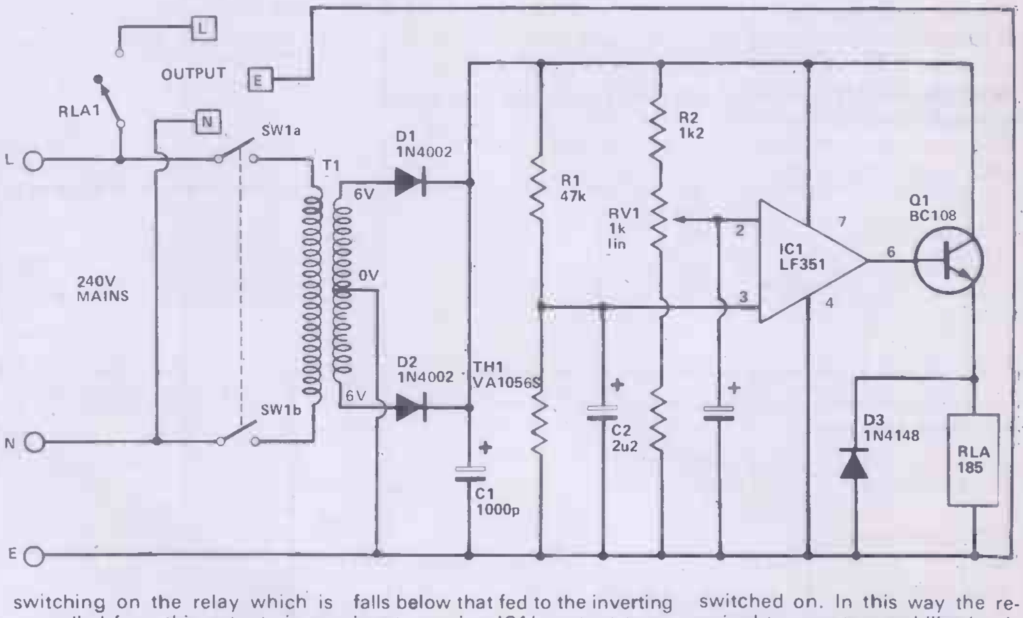
depends somewhat on the characteristics of the individual chip that is used in the IC1 position. Figure 6 shows an alternative warble-tone generator that does not suffer from this defect. The modulation frequency of this circuit can be varied via R2 and the 'tone' frequency can be varied via R5.

Figure 7 shows a variation of the above circuit. This particular design generates a 'wailing' or alternately rising and falling tone, similar to that of an American police car siren.

Finally, the Fig 8 circuit generates a 'zeep-zeep' sound that is similar to the 'Red Alert' alarm signal used in the 'Star Trek' programme. The period or interval of this signal can be varied via R2 and the tone can be varied via R6. This circuit is an ideal project for the experimenter. **HE**

Short Circuits

THERMOSTAT



This simple thermostat will stabilise temperatures to within a fraction of one degree Centigrade. It covers a range which extends from a few degrees C to over 35 degrees C, and is therefore suitable for use as a room thermostat, a thermostat for photographic solutions, etc.

The circuit uses IC operational amplifier IC1 as a voltage comparator. If the voltage at its non-inverting (+) input is higher than that at the inverting (—) input, the output goes to virtually the full positive supply voltage. If the comparative input states are reversed, the output assumes a very low voltage. The inverting input is fed with a reference voltage which is taken from the slider of RV1; the latter acting as the temperature control. The non-inverting input is fed a potential divider which consists of R1 and Th 1.

Th1 is a negative temperature coefficient thermistor, and its resistance varies according to its temperature, with increased temperature causing decreased resistance. If the voltage produced by Th1 and R1 is less than that set at RV1's slider, IC1's output will go high, switching on the relay which is controlled from this output via an emitter follower buffer stage which utilizes Q1. Power is then connected to the heater by RLA1, and the room temperature (or whatever) starts to rise. This causes a reduction in the resistance of Th1, and the voltage fed to IC1's non-inverting input. This voltage soon falls below that fed to the inverting input, causing IC1's output to go low, the relay to de-energise, and the heater to be switched off. The temperature then falls, causing Th1's resistance to increase, and a higher voltage to be fed to the non-inverting input of IC1. This soon results in IC1's output going high again, and the heater being switched on. In this way the required temperature stabilisation is obtained.

Make sure that the relay contacts are capable of handling the currents involved (which will probably be quite high). The thermistor must be fitted in a watertight probe if it is to be used in photographic solutions.

Hobbyprints

We're just etching to tell you about HOBBYPRINTS, we know you won't be able to resist them. They're so good we've even patented the idea (1445171 and 1445172). If you're board with all those untidy strip boards or semi-permanent bread boards then read on.

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Please note that HOBBYPRINT L is £1.20. Print N (Dec HE) is in two parts Part (b) contains the Hebot print and is available for 40p. Print (a) is still 80. The HOBBYPRINTS for Jan 80 are in two parts. (a) has the Cap Counter and PSU, (b) has Digi-Die, Hebot Loop Drive and Crosshatch generator. Each costs 80 pence.

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Please mark the letter(s) of the HOBBYPRINTS on the outside of the envelope.

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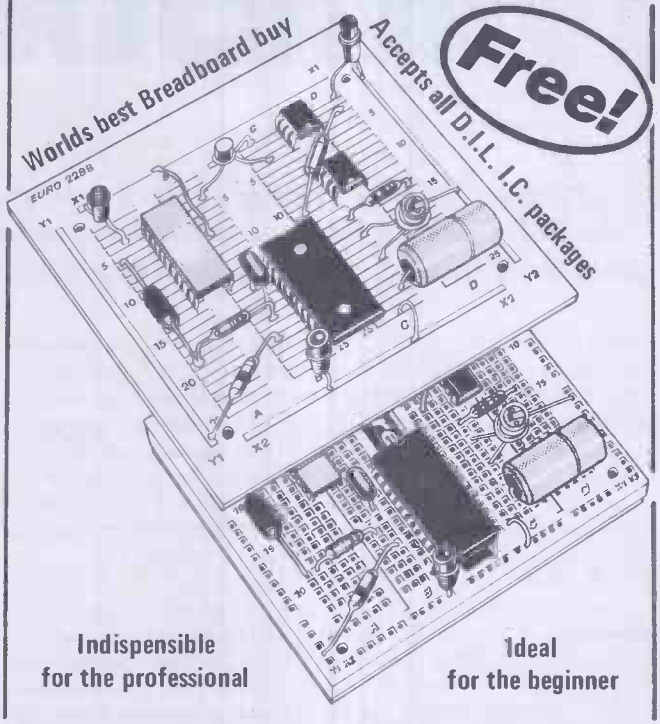
Now the EuroSolderBoard



Design on a EuroBreadBoard — Instal on a EuroSolderBoard

First the EuroBreadBoard
Will accept 0.3" and 0.6" pitch DIL IC's, Capacitors, Resistors, LED's, Transistors and components with up to .85mm dia leads.
500 individual connections PLUS 4 integral Power Bus Strips along all edges for minimum inter-connection lengths.
All rows and columns numbered or lettered for exact location indexing (ideal for educational projects)
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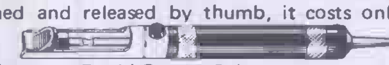
And don't forget the EuroSolderSucker
Ideal for tidying up messy solder joints or freeing multi-pin IC's, this 195mm long, all metal, high suction desoldering tool has replaceable Teflon tip and enables removal of molten solder from all sizes of pcb pads and track. Primed and released by thumb, it costs only £7.25 including VAT & PP



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Miniboards

6 WATT SIREN

A state-of-the-art project to terrify intruders and pussy cats. A police-like "de-dah" alarm that produces a 6-watt output in an 8 ohm speaker when powered from a 12-volt battery supply.

THIS NIFTY LITTLE DESIGN uses the very latest advances in semiconductor technology to implement a very compact, inexpensive, yet exceptionally powerful alarm-sound generator unit that can easily be incorporated into an existing burglar alarm system or similar "security" device. The alarm produces a police-like "dee-dah" signal at levels up to 6-watts in an 8 ohm speaker when powered from a 12-volt battery supply and incorporates a number of unusual features.

The alarm circuit incorporates a basic alarm-signal generator, followed by a power amplifier stage. The alarm-signal section of the unit is designed around an inexpensive CMOS integrated circuit that consumes virtually zero "standby" power. The power amplifier stage is a real state-of-the-art device, a low-cost VMOS power FET which also consumes virtually zero current when in the "standby" mode. Consequently, the unit does not need a separate on/off switch and can be left permanently connected to a 12-volt battery supply. The alarm can be activated either by closing push-button switch PB1, or by applying +12 volts to the junction of R1 and R2 (the low end of PB1).

CONSTRUCTION AND USE

The unit uses relatively few components and can be built in less than one hour. The components are assembled on a standard 1 inch×2½ inch strip of Veroboard, as shown in the photos. Start construction by breaking the copper strips as indicated and then solder the nine wire links into place. Next, solder a suitable IC holder into position and then assemble the rest of the components, taking care to observe the polarities of C1, D1, IC1 and Q1.

When construction is complete, double-check all wiring and then connect the unit to a suitable 8R0 speaker and a 12 volt battery supply, connect PB1 in place and give the unit a functional check by closing the switch. The unit should produce an ear-splitting "dee-

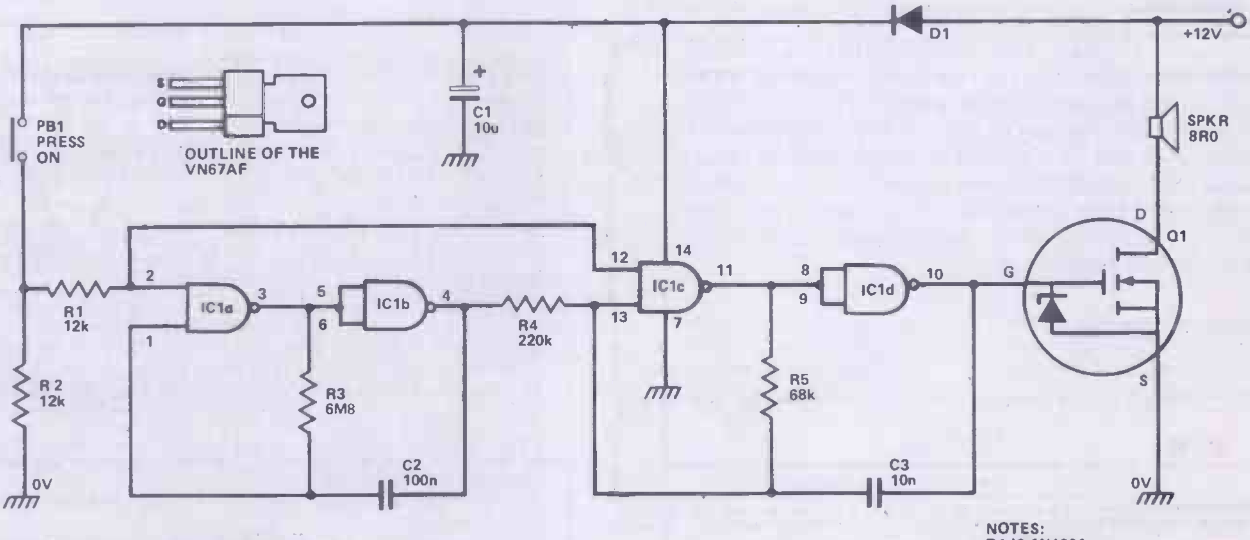


Fig. 1. Circuit diagram of the 6 watt siren.

