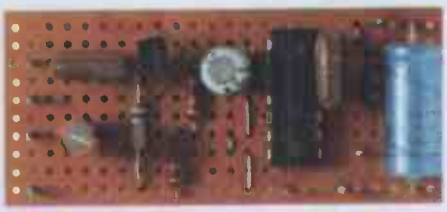
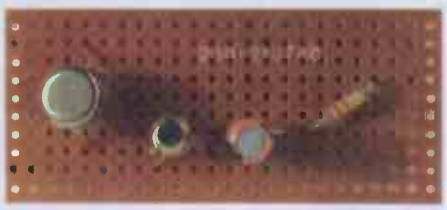
Hobby Electronics

June '80 50p
ISSN 0142-6192

Model Fog Horn



2W Amplifier



Metronome Egg Timer

CB RADIO:

Citizens Still Banned

Special Reports On The Last Year

Model Car Two Channel Proportional RADIO CONTROL

Complete Audio/Tuner Kits

Mk III FM Tuner series

Carriage for Mk III tuner £3 inc

The Mark III series FM tuner has been updated, and now includes a centre zero tuning meter as standard. The instruction manual has been meticulously revised, enabling easy assembly by constructors of various levels of experience - a preview copy may be purchased for £1.00.

Mark III A series 'Reference series' tuner modules .....£171.35 inc.
Mark III B series 'Hyperfi' modules, with switched IF BW, pilot cancel decoder .....£198.95 inc.

A matching synthesiser unit will be made available later this year, and can be retrofitted to either version. All versions include digital frequency readout/clock, VU deviation meters, 6 preset stations, 10 turn pot manual tuning, toroidal PSU, output level adjustment, 110/240v AC input. Full alignment service available.

Power Amplifier

Style and performance - with a real 'belt and braces' PSU design.

After a couple of preview comments, it seems that many of you are waiting to hear about the matching HMOSFET power amplifier for the Mk III tuner. Well, it's out at last - complete with twin toroidal PSUs for comfortable 80W RMS per channel, over 100W peak, but limited by thermal shutdown of the HMOS. 10W-100W log LED output peak indicator, DC offset protection and switch-on pause relay. AC or DC input coupling, direct or relay protected output terminals. The works.
Only one version of this item: Complete kit .....£178.25 inc. Carr. £5.

Preamplifier

More features and facilities, thanks to DC switching and control design

Previewing the most comprehensive audio preamplifier yet..... DC switching of 7 inputs, plus two tape in/outs. 2 low pass, 2 high pass active filters, genuine volum 'ated loudness, 1dB channel matching, with DC volume, balance, bass and treble controls. itable for bus/remote control, tape dubbing, switched monitor etc. 80dB S/N+, THD -75dB or better. Pluggable PU equalization boards, tone control override. Price for complete unit about £149 ex VAT.

Radio/Audio/Communications Modules

LW-MW-SW-SW DC tuned and switched

91072- All switching of bands by a single pin to gnd. Varicap tuned, with LO output for synth. MW/LW version or MW/LW plus 1 or 2 SW bands
MW/LW: £15.58 +1SW £16.73

VHF Tunerheads

Europes largest stock range for broadcast and communications. Probably also the world's - details in the catalogues and PL. Specials are also supplied in the region 30-220MHz.

Pilot Cancel PLL Stereo decoders

944378-2 £26.45

Again, Europe's widest range of stereo decoders including pilot cancel PLL types. The pic shows the 944378 - pilot cancel including post decoder 26/38kHz filtering and muting preamp output

Switched bandwidth FM IF strips

Broadcast FM IF strips for all occasions, including the new 911225 - with diode switched narrow filter option, ultra linear phase ceramic filters, 84dB S/N, and 0.04% THD (40kHz deviation). Plus usual things like AGC, AFC, dev. mute, level meter drive. £23.95 (supplied in screen can with 0.1 edge connection system)
Also the 7230 hyperfi series - as the 911225, but with slope controlled AFC that operates in conjunction with signal level - and an extra IF amp stage for DXing.

Various digital frequency displays

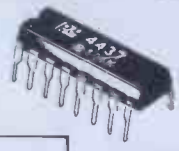
The World's largest range of receiver DFMs is now joined by the DFM7 (shown) - and L shaped version of the DFM3 with remote display mount connector possibility . 1kHz SW resolution with 455kHz or 10.7MHz offsets, 100Hz res up to 3.9999MHz, and VHF to 299.99 MHz in 10kHz steps : £41.75

Semiconductors

Radio/Communications ICs

FOR COMPLETE LISTINGS - SEE OUR NEW PRICELIST

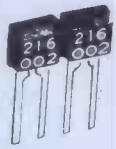
CA3089E	2.11	HA1197	1.61	SD6000	4.31
CA3189E	2.53	CA3123E	1.61	TDA4420	2.59
HA1137W	1.95	TDA1072	3.09	MC1330P	1.38
HA11225	2.47	TBA651	2.53	MC1350P	1.38
HA12412	2.81	TDA1090	3.51	KB4412	2.24
KB4420	1.95	TDA1220	1.61	KB4413	2.24
TBA120S	1.15	TDA1083	2.24	KB4417	2.53
KB4406	0.80	TDA1062	2.24	MC3357P	3.16



SL1610	1.84	SL1626	2.80
SL1611	1.84	SL1630	1.86
SL1612	1.84	SL1640	2.17
SL1613	2.17	SL1641	2.17
SL1620	2.50	SL6600	4.31
SL1623	2.80	SL6640	3.16
SL1624	3.77	SL6690	3.68
SL1625	2.50	MC1496	1.44

VARICAP DIODES.....
A section from our PL:

BA102	0.35	16:1 ratio AM tuning	
BB204	0.41	KV1215 9v triple	2.93
BB105	0.41	KV1211 9v dual	2.01
BB109	0.31	KV1225 25v triple	3.16
MVAM2	1.93	BB212 9v dual	2.25



POWER MOSFETS

100W PA's made simple

Since pioneering the 100W complementary MOSFET technique - Hitachi have developed a range of output devices and drivers that ought to revolutionise opinions and attitudes towards the design of all LF amplification systems. We have a new 48 page application note (£1.50 inc) and complete sets of parts, modules and now the new complete PA system (see above).

2SK133	120v N-ch 100W MOSFET	£6.33	2SJ48 Pch complement		£6.33
2SK135	160v N-ch 100W MOSFET	£7.29	2SJ50 Pch complement		£7.39
PA101B	Kit for 100W MOSFET PA less Heatsink £16.10. (£23 inc heatsink/bkt)				

ULTRA LOW NOISE PU PREAMPLIFIER

The HA12017 is the last word in PU preamps, and general low noise audio design. It is an SIL IC, with 86dB S/N in RIAA configuration, 10v RMS output capability, 0.002% typ THD at 10v RMS output (imagine the overload margin !!!). It comfortably supercedes discrete circuit designs in terms of price/performance, and takes the art beyond the TDA1042's capabilities. (Replaces HA1457) £1.80 each - or an RIAA applications PCB with two ICs for £5.75. Complete with Rs&Cs £9.95.

Radio Control ICs

We have various RC ICs, including NE544 NE5044, and two new ones from OKI

KB4445 - 4 channel dig.prop. FM TX IC. 30mW out (amplifyable) -£2.30 inc
KB4446 - 4/5 ch. dig. prop FM RX IC. Suits KB4445 or RCME syst. £2.65.
KB4445/6 pair: £4.75. New 8 page data-sheet 35p + SAE. More RC ICs in list

CMOS, LPSNTTL, TTL, MPU: Listings in the new pricelist.

Most CMOS is available in low volume - also LPSN. Standard linears and TTL OK.

Things like ICM7216B, ICL8038, 8080A, 6800P, 2708, NE555,NE556, etc

Coming Soon.....

Contain yourselves, RF fans ! Not yet ready for a full launch until autumn, but previewed here

SSB transceiver system : 10kHz to 1000MHz !!

A modular VLF to UHF SSB TX/RX system at last. With the correct first mixer, the basic PCB covers 10kHz to 1000MHz - using LO fed from ext. source (Our 2 IC Mullard synth for instance) and RF PA for TX OP. 0.2uV basic sensitivity in HF , Typ cost for HF synth SSB RX will be less than £200. Add an RF PA for full TRX for another £50. See one in our foyer, and marvel.

Components

Crystal Filters

Most popular types are available ex-stock, and in quantity.

10.7MHz	25kHz Channel spacing 8pole	£16.67
	12½kHz ..	£17.82
	2.4kHz SSB	£19.78
	Monolithic dual roofing filter	£2.30
34.5MHz	1.3dB loss, 80dB stopband HF first filter in synth. RX	£36.80
RC XTALS	FM pairs (no spilts)	£3.74
	AM pairs ..	£3.57
USB/LSB	Xtals for 10.7SSB filter	£2.88 ea

Piezo Sounders

The most efficient warning sounders yet

The latest thing in electro-acoustic efficiency. 1mA of drive from CMOS will give an SPL of 83dB - 10v RMS drive from CMOS uses 3mA for 100dB SPL at 4.8kHz (88dB at 1.65kHz)
The data sheets shows various drive circuits, and give full specifications with regard to broadband responses and power consumption etc. 1 off 44p inc. 100 off 28.75p (25p ex vat)

Keyboard switches and caps

From the world's most widely used switch manufacturers - ALPS - come the biggest and best range of keyswitches, and data entry keyboard switches. The SCM81101 is shown here, with the KT5 2-part cap (with clear top, to enable easy fitting of your chosen legend. Other types are available with built in LED, 90° mounting etc.
SCM81101 : 17p, KT5 : 16p - or 29p/pair

LCD CLOCKS
LCD DVM

Clocks use 1.5v at 15uA only. DVM 9v/1mA

CM161: 7mm LCD 12/24hr, alarms etc £11.44 each
CM172: 13mm, 12hr, alarms,timer etc £14.32 each
CM174: 13mm, 12hr, min/sec stopwatch £14.32 ea
DVM 176: ICM7106 based LCD 3½digit £22.36 each

WHAT's NEW at AMBIT

NEW PRICELIST/SHORTFORM:- 28 pages, FOC with A5 SAE pse

Bigger print than our recent one page list and vastly extended

If you still need convincing to invest £1.60 in the cats, be mean and get this first.

POWER MOSFET APPLICATIONS HANDBOOK by HITACHI :

£1.50 each - or free with pairs of HMOS and the PA101B

Everything you should know about HMOSFET devices theory and applications.

CATALOGUES 60p ea., all three for £1.60
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Parts 1-3 AMBIT catalogues 60p ea, or £1.60 the lot.

Hobby Electronics

JUNE 1980 Vol.2 No.8

Editor: Steve Braidwood, G3WKE.
Assistant Editor: Rick Maybury.
Art Director: Diego Rincon

See page 58

See page 23

See page 43

PROJECTS

FEATURES

NEWS & INFO

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Managing Director: T. J. Connell.

Hobby Electronics is normally published on the second Friday of the month prior to the cover date.

Hobby Electronics, 145 Charing Cross Road, London WC2H 0EE, 01-437 1002.
Published by Modmags Ltd.
Distributed by Argus Distribution Ltd, 12-18 Paul St., London EC2A 4JS.
Printed by QB Ltd, Colchester.

Simply ahead . .

I.L.P's PROVEN RANGE OF HIGH

- FIVE POWER AMPLIFIERS EACH ENCAPSULATED WITHIN LARGE HEATSINK.
- PRE-AMP/ACTIVE TONE CONTROL MODULE COMPATIBLE WITH ALL I.L.P. AMPS AND POWER SUPPLIES.
- SEVEN MATCHING POWER SUPPLY UNITS (FOUR WITH TOROIDAL TRANSFORMERS).
- EASY ASSEMBLY DESIGNS WITH WELL PRESENTED INSTRUCTIONS.

Chosen in more countries throughout the world than any other U.K. make

I.L.P. constructional modules are different. Whereas most others come with components neatly arranged on open P.C.B.s with little else, I.L.P. modules are encapsulated within totally adequate heatsinks and need no extra components to complete them. As a result, I.L.P. power amplifiers, pre-amp and matching power supply units are infinitely more rugged, impervious to working in extremes of temperature and can be easily positioned to requirement. No additional metal work is needed to take away heat, connections are minimal and utterly simple. Circuitry, workmanship and performance are of the highest standards, equal to the demands of loudspeakers, pick-ups, tuners, digital signals, etc., even more exacting than those of today, making amplifier systems less than the best completely inadequate. Now study the tested and guaranteed specs. for I.L.P. That is why more people in more countries prefer these British designed and made modules.

Why toroidal?

Toroidally wound transformers are more compact than their conventionally laminated equivalents, being only half as high and heavy. Their circular profile ensures greater operating efficiency and as such are particularly valuable in heavy duty applications. We have our own production section for winding and making toroidal transformers enabling us to offer this much sought-after type at competitive prices. Four of the larger models in our range of power supply units are now supplied with this type.

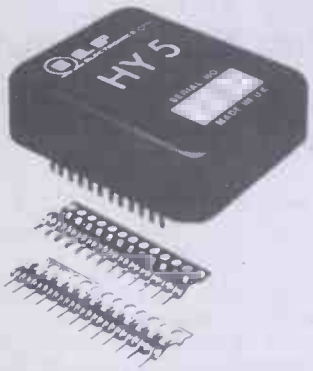
PRODUCTS OF THE WORLD'S FOREMOST SPECIALISTS IN ELECTRONIC MODULAR DESIGN

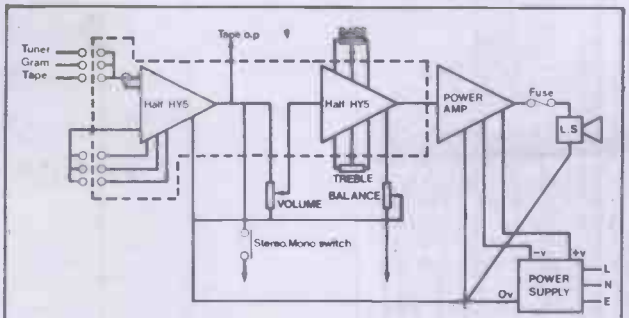
AVAILABLE ALSO FROM WATFORD ELECTRONICS, MARSHALLS AND CERTAIN OTHER SELECTED STOCKISTS

and staying there

PERFORMANCE MODULAR UNITS

HY5 PRE-AMPLIFIER



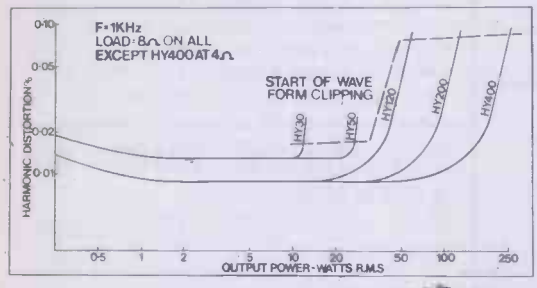


VALUES OF COMPONENTS FOR CONNECTING TO HY5
Volume – 10K Ω log.
Bass/Treble – 100K Ω linear. Balance – 5K Ω linear.

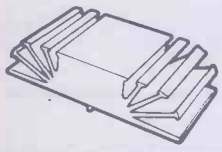
The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm. and provides multi-function equalisation for Magnetic/Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion 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.

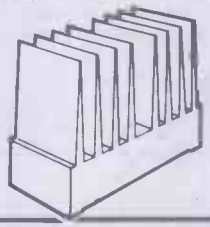
£4.64 + 74p VAT

THE POWER AMPLIFIERS



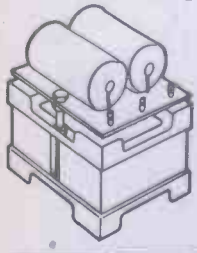
Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105x50x25	155	£6.34 + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0 +25	105x50x25	155	£7.24 + £1.09
HY120	60 W into 8 Ω	0.01%	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 - 16Ω
Input sensitivity – all models 500 mV
Input impedance – all models 100KΩ
Frequency response – all models 10Hz - 45KHz - 3dB

THE POWER SUPPLY UNITS *(Laminated and Toroidal)*



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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Please debit my Account/Barclaycard Account No. . . . . .
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NAME . . . . . .
ADDRESS . . . . . .
. . . . . .
Signature . . . . . .

ELECTRONICS LTD.
FREEPOST 6, Graham Bell House, Roper Close
Canterbury, Kent CT2 7EP.
Telephone (0227) 54778 Telex 965780

Monitor

PUSSY PINCHER

This has got to be one of the best publicity photos we've ever received. The gentleman wearing the stocking over his head is apparently trying to steal the telly. In doing so he has unplugged the set so setting off an ingenious alarm that emits a noise 'not unlike that of a scalded cat' according to the makers Ardente.

As Ardente point out, most burglars these days seem to be more interested in pinching Hi-Fis, Colour Tellys and Video Recorders, after all, who's got any money? To protect your investment this little device called the 'Cat Burglar' (at least they haven't given it a boring number) can be fitted inside virtually any piece of domestic mains powered equipment by nearly anyone. In normal use with the mains plug in socket the alarm is dis-armed, if a thief tries to steal your telly he obviously has to unplug it first at which point the alarm is activated. From the publicity blurb, it would seem that the alarm is activated by some kind of 'trembler', once installed this can be adjusted for maximum effect.

Ardente expect the Cat Burglar to retail for around £30, if you want to get in touch with them, they can be found at: Thames Avenue, Windsor, Berkshire.

CLEVER CLOCK

At around £115 this digital clock may seem a trifle expensive but just ask yourself how many other digital car clocks will tell you (now wait for it) your speed, average fuel consumption, distance travelled, how much fuel left, estimated time of arrival, time to empty tank, distance to empty tank and stopwatch functions (to name but a few)?

Installing the device will certainly keep you busy for a couple of weeks. If the prospect of fitting it yourself is a bit daunting then the importers, Station Garage, Shepperton, Middlesex will gladly put it in for you. For another £70 they can supply the Compucruise driving computer which has several more features including a cruise control for motorway driving.

GAMES AND MORE GAMES

Two new games from NIC this month (we've got more of his stock in our office than he's got in his shop). Both come from Mattel and quite frankly, are not the best we've seen. Number one is called Sub Chase, you have to locate a submerged submarine by means of sonar, when you have manouvred your destroyer over the sub you launch your depth charges. You have to avoid torpedos and destroy as many subs as possible in the time allotted. This game is ultimately beatable but should keep you amused for a couple of hours.

Second game is called Armour Battle, it has a similar type of display to the Sub game and has totally confused us for the past week. If we can ever decipher the instructions we'll tell you how good (or bad) it is.

Both games have an impressive repertoire of noises and tunes, the sub chase in particular is quite musical.

If you want to try it out for yourself then nip round to NIC in Broad Lane Tottenham.

ROBOTS AGAIN . . . . AND AGAIN

It seems Britain is again burying its head in the sand on the subject of Robots. Sir Keith Joseph, writing in a letter to Dr Alfred Spinks of the Advisory Council for Applied Research (ACARD), a government advisory body said, "it is up to individual companies to grasp the opportunities offered by new technology."

This effectively means that the Government will not offer any substantial help to companies wishing to get involved with Robots.

TECHNICAL ENQUIRY SERVICE

We're streamlining our project Technical Enquiry Service so in order to make it ultra-efficient could you ensure that you include an SAE and write the name of the project you're having difficulty with on the outside of the envelope. Please make sure you write Hobby Electronics on the envelope as some letters have been getting mixed up with mail for our sister magazine ETI.

THE PRICE OF ICE

ICE or In Car Entertainment is rapidly becoming the big boom market for Hi-Fi manufacturers. In the next couple of months we will be presenting a very comprehensive review of the current offerings, so, by way of a foretaste how about this extraordinarily cheap stereo radio, cassette combo from our old friends at Minikits.

It is called the HL Autosport and will deliver 8 watts RMS per channel into the speakers that accompany the machine. The interesting thing about this particular device is that the guts are to be found inside a very well known machine costing almost twice the £45 Minikits are charging. Apart from the speakers it comes complete with a mounting kit and full instructions for installation into negative earth cars. The FM stereo radio section works very well indeed and the cassette, whilst not the best one we've heard, is more than adequate. Our only gripe is the omission of a lockable, rewind facility, but for only £45 you can't complain, now can you?

Minikits can now be found at 88 Hainault Road, Leytonstone, London E11 1EH.

News from the Electronics World

PHILIPS — SIMPLY POUNDS AHEAD

Everyone with £547 to spare pay attention now. Philips would like you to know all about the N2554 Micro-processor controlled cassette deck. The N2554 is part of the new Black Tulip range of Hi-Fi separates and offers a unique degree of versatility to both the home and semi-professional user.

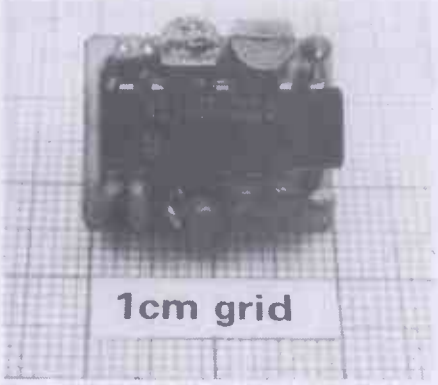
Those of you with sharp eyes may have noticed the rather unusual number of little buttons on the right hand side of the unit. This keyboard controls the coded search system which allows the user to find individual recordings on a cassette tape, play them and repeat them in any chosen sequence.

The system works by recording inaudible pulses onto the tape. The Computer Coded Search (CCS) is capable of programming up to 50 individually identifiable codes onto each side of a cassette tape, this, Philips assure us, is sufficiently flexible for professional use.

As you would expect the proformance figures are pretty good, the N2554 is quite happy to use the latest metal tapes and has separate bias and equalisation switches fo. Chrome and Ferro tapes.

If you're still with us, the N2554 should be just reaching the shops about now. If you can afford one then why not invite us round one night to hear it. Make sure you've got plenty of custard creams too!

SMALL STUFF



Building an R/C system? If you are then you may be interested in this new subminiature Servo Amplifier from Ambit. The circuit (called the SD1) can be used to drive servo motors rated up to 500mA quite happily and Ambit assure us that it can be equally well employed at the front end of high power systems. As you can see it couldn't be much smaller, mayber we'll try it out in the Microbe it looks ideal. If you want to know more then write to Ambit at: 200 North Service Road, Brentwood, Essex CM14 4SG.

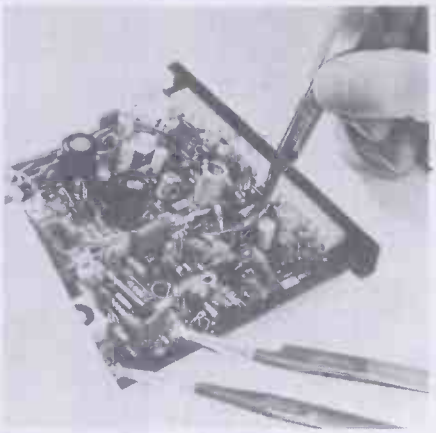
LATE HE

We would like to apologise to everyone for the delay in getting the last two issues onto the newsstands, this was due to circumstances beyond our control.

TRANSFORMERS

Remember the transformer offer in the March and April HE's. Well, that's all they are now — a memory. Sorry, we've sold out.

TOOL TIME



Do you poke about in confined spaces? You do, then take a look at these natty (doubtless state-of-the-art too) metal precision tweezers. They come from a company called Bacho. By the look of them you would be well advised to use them on equipment that has been previously switched off (you would soon discover that anyway). For more information contact Bacho at Bacho Tools Ltd, Beaumont Road, Banbury, Oxon OX16 7TB.

BOOK REVIEW

Ask any electronics engineers which is the best reference book for transistor and sorting out substitutes for foreign semiconductors and chances are he'll say 'Towers'. The Towers International Transistor Selector has been around for some years now. We have just received the latest version called Update 2. It's not cheap at £9.50 but then quality never is. It contains over 20,000 entries (6,500 new ones in this edition alone) and the chances of not being able to find a particular device are pretty slim. This is probably one of the most useful books you'll ever have in your workshop. It is published by W Foulsham & Co ISBN 0-572-00955-0.

CD IGNITION

Some people have been experiencing difficulty in obtaining the high voltage capacitors used in this design. Two types are suggested, they are the B32562 0μ47 and B32563 1μ0. Both are obtainable from Marshalls for 28 and 48 pence respectively.

SINCLAIR ZX80

Many of you have written to us asking for a kit review on the Sinclair ZX80 micro. Ever eager to please we contacted Sinclair a while ago (about the time of its launch). Even then we were informed that we couldn't have one till May. A couple of weeks ago we tried again, it seems they have so many orders that they cannot even supply review models. Worry not though, our sister magazine, Computing Today, got hold of an early preview model and we took the opportunity to play with it. Suffice it to say we were impressed enough to redouble our efforts and with a bit of luck a review will be coming in the next couple of months.

CATALOGUES

One catalogue that isn't in this month's survey is the new offering from Heathkit. The new catalogue is understandably choc full of the new range of computer goodies that Heath are now offering under the name Zenith Data Systems. For your copy write to Heath at Heath Electronics (UK) Ltd, Gloucester, GL2 6EE.

TRANSLATOR TALKING POINT

Remember the talking translator we mentioned last month? Well, it is now on sale over here, price is about £170 and is currently being imported by those well known purveyors of washing machines, Tempo Ltd. Full report coming soon.

ERRATA

Thanks to Mr Corbett for spotting a couple of errors on the Hobbycom in the March HE. The labels for C2 and C3 on the Overlay diagram (fig. 3) have been transposed. A link is missing both on Figs 3 and 4. It is between the positive side of C6 and the junction of C5 and R5.

Miniclock now, the transistor Q2 in Fig. 5 is PNP and the emitter is connected to the +ve line. The collector goes to the junction of R7 and IC1d. The base connection is correct.

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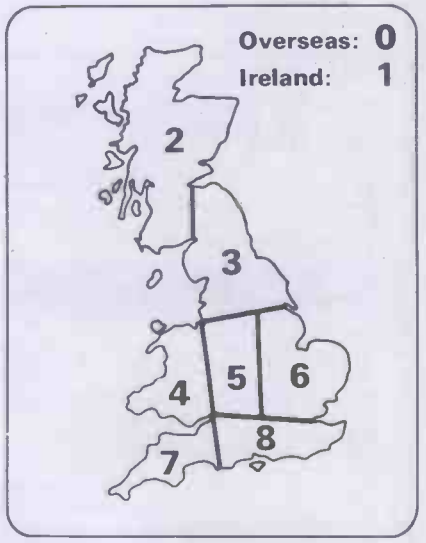


HE Microbe

TWO CHANNEL DIGITAL R/C SYSTEM

At last, the great day has arrived. Hobby Electronics now present what must be the last word in simple, well designed and cheap to build digital proportional R/C systems. The Microbe offers two fully proportional channels and a further two 'switched' channels — all for under £20.

FIRST THE BAD NEWS, the Microbe two channel digital proportional R/C system is not suitable for airborne models. Now for the good news, the complete system excluding servos should cost less than £20 to build!

From the beginning it was decided that the Microbe should be designed for either boats or cars, a full blown 2 +2 system will be appearing later in the year. With this in mind the Microbe has two fully proportional channels (with provision for two 'switched channels' but more of that later) and is possibly the simplest system ever published. The Rx, Tx combination is based on a pair of purpose-built ICs from National, the LM1871 in the transmitter and LM1872 in the receiver. Because most of the clever stuff, ie encoding and decoding, is done in the ICs external components are kept to an absolute minimum. Setting the system up should present few problems and providing you follow our constructional notes will be rewarded with a really first-class system.

CONSTRUCTION

The only thing to bear in mind when building the Microbe is the design of the PCB. If you try to design your own or use the otherwise excellent Veroboard you will come to grief — take it from us because we know, we've got the 'dud' prototypes to prove it. Still on the subject of PCBs, take extra care when drilling the holes for the coils, they are slightly delicate and do not take kindly to being forced into holes that are too small.

Actual assembly is very straightforward, we chose to use sockets for the Rx IC because we are careful drivers, if your model is going to continuously bounce off brick walls then solder the IC directly onto the PCB. Similarly it's a good idea to seal up the transmitter coil with wax.

The wiring up of the servo output leads depend upon the type of servo used. If you're only using one servo and a R/C motor speed controller (the one in April HE is ideal) then try to adopt some kind of uniformity in the plugs and sockets so that the system can be moved from

The complete Microbe system alongside our 'Letricar' test bed. See last month's R/C review for details.

Parts List

RESISTORS (all ¼ W 5%)

R1	22R
R2	100k
R3	220R

CAPACITORS

C1,5,7,8	10n
C2,6	100n
C3	100u Tantalum 16 V
C4	50n
C9	1n

Note. All capacitors except C3 should be miniature disc ceramic or polycarbonate, for best results use high stability types.
Working voltages should not be less than 9 V

INDUCTORS

L1, T3	MKXCSK3464BM
T1	YRCS12374AC2
T2	YMCS17104GO

(See Buylines)

SEMICONDUCTORS

IC2	LM1872
D1	IN4148
XTAL	27MHz min R/C type Rx XTAL is 455 kHz below Tx XTAL

MISCELLANEOUS
Servos — conventional 3-wire type.
Fleet, Sanwa etc etc.
Case — Vero type 301
PCB socket for XTAL
Plugs and sockets for servos.

Buylines

The coils and ICs used in the Microbe are the only components likely to cause problems.

The coils come from TOKO Ltd and are available from Ambit International Ltd. The ICs are available from NIC (see below).

A complete kit of parts for the Microbe for under £20 is available from NIC, 61 Broad Lane, Tottenham (see ad in this issue).

one model to another without changing all the plugs.

If you are likely to be using the Microbe alongside other R/C systems then it is a good idea to use an interchangeable crystal system, we used crystal sockets on both the transmitter and receiver.

Choice of a box and control surface is up to the individual, we opted for a rotary control for the steering and a linear slider for the forward/reverse function, in either case see the section on alignment for hints on selecting the correct values for the control and trim pots.

ALIGNMENT

Assuming you've now got an assembled Microbe in front of you we can now proceed to the dreaded alignment procedure. First the transmitter must be tweaked

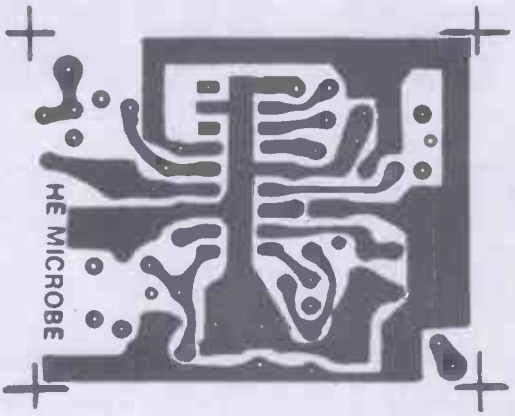


Fig. 6. PCB layout for the Microbe receiver. As with the transmitter, this layout MUST be strictly followed.

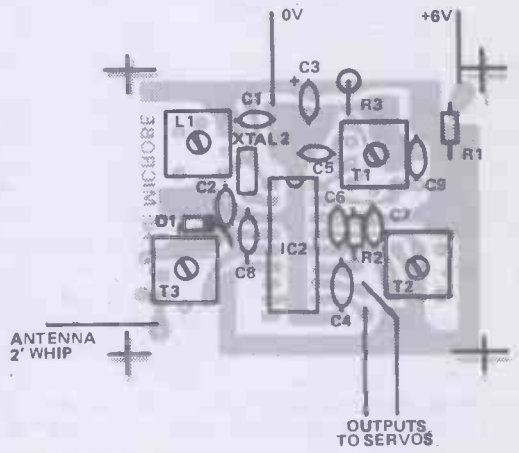
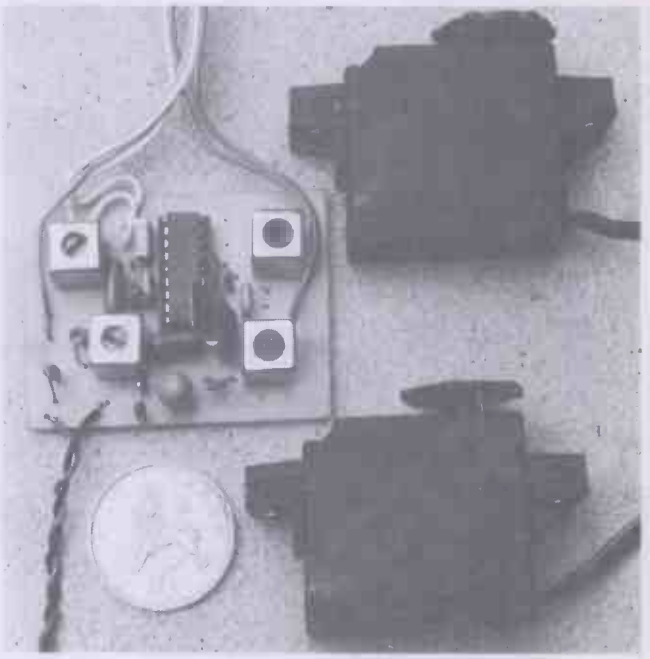


Fig. 7. Overlay diagram for the Microbe receiver. If the system is to take a lot of knocks we suggest you dispense with the IC sockets.



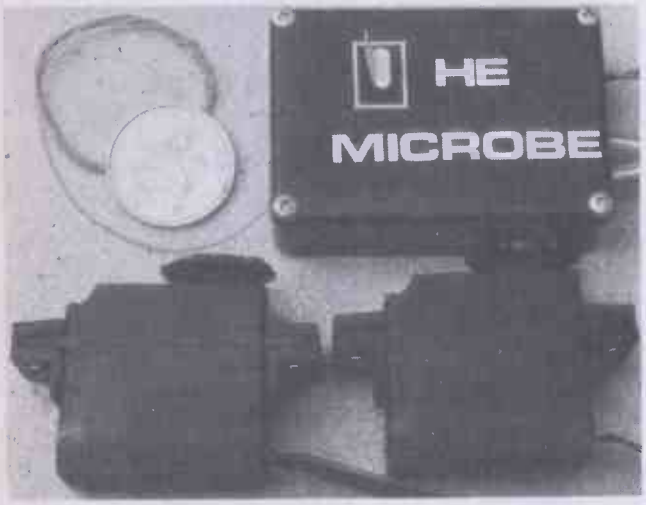
The Microbe receiver next to a couple of standard 3-wire servos. Note the size of the board next to a 10 pence coin!

up for maximum range. Easiest way to do this is with a field strength meter (members of the CB fraternity have at their disposal excellent SWR / FSM meters) otherwise you'll just have to find a receiver capable of receiving on 27 megs and site the TX about six feet away. By twiddling L2 you'll hear a loud buzz of around 100 Hz get progressively louder and softer. Adjust the slug for greatest output then drop some candle wax down the core to seal the slug in place (for the purposes of setting up the transmitter use the values we recommend in the parts list). Make sure all is well by twiddling the pots on the transmitter, the note should change very slightly when either pot is turned.

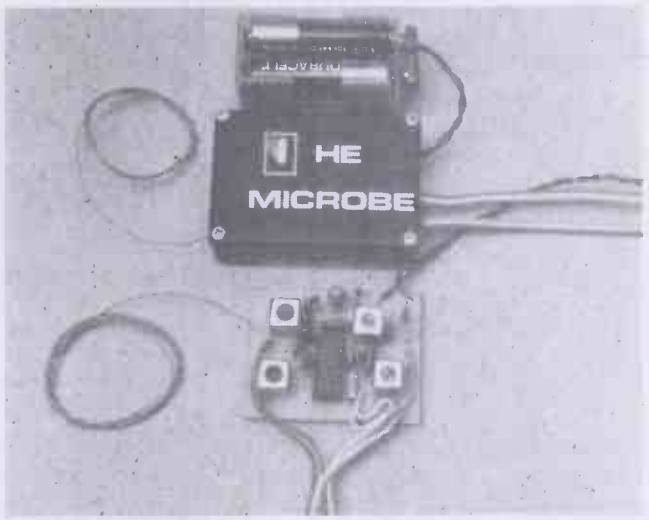
Now for the receiver. The best way to set up the receiver is with a 'scope. Monitor pin 2 of IC2, you should see a broad band of noise, this is the oscillator, if this isn't working nothing else will. Adjust the core in L1 for maximum amplitude. With the transmitter switched on and the servos disconnected (place the Tx about 3 feet away from the Rx aerial) monitor the output from pin 15 IC2. With your non-metallic screwdriver adjust the core in T1 for maximum amplitude, still on pin 15 tweak up T2 and T3, now go through T1, 2 and 3 again just for luck.

If you're particularly unfortunate not to have access to an oscilloscope all is not lost. The Mircobe can be set up by ear but be prepared for a drop in range. To set the system up by ear you need to connect up one servo. Adjust L1 until the servo just starts to quiver, you'll find this happens over about one turn of the slugs travel set it midway. With all the transmitter pots set midway slowly turn T1. At one distinct point the servo should start to turn and come to rest. If it doesn't then move the transmitter pot slowly whilst turning the T1 slug. Now you should have some kind of response, move the transmitter about two feet further away and with a friend turning the control pot on the Tx adjust T2 and T3 for smooth operation. Repeat this sequence at two or three feet intervals, with each successive move the adjustment should become more critical, continue this until you are satisfied it cannot be improved.

The degree of servo rotation is governed by the resistance of RV1 and Rt and RV2 and Rt. (you can use two separate Rts, one for each channel. We found that the best results were obtained by using an 82k resistor for Rt. The servo would move through nearly 180 degrees, as you only use a portion of the rotation of the pot anyway it made the control very responsive. If for any reason you wish to tailor your system then we suggest that you substitute a 500k pre-set pot for Rt and adjust that until you get the rotation you require. Measure the resistance of the preset and substitute a fixed resistor. The values of RV1 and RV2 are similarly flexible, different degrees of servo rotation can be achieved with pots down to about 10k (don't use anything lower or the servo will hardly move at all)



The Microbe receiver in its box. As you can see we cut a slot in the box to allow for easy changing of crystals.



Two Microbe prototype receivers. Our four-battery power source will last approximately 2 hours.

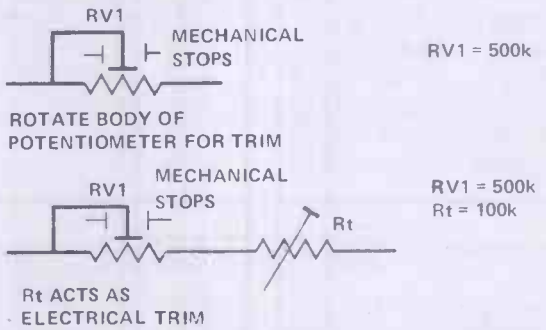


Fig. 8. Two methods of adding 'trim' to the transmitter control pots. Unless you have access to a scope, the 'suck it and see' method is probably best.