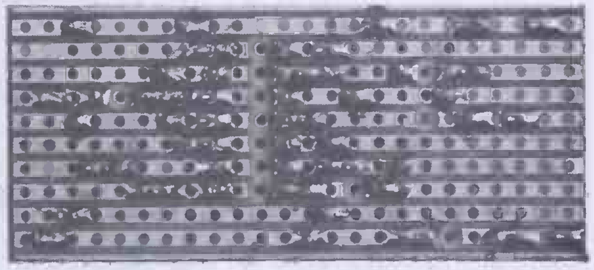
How It Works

IC1a and IC1b are wired as a slow astable multivibrator and IC1c-IC1d are wired as a fast astable. Both these astables are "gated" types, which can be turned on and off via PB1. The output of the ICa-IB1b slow astable is used to modulate the frequency of the IC1c-IC1d fast astable, and the output of the fast astable is fed to the external speaker via the Q1 VMOS power FET amplifier stage.

Normally, with PB1 open, both astables and Q1 are inoperative and the circuit consumes virtually zero standby current. When PB1 is closed both astables operate and the frequency of the fast astable is modulated by the slow astable to produce a "dee-dah" signal, which is passed to the speaker via the Q1 power amplifier stage. D1 and C1 are used to ensure that the astable actions are not adversely influenced by voltage transients induced into the battery supply leads via the speaker.

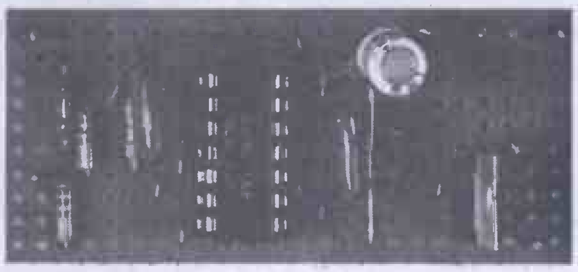
dah'' alarm sound. Note that the speaker used in the system must be an 8RO type with a power rating greater than 6 watts.

If you want to use this unit in conjunction with an existing burglar alarm system, you can either replace PB1 with a set of relay contacts that are activated via the burglar alarm system, or possibly can use the burglar alarm to activate the generator directly by applying 12 volts to the R1-R2 junction under the ''alarm'' condition. **HE**



Above. Component insertion layout. Note the orientation of Q1.

Below. Underside of the Miniboard 6 watt siren. Ensure that cuts in the track are made in the correct places.



Parts List

MINIBOARD No. 7

RESISTORS (All ¼w, 5%)	
R1, 2	12k
R3	6M8
R4	220K
R5	68K
CAPACITORS	
C1	10µ 16V Electrolytic
C2	100n Polyester
C3	10n Polyester
SEMI-CONDUCTORS	
D1	1N4001
Q1	VN67AF
IC1	CD4011B
MISCELLANEOUS	
SPKR	8RO, 10 watt
PB1	Push button switch

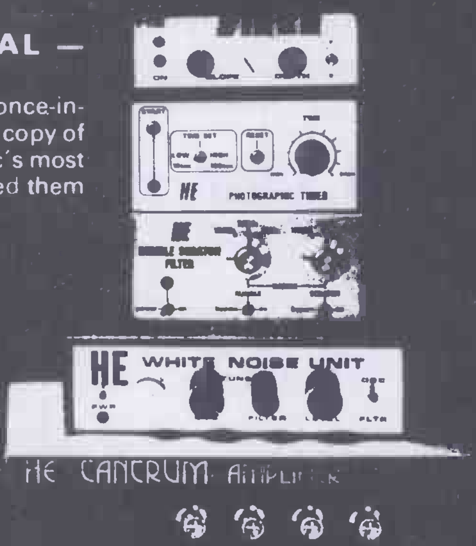
Buylines

The only component that is difficult to find is Q1, the VN67AF VMOS power FET. It can be obtained from J. W. RIMMER, 367 GREEN LANES, LONDON N4 1DY. For price, phone 01-800 6667.

HOBBY ELECTRONICS PROJECT SPECIAL — VOLUME 1

From deep inside the HE specials department comes this once-in-a-lifetime opportunity. You could be one of the first to own a copy of this special re-publication containing 25 of Hobby Electronic's most popular projects. Cover price will be just £1.25. If you missed them first time around then this is your big chance.

More details next month.



COMING SOON!

DISPLAY LIGHTING KITS

Each unit has 4 channels (rated at 1KW at 240V per channel) which switch lamps to provide sequencing effects, controlled manually or by an optional opto isolated audio input.

DL 1000K
This kit features a bi-directional sequence, speed of sequence and frequency of direction change being variable by means of potentiometers. Incorporates master dimming control. **£14.60**

DLZ1000K
A lower cost version of the above, featuring undiractional channel sequence with speed variable by means of a preset pot. Outputs switched only at mains zero crossing points to reduce radio interference to minimum. **£8.00**

Optional Opto Input DLA1 **60p**

INTEGRATED CIRCUITS

555 Timer	21p
741 Op. Amp	19p
AY-5-1224 Clock	£2.60
AY-5-1230/2 Clock/Timer	£4.20
AY-3-1270 Thermometer	£8.20
ICL7106 DVM (LCD drive)	£7.00
LM377 Dual 2W Amp	£1.45
LM379S Dual 6W Amp	£3.50
LM380 2W Audio Amp	80p
LM382 Dual low noise pre-amp	£1.00
LM386 250mW low voltage amp	75p
LM1830 Fluid Level Detector	£1.50
LM2907 f-v Converter	£1.40
LM3909 LED Flasher/Oscillator	55p
LM3911 Thermometer	£1.20
LM3914 Dot/Bar Driver	£2.10
MM57160 (stac) Timer	£5.90
MM74C911 4-digit display controller	£6.50
MM74C915 7-segment-BCD converter	96p
MM74C926 4-digit counter with 7-seg outputs	£4.50
S566B Touchdimmer	£2.50
S9263 Touchswitch 16-way	£4.85
TBA800 5W Audio Amp	58p
TBA810AS 7W Audio Amp	85p
TDA1024 Zero Voltage Switch	£1.00
TDA2020 20W Audio Amp	£2.85
ZN1034E Timer	£1.80

All ICs supplied with data and circuits. Data sheets only 5p.

DIGITAL VOLTMETER/ THERMOMETER KIT

Based on the ICL7106. This kit contains a PCB, resistors, presets, capacitors, diodes, IC and 0 5" liquid crystal display. Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer, using a single diode as the sensor. Requires a 3mA 9V supply (PP3 battery) **£20.75**

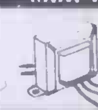
LEDs

LEDS	
0.1" Red	9p
0.1" Green	12p
0.1" Yellow	12p
0.2" Red	9p
0.2" Green	12p
0.2" Yellow	12p
0.2" clips	3p
Rectangular Red	18p
Rectangular Green	20p
Rectangular Yellow	21p

DISPLAYS

DL304 Red 0.3" c.c pin compatible with DL704	70p
DL307 Red 0.3" c.a. pin comp DL707	70p
DL847 Red 0.8" (pin comp. DL747) c.c.	£1.80
DL850 Red 0.8" c.c. (pin comp. DL750)	£1.80
DL727 Dual 0.5" c.a. Red	£1.50

MINI TRANSFORMERS



Standard mains primaries 240V a.c. 100mA secondaries

6-0-6V	80p
9-0-9V	85p
12-0-12V	90p

D.I.L. I.C. SOCKETS

8 pin	8p	18 pin	17p
14 pin	12p	28 pin	24p
16 pin	14p	40 pin	36p

Soldercon Pins 50p/100

24 HOUR CLOCK/APPLIANCE TIMER KIT

Switches any appliance up to 1kW on and off at preset times once per day. Kit contains AY-5-1230 IC, 0.5" LED display, mains supply, display drivers, switches, LEDs, triac, PCBs & full instructions.

CT1000K Basic Kit	£14.90
CT1000KB with white box (56 × 131 × 71mm)	£17.40
Ready Built	£22.50

CAPACITORS

Polyester 250V

0.01	6p	0.22	12p
0 002	6p	0.33	12p
0.033	7p	0.47	15p
0.047	7p	0.68	18p
0.068	7p	1.0	24p
0.1	7p	1.5	27p
0.15	11p	2.2	31p

Electrolytics A Axial R Radial

63V	1.0	R	3p	16V	10	R	3p
	2.2	R	3p		22	R	3p
	4.7	R	4p		33	R	3p
	10	R	5p		47	R	4p
	47	R	8p		100	R	5p
25V	22		6p		220	R	6p
	47	A	6p		470	R	9p
	100	A			1000	R	15p
	110	A	9p	10V	47	A	6p
	470	A	16p		100	A	6p
	1000	A	20p		220	A	6p

Tantalum (bead)

35V	0.1	7p	10V	22	12p
	0.22	7p	6.3V	33	12p
	0.47	7p		47	14p
	1.0	7p	3V	100	14p
25V	2.2	8p			
	4 7	9p			
	10	12p			

VOLTAGE REGULATORS

Available in 5V, 12V & 15V versions.

78L series 100mA pos.	26p
79L series 100mA neg.	60p
78 series 1A pos.	62p
LM317T adjustable 1 2V-37V 1.5A	£1.80

MINI KITS

These KITS form useful subsystems which may be incorporated into larger designs or used alone. Kits include PCB short instructions and all components.

TEMPERATURE CONTROLLER/THERMOSTAT
Uses LM3911 IC to sense temperature (80°C max.) and triac to switch heater. PCB (4 cm sq.) potentiometer, plus all other components included with instructions.
500W **£3.20** 1KW **£3.50**

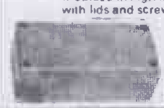
SOLID STATE RELAY
Ideal for switching motors, lights, heaters etc. from logic. Opto isolated with zero voltage switching. Supplied without triac. Select the required triac from our range. **£2.60**

BAR/DOT DISPLAT
Displays an analogue voltage on a linear 10-element LED display as a bar or single dot. Ideal for thermometers, level indicators etc. May be stacked to obtain 20 to 100 element displays. Requires 5-20V supply. **£4.75**

BURST FIRE/PROPORTIONAL TEMPERATURE CONTROLLER
Based on the TDA1024 Zero Voltage Switch this kit contains all the components required to make a "burst fire" power controller or a "proportional temperature" controller enabling the temperature of an enclosure to be maintained to within 0.5 C.
1.5KW **£5.25** 3KW **£5.55**

BOXES

Moulded in high impact ABS. Supplied with lids and screws. Black or white.