INSTALLATION

That just about covers the Microbe system, installation within a box is essential to protect the receiver, (use a waterproof one if your model floats!). It is always a good idea to wrap the receiver up in a piece of foam rubber to protect it against knocks. One final word of warning the Microbe is NOT intended for model aircraft, range on a good day with the wind in the right direction will never be much more than 100 yards, but then that is more than enough for a model car or boat. Don't complain to us if your model runs away from you and we certainly don't want any techical enquiries from people that have built it on anything other than our PCBs. Good luck. **HE**

You will need a licence to operate the Microbe. It costs £2.80 for five years. An application form is available from: The Home Office, Radio Regulatory Department, Waterloo Bridge House, Waterloo Road, London SE1 8UA

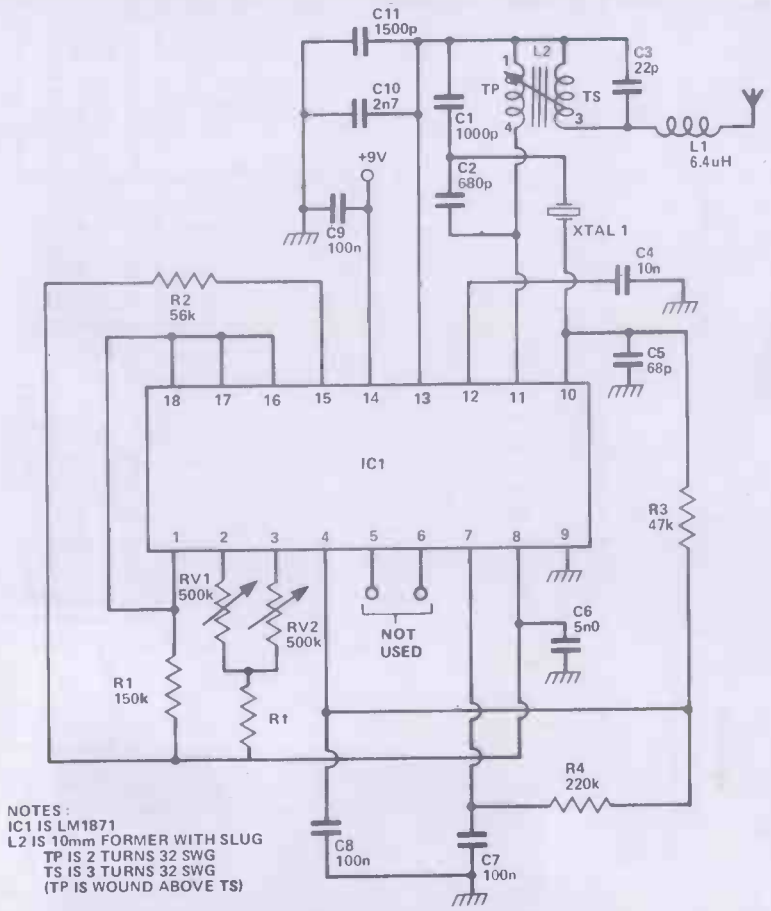


Fig. 1. Circuit diagram of the Microbe Transmitter.

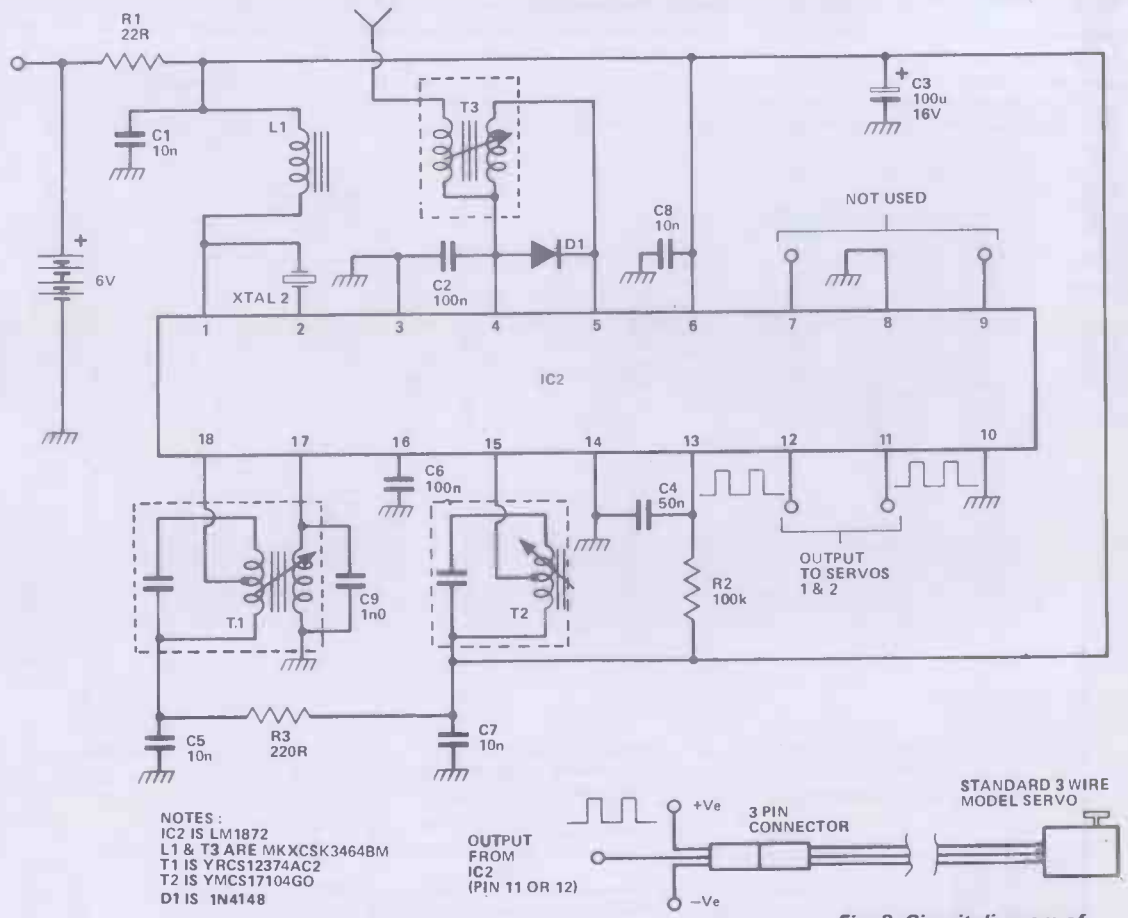


Fig. 2. Circuit diagram of the Microbe receiver.

How it Works

TRANSMITTER

Just about all the clever stuff is done by the IC, the external crystal oscillator is controlled by the network comprising L2, C1, 2 and 3, the encoder is controlled by the pots RV1 RV2 and Rt. The unused pins 5 and 6 when grounded will make the unused pins on IC2 (6&7) go high, this can be used for simple switching functions.

For details of adjusting and setting up the control Trims see 'Alignment'. Rt can be two separate resistors for each control pot.

How it Works

RECEIVER

As with the transmitter all the hard work, decoding etc is done by the IC. The oscillator comprising XTAL L1 and C1 runs at 455 kHz below the transmitter frequency. T1 controls the mixer section, T2 adjusts the IF response and T3 optimises the aerial input sensitivity. The diode D1 protects the IC against static discharge. C8 provides compensation for the AGC loop which spans a 70dB range.

The receiver section is a simple single conversation design with AGC which mixes down the 455kHz and provides 56dB of gain with the transformers suggested.

The digital decoder section within the IC provides another 30dB of gain resulting in an overall system gain of 88dB.

For best results the aerial should not be less than 24 inches long.

Parts List

RESISTORS (all ¼ W 5%)

R1	150k
R2	56k
R3	47k
R4	220k
Rt1, Rt2 } Rt	(see text)

POTENTIOMETERS

RV1,2	500k Lin slider (see text)

CAPACITORS

C1	1000p
C2	680p
C3	22p
C4	10n
C5	68p
C6	5n0
C7, 8, 9	100n
C10	2n7
C11	1n5

Note. All capacitors should be disc ceramic or polycarbonate high stability for best results.
Working voltages should be not less than 9 V

SEMICONDUCTOR

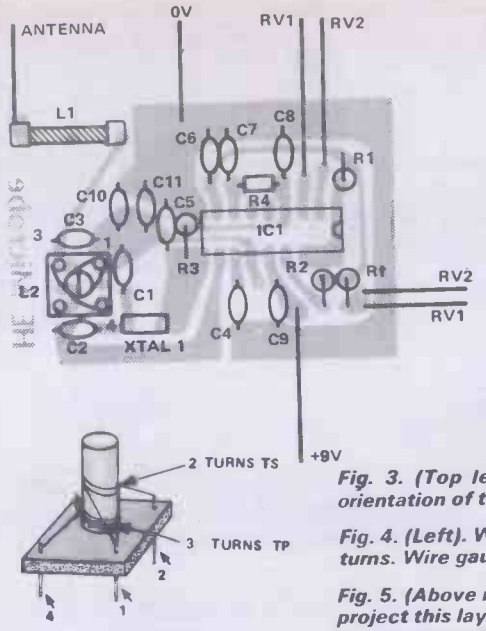
IC1	LM1871 (see Rx Buylines)
XTAL	27MHz min R/C type — see text

INDUCTORS
L1 6.4uH min choke
L2 — See text

MISCELLANEOUS
Case to suite (Vero Box on prototype type 101)
PCB socket for XTAL
Aerial, 3ft telescopic with base
Switch — min toggle
10mm coil former with slug.

Buylines

None of the transmitter components should be difficult to obtain. See text for coil winding details. See the receiver 'Buylines' for details of a kit.



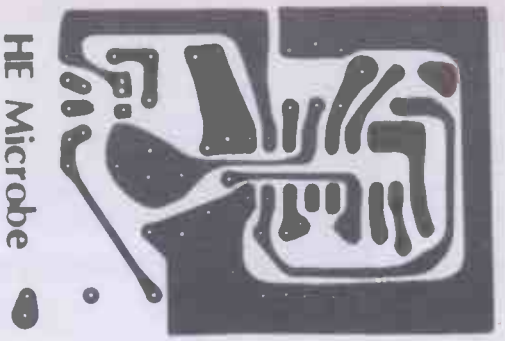
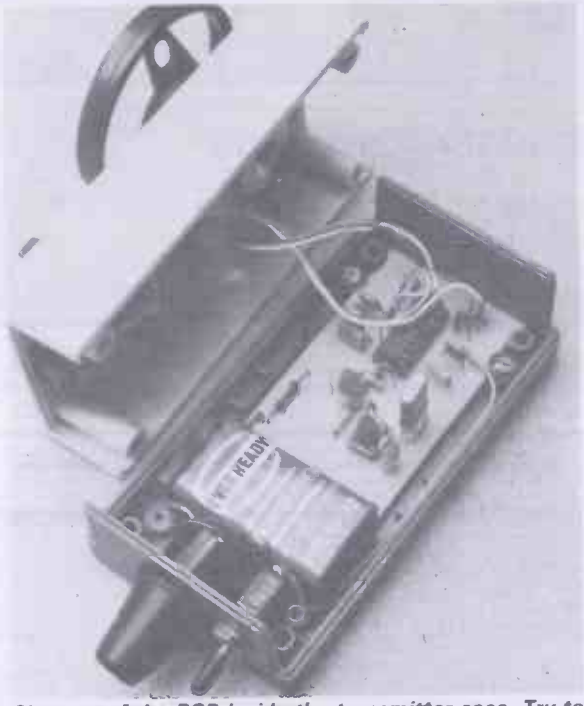


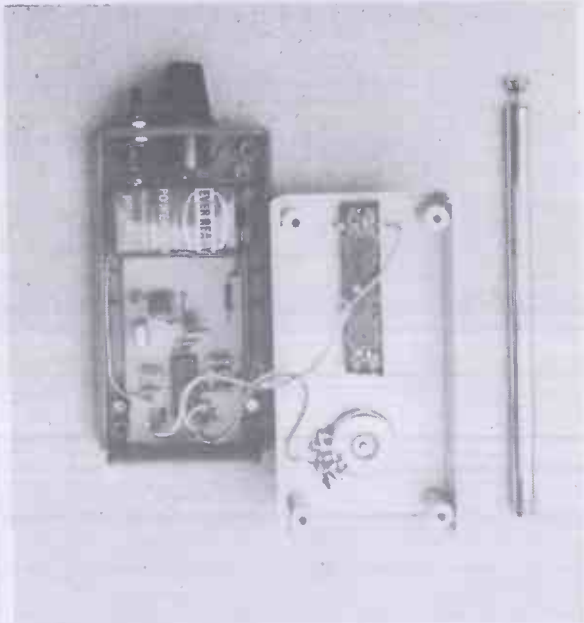
Fig. 3. (Top left). Overlay diagram for the Microbe transmitter, note the orientation of the coil L2, for winding details see Fig. 4.

Fig. 4. (Left). Winding details of L2. The coil comprises two windings of 2 and 3 turns. Wire gauge is not critical, we used 32 SWG.

Fig. 5. (Above right). PCB layout for the Microbe transmitter. For a successful project this layout MUST be used.



Close up of the PCB inside the transmitter case. Try to use ceramic or polycarbonate capacitors as far as possible.



Inside the transmitter front panel, we suggest that you use a pre-set on the slider for trimming. The aerial and base are standard radio control items. Both may be obtained from R/C hobbyist shops. Instead of a telescopic aerial a length of piano wire (24 inches) may be used but be prepared for a drop in range.

TTLs by TEXAS

7400	11p	74278	290p	4019	45p
74S00	60p	74279	110p	4020	100p
7401	12p	74283	160p	4021	110p
7402	12p	74290	150p	4022	100p
7403	14p	74293	150p	4023	25p
7404	14p	74298	200p	4024	50p
74S04	90p	74365	100p	4025	27p
7405	18p	74366	100p	4026	130p
7406	32p	74367	100p	4027	50p
7407	32p	74368	100p	4028	84p
7408	17p	74390	200p	4029	100p
7409	19p	74393	200p	4030	55p
7410	15p	74490	225p	4031	200p
7411	24p	**74LS SERIES**		4033	180p
7412	20p	74LS00	14p	4034	200p
7413	30p	74LS02	16p	4035	110p
7414	50p	74LS03	18p	4036	295p
74C14	90p	74LS04	16p	4037	115p
7416	27p	74LS05	25p	4038	120p
7417	27p	74LS08	22p	4039	295p
7420	17p	74LS10	20p	4040	100p
7421	40p	74LS11	40p	4041	80p
7422	22p	74LS13	40p	4042	80p
7423	34p	74LS14	72p	4043	90p
7425	30p	74LS15	45p	4044	90p
7426	40p	74LS20	20p	4046	110p
7427	34p	74LS21	40p	4047	100p
7428	17p	74LS27	38p	4048	120p
7430	17p	74LS30	20p	4049	50p
7432	30p	74LS32	27p	4050	49p
7433	40p	74LS42	70p	4051	80p
7437	35p	74LS47	90p	4052	80p
7438	35p	74LS51	24p	4053	80p
7440	17p	74LS55	30p	4054	150p
7441	70p	74LS73	50p	4055	125p
7442A	60p	74LS74	36p	4056	135p
7443	112p	74LS75	40p	4059	600p
7444	112p	74LS76	45p	4060	140p
7445	100p	74LS83	110n	4063	120p
7446A	93p	74LS85	100p	4066	55p
7447A	50p	74LS86	40p	4067	450p
7448	80p	74LS90	40p	4068	27p
7450	17p	74LS92	70p	4069	27p
7451	17p	74LS93	80p	4070	30p
7453	17p	74LS96	110p	4071	25p
7454	17p	74LS107	45p	4072	25p
7460	17p	74LS109	80p	4073	25p
7470	36p	74LS112	100p	4075	25p
7472	30p	74LS113	90p	4076	107p
7473	34p	74LS114	45p	4081	27p
7474	30p	74LS122	80p	4082	27p
7475	30p	74LS123	70p	4086	72p
7476	35p	74LS124	180p	4089	138p
7480	50p	74LS125	60p	4093	80p
7481	100p	74LS126	60p	4094	250p
7482	84p	74LS132	95p	4095	95p
7483a	90p	74LS133	30p	4096	95p
7484	100p	74LS136	55p	4097	340p
7485	110p	74LS138	75p	4098	120p
7486	34p	74LS139	75p	4099	200p
7489	175p	74LS145	120p	40100	220p
7490A	30p	74LS147	220p	40101	132p
7491	80p	74LS148	175p	40102	180p
7492A	46p	74LS151	100p	40103	180p
7493A	30p	74LS153	60p	40104	99p
7494	84p	74LS154	200p	40105	99p
7495A	70p	74LS155	90p	40106	90p
7496	65p	74LS156	90p	40107	60p
7497	180p	74LS157	80p	40108	470p
74100	130p	74LS158	90p	40109	100p
74104	65p	74LS160	130p	40110	308p
74105	65p	74LS161	100p	40114	250p
74107	34p	74LS162	140p	4502	120p
74109	55p	74LS163	100p	4503	70p
74110	55p	74LS164	120p	4507	55p
74111	70p	74LS165	160p	4508	290p
74116	200p	74LS166	180p	4510	99p
74118	130p	74LS173	110p	4511	150p
74119	210p	74LS174	110p	4512	80p
74120	110p	74LS175	110p	4514	265p
74121	28p	74LS181	320p	4515	300p
74122	48p	74LS190	250p	4516	110p
74123	48p	74LS191	100p	4518	100p
74125	55p	74LS192	100p	4520	100p
74126	60p	74LS193	100p	4521	250p
74128	75p	74LS195	140p	4526	108p
74132	75p	74LS196	120p	4527	150p
74135	50p	74LS197	120p	4528	120p
74136	75p	74LS221	140p	4538	120p
74141	50p	74LS240	175p	4543	180p
74142	200p	74LS241	175p	4553	450p
74145	90p	74LS242	170p	4556	72p
74147	190p	74LS243	170p	4560	250p
74148	150p	74LS244	195p	4569	250p
74150	100p	74LS245	350p	4572	40p
74151A	70p	74LS247	140p	4583	90p
74153	70p	74LS248	140p	4584	90p
74154	100p	74LS249	140p	4585	150p
74155	90p	74LS251	140p	4724	250p
74156	90p	74LS253	140p	40097	90p
74157	70p	74LS257	120p	14411	1100p
74159	190p	74LS258	160p	14412	1100p
74160	100p	74LS259	160p	14433	1100p
74161	100p	74LS266	100p	14500	700p
74162	100p	74LS273	195p	14599	290p
74163	100p	74LS279	90p	CD22100	350p
74164	120p	74LS298	249p	CD22101	700p
74165	130p	74LS324	200p	CD22102	700p
74166	120p	74LS348	200p	**INTERFACE ICs**	
74167	200p	74LS365	100p	OM8123	175p
74170	240p	74LS367	100p	DP8304	450p
74172	450p	74LS368	100p	DM8835	250p
74173	120p	74LS373	180p	DM8836	250p
74174	90p	74LS374	195p	MC1488	100p
74175	85p	74LS378	200p	MC1489	100p
74176	90p	74LS390	160p	25S10	350p
74177	90p	74LS393	160p	75107	160p
74178	160p	74LS445	140p	75150	175p
74180	93p	74LS668	100p	75154	175p
74181	160p	74LS669	100p	75182	230p
74182	90p	74LS670	400p	75322	300p
74184A	150p	**4000 SERIES**		75324	375p
74185	150p	4000	15p	75325	375p
74186	500p	4001	27p	75361	300p
74188	325p	4002	25p	75363	400p
74190	90p	4006	95p	T5365	350p
74191	90p	4007	25p	75451	72p
74192	90p	4008	80p	75491/2	96p
74193	90p	4009	40p	8T26	250p
74194	90p	4010	50p	8T28	300p
74195	95p	4011	27p	8T95	200p
74196	95p	4012	25p	8T97	200p
74197	80p	4013	50p	81LS95	140p
74198	150p	4014	84p	81LS96	140p
74199	150p	4015	84p	81LS97	140p
74200	1000p	4016	45p	81LS98	140p
74221	160p	4017	80p	9601	110p
74251	140p	4018	89p	9602	220p

93 SERIES

9301	160p
9302	175p
9308	316p
9310	275p
9311	275p
9312	160p
9314	165p
9316	225p
9321	225p
9322	150p
9334	360p
9368	200p
9370	200p
9374	200p

LINEAR I.Cs

AY1-0212	600p
AY1-1313	668p
AY1-1320	320p
AY1-6050	140p
AY3-1270	840p
AY5-1224A	240p
AY5-1315	600p
AY5-1317A	775p
CA3019	80p
CA3046	70p
CA3048	225p
CA3080E	72p
CA3086	48p
CA3089E	225p
CA3090AQ	375p
CA3130E	90p
CA3140E	50p
CA3160E	100p
CA3161E	140p
CA3162E	450p
CA3189E	400p
DAC1408-8	225p
FX209	750p
ICL7106	850p
ICL8038	340p
ICM7555	80p
LF356P	95p
LM10C	425p
LM301A	30p
LM311	120p
LM318	200p
LM319	225p
LM324	50p
LM339	75p
LM348	95p
LM377	175p
LM380	75p
LM381AN	200p
LM709	36p
LM710	50p
LM725	250p
LM733	100p
LM741	18p
LM747	70p
LM748	35p
LM2917	250p
LM3900	70p
LM3909	70p
LM3911	130p
LM3914	250p
LM3915	250p
LM4136	120p
MC1310P	150p
MC1458	48p
MC1495L	350p
MC1496	100p
MC3340P	120p
MC3360P	120p
MK50398	750p

VOLTAGE REGULATORS
Fixed Plastic TO-220

1A	+ve		−ve	
5V	7805	60p	7905	70p
12V	7812	60p	7912	70p
15V	7815	60p	7915	70p
18V	7818	60p	7918	70p
24V	7824	60p	7924	70p

100mA	TO-92			
5V	78L05	30p	79L05	70p
12V	78L12	30p	79L12	70p
15V	78L15	30p	79L15	70p

OTHER REGULATORS		78HGKC	600p
LM309K	135p	78HO5KC	600p
LM317T	200p	78MGT2C	135p
LM323K	550p	78P05	900p
LM723	37p	79BIGKC	700p

OPTO-ELECTRONICS

2N5777	45p	ORP60	90p
OCP71	130p	ORP61	90p
ORP12	90p	TIL78	70p
OPTO-ISOLATORS			
ILD74	130p	TIL111	90p
MCT26	100p	TIL112	90p
MCS2400	190p	TIL116	90p

LEDS

0.125		0.2"	
TIL32	75p	TIL220 Red	16p
TIL209 Red	13p	TIL222 Gr	18p
TIL211 Gr	20p	TIL228 Red Rectangular	22p
TIL212 Ye	25p	LEDs (R, G, Y)	30p
TIL216 Red	18p		

DISPLAYS

3015F	200p	NSB5881	570p
DL704	140p	TIL311	600p
DL707 Red	140p	TIL312/3	110p
707 Gr	140p	TIL321 2	130p
DL747 Red	225p	TIL330	140p
747 Gr	225p	7750 60	200p
FND357	120p	**DRIVERS**	
FND500	120p	9638	200p
FND507	120p	9370	200p
MAN3640	175p	UDN6118	320p
MAN4640	200p	UDN6184	320p

VEROBOARDS

	0.1 (copper clad)	0.15 (copper clad)
2.5×3.75"	48p	43p
2.5×5"	57p	51p
3.75×3.75"	57p	—
3.75×5"	64p	64p
3.75×17"	222p	194p
4.75×17.9"	290p	—
Pkt of 100 pins		50p
Spot face cutter		86p
Pin insertion tool		118p
Vero Wiring Pen + 2 wire spools + combs		370p
Combs		7p

MM57160	620p		
NE531	150p		
NE555	22p		
NE556	70p		
NE5534AN	300p		
NE561B	425p		
NE562B	425p		
NE565	130p		
NE566	155p		
NE567	175p		
NE571	425p		
RC4151	400p		
SAB3209	POA		
SAD1024A	1250p		
SFF96364	1100p		
SN76003N	250p		
SN76013N	140p		
SN76013ND	120p		
SN76023N	140p		
SN76023ND	120p		
SN76477	200p		
SP8515	750p		
TAA621	275p		
TBA641B11	225p		
TBA651	200p		
TBA800	90p		
TBA810	100p		
TBA820	90p		
TCA940	175p		
TDA1004	300p		
TDA1008	320p		
TDA1010	225p		
TDA1022	600p		
TDA1024	120p		
TDA1034B	250p		
TDA1170	250p		
TDA2002V	325p		
TDA2020	320p		
TL071	50p		
TL072	95p		
TL074	150p		
TL081	45p		
TI082	95p		
TL084	130p		
TL170	50p		
UAA170	200p		
UON6118	320p		
UON6184	320p		
ULN2003	100p		
XR2206	350p		
XR2207	400p		
XR2211	600p		
XR2216	675p		
XR2240	400p		
ZN414	90p		
ZN419C	225p		
ZN424E	135p		
ZN425E	400p		
ZN1034E	200p		
95H90	800p		

TRANSISTORS

AC126	25p	BF259	36p	TIP30A	48p	2N3442	140p
AC127/8	20p	BF839	25p	TIP30C	60p	2N3553	240p
AC176	25p	BFR40	25p	TIP31A	58p	2N3565	30p
AC187/8	25p	BFR41	25p	TIP31C	62p	2N3584	250p
AF116	50p	BFR79	25p	TIP32A	68p	2N3643/4	48p
A0149	70p	BFR80	25p	TIP32C	82p	2N3702/3	12p
AD161/2	45p	BFR81	25p	TIP33A	90p	2N3704/5	12p
AU107	200p	BFX29	30p	TIP33C	114p	2N3706/7	14p
BC107/8	11p	BFX30	34p	TIP34A	115p	2N3708/9	12p
BC109	11p	BFX84/5	40p	TIP34C	160p	2N3773	300p
BC117	20p	BFX86/7	30p	TIP35A	225p	2N3819	25p
BC147/8	9p	BFX88	30p	TIP35C	290p	2N3820	50p
BC149	10p	BFW10	90p	TIP36A	270p	2N3823	70p
BC157/8	10p	BFY50	30p	TIP36C	340p	2N3866	90p
BC159	11p	BFY51/2	30p	TIP41A	65p	2N3902	700p
BC169C	12p	BFY90	90p	TIP41C	78p	2N3903/4	18p
BC172	12p	BRY39	45p	TIP42A	70p	2N3905/6	20p
BC177/8	17p	BSX19/20	20p	TIP42C	82p	2N4036	70p
BC179	18p	BU104	225p	TIP54	160p	2N4037	65p
BC182/3	10p	BU105	190p	TIP120	120p	2N4058/9	12p
BC184	11p	BU108	250p	TIP122	130p	2N4060	12p
BC187	30p	BU109	225p	TIP142	160p	2N4061/2	18p
BC212/3	11p	BU205	200p	TIP147	160p	2N4123/4	27p
BC214	12p	BU208	200p	TIP2955	78p	2N4125/6	27p
BC237	15p	BU406	145p	TIP4055	70p	2N4401/3	27p
BC327	16p	E300	50p	TIS43	34p	2N4427	90p
BC337	16p	E308	50p	TIS93	30p	2N4871	60p
BC338	16p	E310	50p	ZTX108	12p	2N5087	27p
BC461	36p	MJ2501	225p	ZTX300	13p	2N5089	27p
BC477/8	30p	MJ2955	90p	ZTX500	15p	2N5172	27p
BC516/7	50p	MJ3001	225p	ZTX502	18p	2N5179	90p
BC547B	16p	MJE340	70p	ZTX504	30p	2N5191	90p
BC548C	9p	MJE2955	100p	2N696	35p	2N5194	90p
BC549C	18p	MPF102	45p	2N697	25p	2N5245	40p
BC557B	16p	MPF103/4	40p	2N698	45p	2N5296	55p
BC559C	18p	MPF105/6	40p	2N706A	20p	2N5401	50p
BCY70	18p	MPS6531	50p	2N918	45p	2N5457/8	40p
BCY71/2	22p	MPS6534	50p	2N930	18p	2N5459	40p
BD131/2	50p	MPSA06	30p	2N1131/2	20p	2N5460	60p
BD135/6	54p	MPSA12	50p	2N1613	25p	2N5485	44p
BD139	56p	MPSA13	50p	2N1711	25p	2N5875	250p
BD140	60p	MPSA20	50p	2N2102	70p	2N6027	48p
BD189	60p	MPSA42	50p	2N2160	350p	2N6107	65p
BD232	95p	MPSA43	50p	2N2219A	30p	2N6247	190p
BD233	75p	MPSA56	32p	2N2222A	30p	2N6254	130p
BD235	85p	MPSA70	50p	2N2369A	20p	2N6290	65p
BD241	70p	MPSU06	63p	2N2484	30p	2N6292	65p
BD242	70p	MPSU07	90p	2N2646	45p	2SC1172	150p
BDY56	200p	MPSU45	90p	2N2904/5	30p	3N128	120p
BF200	32p	MPSU65	78p	2N2906A	30p	3N140	100p
BF244B	35p	OC28	130p	2N2907A	30p	3N141	110p
BF256B	70p	OC35	130p	2N2926	9p	3N201	110p
BF257/8	32p	TIP29A	40p	2N3053	30p	3N204	100p
		TIP29C	55p	2N3054	65p	40290	250p
				2N3055	48p	40361/2	75p
						40364	120p
						40408	70p
						40409	85p
						40410	85p
						40411	300p
						40594	97p
						40595	105p
						40673	75p
						40841	90p
						40771/2	90p

DIODES

BY127	12p
BYX36-300	20p
OA47	9p
OA81	15p
OA85	15p
OA90	9p
OA91	9p
OA95	9p
OA200	9p
OA202	10p
1N914	4p
1N916	7p
1N4148	4p
1N4001/2	5p
1N4003/4	6p
1N4005	6p
1N4006/7	7p
1N5401/3	14p
1N5404/7	19p
IS920	9p

HEAT SINKS

For TO220 Voltage Regs and Transistors	22p
For TO5	12p

BRIDGE RECTIFIERS

1A	50V	19p
1A	100V	20p
1A	400V	25p
1A	600V	30p
2A	50V	30p
2A	100V	35p
2A	400V	45p
3A	200V	60p
3A	600V	72p
4A	100V	95p
4A	400V	100p
6A	50V	80p
6A	100V	100p
6A	400V	120p

10A, 400V	200p
25A 400V	400p

ZENERS

2.7V-33V 400mW	9p
1W	15p

TRIACS PLASTIC

3A 400V	60p
3A 500V	65p
6A 400V	70p
6A 500V	88p
8A 400V	75p
8A 500V	95p
12A 400V	85p
12A 500V	105p
16A 400V	110p
16A 500V	130p
T2800D	130p

THYRISTORS

1A	50V	40p
1A	400V	65p
3A	400V	90p
8A	600V	140p
12A	400V	160p
16A	100V	160p
16A	400V	180p
16A	600V	220p
BT106		110p
C106D		45p
MCR101		36p
TIC44		35p
2N3525		120p
2N4444		140p
2N5060		34p
2N5064		40p

LOUDSPEAKERS

Size			
2½"	64R		70p
2½"	8R		70p
2"	8R		80p
1½"	8R		80p

MEMORIES

2102-2L	120p
2107B	500p
2111-2	225p
2112-2	300p
2114	400p
2114-2L	500p
4027	375p
4044	900p
4116	500p
5101	510p
6810	350p
74S201	350p
82516	325p
ROM/PROMs	
71301	700p
74S188	225p
74S287	350p
74S387	350p
74S470	650p
74S471	650p
74S571	650p
B2S137	750p
93427	400p
93436	650p
93446	650p
93448	900p
CPUs	
1600	1200p
1802CE	650p
2650A	2000p
6502	1000p
6800	700p
6802	1250p
6809	2500p
8080A	550p
8085A	1400p
1NS8060	1000p
Z80	1100p
Z80A	1250p
EPROMS	
1702A	500p
2708	800p
2716 (+5V)	£16
SUPPORT DEVICES	
3242	800p
3245	400p
6532	1000p
6820	500p
6821	500p
6845	2500p
6850	500p
8205	320p
8212	225p
8216	225p
8224	400p
8228	525p
8251	700p
8253	1200p
8255	550p
8257	1100p
8259	1400p
Z80P10	650p
Z80AP10	800p
Z80CTC	650p
MC14411	1100p
MC14412	1100p

UART

AY-3-1015P	500p
AY-5-1013P	400p
IM6402	500p
TMS6011NC	400p

CHARACTER GENERATORS

3257ADC	900p
MCM6576	1000p
RO-3-2513 U.C.	600p
RO-3-2513 L.C.	700p
SN74S262AN	900p

KEYBOARD ENCODER

AY-5-2376	900p

TRANSFORMERS
(prim 220/240V)

6-0-6	100mA	88p
9-0-9	75mA	92p
0-120	12500mA	280p
0-25V (5VA)		250p
9-0-9 1A		270p*
12V 2A		350p*
0-12-15 20-24-30 1A		340p*
15-0-15 1A		265p*

(Please add 50p p&p charge to all marked * above our normal p&p charge).

RESISTORS High Stab 5% E12 Carbon Film

¼W 10R-1M one value	7p/5pcs
½W 10R-10M one value	5p/3pcs

Miniature Presets Hor/Vert 100R-1M 12p
Carbon Track Pots 5K-1M Log or Lin
Single 30p
Single with Switch 60p
Dual 72p
SLIDER POTS 60mm Track
LIN 5K, 10K, 50K, 100K 60p
LOG 10K 60p

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	10p	18 pin	20p	24 pin	28p
14 pin	11p	20 pin	22p	28 pin	32p
16 pin	12p	22 pin	25p	40 pin	40p

WIRE WRAP SOCKETS BY TEXAS

8 pin	30p	18 pin	70p	24 pin	90p
14 pin	40p	20 pin	75p	28 pin	110p
16 pin	55p	22 pin	80p	40 pin	140p

SUBMINIATURE SWITCHES

Toggle SPST	60p
SPDT	65p
DPDT	70p
DPDT (centre off)	85p
Push to make	15p
break	25p
Push latching SPCO	60p
SLIDE DPDT	18p
ROCKER SPST	28p
WAFER	
1P/12W	45p
3P/4W	45p
4P/3W	45p
2P/6W	45p

CRYSTALS

100KHz	300p
1MHz	370p
1.008MHz	370p
3.2768MHz	350p
3.579545MHz	200p
4MHz	350p
8.867237MHz	400p
10.7MHz	350p
18MHz	300p
20.690MHz	210p
27.145MHz	210p

ANTEX SOLDERING IRONS

C-15W	400p
CX-17W	420p
CCN-15W	420p
X25	420p
SPARE BITS	
C/CX/CCN	46p
X25	50p
SPARE ELEMENTS	
C/CX/X25	180p
CCN	200p
ADCOLA IRONS	
K1000	550p
K2000	550p

VEROBOARDS

DIP Breadboard 4.15 × 6.15	270p
(Suitable for 20 × 14 pin or 16 × 16 pin DIL ICs) DIP Breadboard as above with tracks for 31 way connector	340p
V-Q Boards for ICs (No track cutting)	105p

CONNECTOR PLUGS

31 way Plug	110p
31 way Socket	110p
S-100 Busboard	£12

EDGEBOARD CONNECTORS 0.156" PITCH

2 × 10 way	85p	2 × 22 way	135p
2 × 15 way	100p	2 × 25 way	160p
2 × 18 way	120p		

COUNTERS

74C925	475p
74C928	600p
ICM7216B	£20
ICM7217A	850p
ZN1040E	700p

TTL & ECL

MC4024	325p
MC4044	325p
10116	70p
10231	350p

SPECIAL OFFERS (subject to stocks)

555	£18/100	7805	£5/10
741	£16/100	7812	£5/10
2114L-3	£4.50	7905	£6/10
2708	£6.75	7912	£6/10
2708 (650 ns)	£4.00	2114L 450 ns	£28/8
2716 (plus 5V only)	£16.00	P&P + VAT Extra	
4116 (200 ns)	£36/8		

BREADBOARDS

EXP350 3.6" x 2.1" (Up to 3 x 14 pin ICs)	£3.15
EXP650 3.6" x 2.4" (Up to 1 x 40 pin IC)	£3.60
EXP300 6" x 2.1" (Uto 6 x 14 pin ICs)	£5.75
EXP600 6" x 2.4" (Up to 1 x 40 pin DCs)	£6.30

IC TEST CLIPS

14 pin	£2.60	24 pin	£4.90
16 pin	£2.75	40 pin	£7.90

PROTOBOARD (R) SOLDERLESS BREADBOARDS

Socket Strips / Bus Strips / Binding Posts mounted on sturdy base plate

PB6	6 x 14 DIL ICs	£9.20
PB100	10 x 14 DIL ICs	£11.80
PB102	12 x 14 DIL ICs	£22.95
PB103	24 x 14 DIL ICs	£34.45
PB104	32 x 14 DIL ICs	£45.95

(The above boards are suitable for all DIL ICs.)

16 KEY KEYPAD (Reed Switches)	£4.00
UHF Modulators	£3.75
Reed Switches (12VA)	£0.25
LOGIC PROBE	£18.00
MULTIMETERS	
SUPERTESTER 680R	£33.00
MICROTEST 80R	£17.00
TMK500	£22.00
Pocket multimeter	£4.75

COMPUTER KITS
MEMORY MAPPED VDU INTERFACE KIT

SERIAL I/P VDU INTERFACE KIT	£45.00
ELF II MICROCOMPUTER KIT	£56.00
ELF II WIRED AND TESTED	£79.95
GIANT MONITOR BOARD KIT FOR ELF II	£99.95
4K STATIC RAM BOARD FOR ELF II	£35.00
ASCII KEYBOARD KIT	£69.44
(Please add 75p p&p to all above items).	£50.58

We carry a large stock of 74 and 74LS TTLs, CMOS, Linears, Memories, etc. and can normally offer ex-stock deliveries. We welcome inquiries for volume quantities both from local and overseas buyers.

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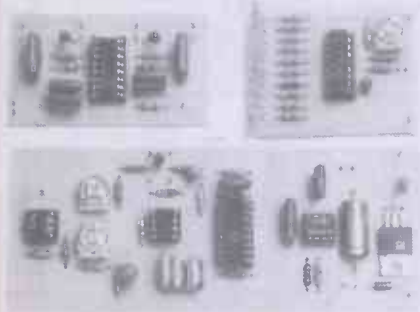
Hobby Electronics

CAR BOOSTER

Having trouble hearing your car stereo? Not any more, with the HE car stereo booster pumping out 18 watts RMS per channel. Not only will *you* be able to hear the music over the road noise, so will half the street. This simple to build little circuit will connect up neatly to your existing equipment and will give results comparable to, and in most cases better, than commercial units costing many times more. You can't afford to miss it.