B2 95×71×35mm	65p
B3 115×95×37mm	78p

ZENER DIODES

400mW3.3V-30V	8p
1.3W 7.5-27V	15p

RESISTORS

¼W 22ohm-10M

Pack of 10 (one value)	10p
10 Packs (10 values)	80p

TRIACS

400V Plastic Case (Texas)

3A	49p	16A	90p
8A	58p	20A	165p
12A	70p	25A	190p
6A with trigger	80p		
8A isolated tab	65p		
Diac	18p		

ALL COMPONENTS ARE BRAND NEW AND TO SPECIFICATION. ADD VAT AT CURRENT RATE TO ABOVE PRICES PLUS 35p P&P. MAIL ORDER — CALLERS WELCOME BY APPOINTMENT.

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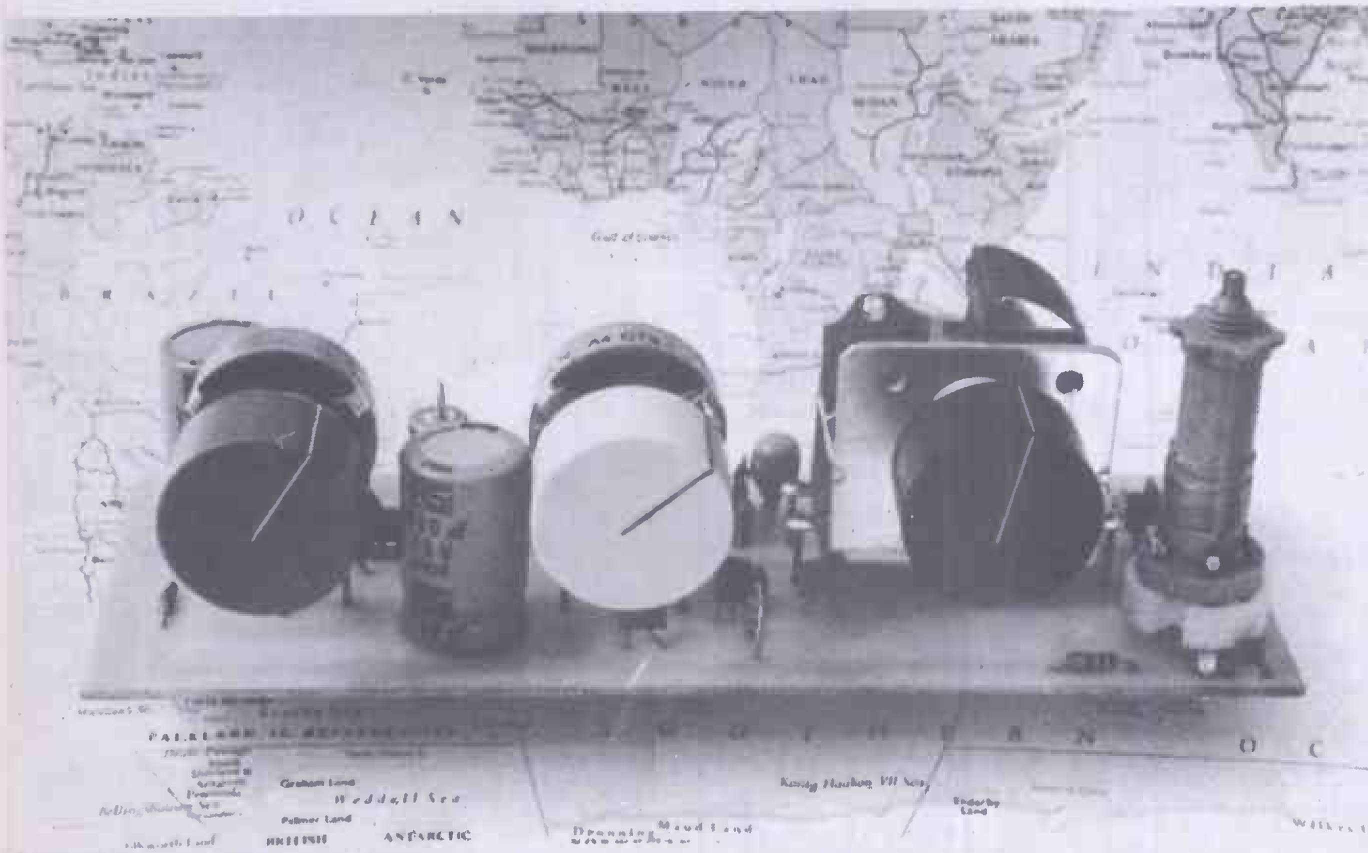
Short Wave Radio

Far away places with strange sounding names . . . Eavesdrop on the ether with this great project. 1 to 30 MHz in three sensitive and selective ranges.

IN THE BAD OLD DAYS OF RADIO, sometime after the appearance of crystal sets but before the superhet became a practical proposition a breed of radio receiver became popular called a TRF. The letters stand for 'Tuned Radio Frequency' and the circuits usually contained several tuned (that is highly selective) stages of radio amplification. As superhet (short for superheterodyne) receivers were developed the humble TRF became less popular. Superhets mix a local oscillator signal generated inside the receiver with the received signal to convert all signals to an arbitrary intermediate frequency before amplifying and detecting them. The advantage of this arrangement is that the IF amplifier can be optimised for one particular frequency giving a narrow 'passband' and good selectivity. The vast majority of modern radio receivers now use superhet circuits, even the cheap transistor pocket portables. Over the years, the radio spectrum has become increasingly crowded; especially the Short Wave bands and this has led to the development of a number of different modes of transmission. Amplitude modulation (AM) where the carrier wave is modulated in strength by the audio signal, is still used universally by commercial broadcasting stations at frequencies below VHF and very simple receivers, even a crystal set, can detect transmissions in this mode. However, many radio amateurs use continuous wave (CW) for morse code and single sideband (SSB) for speech. These signals are best resolved through the use of special detectors or with a direct conversion receiver. Many commercial short wave



The HE short wave radio spans the world.

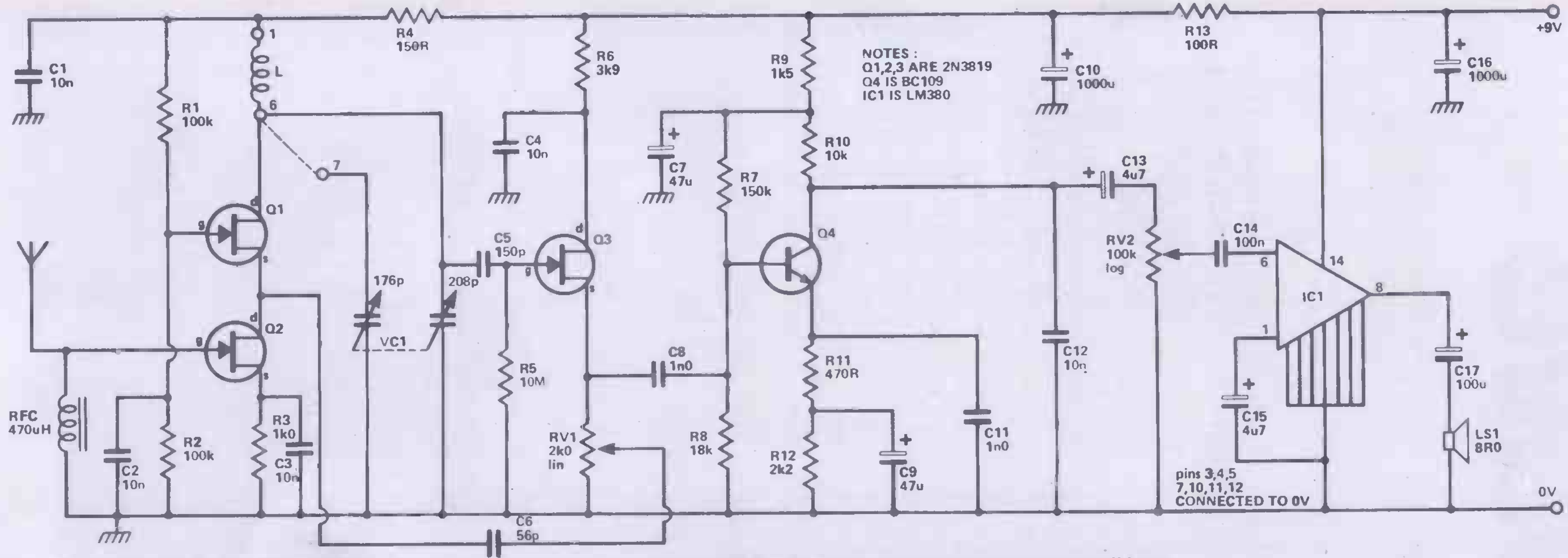


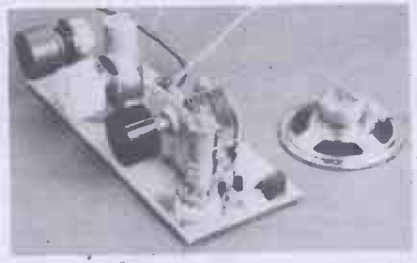
Fig. 1. Circuit diagram for the HE Short Wave Radio. For complete coverage of the SW Band you will need the three range coils (L), see parts list.

How it Works

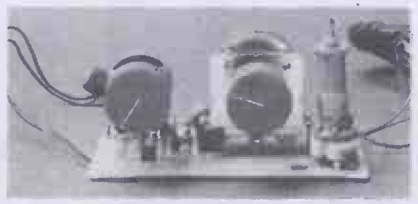
Q1 and Q2 form a broadband radio-frequency amplifier whose output is tuned by L (the Denco tuning coil) and VC1 (the variable capacitor). The circuit arrangement of Q1, Q2 may be unfamiliar. It is called a 'cascode' amplifier and has the advantage of minimising the effects of junction capacitance in the transistors which can restrict gain at high frequencies and may cause instability owing to unwanted phase shifts. Resistors R1, 2, 3 set the bias for the stage with the RF choke providing a DC return for the gate of Q2. Capacitors C2, 3 provide RF decoupling at appropriate points with R4, C1 decoupling the positive power supply to the whole stage; preventing unwanted signal feedback down the supply line.

The amplified RF signal 'tuned in' by VC1 is coupled to the gate of source-follower Q3 by C5. R5, 6 and RV1 set the DC conditions for this stage which acts as a buffer between the tuned circuit and the detector stage Q4. Reducing the loading on the coil makes the receiver more selective, especially important on the crowded Short Wave bands. A portion of the signal is tapped off from RV1 and fed back to the RF amplifier via C6. This technique, called 'regeneration', increases the gain of the stage and further improves the selectivity. The buffered RF signal at the source is coupled to Q4 by C8. Transistor Q4 is connected as a conventional common emitter stage with bias provided by R7, 8. Decoupling at RF is provided by C11, 12 while C9 decouples the stage at audio frequencies. This circuit has the advantage over a simple diode detector of providing some audio amplification. In fact, with a short aerial and a good earth there is sufficient output to drive a crystal earpiece directly. Just connect one wire to the collector of Q4 and the other wire to 0 V. R9 and C7 provide decoupling for the whole stage.