PUSH BUTTON VOLUME CONTROL



Tired of twiddling pots? Weary of winding volume controls? Sit back in your armchair and adjust the volume of your stereo system electronically. This gadget is actually three projects in one and is guaranteed not to go noisy (as most pots do eventually) or wear out. The system even has a 'memory' so you can instantly mute the sound (if the phone rings) and return it back to where it was. Would we lie to you? Find out next month. (Of course we wouldn't).

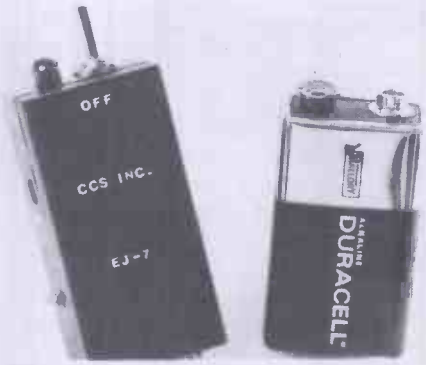
SOUND OPERATED FLASH TRIGGER

Have you ever wondered how those amazing pictures of bursting ballons and smashing light bulbs are taken, then worry no more. This nifty gadget will connect up to virtually any electronic flash gun. In a darkened room with the shutter open it will 'fire' the flash gun in response to a sharp noise. Now you can take pictures of milk splashes and unsuspecting burglars, let your imagination go wild next month.

ELECTRONICS IN PHOTOGRAPHY

Next month we take an in-depth look at how the sciences of photography and electronics are coming together. We have persuaded a professional photographer to review the latest equipment on the market and take a candid look at what we can expect to see in the not-too-distant future. Gone are the days when cameras sprouted knobs and buttons, these days a modern camera will even operate the shutter (electronically of course), focus, set the aperture and even develop the film for you.

ELECTRONIC ESPIONAGE



Have you got a secret? If you have, and it's intersting enough then there's a good chance someone is trying their damndest to find out all about it. Next month Rick Maybury dons his cloak and dagger to find out how electronics is helping the spy industry to become even more devious. A few years ago we could all laugh at the gadgets in James Bond films, now it's not so funny. We look at bugs no larger than the head of a match, how tapping the telephone has progressed and a couple of other devices some people would rather you didn't know about. All this plus some pictures of equipment that has never been published before, the HE guide to de-bugging your home and office and look round one of the world's foremost surveillance and anti-bugging equipment shops, right here in Britain.

HAZARD FLASHER

Many older cars lack this now essential (and in some countries compulsory) feature. If you have broken down you can alert motorists and maybe even summon help. This simple little circuit will flash both sets of indicators simultaneously and give an audible warning that the system is functioning. It could save your life one foggy day!!!

PLUS PLUS PLUS

The results of the Heath PMM competition and news of a new series from Ian Sinclair

The July issue will be on sale June 13th

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

Books from the HE Book Service

28 Tested Transistor Project £1.55
Richard Torrens. The projects can be split down into simple building blocks which can be recombined for ideas of your own.

Electronic Projects for Beginners £1.65
F. G. Rayer. Divided into 'No Soldering Projects,' Radio and Audio Frequency, Power Supplies and Miscellaneous.

Practical Electronic Calculations and Formulae . £2.55
F. A. Wilson. A valuable reference for the home and laboratory, containing all the most frequently used, and some of the less well known electronic formulae and calculations.

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.

Linear IC Equivalents and Pin Connections . . . £3.10
Adrian Michaels. Gives most essential data for popular devices.

Electronic Security Devices £1.75
R. A. Penfold. Full of constructional circuits covering the most basic security systems to the Ultrasonic and Doppler Shift systems.

How To Build Your Own Solid State Oscilloscope £1.80
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..

50 FET (Field Effect Transistor) Project £1.55
F. G. Rayer. Contains something of interest for every class of enthusiast. Short Wave Listener, Radio Amateur, Experimenter or audio devotee.

50 Circuits Using 7400 Series ICs £1.65
R. N. Soar. The author has managed to compile no less than 50 interesting and useful circuits using this range of devices, covering many different aspects of electronics.

Essential Theory for the Electronics Hobbyist £1.55
G. T. Rubaroe gives the hobbyist a background knowledge tailored to meet his specific needs.

Beginners Guide to Building Electronic Projects . £1.55
R. A. Penfold. Covers component identification, tools, soldering, constructional methods and examples of simple projects are given.

50 Projects using IC CA3130 £1.25
R. A. Penfold. Describes audio projects, RF project, Test Equipment, Household and miscellaneous circuits.

IC 555 Project £2.05
E. A. Parr. Circuits are given for the car, model railways, alarms and noise makers. Also covers the related devices 556, 558 and 559.

Second Book of CMOS IC Projects £1.80
R. A. Penfold. Following in the success of the original CMOS projects book we present the second volume covering all aspects of CMOS technology from multivibrators to triggering devices.

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:

Hobby Electronics Book Service, Modmags Ltd, 145 Charing Cross Road, London WC2H 0EE.

Clever Dick

This month we help out an amateur astronomer 'get his ears on' and the mystery of the old HE projects is solved.

OKAY, pay attention now, it's CD time again. Frank Pressdee wins this month's HE Binder for possibly the worst collection of puns ever to elicit a groan, here goes.

Dear CD,

On a musical note, how about featuring a constructional project for a Chorus Generator in a future issue of HE. In the shops these units sound expensive, to the tune of £100.

Surely your technical boys can band together to compose a circuit for such an instrument. This, I'm sure generate a chorus of applause from us electronic music enthusiasts.

Frank Pressdee
Wednesbury

Circuits on that scale are enough to make most designers quaver in their boots. Luckily our sister magazine ETI is not afraid of such enterprises. They have managed to get that Baron of the Breadboard, Mr Tim Orr, to design a Chorus Machine for them. Part one was in last months (May) ETI. You'll need plenty of dough (Do ray me, oh forget it), you may have to sell your car (Allegro?) to pay for it though.

The silly season is here again. Mr R Robots peculiar reading habits are matched only by his dubious name and place of residence.

Dear Clever Dick,

Re. your interesting comments on Negative Ions, may I bring your attention to a most informative article by Adrian Hope in the March edition of Ev'ry'ay E'ec'ro'i's.

Reg Robot
Electroville

No you may not!

Dear Dick,

As the Government is going to abandon we lowly folk in a nuclear war (except for a few pistol-packing guys in command posts) I ask that you publish a circuit for a Geiger Counter for the few that emerge from holes. It would be a good idea so that we can know exactly what will be safe to eat and drink, not being contaminated by fallout.

One last suggestion, how about a circuit I saw some years ago, when a steady, low heat was applied to this device it produced a low voltage, enough to work a pocket radio. I believe it was made from two different metals.

F G Wagstaff
Somerset

Yes, we have got plans for a pocket radiation monitor, for the October issue in fact. Hopefully we can get it into print before it is too late. Superpowers please note, don't do anything until October.

Your second enquiry refers to the Thermocouple, it is a very simple device, composed, as your suggest, from two dissimilar metals. According to the HE reference books the simplest type of themocouple consists of a junction of two metals (Platinum and Rhodium are supposedly quite good) connected in series to another junction, one should be hot, the other cold. Under these conditions a small (around 6-10 uV at 0° and 100°C) voltage will flow. The low voltage and expensive materials may explain why we don't hear too much about them.

Mr J F Button has a few questions concerning our projects, like the flies in winter, where do they go?

Dear Dick,

I have several queries:

(1) Please tell me where you buy the transfers that you use for decorating the projects since you have so many different types?

(2) What happens to the projects which have no practical use in the office, eg; Dice, LED Displays etc?

(3) Who pays for the components used in projects?

(4) Where did you buy the 2% tolerance resistors used in the DFM project (April HE)?

Congratulations on the excellent magazines — HE & ETI — keep up the good work.

Winchester *J F Button*

There is nothing mysterious about our panel lettering, we use either Letraset, Mecanorma or Chartpak rub-down transfers. There are something like 2000 different typefaces to choose from and most, if not all are available from artists supply shops, many are to be found near universities or colleges. The only problem from your point of view is expense, because we buy (and use) in quantity it doesn't cost us as much, maybe you could get a few mates together and buy a selection.

Despite what many people think we keep all our projects in working order, this is simply because we like to put them on our stands at exhibitions etc for people, like yourself, who want to play with them, or simply see

how we did it. By the way, just to dispel another rumour, 99% of all our projects are designed and built by our own workshop team and they all work (the projects that is), errors usually creep in when we publish them, although our record for mistakes isn't as bad as some magazines we could mention.

Your third question is easy to answer, you the readers pay for our projects, by buying HE you pay for our wages, offices etc, it's just like any other business, thanks from all of us. If a few more of you buy HE then we can put in for a wage rise, how about it?

Your last question is also easy, because many of you do not live near a components shop we try to ensure that all of the components we specify are obtainable by mail order. The 2% tolerance resistors you mention are readily available from Maplin, Watford, etc.

Mr R H. Durn from West Yorkshire wants to go star gazing, electronically of course.

Dear Dick,

Several years ago I took up astronomy as a hobby and now I am a very keen amateur. Anyhow, a few months ago I came up with the idea of building a small radio telescope. Since I hardly know anything about electronics I was wondering if you could give me any information on the subject.

R H Durn
W. Yorkshire

This is not a subject we know too much about either, however, our resident sky watcher Peter Green has dug down into his library and come up with a couple of titles that may be of use to you.

Radio Astronomy For The Amateur by David Heiserman. Published by W Fousham & Co, price £4.35.

Introduction To Radio Astronomy by John Potter Shields.

Both these books have details, circuits etc for constructing Radio Telescopes, the first one by David Heiserman is probably better for the beginner.

Martyn Daniels has been having some problems with his right foot, faster than a traffic warden booking a Rolls Royce-HE to the rescue (well, almost).

Dear Dick

I have two endorsements on my driving licence and would loose my job if I lost my licence. So; how about a circuit for a Radar Speed trap detector. If you can't supply constructional details, who can?

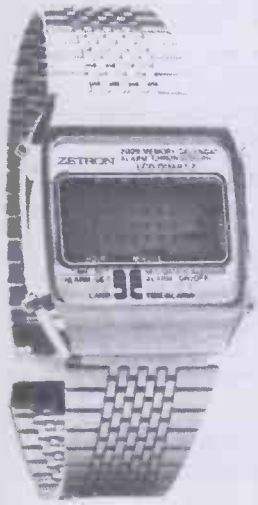
Martyn Daniels
Worcester

Unfortunately Martyn Radar detectors bring us into the nether-world of the 1949 Wireless Telegraphy Act. It appears that the equipment you desire can be brought and sold quite legally but may not be used because it receives on a restricted band of frequencies. The circuit itself is a bit out of our scope anyway because it operates in the radio spectrum where frequency is measured in Gigo Hertz (10") Hz. Not only that we have heard that many so-called detectors do respond to Police radar but only when you've been through the beam making their worth somewhat suspect. If you still want to get involved we suggest you look at a commercial unit but remember do not switch it on otherwise you'll be breaking the law. (Luckily it's not endorsable though.) NIC at 61 Broad Lane, Tottenham has one for £21.95. **HE**

MITRAD (MIDLAND TRADING COMPANY)

ZETRON **BRITAIN'S FINEST SELLING RANGE** **ZETRON**

GENTS MEMORY CALENDAR ALARM CHRONO



A really successful watch incorporating all the latest technology.

Hours, mins, secs, weekday and snooze alarm indication on constant display.

A further two optional display modes are available, one being the calendar and month, which can be increased or decreased to give the appropriate month of the year.

A 1/106th second chronograph with split and lap mode facilities are built into the watch with a 12-hour capacity.

A 21-hour alarm with a 10-minute snooze function is also standard to this watch. A further feature is the backlight and fully adjustable stainless steel bracelet.

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STAR VALUE
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GENTS QUARTZ ANALOGUE

A truly superb timepiece with extreme accuracy. A choice of two colours on this outstanding watch are available, blue or white.

The calendar in the watch can be set to give a readout in either French or English with date indication being automatic.

An infinitely adjustable stainless steel strap is built in as part of the watch.

The watch is fitted with a long-life battery and comes with luminous markings to aid night-time vision.

YES ONLY £19.95

NEW ZETRON L.C.D. CALCULATOR NEW

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Four basic functions, chain and mixed operations, constants for four functions, % calculations including discounts and mark-ups. Automatic accumulation in four functions.
★PLUS★
Square Root facility
★PLUS★
Memory facility
★PLUS★
Auto Power Off (7 minutes)

ALL THIS FOR A MODEST £4.95

GENTS MELODY ALARM CHRONO DUAL TIME

Brand new Melody Alarm, Chrono, Constant display of hours, mins, secs, weekday, am/pm and mode square flag indication.

The chrono runs to a 1/10th sec (running horse style) split and lap mode facilities are standard. Dual timing facilities. The alarm system is unique in the fact that it plays the tune "Yellow Rose Of Texas" for 20 seconds.

The tune can be actuated at any instance by the press of a button. Backlight, infinitely adjustable stainless steel strap.

VERY LOWLY PRICED
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NEW QUARTZ L.C.D. TIMER NEW

A new style timer incorporating split second accuracy. The timer is finished in a strong black plastic case with large L.C.D. readout of hours, mins and secs. A further optional display mode of month, date and weekday is available. The timer incorporates a 1/100th sec chronograph with numerous facilities.
(i) The timer can be frozen.
(ii) Two people can be timed simultaneously.
(iii) Split and lap mode facilities are available. A strong black cord is attached to the timer which aids movement at sporting events.

Battery replacement is made easy with a screw back.

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Citizens Banned II

CB

HE's CB Editor Rick Maybury was invited along to the NATCOLCIBAR Technical Committee. We have a picture report on the latest demonstration, news of the Birmingham CB Carnival and another petition. In place of the original 'Citizens Banned' article we have a Club Directory and a new series about CB personalities.

ORIGINALLY I intended that this month's episode of Breaker One Four would have been a backward glance of the year's events since HE first became involved with CB. Fate, in the shape of events beyond our control deemed it necessary that this issue goes to press one week later than scheduled. That one week was probably the most important week in the history of British CB, three major events and at least six regional demonstrations over the weekend of the 26th 27th April made a golden opportunity we couldn't afford to miss.

So, instead of the intended feature Citizens Banned II we now present an extended version of BOF to cover these events. However, the latest Club Directory and a new feature, CBVIP, are included this month, but now to the first of these events.

NATCOLCIBAR

Or, to everyone else, the National Committee for the Legalisation of Citizens Band Radio. On the 25th April I was invited to attend the Technical Sub-Committee of NATCOLCIBAR at County Hall London.

The Committee was chaired most decisively by Richard Town and ably assisted by James Bryant and Bernie Murray, representatives from VERY large UK electronics companies and a couple of not so English companies were also to be seen. Not so obvious were the members of one or two monthly magazines also with an interest in CB. I am sworn to secrecy over specific details but I'm pretty sure they'll be sick when they discover what they missed. Suffice it to say that the proposals NATCOLCIBAR will ultimately present to the Home Office may contain some interesting reading.

The second outcome of this meeting can be seen on page 30. In conjunction with NATCOLCIBAR we are publishing this petition. As you can see it is short and to the point, you will have no excuse if you ignore this one because TANDY have offered to accept these forms in any of their shops on NATCOLCIBAR's behalf. You can if you wish return them to us at our usual address. In either case they must be returned by the 30th June to be handed over at the next major CB demo on the 6th July in Trafalgar Square. More forms are available either from the GLC or TANDY shops nationwide.

LONDON DEMO AND BIRMINGHAM CARNIVAL

The other main events of the CB Weekend were the series of regional demonstrations and the first ever CB Carnival in Perry Park Birmingham.

As we are somewhat limited, in that we can only be in one place at a time we covered the London Demo and the Carnival.

In terms of numbers both were slightly disappointing, conservative estimates in London put the figure at the London Demo at around the 500 mark. That wasn't really as many as we had hoped for but not bad considering the distinct lack of coverage given to the event by the press. Please take note now that the Demo for the 6th of July will be held in Trafalgar Square, London. Please turn up if you want CB because it's no good the same old faces turning up time after time. If you want CB then do something about it.

CB CARNIVAL

Again, the turnout was lower than we had hoped for but this could have been due to the lack of publicity. We got the location wrong in last month's BOF but that was due to circumstances beyond our control. Even so, around 1 000 of you thought it worthwhile, we were there dishing out balloons and mags, so were a sizeable selection of local Hot Rods and by all accounts a good day was had by all. Keith Townsend assures us that the next Carnival to be held in the Summer will get much more advance publicity, news of that, hopefully next month.

Bernie Murray proudly displays his UKCBC Tee-Shirt.

Councillor Theo Yard addressing the crowd just before the march commenced.

The procession leaving Speakers' Corner

UBA members 'pushing' for 27MHz

The procession in Trafalgar Square. How about an aerial up there lads?

NEWS FROM THE STATES

Now back to business, we have received an unusually large post bag this month, first away is Jim Roths from Hy Gain Electronics over there in Nebraska (that's America dummy). He would like to point out that we had prematurely reported the demise of Hy-Gain in the February BOF. In fact Hy-Gain are alive and well and although they no longer produce rigs they are producing an immense range of antenna systems for just about anybody that wants one. Jim was good enough to send us their latest catalogue, take it from us that should you need wide band VHF log periodic Antenna for 30 to 76 MHz, a 50-foot crank up tower and a trailer to move it round on then they can help you. Wonder how long it would take the HO to figure that one out!

Still in the 'States Mr S. C. Rimple of the Transworld Trading Corp, Dallas, Texas, writes to us to thank us for the mention of Magic Mike. If you can remember back to February (again) we said that Big Glynn Hall at Wintjoy had them in stock. Well, Mr Rimple would like to draw your attention to his latest model which will enable you to get prosecuted twice over for illegal transmissions. (27MHz and 49MHz, the operating frequency of this cordless mike). Oh well, thanks anyway Mr Rimpel.

Last but not least comes a press release from the famous Firestik antenna company of Phoenix Arizona who have also seen HE. (See, even American CBers read HE), they would like you to see the film 'Smokey And The Bandit' which although we haven't seen yet (how about some tickets whoever made it?) has a lot of CB action in it and makes good use of Firestik antennas particularly on Mr Burt Reynolds car.

BACK HOME

Back to good old CBless Britain now. As you may have noticed last month's HE was a little late due to industrial action. This meant that we could not get cracking with our National Directory of Handles. Fear not though, already we have something like 4,500 names and because of the immense popularity we are holding publications over one more month. There is still time to register your handle and get yourself a genuine callsign but hurry.

The C-Beastie this month is dedicated to David Carman who phoned us up a couple of weeks ago sounding most disturbed over their absence during the past couple of months, hope we've made up for it now Dave.

CB CELLARS

So many companies seem to be selling CB equipment these days that we've decided to give them their own column. With a little luck BOF will be getting out and about a bit more now so we can report on how things are going.

Last month we went along to Mura Electronics to meet Elliot Kahan, David Gross and Ged Crow. This villainous trio have a very good range of bits and pieces on offer and have something like 40 different antennas in stock. Best of the bunch was a really professional looking device called the GP227. This "living room" aerial slotted together to make an eighth wave aerial with tri-lobal ground planes, it looks a little like a hat stand. Although they usually stock a range of "Tweety Boxes" they had an interesting little device called the "Lazar" which made a fair impression of Star Wars sound effects for only £19.95. Mura have offered to give a 10% discount on any of their wares if you take the ad in this issue along to their shop, it's well worth a look round.

Incidentally, Mura are planning to open the first CB shop in the West End of London, just down the road from our offices in Tottenham Court Road at the end of May.

A corner in 'Mura's' shop, some of the items in the show case are very interesting indeed!

If you want to get CB accessories on a Sunday then you could do worse than pay SRU Autos down in Addlestone (near Chertsey) a visit. Besides a very complete range of CB odds and ends, antennas (Firestiks a speciality) you can drool over the customising goodies that they can sell you for your wheels. They can be found at 229 Chertsey Road, Addlestone in Surrey.

CBVIP

Starting this month BOF has a new feature, CBVIP. For the next few issues we will give 'carte blanche' to people, who, have over the last year or so made some contribution to legalisation.

We start straight away with two personalities, both of whom you should know very well. Firstly the 'daddy of them all', James Bryant, President of the CBA and CB Campaigner for more years than we care to remember. Sorry we couldn't get a picture of James in time.

Our second contribution comes from someone, who, whilst extremely active in campaigning for CB has preferred to avoid the limelight, for obvious reasons.

'Mack The Hack' has again put pen to paper in his own unique style. For those curious to know what Mack looks like we have a picture taken a few years ago to protect his anonymity.

THE NEWS

"Ayotollah bites dog", "Mad Pope slays seven", "Mr. Carter kicks ambassador", "Mrs Thatcher and ministers continue to discuss Citizen's Band". Given the media's fondness for the sensational which of the above headlines are we least likely to see? Right — but it's the only one that's true.

"No news is good news" is not the proverb to quote to the breaker. Members of the National Committee are contacted several dozen times per week by frustrated breakers and clubs who have heard nothing of CB in the media but news of the occasional bust (not page 3 of the Sun, idiot, the other sort). These people, understandably, are often extremely frustrated by the apparent lack of any progress towards legal CB and sometimes even want us to take drastic, if not violent, action to promote the course.

In fact there has been a great deal of progress. It's just that the press prefer to report strikes, slayings and sex rather than steady democratic progress towards a worthwhile objective. The first three sell more newspapers!

As you will know there has been progress. It is likely that the Government will legalise CB — but not on 27MHZ — before the end of the year. This will only happen if the pressure is kept up. If we sit back and wait for it to happen — it won't.

So it is even more important than ever to write letters and postcards and keep the petitions coming in. Every CB supporter should write to Mr. T. Raison at least once a month, whether he answers or not, and should also write frequently to Mr. W. Whitelaw and Mrs. Thatcher. These letters should be sent to the House of Commons, London SWIA OAA — the campaign to send postcards to Mr. Raison's home is now over as the postman, the dustmen, and Mrs. Raison were beginning to complain.

I cannot emphasise too strongly that although we are near to success continued pressure is essential. The best methods are not dramatic but tedious — keep writing. Demonstrations are important to keep CB in the public mind but the steady "plop-plop-plop" of letters falling on Tim Raison's doormat (in the House of Commons please) is what will win us the day. Many people will not write for fear of being busted or appearing on some Government list of "troublemakers". This is not Moscow — writing to the Government is what wins here — and the NCLCBR have NEVER heard of anyone being busted because he wrote to an MP. So write-write-write.

James M. Bryant.
National Committee for the Legalisation of CB Radio,
President, Citizen's Band Association.

Mack The Hack with his 'Ears On' at a very early age. Actually he hasn't changed much!

Many happy returns of the birthday of BOF. So what has happened on the CB scene since Hobby Electronics gave birth to BOF 12 months ago?

Well, we all know that we do not have legalisation — yet. But each morning I scan my newspapers hoping that I can read some item that reports a date for legalisation. Although I feel sure I would know before the press as I constantly have my ears glued to the box, and what better way to hear what's happening in our CB world.

A year ago it was as difficult to purchase a CB antenna as was a rig, but nowadays . . . Well, just look at the adverts in HE. Is it so difficult to obtain rigs now? Of course not. I'm not allowed to say how one can obtain them but read on, Nudge nudge, wink wink.

A few months ago, rigs that were obtainable were mostly excess and, secondhand equipment from the U.S.A. There were plenty of 23 channel rigs and the 40 channel ones were rather bulky but still expensive. If one was to poke one's nose into the works you would find that the technology was a few years old.

Now, I have seen rigs with autoscan, memory, and they use the latest IC's. As for size, I recently saw a 40 channel 4 watt mobile rig that will fit into your pocket. Even antennas have changed. 12 months ago a DV 27 was thought to be the 'non sus' or disguise type. I am sorry if I am insulting anyone. but you must be loony if you use one today. Some current antennas are very difficult to discriminate between CB or normal mobile radio types. I used to enjoy a little game, spotting the CB antenna and shouting at the buddie "What's your handle'.

Eyeball 20s a year ago were close-kept secrets. They were mostly drinking 20s where breakers would congregate for a natter, conduct deals for gear, and of course a drink or two. If ever the 20 got mentioned over the channels then they were changed instantly. Nowadays the eyeball 20s, clubs, call them what you will, are openly published. Again just read the pages of BOF. The activities of the breakers at these 20s are the same. I recall that last year (and earlier) if you wanted an eyeball with a breaker for a deal or whatever, it would be a question of what other breakers you knew. "Do you know Billy the Kid's landline?" The other breaker would come back with "That's a 4." "Well Billy the Kid will give you my landline" and that was how it was done. Then there was the phone box trick. If you were confident that the other breaker was safe you would both find a phone box that worked of course. Then over a channel one would give the number of the phone box and the first breaker would ring the number and give either your base 20 or base landline and then just in case, a prompt departure was made.

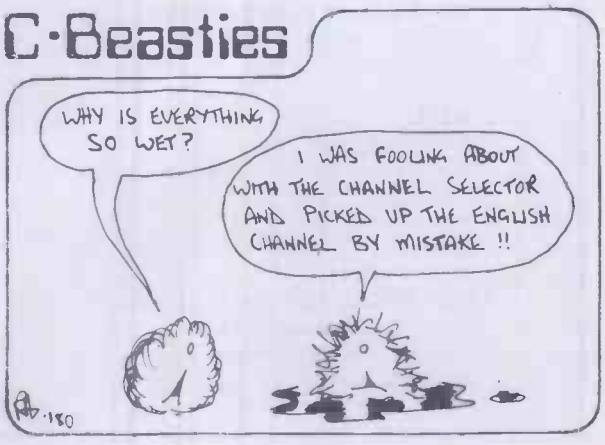
So what have I been up to in the last year? I want to see legal CB in this country, and because of this, I've sipped brandy and tea with MPs, written letters and sent postcards to others. I have managed to have my say on radio 'phone-ins'. I have signed, and collected other signatures for petitions. I have also attended demos and meetings. Some of my good buddies and I were pursuaded to study for the RAE. I took the exam in December but I failed, so I shall try again in May. One reason why I started this may have been something to do with waiting for the legalisation of CB. Don't let anyone kid you that the study and exam is easy.

One day the Breaker Takers might get me and snatch my rig. It may cost me a few Green Shield stamps for a fine, but I know they can never take the friendship of the good buddies that I have made whilst involved in the CB scene.

By the time of BOF's next birthday we should have legalisation. If for some silly reason we have not, I believe that this country will have a very successful illegal system. We already have in 'Smoky Town' 'News on Ten' (on channel 10). Many breakers have their ears glued to the box listening for 10-33s. I have heard a rumour (here we go again) that the authorities intend to put a carrier over on 27MHz. I don't know how they can do this without causing interference to other so called users of 27. Can they? What could or would we do then? 2 metres perhaps?

As my 10-10 I would like to quote a sticker I saw on a mobile recently. 'After sex I love my CB radio best' Now that's a big 10-4.

Mack the Hack
London.



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Metronome

Just marking time? Feel the pulse with this easy-to-build project!

THIS PROJECT IS CHEAP, quick, easy . . . and you learn while you experiment!

Although designed as a metronome, producing regular 'clicks' (an invaluable aid to aspiring musicians), this handy little gadget can operate in a multitude of ways with just one or two simple circuit changes. To give you a hint, try changing the capacitor C1 for a much lower value one — say 10n. Now what do you hear?

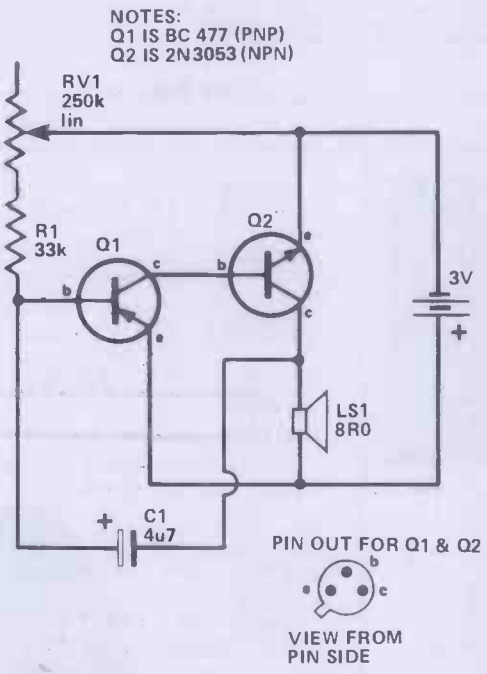


Fig. 1. Circuit diagram of the metronome. The circuit is drawn with the negative wire from the battery at the top of the diagram to make it easier to understand the operation of Q1.

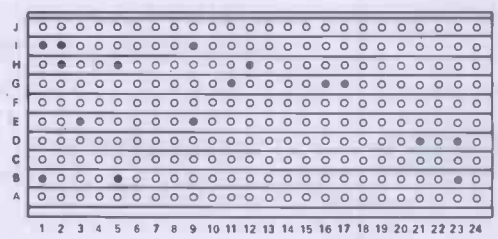


Fig. 2. Soldering guide for the veroboard, shown here copper side up. In this project it is not necessary to break any of the tracks.

CONSTRUCTION

Using our specially prepared drawings, and Hints for Constructors, building the unit is a cinch.

How it Works

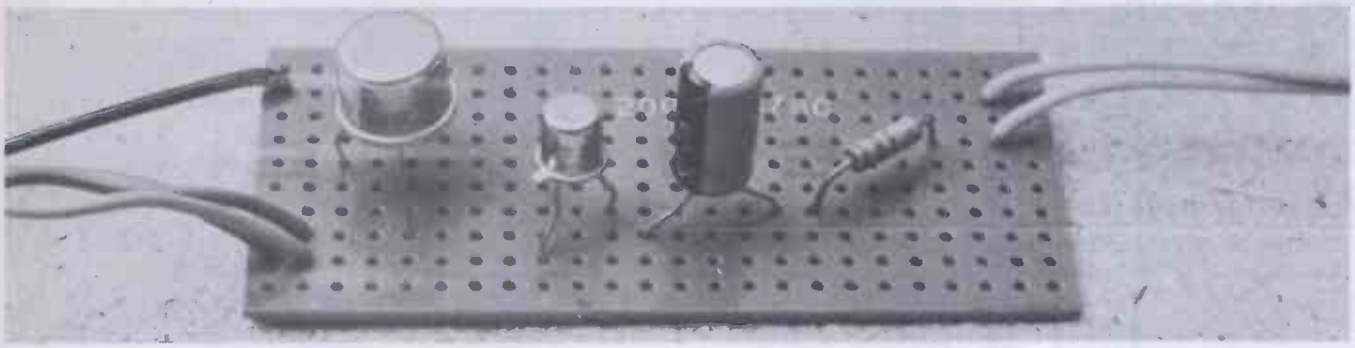
When power is first applied to the circuit, both transistors are turned off and have a high resistance to current flow between their collectors and emitters. We can pretend that the loudspeaker isn't there for a moment (because the loudspeaker has a very low resistance compared with that presented by the collector-emitter junction of Q2 and the timing resistance of RV1 in series with R1).

Now we can see that when power is applied, C1 will begin to charge up as current flows into it via RV1 and R1. When the voltage across C1 reaches about —0.6 volts it is sufficient to begin to forward bias the base-emitter junction of Q1 and this transistor begins to 'turn on'. Current now flows through the collector-emitter junction of Q1, from the negative terminal back to the positive terminal of the battery.

When a current flows in the base-emitter junction of a transistor, a greater current is able to flow in the collector-emitter junction. So the current passing through the base-emitter junction of Q2 causes Q2 to 'turn on' and let current flow from the negative terminal of the battery through Q2 and LS1 to the positive terminal.

This surge of current makes the loudspeaker produce a 'click'. While Q2 is 'turned on', the voltage at its collector rises from being close to the positive terminal of the battery towards the negative terminal. This rise in voltage affects C1 which is connected to this point and causes it to charge via the base-emitter junction of Q1. As C1 reaches full charge, the current being drawn becomes too small to keep Q1 'turned on'. As Q1 'turns off', it causes Q2 to 'turn off' too and the voltage at Q2 collector falls back towards the positive terminal of the battery.

Of course, C1 is also affected by this voltage change and reflects it at the junction of C1, R1 and Q1 base. This point becomes about two volts positive of the positive terminal of the battery. This reverse-bias on Q1 base keeps Q1 and Q2 'turned hard off' and the cycle repeats as the voltage on C1 goes from +2V to —0.6V as current flows through RV1 and R1. The time between 'clicks' is determined by the resistance of RV1 in series with R1; the lower the resistance, the more current flows and the less time passes between each 'click'.



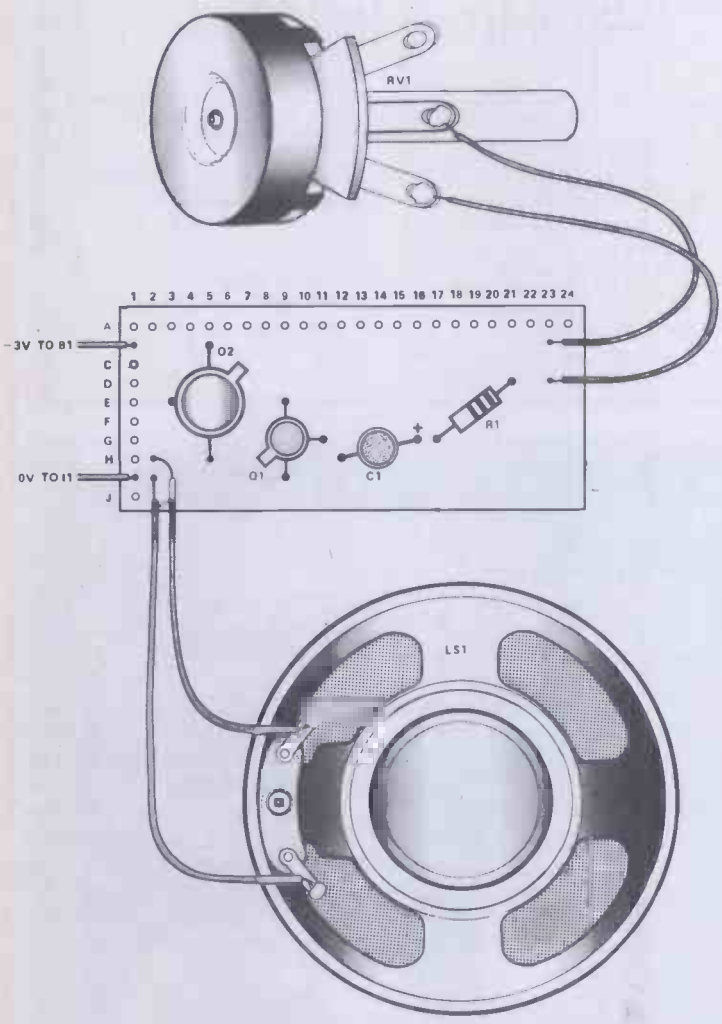


Fig. 3. Component layout of the metronome. A small 3V battery is connected with the positive terminal connected to track "I" and the negative terminal to track "B", as indicated.

Parts List

RESISTOR (¼W, 5%)
R1 — 33k

POTENTIOMETER
RV1 — 250k LIN

CAPACITOR
C1 — 4μ7 16V Electrolytic

SEMICONDUCTORS
Q1 — BC477
Q2 — 2N3053

MISCELLANEOUS
LS1 — 8ohm Loudspeaker
3V battery
Knob for potentiometer
Veroboard

Buylines

All of the components used in this project should be available from your usual supplier or from the larger mail-order companies.

The hints below apply generally to projects constructed on Veroboard. For this particular project the section "cutting the board" is not applicable.

HINTS FOR CONSTRUCTORS

Cutting the board. Rotate the "spot face cutter" while pressing gently to make the breaks in the copper track. If you do not have Vero's special tool, use a drill — ⅛" is about right. Always check that no bits of copper swarf are shorting to an adjacent track.

Inserting components. Long nose pliers come in handy for forming leads and inserting components. Do not bend the leads close to the body or they may break off. Check that components are not shorting to each other or to any wire links on the board.

Always insert the low profile components first: wire links, resistors, capacitors etc. Put the semiconductors in last.

Soldering. Make sure the component leads and the soldering iron are clean. If you use new components there should be no problem. Use a small soldering iron. 15 watts is ideal; 25 watts is really a safe maximum. Hold the components still when you solder them AND until the solder has set — about five seconds. Do not use too much solder or you may bridge the tracks and BE QUICK!

When the joint is cool, trim the lead with a pair of sidecutters.

Short Circuit

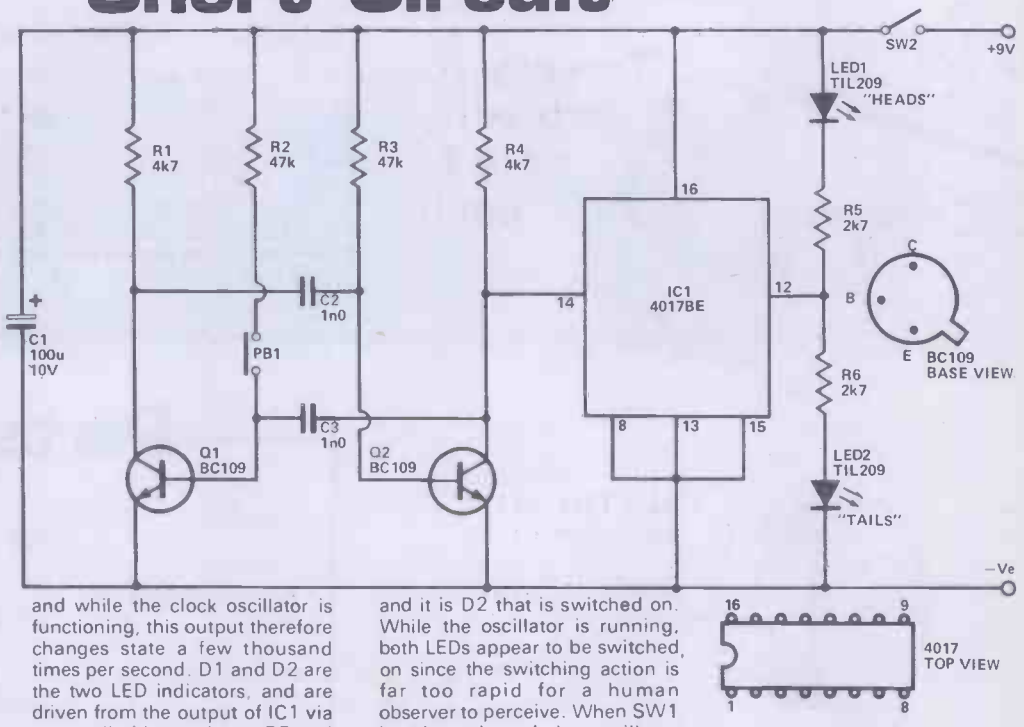
"HEADS" OR "TAILS"

This simple novelty circuit is designed to electronically simulate the tossing of a coin; randomly producing a "heads" or "tails" output. The output of the unit is displayed on two LEDs, one being marked "heads", and the other being given a "tails" legend. The unit has a push button switch which is briefly depressed in order to "toss the coin", and only one of the LEDs will be switched on when this switch is released, indicating the decision of the unit.