The audio output from Q4 is coupled to RV2 via C13. Potentiometer RV2 acts as the volume control and a portion of the signal across it is coupled to the input of audio amp IC1 via C14. Circuitry inside IC1 is decoupled by C15 and the audio output is coupled to the loudspeaker via C17. Capacitors C10 and C16 provide overall decoupling and help to prevent instability and spurious oscillations.



Use of shielded cable for the loudspeakers avoids instability problems.



No case is necessary, but use of our PCB is really essential,

Parts List

RESISTORS (All ¼W, 5%)

R1, 2	100k
R3	1k0
R4	150 R
R5	10M
R6	3k9
R7	150k
R8	18k
R9	1k5
R10	10k
R11	470R
R12	2k2
R13	100R

CAPACITORS

C1, 2, 3, 4, 12	10n Ceramic
C5	150p Ceramic
C6	56p Ceramic
C7, 9	47u Tantalum
C8, 11	1n Ceramic
C10, 16	1000u Electrolytic
C13	4u7 Electrolytic
C14	100n Ceramic
C15	4u7 Tantalum
C17	100u Electrolytic

POTENTIOMETERS
RV1 2k0 Lin
RV2 100k Log

VARIABLE CAPACITORS
Jacksons 00 208/176 SM. Dual ganged 208p-176p with slow motion drive.

INDUCTORS
RFC PCB Mouting miniature 470uH choke
Denco 'Blue' dual purpose coil. Ranges 3, 4, 5

SEMICONDUCTORS

Q1, 2, 3	2N3819
Q4	BC109
IC1	LM380

MISCELLANEOUS
B9A PCB mount valveholder. PCB,
8R speaker, 9 V battery (PP9 or similar)

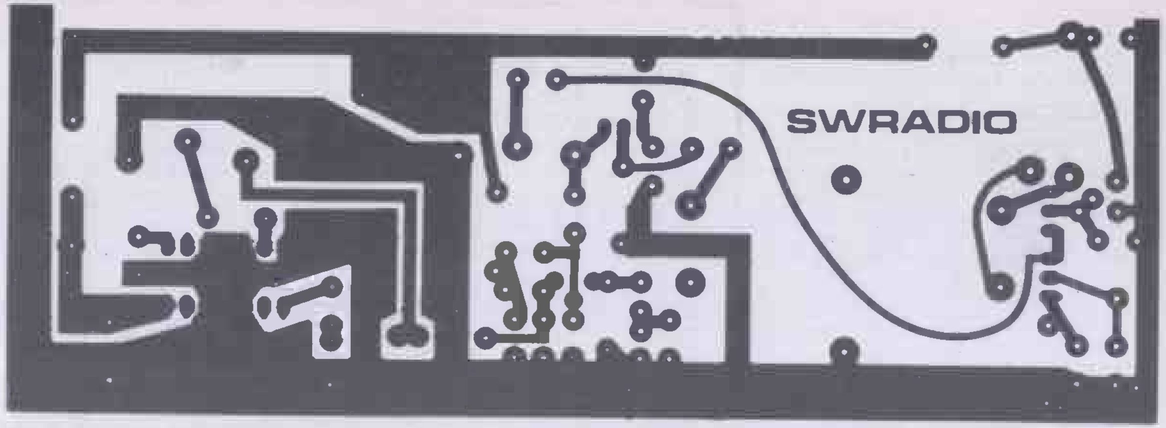


Fig. 2. The PCB foil pattern for the SW Radio. We strongly recommend you use our design.

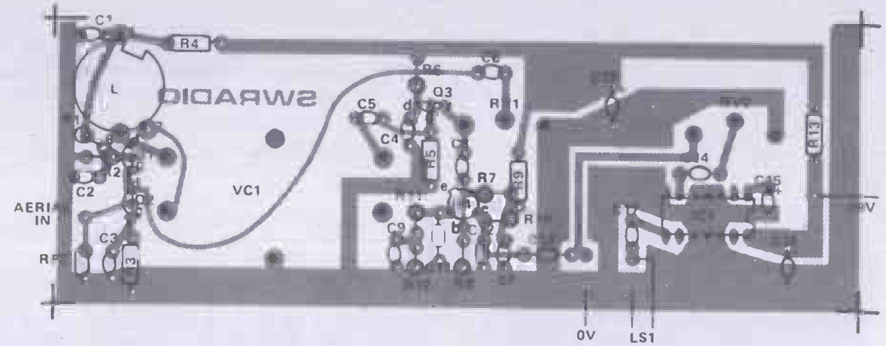
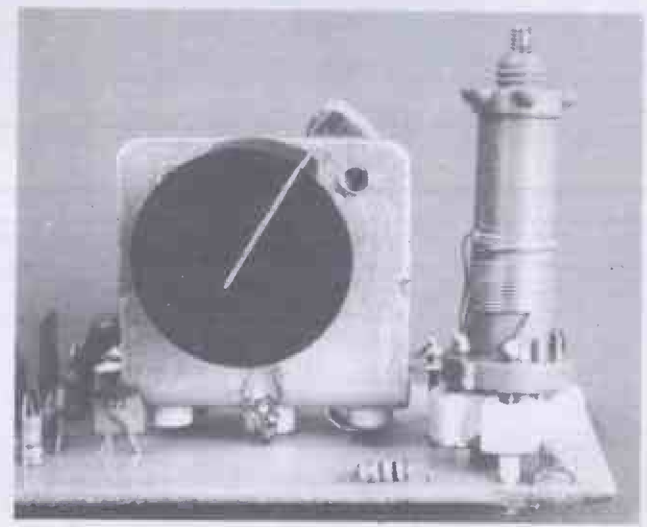


Fig. 3. Overlay diagram for the SW Radio.

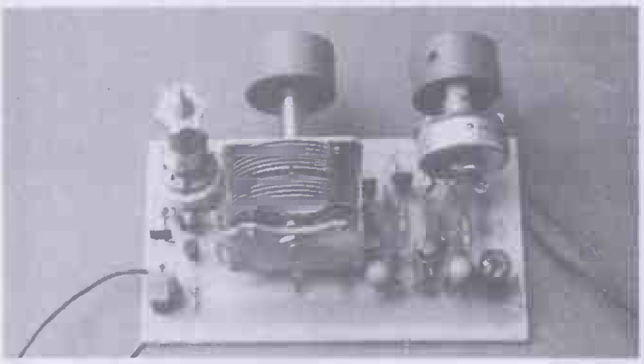
Buylines

The majority of the components used in this project should be readily available from your usual supplier. However, the variable capacitor, choke and tuning coils may be more difficult to obtain. Watford Electronics should be able to supple these components as well as the more common ones.



Use of plug-in coils avoids complicated and expensive switching.

receivers incorporate two or three detection systems and can cope with most modes of transmission. They may also feature a digital frequency readout covering 0.5 to 30MHz. Sounds great doesn't it? Of course, such a receiver might cost several hundred pounds.



This version drives a crystal earphone directly. Even cheaper!

CHEAP AND CHIRPY

By contrast, you can listen to the wonderful world of squawk, crackle and pop (music) with the Hobby short wave radio for about a 'tenner'. If you are happy with earphone reception or have your home Hi-Fi handy it will cost even less! You should be able to tune the whole Short Wave band from about 1.5 to 30 MHz using three plug-in coils. Use of a TRF circuit means that no alignment is needed and though there is only one tuned circuit, the receiver is made quite sensitive and selective by applying variable positive feedback: 'reaction' or 'regeneration'. By increasing the feedback until the circuit is just oscillating, it is possible to resolve CW morse transmissions and with care SSB.

Our chart shows what you are likely to find on the short wavebands and where. Although it looks rather sparse, you will probably find that there is not an empty spot on the dial until about 15 or 20 MHz. By far the most interesting reception is provided by the range 4 coil covering about 5 to 15 MHz. You should be able to receive broadcast tranmissions from many foreign stations throughout the range. Using the prototype, we received English language transmissions for Cuba, Israel, Moscow, America, Vatican City, Canada and, of course, the BBC World Service to name but a few. Most stations identify themselves on the hour. Reception will vary during the day and according to the time of year but it is always possible to pick up something and there are numerous beacons and code transmissions scattered around the dial.

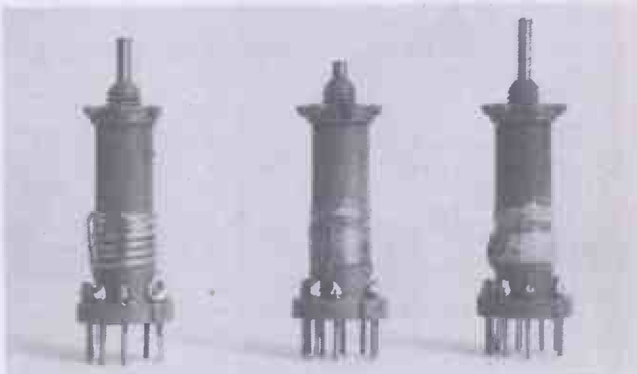
CONSTRUCTION

Use of the specified components and our PCB is essential to ensure stability. Radio frequency waves are awkward little things and find their way into everything. Indeed, at very high frequencies they will not even travel down a wire, preferring instead to run along the outside of a conductor.

The variable capacitor and two potentiometers are mounted on the PCB supported by stiff pieces of wire. All the other components with the exception of the loudspeaker mount directly on the board, keeping the component legs as short as possible. Our photo's should give you the general idea.

A mixture of capacitor types is specified. They are chosen both for their physical size and electrical characteristics and you should try to obtain the right types. None of the components are very out of the ordinary. Q1, 2, 3 are conventional junction FETs and no special handling precautions are required.

The coils plug into a modified B9A PCB mount valveholder. Simply remove the centre spigot and the connectors for all the pins except 1, 6 and 7. A short wire link can be soldered between pins 6 and 7 on the range 3 (low frequency) coil effectively connecting both sections of VC1 to the coil when range 3 is selected. In this way, a greater tuning range is obtained. Do not worry that there are no connections to pins 8 and 9; this coil is not used. To change range, simply plug in the appropriate coil. VC1 should be the slow motion drive component. Although it costs a little more, it is worth the extra expense and obviates the need for a bandspread control.

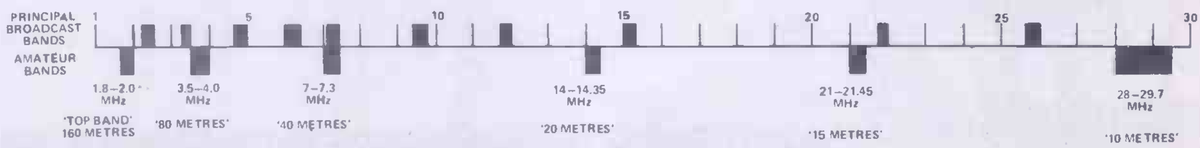


Three plug-in coils cover all your favourite bands.