The circuit uses Q1 and Q2 in what is virtually a standard astable multivibrator circuit. The only deviation from the standard configuration is the inclusion of push button switch SW1 in the bias circuit for Q1. As the circuit stands there is no bias to Q1, and the circuit therefore fails to oscillate. However, if SW1 is operated the circuit can function normally. A roughly squarewave output is then produced at the collector of Q2, and the specified values give an operating frequency of many kilohertz.

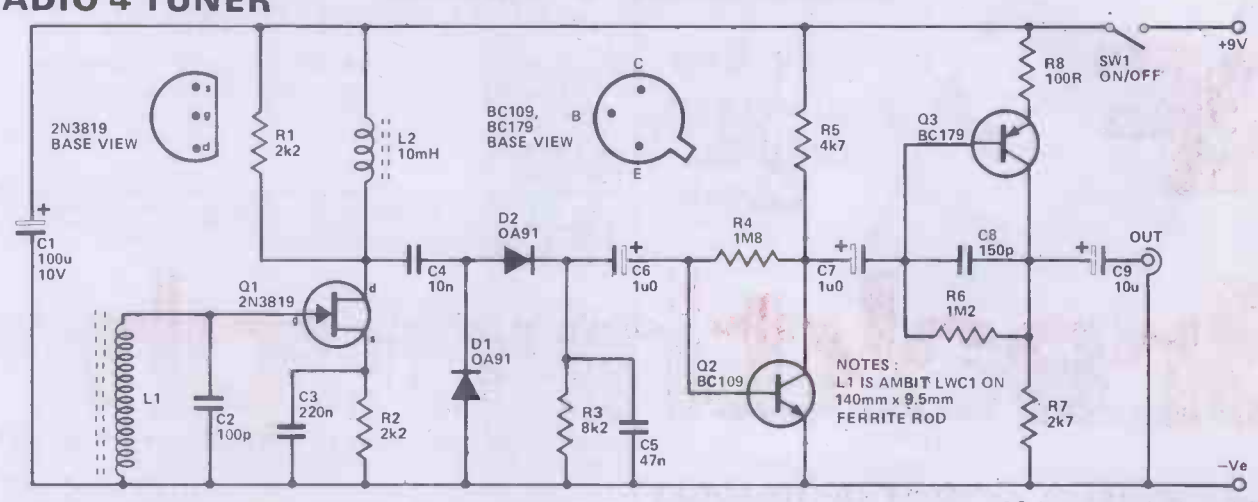
This squarewave output is fed to a 4017 divide by ten circuit, which is used here effectively as a form of bistable circuit. After each five input cycles, the output of IC1 (pin 12) changes state, and while the clock oscillator is functioning, this output therefore changes state a few thousand times per second. D1 and D2 are the two LED indicators, and are driven from the output of IC1 via current limiting resistors R5 and R6. When IC1's output is low, R6 and D2 are effectively short circuited by the output stage, but D1 will be switched on. Conversely, when the output is high, D1 and R5 are short circuited, and it is D2 that is switched on. While the oscillator is running, both LEDs appear to be switched on since the switching action is far too rapid for a human observer to perceive. When SW1 is released, and the oscillator stops, IC1 will stay in whatever output state it happened to have at the instant the oscillator stopped. There is, of course, no way of predicting which state this will be, and which of the LEDs will be switched on. It is purely a matter of chance whether the unit indicates "heads" or "tails."

SW2 is the on/off switch. The current consumption of the circuit is only about 5 mA.



Short Circuit

RADIO 4 TUNER



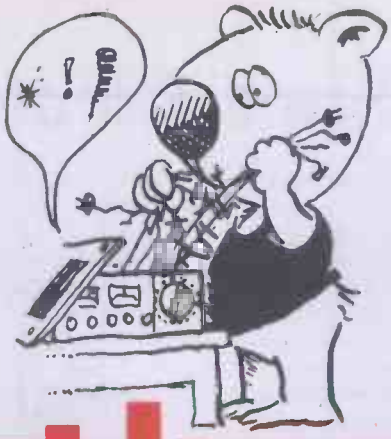
This tuner has primarily designed for use with a tuner/amplifier which does not have long wave coverage, and is therefore unable to receive the BBC Radio 4 LW transmission. However, it can also be used as a personal receiver for reception of Radio 4 if the output is fed to a crystal earphone or a pair of high impedance magnetic headphones.

Q1 is used as a JFET common source amplifier, and its gate terminal is fed direct from the ferrite aerial (L1). This is quite acceptable since a JFET has an extremely high input impedance and will not place a significant degree of loading on the aerial. L1 is used to bias the gate of Q1 to the negative supply rail. C2 brings the ferrite aerial to resonance at approximately the Radio 4 frequency of 200kHz, and L1 is simply slid along the ferrite rod to tune the unit to precisely the correct frequency. L2 forms the main source load for Q1, but it was found to be necessary to damp this using R1 in order to prevent instability.

The amplified RF output from Q1 is fed by C4 to a straight forward AM detector circuit which is comprised of D1, D2, R3, and C5. The demodulated AF signal is then coupled by C6 to a high gain, low noise, common emitter amplifier based on Q2.

This considerably boosts the signal, but it is still at an inadequate level to drive many amplifiers. A second common emitter stage using Q3 is therefore used to further boost the signal, and this gives an output amplitude of several hundred millivolts RMS. The full gain of Q3 is not required, and R8 is therefore used to provide local negative feedback which produces the required reduction in gain. C8 rolls off the high frequency response of Q3. This aids stability and improves the signal to noise ratio of the unit.

The tuner only has one control, and this is on/off switch SW1. The current consumption of the unit is only about 2.5 mA.. When the correct position on the ferrite rod for L1 has been located, it should be firmly taped or glued in this position.



RF Breakthrough

The evanescent (look it up in a dictionary) nature of most forms of RF interference to Hi-Fi equipment is often sufficient to cause an otherwise methodical, logical-acting and patient person to erupt into behaviour characteristic of a clockwork orange. "It's those furshlugginer CBers again! . . . !!!!!!!" is not an uncommon cry. To suggest that the fault lies within the equipment is regarded as treasonous! Here's how to delete those expletives.

IF YOU HAVE EVER been aggravated by the sound of the local taxi service's radio in the middle of your favourite record, or if the nearest TV transmitter imprints its sound track on tape every time you make a recording, you have been struck by that infuriating phenomenon known as RF breakthrough.

With the huge number of broadcasting stations, taxi radios and CB freaks — among many others — now operating, the problem of radio frequency interference is a major headache. And the problem is not restricted to those with Hi-Fi equipment; public address systems, hearing aids and even electronic musical instruments all suffer. (We won't delve into the case of the man who claimed to pick up transmissions through a filling in his tooth!)

The cause of radio breakthrough into audio equipment is almost invariably within the suffering audio equipment. It's rarely caused by a fault within the transmitter, or even by faulty operational procedures.

The phenomenon is generally known as "audio rectification" because of the way the interference is picked up. In essence, the unwanted RF energy is picked up by some part of an audio system which acts as an antenna — speaker and interconnecting leads, or even an incorrectly earthed equipment casing.

The energy is passed on through the audio system until it strikes a component or suitable element which is operating non-linearly, which acts as a rectifier. This could be a valve, a transistor, an integrated circuit, or even a poorly soldered joint!

The rectified signal is then amplified by the remainder of the audio system. (In some cases the speaker leads may act as the antenna and a faulty connection on one of the speakers as the rectifier — as has happened with large and powerful PA systems).

Of course there are other causes than transmissions by radio stations, television channels or CBers. Electrical machines and appliances often behave as transmitters of spurious radio frequencies, sending noise instead of the more coherent transmissions from radio stations.

Regardless of what form the breakthrough takes — noise or regular broadcasts — radio frequencies may be carried to the audio equipment along two paths, through the air, or through the mains power supply. The main methods of controlling these two forms are: shielding for airborne radio frequencies and filtering for line-carried interference. The cure for one will have no effect on the other.

In most cases the causes of this type of interference are introduced into the early stages of a preamp, or are picked up and introduced by the power supply leads. To check that this is in fact so, just turn down the volume control when you notice the interference. If this does reduce the interference, it is being introduced before the volume controls, which are normally in the output stage of the preamp, or its equivalent in an integrated unit.

If the level of the interference remains constant when the volume control is turned down, the interference is probably being picked up in some stage after the volume control.

CONTROL-AFFECTED INTERFERENCE

If the volume control does affect the level of the interference, it is most likely that the signals are introduced in one of three places — via the mains cable, via the interconnecting leads between the main amp and the auxiliary equipment, or via the speaker leads themselves.

It may also be caused by a poor, or nonexistent earth connection — this should be checked thoroughly before looking further. To check this aspect, examine the continuity of wiring at the input and output sockets on the equipment, and also check the earthing facilities in the interconnecting cables themselves.

Having checked out all the earth connections, it is advisable next to check the speaker leads. Although it is hard to see how a signal picked up here would be of sufficient level to produce an audible output, or even be affected by the volume control, signals picked up by the speaker cables may be routed in such a way as to show these symptoms. If the RF signal is picked up in the speaker leads, it is fed back into the amplifier's circuitry through the negative feedback loop. And while feedback is applied after the volume control, some of the radio frequencies may be conducted back into the earlier stages of the preamp.

Sometimes the speaker leads can be of such a length that they actually resonate at the interfering frequency, in which case an instant cure may be obtained by shortening or lengthening the cables. Unfortunately, this may merely substitute one cause of interference for another, and the taxi company may simply be replaced by a local TV channel. Twisting the cables, or using shielded cable may also be effective here.

Another possible cure is to connect a capacitor across the amplifier's output terminals, or from each terminal to earth. The high audio frequencies will not be degraded if a capacitance of about 100nF (0.1uF) is used as the impedance is very low at this point in the circuit.

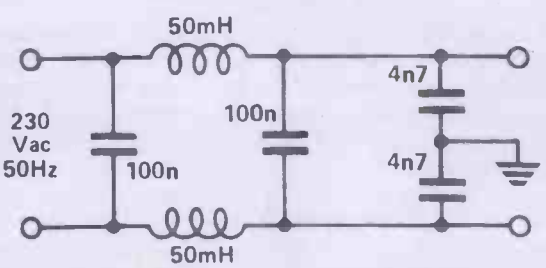


Fig 1. Circuit of a mains input filter which may be home made. If you do make it yourself it is essential to use capacitors rated for mains operation. Ceramic types rated at 400 VAC or, better still, 630 VAC, are recommended.

A capacitance of about 10nF is generally sufficient to remove radio frequencies, although it is best to use the smallest value that gives relief from the problems (provided sufficient capacitors are on hand to allow a few experiments). *Always* use ceramic capacitors for this purpose.

SIGNAL LEADS

If the checks already covered don't cure the problem, the next trouble spot to check is the signal leads. The quickest and easiest way to do this is to check all externally connected components, such as the turntable, tape deck or tuner. If the interference is eliminated when one of these leads is disconnected, then the cable connecting the component to the amplifier is not properly screened. The metallic shield or braid on the cable should be checked to see that it is complete, and that it makes a good earth contact at the component, and at the amp.

If one of these remedies has any result, check for line-carried interference by connecting a line filter in series with the incoming mains power line. These filters are available from some electronics suppliers, or a unit may be made as shown in Figure 1.

If you make this filter yourself, do not under any circumstances increase the values of the capacitors shown, and make absolutely certain that the capacitors are rated for at least 400 volts AC operation (preferably more for safety).

When the signal strength of the unwanted signal is very high, as it may be in areas close to transmitting antennas, the signal may find its way into the circuitry despite these precautions. This is most likely when the amplifier or the ancillary components do not have a metallic case, or when the metal cabinets are not correctly earthed. If a non-metallic case is thought to be the problem, the cure is an earthed shield — aluminium foil is suitable when securely earthed.

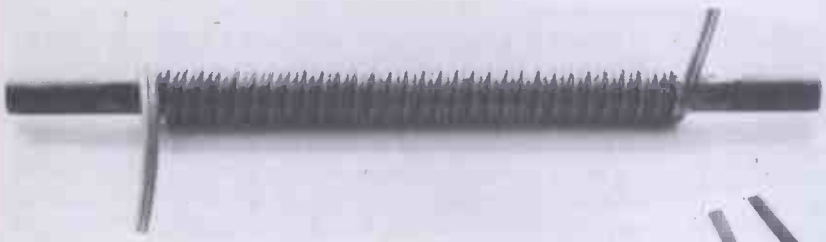
If the signal still finds its way into the system more drastic measures will be required. Firstly, check that there no *dry joints* — joints where the solder has been incorrectly applied and has set around a conductor without making good electrical contact — for a dry joint can act as an almost perfect rectifier. If a visual examination shows any doubtful joints — if they look crystalline or grey — resolder them by giving them a touch with a hot soldering iron.

Electrolytic capacitors may cause problems because they tend to have high inductive reactance at radio frequencies, which may prevent them passing the unwanted radio frequencies to ground. Suspicious capacitors may be checked by temporarily wiring a 10nF (0.01 µF) capacitor in parallel. Permanent wiring of the additional capacitor may follow if this is found to cure the breakthrough problem.

If the problem remains after all these checks, it may be necessary to modify the amplifier as outlined below — not a job for the inexperienced.

UNAFFECTED BY VOLUME CONTROL

Sometimes the unwanted radio frequency breakthrough will be heard at a constant level, which is not affected by settings of the volume control. When this happens (or when all other attempted remedies have failed) it will be



Interference pickup on speaker leads may be cut by winding part of the lead, nearest the amplifier terminals, on a ferrite rod — available at many parts suppliers.

An alternative method is to wind 'suspect' leads onto ferrite rings, well, it's worth a try anyway.

necessary to use some form of filtering at the input to the power amplifier. This is a job for those experienced in electronic matters as it involves knowledge of the input circuitry of the amp, and it should not be attempted by the Hi-Fi (or electronics) novice.

One way of providing this filtering, which has proved successful, is shown in the diagram. Unfortunately it is impossible to quote exact component values as these will be determined by the circuitry of the individual amplifier. However, it is important that the component values be chosen so that there is no audible change in the frequency response as a result of the modifications. Only in really severe cases which have withstood all possible solutions will it be necessary to trade off frequency response against interference removal. The capacitors used should be ceramics (not paper or polyester types) and inductor L1 may be a ferrite bead.

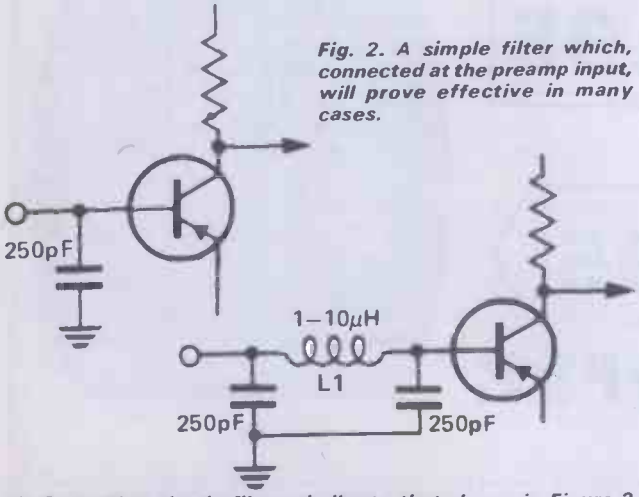


Fig. 2. A simple filter which, connected at the preamp input, will prove effective in many cases.

Fig 3. Another simple filter, similar to that shown in Figure 2, but generally more effective in stubborn cases.

BREAKTHROUGH IN FM TUNERS

Electricity, the very thing that makes radio transmissions possible, also interferes with those transmissions. Although FM broadcasting has considerably reduced the problems, it is not totally immune, and breakthrough still occurs. As with stray noise picked up within the other components of the audio system, FM interference is also either airborne or line-carried.

Sometimes the same cures as are used in the rest of the system will be sufficient to remove unwanted breakthrough, but it is also possible to remove the offending source in many cases, since a majority of the problems arise from household appliances.

Identifying the source may be the most baffling problem of all, as the cause may be as diverse as a car's ignition system, or a faulty fluorescent light fitting.

A car ignition system gives rise to a fast and steady popping type of interference. Most cars should be fitted with suitable suppressors, but older cars, or cars with faulty suppressors, may still cause serious problems for FM users near main roads.

A number of household appliances which are operated by electric switches cause irregular clicking — the switching of fridge thermostats is well known, and others like electric typewriters, adding machines or even relays in the lifts of high rise buildings can contribute.

Whining, or a steady level of scratchy noise often arises from electric motors which produce sparks in operation, and from electric generators. And a simple faulty fluorescent light fitting can give rise to a buzzing hum.

Obviously with devices such as these, the easiest cure may be the source — if you can find it.

WHERE DOES NOISE COME FROM?

It may seem strange that these useful and apparently harmless devices should cause problems by generating radio frequencies, but there are many ways in which they can develop such frequencies.

Any sharp pulse from switching, or somehow interrupting, an electric circuit contains some radio

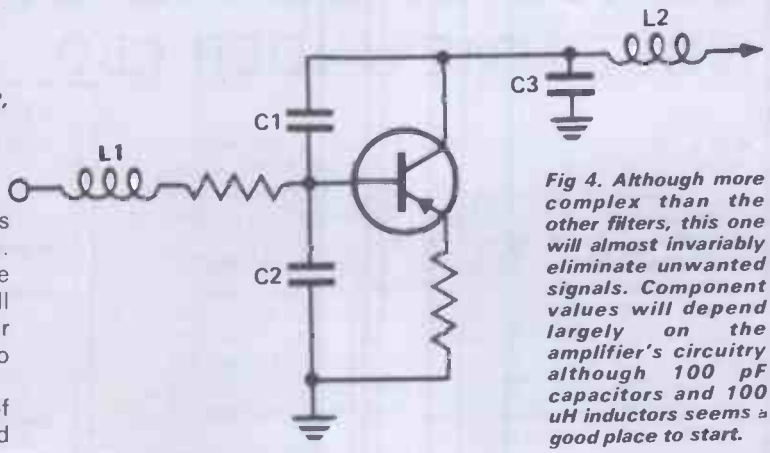


Fig 4. Although more complex than the other filters, this one will almost invariably eliminate unwanted signals. Component values will depend largely on the amplifier's circuitry although 100 pF capacitors and 100 uH inductors seems a good place to start.

frequency energy. Thus switches, thermostats and some motors cause problems. And any machine which causes sparks in operation is a likely candidate. After all, the very first radio transmissions were made with the aid of a spark transmitter, in which capacitors were allowed to discharge across a spark gap. Spark transmitters produce so much radio frequency energy that they can affect very wide areas of the RF spectrum and cause widespread interference to most receiving devices. Some electric motors are not so very different, and almost every electric switch in an ac circuit produces sparks in operation. An arc lamp is virtually an enormous spark, generator.