If you do not need the audio amplifier stage, the output from the negative side of C13 will drive an external amplifier or a crystal earpiece directly. The cheaper 8 Ohm magnetic earphones will not work here. Connect the ground or shield of your amplifier input to 0V and the other wire to C13. A hole is provided on the board for this connection.

In use, the regeneration control RV1 should be advanced until just before the circuit begins to oscillate (stations will be received as whistles when the set is oscillating); this is the most sensitive state. The setting of the 'regen' control will vary over the tuning range and according to the coil in use. To receive morse code CW and SSB, advance RV1 just past the point of oscillation. The SSB transmissions sound like Donald Duck voices and considerable care is needed to resolve them.

The Hobby SW radio offers an economical and simple solution to the problem of getting your ears on the world out there. Build it now and happy listening!



Our chart shows the principal broadcast and 'ham' bands, but there's more out there than you think.

WE DID WARN YOU!

Nobody likes to gloat, but nearly six months ago we warned you about our diminishing stocks of backnumbers. The ones shown here are all that are left! Hobbyprints are *still* available.

Shown here are all of the backnumbers still available. They are **£1.00 each** inc. P&P. When ordering please quote the issue number, i.e. Nov. 78 is issue 1 Vol. 1. Next to each issue is the relevant Hobbyprint code letter, please note that Hobbyprints are still available for every issue.

Please send me the following back issues Nos . . . .

Cheque/P.O. enclosed £ . . . .

Hobby Electronics Backnumbers Dept.
145 Charing Cross Road, London WC2H 0EE

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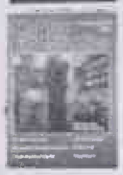
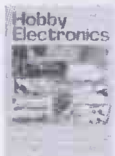
JUNE 79 (Hobbyprint H)
Projects: GSR Monitor, Envelope Generator, Drill Speed Controller.
Features: Citizen Banned, Display Techniques, Moving Coil Meter, Electronics in Music Pt 2, etc.

JULY 79 (Hobbyprint I)
Projects: Shark, Baby Alarm, Point Controller, Linear Scale Ohmeter.
Features: Cassette Decks and Tapes, Binary Numbers, Fixed Resistors, Short Circuits Special, etc.

AUGUST 79 (Hobbyprint J)
Projects: Home Security Sound System, LED Tachometer, Injector/Tracer, Constant Volume Amplifier.
Features: Security Installation, Variable Resistors, Tools, Satellite Power etc.



SEPTEMBER 79 (Hobbyprint K)
Projects: Combination lock, Light dimmer, Starburst, Ultrasonic Switch.
Features: Electronic Timekeeping, Thyristors, Radio Control, FET Special.



OCTOBER 79 (Hobbyprint L see Hobbyprint Ad)
Projects: Tantrum, Hobbytune, Analogue Frequency Meter, Multi Siren.
Features: Home Computing, Electronic Games, Microwave Cooking, Breaker One-Four.

DECEMBER 79 (Hobbyprint N)
Projects: Scalextric Controller, Ring Modulator, Bargraph Voltmeter, Hebot II.
Features: TV Receivers, Project Fault Finding, Data Supplement.

JANUARY 80 (Hobbyprint O)
Projects: Hebot III, La/p Counter, Crosshatch Generator, Digi-Die.
Features: Mini TV Survey, CMOS Spread, Spacelab.

FEBRUARY 80 (Hobbyprint P)
Projects: Passionmeter, Infra-Red Control, Win Indicator.
Features: Short Circuit Special, Kezy Does It, Power to the People.

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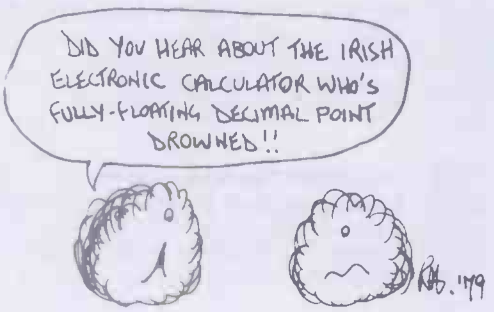


DID YOU HEAR ABOUT THE IRISH ELECTRONIC CALCULATOR WHO'S FULLY-FLOATING DECIMAL POINT DROWNED!!

Breaker One-Four

Send any news, comments, or information you may have to:
Breaker One Four,
Hobby Electronics,
145 Charing Cross Road,
London WC2H 0EE.

At last, the winners of the Tape Competition and the famous K 40 review. Plus, some more clubs for your notebook.

NCLCBR

That stands for the National Committee for the Legalisation of CB. It was set up at the meeting last December as reported in BOF. The committee held its first meeting early in January. The members of the committee have not wasted any time in setting the ball rolling. A demonstration is planned for April the 27 the venue is unclear at the moment but probably around Trafalgar Square London. The next meeting of the committee is planned for Saturday the 9th February. Contact your local club chairman for details.

The demonstration planned for the 26th of January appears to have been a hoax, unfortunately HE goes to press a few days prior to this so we won't know until it's too late. If anyone has got details of CB events please by all means tell us but please no more wind ups.

CHANNEL CONFUSION

Have you ever wondered why this feature is called Breaker One Four? Simple, or least so we thought. Channel 14 has been the English breaker channel for about a long as we can remember, except in areas where 14 is unusable due to local interference. It now transpires that most areas north of Birmingham have been using channel 19. Sorry to all concerned but it's a little too late to change the title.

CLUB NEWS

News of clubs is still trickling in. Just. Remember if you want a mention in BOF just drop us a line giving details of your club and where you meet if possible. On to this month's offerings.

CBA-SW
Chairman D J Bennet
7 Wookey Hole Road,
Wells,
Somerset. Tel. 75306.

Harrow and Wembley Citizens Band Group
Secretary, Bill Ridgeway
7 Sandringham Crescent,
Harrow,
Middlesex. HA2 9BW.
Meeting place: Queens Arms High St Harrow 7.30pm
1st and 3rd Wednesdays each month.

CALIFORNIA TEAMING

After BOFs recent jaunt to the USA last year we were surprised to hear from an American Breaker that we spoke to in the 'States. As we were using CB quite legally we did not mind giving out details of our address in England. A postcard from the 'States arrived just before Christmas giving details of our chat. This is almost the same as the Ham QSL in fact many European countries do send QSL cards for CB contacts.

This set us thinking, we know HE does get around the world, most countries in Europe can buy HE on the bookstalls. So, if we have any CBers in other countries who would like to send us an example of their QSL card we will reciprocate. As it's not illegal to listen to foreign CB we may get some special HE QSL cards made up so we can reply to any overseas stations. Well, how about it.

TAPE COMPETITION

The entries for the competition were a little disappointing, not from the quality but the number. The answers to the questions are as follows:

(1) Channel 14 is 27.125 MHz
(2) SWR stands for Standing Wave Ratio.
(3) A 'Firestick' is a make of CB antenna.

The suggestions for new slang for (a) a production line car, (b) the police and (c) the Home Office were quite good. Alongside the name of each winner we have printed their best suggestion.

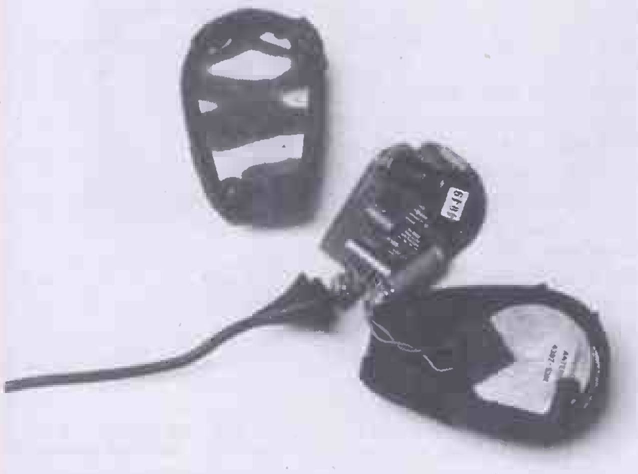
K Bareham, Surrey. The Home Office-Wave Rovers.
Lance Brake-Whitley, Croydon. Production line car-Road Beater.
M D Barson, Whitstable. Home Office-Desk Jockeys.

M. Jay London. Home Office-Gear Grabbers.
T. Jenkins Devon. Car-Breaker Taker
Dave Finch Southampton. Police-Charlie Clore (Rhyming slang-Law)
E. Peters Dulwich, Home Office-Earwigs
M. Dilton Newcatle. Car-Mouthmobile.
Peter Raines London Police — Blues
J. Wilson Glasgow. Car-voice box

K 40 REVIEW

Bet you're thinking 'How can they test a CB mike when CBs are illegal.' Well, it just so happens we can, almost. Here at HE we have a licensed radio amateur, he comes complete with a transceiver. Problem solved, a genuine 'on air' test. We decided to hook up the K 40 to the rig and try it out on the 11 metre amateur band. (27 MHz is around 10 metres so we're pretty close.)

Before we get to the test proper a few words on what is supposed to happen. You may be familiar with power mikes, they usually incorporate an audio amplifier to 'boost' the level of audio to the rig's input and driver stages. This would hopefully increase the level of modulation giving a stronger signal, in theory at least. The trouble arises when these are coupled up to modern rigs that incorporate compression circuits, designed to reduce the level of strong peaks from the microphone. Result, the signal from the power mike often gets severely clipped and distorted making it worse than ever.



The K40 opened up for inspection

The K 40 works on a different principle. Within the mike case lurks a purpose designed op-amp IC. This 'looks' at the output from the microphone and amplifies the portions of the signal that are below a predetermined level. This increases the amount of signal that reaches the modulator stage resulting in a stronger (though not louder) signal.

The really clever bit of the K 40 design is the FET controlled charging circuit. The K 40 circuitry does not require batteries, instead an electrolytic capacitor is charged from the rigs existing mike leads. When the mike is keyed the IC is powered from the internal capacitor. When the rig is in the receive mode the capacitor re-charges. The current consumption is so low that a two second period of receive will power the mike in the transmit mode for around three minutes.

As an added bonus the K 40 has a 'Hi Lo' switch that increases the treble content (Hi) for operation in crowded cities. The higher frequencies stand a better chance of punching through the mush. Limiter circuits in the mike also maintain a constant input to the rig whether the mike is half an inch or two feet from the mouth. This, is it claimed is especially useful to truckers who have a high level of background noise in their cabs. They just hold the mike as close to the mouth as possible and the background noise is cancelled out.

Finally, the mike has a permanent magnet built into the rear of the case, no hooks or clips needed, just stick it to any metal surface when not in use.

So, does all this fancy stuff live up to the manufacturers claims? In short yes. Our Ham friend reported excellent 'copies' from as far away as Germany. A comparison test involving the standard mike and the K 40 was favourably reported from the other end. We will continue to review the K 40, this time on a mobile 2 metre rig under noisy conditions. In the meantime we would like to thank Wintjoy for the opportunity to test the K 40 and say that for around 40 quid it's a touch pricey but well worth looking into.

15 PENCE = LEGAL CB?

Our penultimate item this month comes from that well known personality of the Airwaves (Rumour has it he's a licensed amateur) 'Mack The Hack'. He writes to us with a very worthwhile suggestion.

Would you spend 15p to help get CB legalised? I'm sure you are all screaming 10-4 for sure.

In the recent Commons debate on CB. It was stated that 'The Minister (Home Office) has received 3,300 letters on the subject since May. That will be a drop in the ocean compared to the number of letters he will receive during the next few months'.

It has been suggested that all interested persons send post cards, (No not QSL cards), to the Minister.

The one I sent with views and greetings from London had this message. 7th Jan. 1980. 1140am GMT. 10-20 Victoria embankment, in 10-33.
Dear William,
*10-50 (accident) Blackfriars underpass, traffic tailback to your works 10-20 (Parliament Square) wish you'd been there. If **Citizens Band Radio** was legal I would have been forewarned and able to have taken alternative route.*

Yours faithfully, Mack the Hack.

CB4 UK NOW (please).

This postcard cost 7p and the stamp 8p (2nd class) and was sent to Mr William Whitelaw, House of Commons London.

Whenever I see a situation where CB could have helped I think that I'll send the Rt Hon William Whitelaw another postcard.

Now why don't you do the same. It will only cost you 15p and less time to write than it takes you to read this. Mack the Hack.

We can see nothing wrong with that idea. How about sending a postcard. It might just make the difference.

AND FINALLY . . . .

Lastly a couple of items from Wintjoy Ltd who seem to be just about the biggest dealers of CB accessories in the UK at the moment. They are compiling a map of Great Britain showing each town with its calling channel. If you would like to drop them a line giving details of your local 10.20 they would be most grateful. (This is not as sinister as it sounds, more about this next month). Finally, they would like to apologise for the breakdown of their phones earlier last month. Phone bill has been paid and they've now got their ears on.

LATE NEWS

Just managed to get this in, in the nick of time. A major demo is planned for Sunday, February 23rd. Venue should be Hyde Park, Speakers Corner again. The march should commence around 11 am. See you there.

HE

SPECIALS

HOBBY ELECTRONICS PROJECTS SPECIAL

Contains twenty five of the very best projects from Volume 1 of Hobby Electronics. It will be available in about six weeks and should be on your newsagents shelves for just £1.25.

FROM HE

Into Electronics Construction

Part 2 BY IAN SINCLAIR

The most fundamental device in electronic construction — the transistor. This month Ian Sinclair takes a close look at this and other important components.

YOU ENDED UP LAST MONTH with a working circuit, which flashed a couple of LEDs on and off. What makes this circuit electronic as distinct from just electrical is the fact that there are no moving parts in the circuit to cause the flashing, it's all done by these remarkable transistors along with the capacitors, resistors and LEDs.

This month we're going to spend some time finding out what a transistor does, and learning a bit about how it does what it does. One way of learning would be to read every book about transistors you could lay your hands on — but the HE way is easier, just stay with us. What we'll do is to build a circuit that helps to explain what the transistor is doing in the circuit, then we'll take it from there.

To work then. Take the components off the board, gently pulling the leads out of the Eurobreadboard holes. Don't pull the leads out violently, because we want to be able to use these components over and over again. Providing you don't get the leadout wires too badly kinked at the ends, they should last out this course and still be useful to you for years to come. I find that a pair of tweezers is very useful for taking components off, and also for inserting the leadwires into the holes. Unlike pliers, tweezers can be used in one hand, and they're not so heavy to hold either.

SIMPLE STARTERS

The first circuit is a very simple one. The table of connections is shown in Fig. 2.1, it's just a LED with its cathode connected to the negative (—) lead of the battery — the part of the circuit we usually call earth — and its anode connected to a 1K5 resistor. There's no connection between the other end of the 1K5 and the battery positive (+) lead. Now if you clip the battery on, but leave the + lead free, not plugged anywhere into the board, nothing happens. If you now plug the battery + lead into the board at XI, the LED lights. What does this tell us? The LED lights when an electric current flows through it and current flows only when there is a complete circuit. All familiar stuff, you say? Yes, but we need to bear it in mind when we make the next step.

The next step is to see if enough current will flow through you — yes, you. Touch the lead of the 1K5 resistor which is plugged into XI, and with the other hand hold the battery + connection. Does the LED light now?

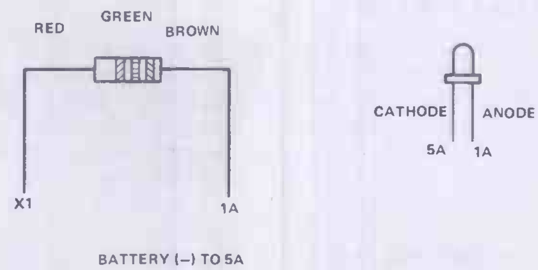


TABLE 1

X1:	1K5 to 1A
1A:	LED Anode; 1K5 from 1A
5A:	LED Cathode; B (—)

Fig. 2.1 A simple LED and resistor circuit.

Why not? It's because your resistance is too high. A 6 V battery simply won't pass enough current through you to light the LED. The voltage of a battery measures how much push it can give to an electric current, and 6 volts isn't much of a push. It's just as well, in fact. If a 6 V battery could push enough current through you to operate the LED, you wouldn't feel very comfortable. To be precise, you would suffer electric shock, which is what happens if you touch a high voltage which *can* pass quite a lot of current through you.

OK, so you have a lot of electrical resistance, and a 6 V battery doesn't pass enough current through you to light an LED. Now set up the circuit which uses the table of connections shown in Fig. 2.2. This time we've used a transistor, the 1K5 resistor, and the LED in the circuit.

TABLE 2

X1:	1K5 to 1A; B (+)
1A:	LED Anode; 1K5 from 1A
5A:	LED Cathode; Transistor collector
7A:	Transistor base
10A:	Transistor emitter; B (—)

Fig. 2.2 Using a transistor to control the LED.

The battery + connects to one end of the 1K5 resistor at line XI, and the battery negative connects to the emitter of the transistor at line 10A. At the moment, the base of the transistor isn't connected anywhere, just plugged into line 7A. Now there's an electrical circuit present here. Current could flow from the battery + through the 1K5 resistor, through the LED, through the transistor collector and emitter leads and so back to the battery. Why doesn't it? We know that current can pass through the resistor and the LED, so it must be the transistor which stops the current. The transistor works in this circuit like a large resistance — it won't allow enough current to flow to light the LED.

Watch this now. Plug a piece of wire into line 7A, so that it connects with the base leadout wire of the transistor. Remember you don't have to force both wires into one hole, any hole in line 7A will do. Hold a bit of this bare wire in one hand (don't let it come against any other part of the circuit) and touch the battery + terminal with the other hand. What happens? What's more important, why does it happen?

RESISTANCE

The glowing LED indicates that there is current flowing between the collector and the emitter leads of the transistor. This didn't happen before, and we reckoned then that the transistor must have a high resistance between its collector lead and its emitter lead. Now it looks as if it has a low resistance between these two leads. Stop touching the wires — and the LED goes out again.

It looks as if a connection to the base lead of the transistor can make the difference between a transistor being a high resistance and being a low resistance. We've found already that we have a high resistance between our hands — we can't pass enough current to light an LED. That small amount of current which passes from one hand to the other seems to be enough, however, to make the transistor change over from being a high resistance to being a low resistance. All it has to do is to flow into the base leadout wire.

Try moistening your fingers, then hold them on the wires again. The LED glows a bit more brightly this time. You don't feel any current flowing through you, though, so you can only be passing a very small amount of current, much less than the transistor allows to pass through the LED.

Stop to gather breath and ideas. A circuit which includes connections to a transistor collector and emitter doesn't pass current unless there's a small amount of current flowing into the base terminal from a positive voltage. That's the way these particular transistors work — they're all of a type called NPN which conducts when both the base and the collector are connected to positive voltages. What this little lot has shown is that the transistor acts as a tap for electric current. A small amount of current flowing through you has caused the transistor to pass a much greater current through the LED. You can think of the base lead of a transistor as acting like a tap which controls the flow of current between the collector and the emitter.

TRANSISTOR TAP

There's an important difference, though. The transistor, unlike a tap, is controlled electrically. The amount of current which flows into the base controls the amount of current which flows between the collector and the emitter. The name 'transistor' comes from the original name 'transfer resistor', because the discoverers of transistor action noticed that the resistance between the collector and the emitter changed when the amount of current flowing into the base changed. The word 'controls' doesn't just mean that the current can be switched on and off, either. Let's look for a moment at an experiment that we can't do (without a lot of expensive equipment) but whose results are important. Fig. 2.3 shows what's involved. A transistor is connected with its collector and emitter in one circuit, complete with a meter to measure the current (a milliammeter) which flows through the transistor from collector to emitter. There's another meter too, a current meter of the type called a microammeter, which can measure very small currents. This meter is connected to the base of the transistor, and to a current regulator which can control the amount of current which passes.

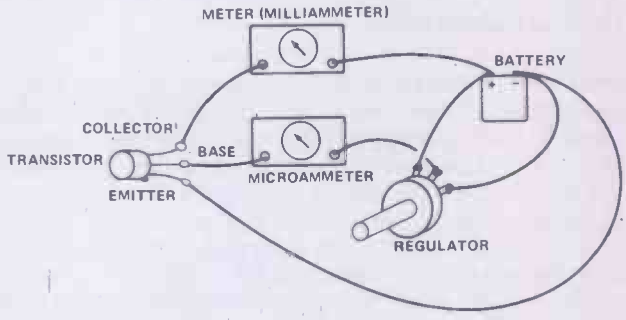


Fig. 2.3 The arrangement which shows how a transistor controls current. You don't need to do this one, but you should know about it.

What happens? Well, as you'd expect, passing some current into the base of the transistor causes current to flow between the collector and the emitter. That much we knew already. What is new is how these currents change when we alter the regulator. We'll find that, for example, doubling the amount of current into the base terminal causes the other current, the current between the collector and the emitter, to double also. In fact, any change we make to the base current causes an exactly proportional change to the collector-emitter current. Mathematically, this is simple proportion, so that the collector-emitter current is directly proportional to the base current. If we drew a graph, plotting collector-emitter current in one direction and base current along the other direction, the graph would be a straight line.

That's very convenient, because it means that the ratio:—

$$\frac{\text{collector-emitter current}}{\text{base current}}$$

is constant. Suppose, for example, that the ratio happens to be 100. A ratio of 100 means that the collector-emitter current is one hundred times the base current — always. If the base current happens to be 10 microamps, for example, then the collector-emitter current is 10×100 microamps, which is 1000 microamps (equal to one milliamp). Can we work this the other way around? Yes, if the collector-emitter current is 10 milliamps, then the base current has to be one hundredth of this,

$$\frac{10}{100} \text{ milliamps, or } 0.1 \text{ mA.}$$

VARIABLE VOLTAGES

OK so far? The action of the transistor is sometimes called current amplification, because a small amount of current into the base controls a larger current between the collector and the emitter. Notice one very important point — amplification of this sort doesn't mean making current greater — it means using a small current to control a large one, like making a large-scale copy.

So far, we've been working with just one electrical quantity, current, and we've been relying on the voltage of a battery to keep the current flowing. Will the current flow at any voltage, or do we need a certain amount of voltage to keep current flowing through a transistor? Once again, we can discover this by experiment only if we have suitable measuring instruments, so we'll describe what happens.

Suppose we set up voltage measuring instruments, called voltmeters, to measure the voltage between the base and the emitter and also between the collector and the emitter of a transistor, as in Fig. 2.4. We'll keep the current measuring meters in place also, so that we know when there is a current flowing, and we'll regulate the voltages, not the currents. What would we expect to read from these meters?

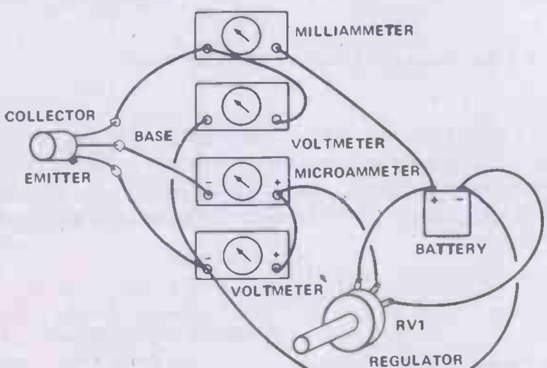


Fig. 2.4 Another one you don't need to do for yourself — it shows how the voltage between the base and the emitter of a transistor controls the current.

Well, the first thing we would notice with this small fortune in measuring instruments is that no current flows at all when the voltage reading at the base is only around a quarter of a volt (0.25 V). The meter is connected between the base and the emitter, so that this is the base-to-emitter voltage. That's one important difference between a transistor and a resistor, because a resistor passes current when any voltage is placed across it. The transistor behaves as if there's some sort of switch inside, preventing current flowing.

If we jack up the voltage, slowly and steadily, we see the current start to flow at somewhere around half a volt, between 0.5 V and 0.55 V. Can't we be more precise? No, we can't, because the voltage at which the transistor starts to conduct varies — it depends on the temperature of the transistor for one thing, and also on the transistor itself. That doesn't just mean what type of transistor, but which individual transistor you use. They're not as alike as peas in a pod as far as this is concerned, and even transistors which were made on the same production line and at the same time from the same materials show these differences. It's just something we have to live with.

CURRENT

When current starts to flow in the base-to-emitter circuit, current will also flow in the collector-to-emitter circuit, just as we have now come to expect. Now for another measurement. Let's suppose that the current which flows into the base is a small quantity, ten microamps (written as 10 μA), and that we needed a voltage of 0.5 V to make this amount of current flow. How much voltage do we need to make 100 μA, ten times as much, flow? If we were dealing with a resistor, the answer would be simple — ten times as much, 5 V would be needed. How much voltage does the transistor need? Just 0.06 V more, that's all. In our example, that's a rise of voltage from 0.5 V to 0.56 V.

Far from making life difficult, this makes transistor electronics rather simpler. When a small transistor is conducting, its base to emitter voltage woll be somewhere between 0.5 and 0.6 V, whether the current is large or small. We've said 'small', because some large power transistors may need a volt or so between the base and the emitter if they are to pass really large currents; we shan't be using that size of transistor in this series.

There's one more trick left up the sleeve. Suppose the measuring circuit is changed to the arrangement shown in Fig. 2.5. The new variable resistor RV2 lets us control the voltage at the collector. Up till now we've left that voltage at 6 V, because the battery supplies 6 V. What happens if we set the transistor conducting, and then start winding this voltage down? The answer, surprisingly, is practically nothing! Once we set the current flowing, using RV2 to regulate the current in the base-emitter circuit, the collector voltage has very little effect, until the voltage drops right down to about 0.2 V.

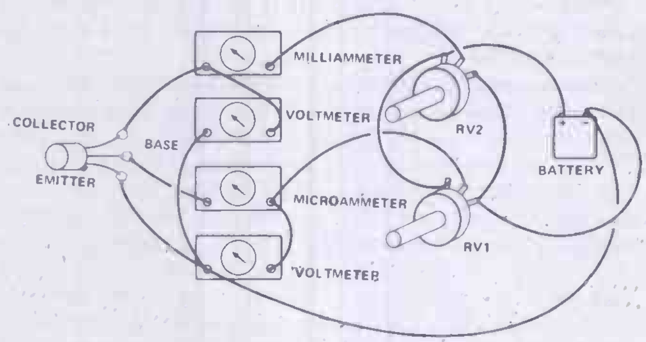


Fig. 2.5 This is the last of 'em! It shows how the voltage between the collector and the emitter of the transistor affects (or doesn't affect) the current.

Only when the voltage drops this low (the figure of 0.2 V is called the saturation voltage) does the current suddenly start to drop. What do we make of the show so far? Let's list what the transistor does.

1. The current that flows between the collector and the emitter is always a fixed amount times the current that flows between base and emitter. This 'fixed amount' varies from transistor to transistor.

2. The voltage between the base and the emitter has to be around 0.5 to 0.6 V to keep the transistor conducting.

3. The amount of current isn't affected much by the voltage at the collector, unless this drops to about 0.2 V or less.

LIGHT LED

Now let's try a circuit. Fig. 2.6 is the table of connections on the Eurobreadboard, which should result in a circuit which lights the LED. The transistor collector is connected to +6 V, and the emitter connects to the 2K2 resistor and then to the LED. When current flows, then, it flows through the transistor, the 2K2 resistor, and the LED, causing the LED to light.

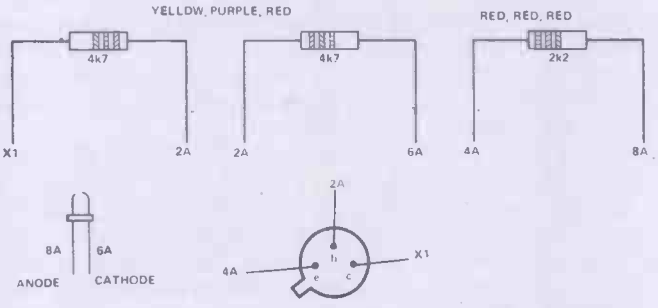


TABLE 6

X1: B(+); 4K7 to 2A; Transistor collector
2A: Transistor base; 4K7 to 6A; 4K7 from X1
4A: Transistor emitter; 2K2 to 8A
6A: B(—); 4K7 from 2A; LED cathode
8A: 2K2 from 4A: LED Anode

Fig. 2.6 How the components are connected for an "emitter follower" circuit.

All right? The LED lights when it's connected to the emitter of the transistor. Now change the connections, by taking the end of the 2K2 resistor which was plugged into 4A and now plugging it into 2A. This is the connection to the base of the transistor. Does the LED light here too?

It does, and the experiment shows that the voltage at the base must be about the same as the voltage at the emitter. This is a different type of transistor circuit, called an emitter-follower, in which we connect the collector of the transistor to the + supply voltage, but we don't connect the emitter of the transistor to the negative supply voltage. Instead, the emitter is connected to a 'load', the resistor, LED or whatever it is we're controlling with the transistor. We'll look at these different connections again in the next part when we learn a bit more about circuit diagrams. The emitter-follower circuit makes use of the fact that the voltage between the emitter and the base of a transistor is always low, about 0.5 to 0.6 V.

WET CURRENTS

Now for this month's project circuit, which makes use of all that we've learned about transistors so far. The circuit is for a moisture detector, useful for showing when your plants are well watered, or if the washing-machine is dripping water, unseen, on the floor underneath. The principle is very simple, it makes use of the first experiment you tried out this month. A very small current into the base circuit of a transistor will cause a much greater current to flow between the collector and the emitter of the transistor. Now water doesn't conduct electric current very well, but it conducts a lot better than air or most dry materials. If we have a couple of wires, one connected to the positive of the battery and the other to the base of a transistor any slight current which passes from the positive terminal to the base will cause a much larger current to flow through the transistor between the collector and the emitter. The 'slight current' can be caused by water touching both wires, so that the wires act as a sensor or detector of water or steam. One useful way of making this more sensitive is to use two of the copper strips in a sheet of Veroboard (Fig. 2.7) with the wires soldered to the strips, and a piece of cotton fastened across the board. Cotton retains moisture, so that current leaks quite happily from one track to another if any water falls on the detector.

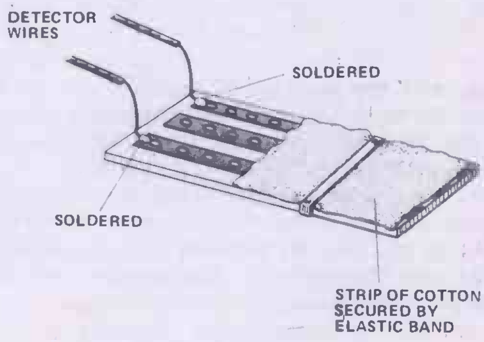


Fig. 2.7 One form of the water detector board.

If you're not too happy with soldering yet (wait until Part 5) then try the scheme shown in Fig. 2.8. This uses a wood or hardboard base with aluminium cooking foil glued to it. The foil is cut with a modeller's knife so that

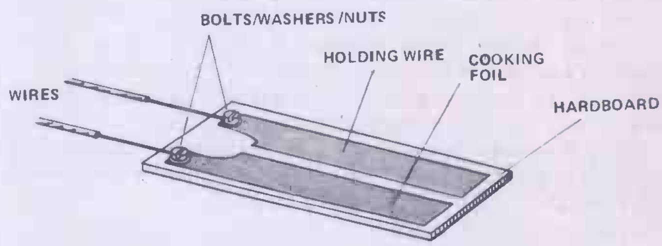


Fig. 2.8 A version of the water-detector board which doesn't need any soldering.

it's in two separate pieces, with a thin wooden track between them. Electrical connections are made from the aluminium foil into our circuit by bolting the connecting wires to the foil, using small-gauge nuts and bolts and large diameter washers. Remember that only single-coil wire should be plugged into the Eurobreadboard.

That settles the detecting part of it, which can be a long distance from the rest of the circuit if you like. The electronics part of it all consists of two transistors, three fixed-value resistors, an LED, a silicon diode and a component you haven't met before — a 10K potentiometer. The potentiometer, usually referred to as a pot is a type of resistor with an extra contact whose position can be varied. The one we've used is called a 10K pot because there's a resistance of 10K (more about these units later) between the two end connections, and this value of resistance is fixed. There's another connection, though, to a contact which can slide over the resistor

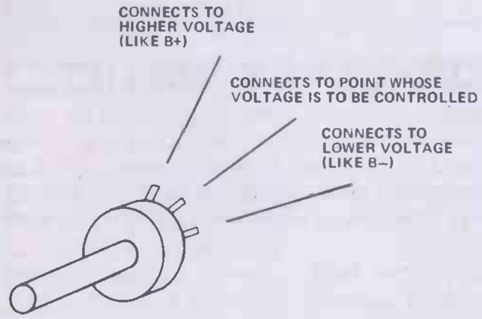


Fig. 2.9 The potentiometer.

materials, and the position of this contact can be set anywhere between one fixed contact and the other by turning the shaft of the pot. Suppose, for example, we connect this pot to +6 V at one end and to zero at the other. We can move the sliding contact to the zero end, making the voltage at the middle contact equal to zero. We could set the contact to the +6 V end, making the voltage at the middle contact equal to +6 V. We can also set the contact half-way, which makes the voltage of the middle terminal equal to +3 V, and we can set the contact so that the voltage of the middle terminal can be any value between 0 and +6 V.

CONNECTIONS

It's a very useful device, and we'll be using it again later in the series. The connections are always the same on these rotary potentiometers. They are set in a row, and when you're looking from the front, looking down the shaft of the potentiometer, then the end which connects to the higher voltage is on your left and the end which connects to the lower voltage is on your right. The moving contact is between them in the middle. That's the way it's going to be connected in this circuit, and that's the way it's connected in most circuits.

The connections can be made by stripping the insulation from an inch or so of single-core wire, and wrapping this bare end several times tightly round one of the potentiometer terminals. This doesn't give as good a connection as soldering, but it'll do for experimenting with provided you don't allow it to loosen too much by moving the whole potentiometer around too much. Fig. 2.10 shows these leads labelled, so that you can see where they plug into the board.

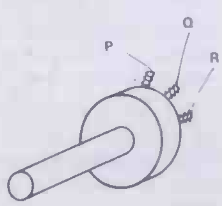


Fig. 2.10 Making the connections to the potentiometer for the water-detector circuit.

The rest of the connections are shown in the table of Fig. 2.11. Remember that the transistors must be connected the right way round — you should know by now how to identify the emitter lead of this type of transistor by its metal tab. The LED also has to be the right way round — though the circuit will still work with the LED connected the wrong way round, there's a chance of damaging the LED. The diode also has to be connected the right way round, otherwise the LED will never light and may possibly be damaged.

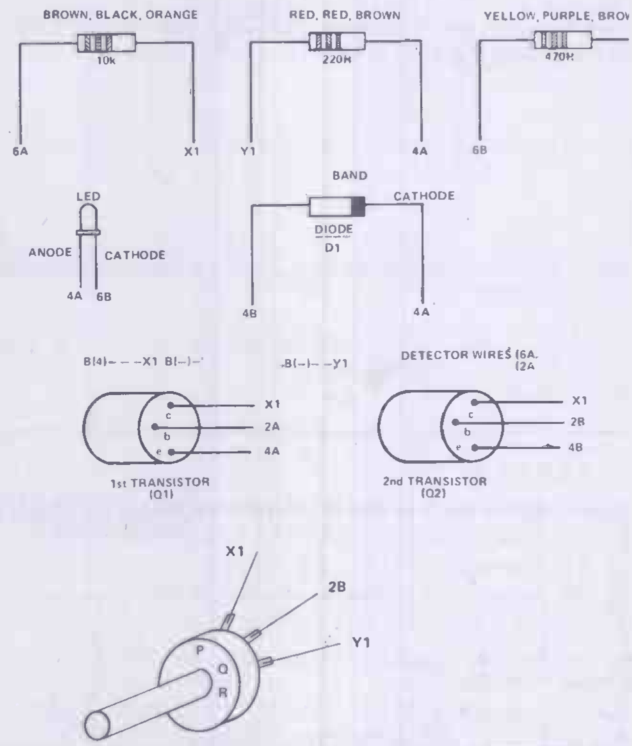


TABLE 11

X1: 10K to 6A; Collector Q, Collector Q; Potentiometer P; B (+)
2A: Base of Q; Detector wire 1
4A: Emitter of Q; Anode of LED; Cathode of D1; 220R to Y1
6A: 10K from X1; detection wire 2
Y1: 220R from 4A; Potentiometer R; B (—)
6B: Cathode of LED: 470R to 4B
4B: 470R from 6B: Anode of D1; Emitter of Q
2B: Base of Q; Potentiometer Q

Fig. 2.11 The connections for the water-detector circuit.

SETTING UP

How do we use it? The pot adjusts the sensitivity of the circuit for detecting water. You can, for example, place the detector where you want to detect water and turn the potentiometer shaft fully clockwise. If you've connected it the right way round, the circuit should now be at its maximum sensitivity, and a drop of water on the detector plate bridging across the contacts should cause the LED to glow.

Sometimes you don't need so much sensitivity. You can use two bare wire leads in a plant pot, for example, and adjust the potentiometer so that the LED just switches off when the soil is damp enough. Now if you add too much water, the LED glows to warn you!

Suppose you want to use the unit to warn of dryness? It's easy, you just reverse the LED and the diode connections as shown in Fig. 2.12. Now you set the potentiometer so that the LED just switches off when the moisture around the detector is getting a bit low, and the LED will shine a warning to you when things are too dry. It would never light in my local!

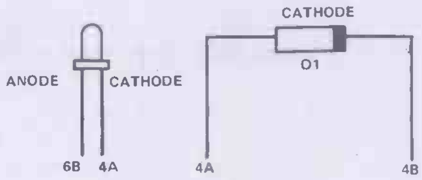


Fig. 2.12 How to plug in the LED and the diode so that the unit warns of dryness.

Next month — circuit diagrams, and a big step forward in circuit construction.

ADDITIONAL SHOPPING LIST

Part 2

These are the extra components which you'll need to add to last month's list for the new work this month.

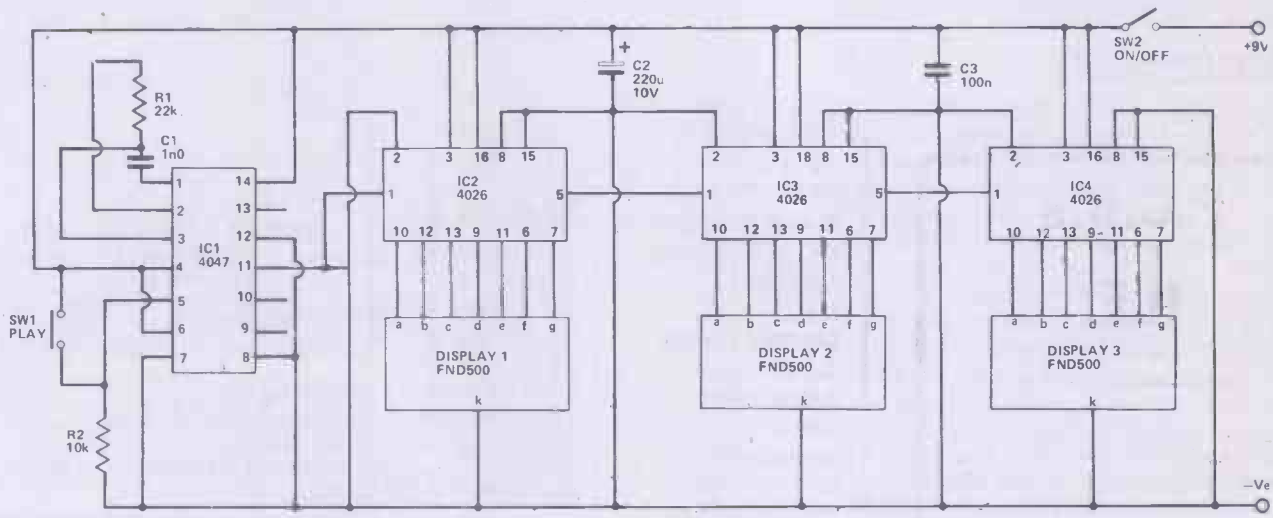
Resistors: 1 × 220R
1 × 470R
1 × 2K2
2 × 4K7
1 × 10K

Potentiometer: 10K miniature type

Hardware: small strip of Veroboard or hardboard (see details in text).

HE

Short Circuit



ONE ARMED BANDIT

This circuit is designed to give an approximate simulation of a one armed bandit fruit machine, and is only intended for home-entertainment purposes. The unit has three seven segment LED displays, and when a pushbutton is depressed, all display segments appear to light up. When the button is released, a random number is displayed. The idea of the game is to obtain a row of three identical numbers in the display, with (say) 1 point being scored for "000", two points for "111", etc., up to 10 points for "999". The object of the game is to score as many points as possible in an agreed number of attempts, say 25 or 30.

The circuit consists basically of a clock oscillator using IC1 and a three stage counter which uses IC2 to IC4. The 4047 CMOS device used in the IC1 position is a monostable/astable device which is used here in the true gating astable mode. Under quiescent conditions R2 takes the gating input (pin 5) low, and prevents the circuit from oscillating. Depressing SW1 takes the gating input high, and starts the circuit oscillating at a frequency which is controlled by R1 and C1. The specified values give an operating frequency of about 10kHZ, although the exact frequency is unimportant, it just needs to be reasonably high.

The display section uses three CMOS 4026 decade counter/seven segment decoders, which can be used to directly drive high efficiency common cathode displays such as the FND500, DL704, etc. The three display circuits are connected in series, in the normal way, so that one thousand clock pulses take the display through every number from "000" to "999", and then back to "000" again.

Thus, when SW1 is operated the display cycles through every number about ten times per second, with all the display segments appearing to switch on continuously as the action of the display is too fast for a human observer to perceive. When SW1 is released, the display is "frozen" at whatever number it happened to be displaying when IC1 ceased oscillation. There is, of course, no way of operating SW1 to definiately obtain one of the winning numbers, and it is purely a matter of chance whether or not one of these is displayed, as is the case with a real one armed bandit machine.

IC1 to IC4 are all CMOS devices, and normal CMOS handling precautions should be observed when dealing with these. The current consumption of the unit can be over 50 mA when certain numbers are displayed, and a large battery such as a PP9 should be used as a power source.

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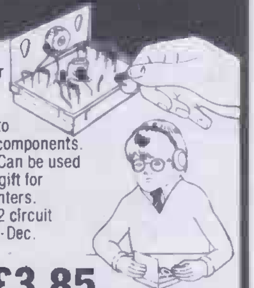

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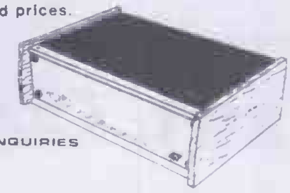

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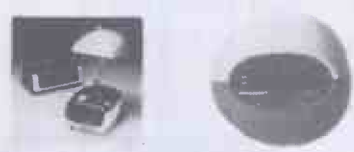

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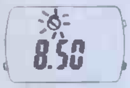

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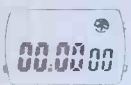

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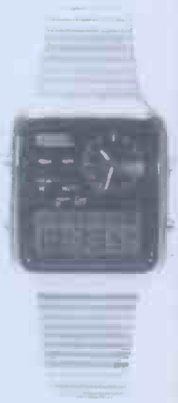

Analog part display; hr, min, sec. Digital part display; hr, min, sec, date, day and colon. Calendar-month, date, day. Stopwatch — hr, min, sec, 1/100 sec. Lap/stop and stop marks. Counter function. Time and calendar setting function.

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