When trying to eliminate RF noise in the FM tuner, it is necessary to find where the noise is coming from — power lines or through the air. A simple means of doing this is to disconnect the antenna and link the tuner's terminals to ground. If the noise persists, it is carried through the power lines; if it has disappeared, it is airborne.

If the noise is found to be airborne, and you have a directional outdoor antenna with a run of 300 ohm balanced feeder, it is possible that the noise is being picked up in the feeder cable. In this case a shielded feeder is essential — in spite of its extra cost — and this may reduce or completely eliminate the problem.

LINE CARRIED NOISE

If the noise is carried through the power lines, it is worth looking for a generating source within the home. When a machine or appliance is suspected, it can be verified by having somebody turn the machine on and off while you listen to the noise on the audio system with the FM as source.

If you do manage to identify a source within your home, it is worth checking with the manufacturer of the appliance or machine to see whether radio frequency suppression is normally fitted, or is available. Unless the manufacturer has some simply-fitted device, it is best to consult an expert, as there are many different methods of applying the suppression.

Generally the method will depend on a bypass of the RF to ground via a capacitor. If you know the details of the machine's operation and have electronics experience, you may be able to decide where the capacitor should go and what value should be used. If you have any doubts at all, however, consult an expert.

When constructing a shield, make certain that it is well bonded at all joints and that the earth connection is firm.

If you cannot locate the noise source, it will be necessary to run through the same procedures as were used for eliminating breakthrough from the system as a whole.

If after taking every humanly possible measure you still suffer from radio frequency interference, you have only three options left: You can sell your equipment, you can sell your house, or you can blow up the offending source.

We cannot really recommend any of these. **HE**

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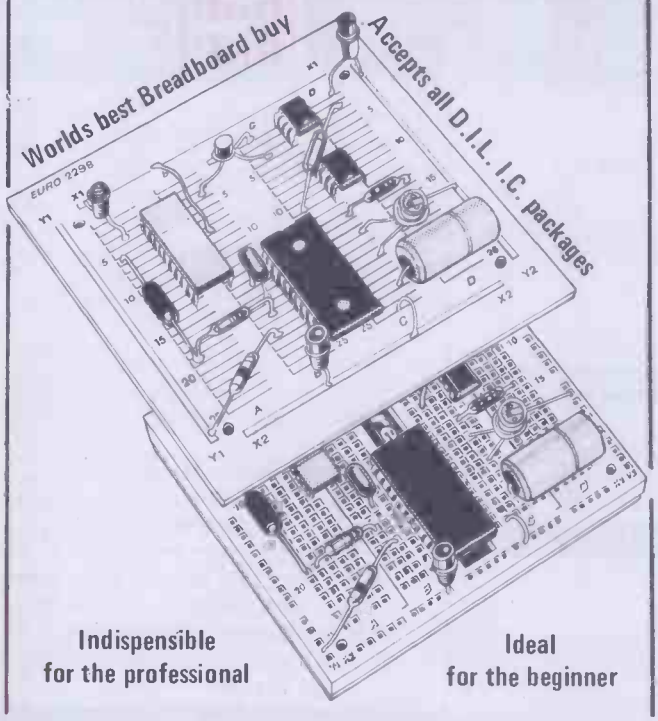

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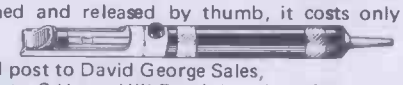

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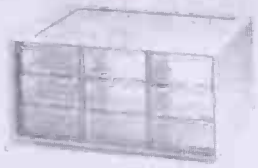

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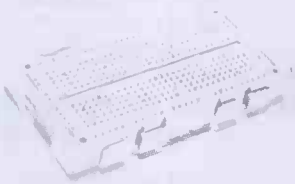

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K109	15	BC114 transistors
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K112	12	3A 100B rects, wire ended
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K115	18	SP1218 (2N3702) transistors
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K120	6	prs 2S096/2SB496 AF OP sim to AC128/176
K121	20	7V5 400mW zeners
K122	10	VR525 5 25V 2.2W zener
K123	10	56V 1W zener
K124	50	.02µF disc ceramic
K125	200	1k 5A ¼W carbon film resistors
K126	100	3000pF 63V polystyrene preformed caps
K127	25	47µF 25v axial lead caps
K128	25	15µF 40V do
K129	8	AA113 diodes
K131	10	VA1086 thermistor
K133	20	3-way 5A term blocks
K134	50	unmarked untested OC71 transistors
K135	30	4.7µF 10V radial elecs
K136	4	AC187k transistors
K137	5	18µF 100V non-polarised caps
K138	30	¼" coil former with slug
K139	40	.025µF 50V mylar caps
K140	30	.05 do
K141	40	0.01µF 400V axial caps (C296)
K142	25	wire ended neons std size, 90V
K143	200	squares mica insulation 25mm sq.
K144	30	1RS 3W wirewound resistors
K146	25	330µF 4V axial caps
K148	30	transformer former type X228
K149	12	Ferrite rod type XO36
K150	10	switches type W430
K151	12	0.125" red LEDs
K152	10	0.2" red LEDs
K154	15	5-pin 180° Din socket, clip fix

The Egg Timer

HE proudly present the ultimate Egg Timer. Shake it and set it down, you can have either soft or hard-boiled. Yes folks it's all here — don't delay, build it today. . . .

OKAY, so you've *got* an egg timer. Odds on it's nothing like this one!

Conventional egg timers — the coloured-granules-in-a-three-minute-hour-glass variety — do their job efficiently, but silently. You have to watch them to see when your egg is ready. Either you stand and stare at it for the duration or you need sharp wits to instinctively 'know' when the time's up. Lack of audible indication on conventional egg timers is a consequence of inadequate design. Lack of sharp wits in the morning is a consequence of soft living.

This project tackles the first problem, the second is up to you!

FEATURES

Conventional egg timers (even electronic ones we've seen) lack the option of 'hard' or 'soft' timing. Even if the electronic ones have an audible indication, they have the disadvantage of including an on / off switch.

This egg timer project includes the hard / soft option, does not include an on / off switch and 'bleats' when your egg is ready. We could have had it go 'cluck, cluck' or even 'cock-a-doodle-doo', but considered this a little *too* corny, and besides, it complicated the project unnecessarily!

Operation is very simple. First, you pick it up and shake it — the device lets you know with a soft bleep when it's been shaken enough. You then put it down on one end. Which end depends on whether you want a long time period (for a hard egg) or a shorter period (for — you guessed it — a runny one). After the appropriate period has elapsed the timer will issue a one second-long bleat and turn itself off until shaken awake again.

Has it got a microprocessor inside?

No, it's all done with one CMOS IC, a couple of transistors and fifty pence worth of mercury switch.

CONSTRUCTION

The project is best constructed on the printed circuit board designed for it. Be sure to get the IC, transistor and diodes correctly oriented when inserting the components in the board. Take care also with the electrolytic capacitors.

Egg Timers come and go but now, with the HE Egg Timer at your disposal, you need never suffer from runny or hard-boiled eggs again. A quick shake is all you need, perfect eggs every time.

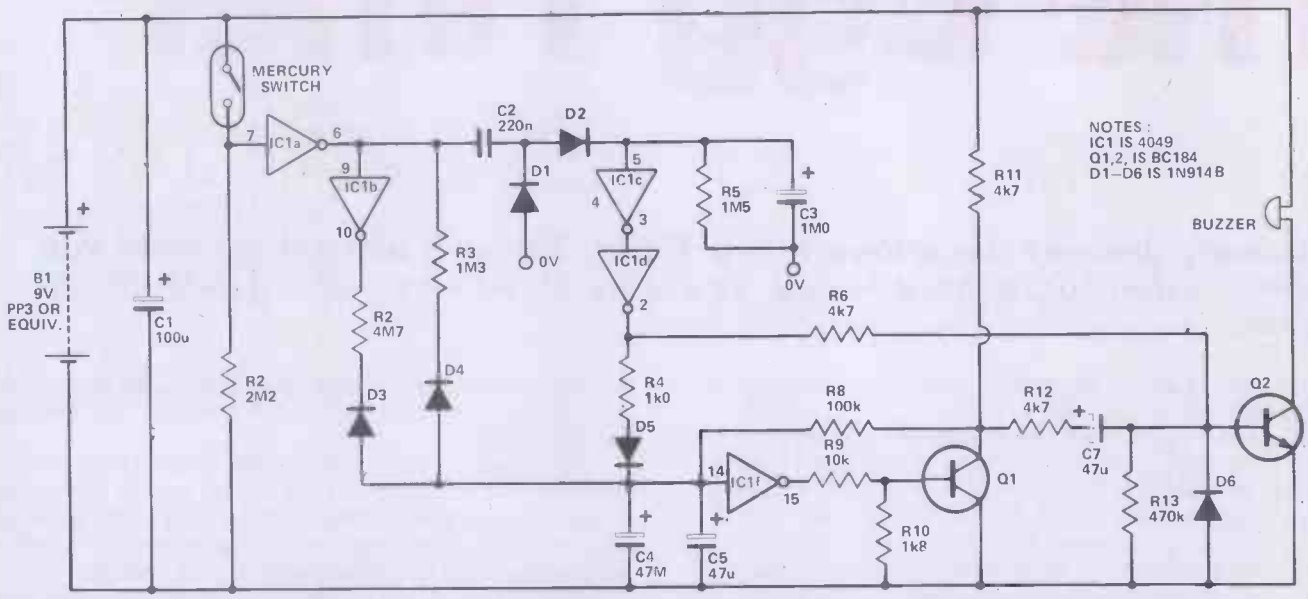


Fig. 1. Circuit diagram of the famous HE Egg Timer. No on-off switch is shown simply because it doesn't need one!

How it Works

The timing period is initiated by shaking the egg timer. Initially, C3, C4 and C5 are discharged and both transistors are biased off. IC1a is a buffer whose output is high when SW1 is open and low when it is closed. Shaking the timer will therefore cause an alternating voltage to appear on the output of IC1a. C2, C3, D1 and D2 form a rectifying network which charges C3 using this output of IC1a. Once C3 has charged past the threshold voltage of IC1c (indicating that the timer has been shake), two things will happen: Firstly, C6/R6 will pass current to turn-on Q2 and C5 start charging via D5 and R4. When C4 and C5 have charged to the threshold voltage of the Schmidt trigger formed by IC1f and Q1, Q1 will turn on and terminate the bleap.

Meanwhile, C3 will have discharged through R5 (assuming you're not still shaking the thing) and IC1c and IC1d will have reverted to their original state.

C4 and C5 will then discharge via either R2/D3 or R3/D4, depending on whether SW1 is closed or open. This is the really clever part. SW1 is now only used to start the timing period but, depending on which end of the device is uppermost during that timing period SW1 will either be open or closed and either R2 or R3 will determine the length of the period.

When C4/C5 have discharged sufficiently. Q1 will switch off, charging C6 via the base of Q2 causing the final one-second beep.

Carefully follow the overlay diagram and you should experience little difficulty.

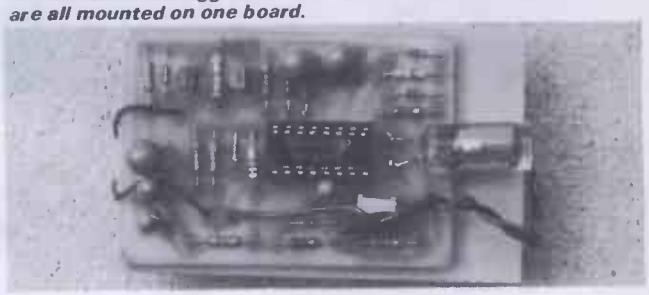
The choice of a housing for the project depends a little on your kitchen decor — select a container that's large enough to enclose the PC board and battery though. We've used a cardboard mailing tube on the prototype.

However, that plastic ornamental emu's egg that Aunt Aggie gave you for Easter may do just as well — assuming it will stand securely on either end (. . . maybe that's not such a good idea after all).

The buzzer may be mounted either onto the outside of the container or on the inside. The latter will result in a loss of volume though. A few holes in the case will allow the buzzer to be heard better if you wish to mount it inside.

The whole assembly should be packed in the container chosen using sponge rubber scraps — it has to stand a lot of shake, rattle and roll.

When you do this, make sure that the metal case of the battery does not come in contact with the copper side of the PC board.



Two views of the Egg Timer. The main PCB, battery and buzzer are all mounted on one board.

Parts List

RESISTORS (All ¼W, 5%)

R1	2M2
R2	4M7
R3	1M8
R4	1k
R5	1M5
R6	4k7
R7	22k
R8	100k
R9	10k
R10	1k8
R11, R12	4k7
R13	470k

CAPACITORS

C1	10µ 16 V tantalum
C2	220n ceramic
C3	1µ 16 V tantalum
C4	47µ 16 V tantalum
C5	47µ 16 V tantalum
C6	10µ 16V tantalum
C7	47µ 16V tantalum

SEMICONDUCTORS

D1-D6	1N914 or similar
Q1, Q2	BC184
IC1	CD4049

MISCELLANEOUS

B1	9 volt, battery (PP3 or similar)
BZ1	piezo electric buzzer (6 V operation)
SW1	Mercury switch (see Buylines)

Suitable box, PCB, Battery Clip.

Buylines

None of the components should be difficult to obtain. The buzzer is a solid-state, piezo-electric device and is obtainable from Watford or Maplin. The mercury switch is available from Watford Electronics.

If you wish to copy our design you will need a cardboard mailing tube with end caps. We used a tube with 2in. diameter. Cut a length of about 6in. and paint it in polyurethane varnish to prevent it peeling. Find a scrap of PCB material and cut it to fit inside the tube, i.e. 6in. x 2in. The PCB is then attached to this board along with the buzzer and battery — see pictures for details. If you want to increase the volume of the buzzer you can cut a few holes in the side of the tube.

ADJUSTMENTS

If you like your eggs super hard — or perhaps extremely runny, or even somewhere between these extremes, the time periods may be changed by altering the value of R2 or R3 — one will alter the softness of the 'hard' egg, the other the density of the 'soft' egg. See 'How it Works' for an *egg*splanation of the circuit operation. **HE**

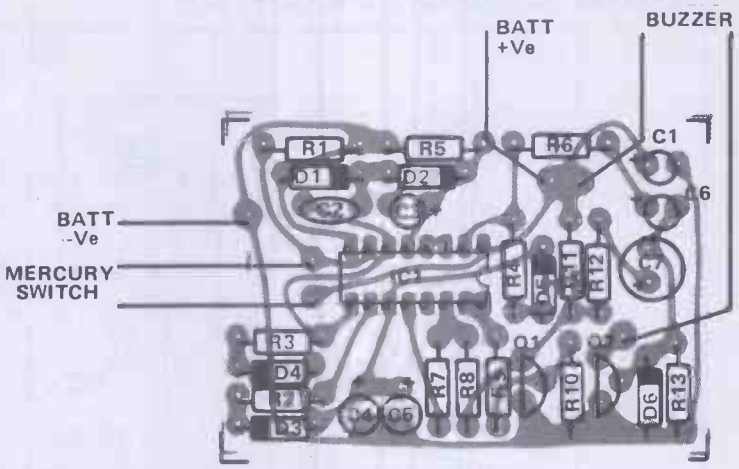


Fig. 2. Above — Overlay diagram of the Egg Timer. As usual take care when inserting polarised components.

The HE Egg Timer in its 'swish' case made from a cardboard mailing tube. All the components fit neatly onto the main board.

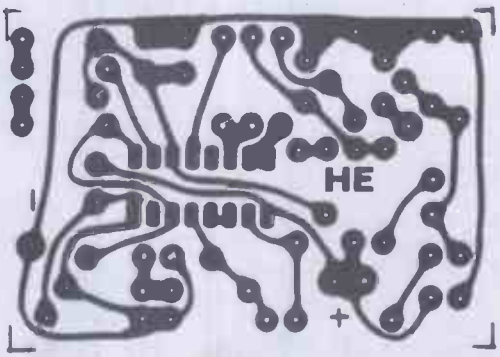
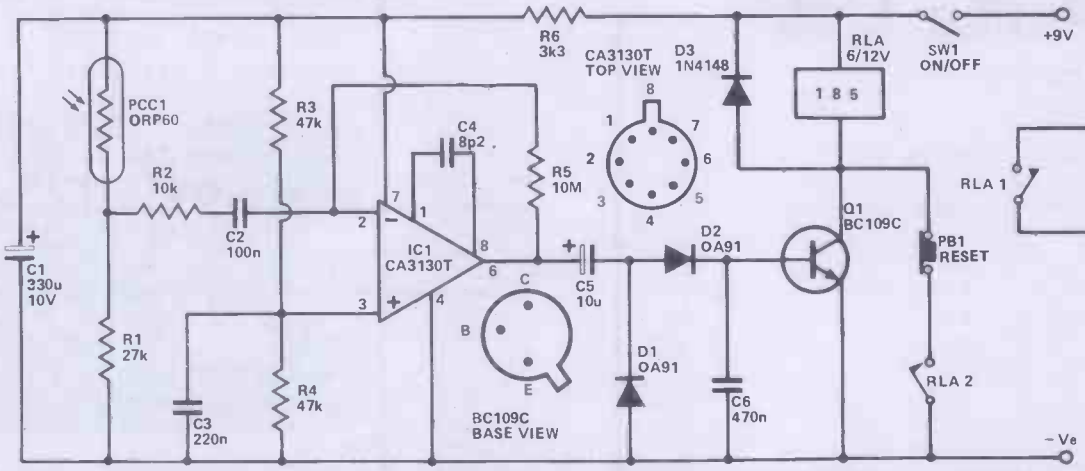


Fig. 3. PCB foil pattern. The design will shortly appear as a HOBBYPRINT rub-down transfer. If you've never used HOBBYPRINTS before then see the ad in this issue. First class results guaranteed every time.

Short Circuit

LIGHT CHANGE DETECTOR



This simple light activated switch can be employed in intruder alarm systems, or in certain other applications where a proximity detector is required. It is not a light operated switch of the type which responds to some particular ambient light level, but instead, it responds to rapid changes in light level. It will, for example, trigger if a torch is shone on or near the photocell, or if someone passing in front of the unit casts a shadow onto the photocell. The unit is unaffected by natural, slow changes in light level.

The photocell used in the unit is cadmium sulphide photoresistor, PCC1, and together with R1 this forms a potential divider connected across the supply lines. The voltage at the junction of R1 and PCC1 depends upon the resistance of PCC1, which in turn depends upon the light level to which this component is subjected.

IC1 is an operational amplifier which is used here in the inverting mode. R2 and R5 form a negative feedback network which set the voltage gain of the circuit, and a high degree of gain is required in order to give the unit good sensitivity. The gain of the amplifier is approximately equal to R5 divided by R2, or about 1,000 times (60dB.) in other words. The output from PCC1 and R1 is coupled to the input of the amplifier, but C2 provides DC blocking here, so that the DC output from these components is of no consequence. However, rapid changes in the output voltage from the photocell circuit will be passed to the input of the amplifier, and will appear greatly boosted at the output.

The output from IC1 is coupled by C5 to a smoothing and rectifier circuit consisting of D1, D2, and C6. When the unit is activated, the positive bias produced across C6 is sufficient to bias Q1 into conduction, so that it energises the relay coil which forms its collector load. RLA2 then closes and maintains the supply to the relay coil, so that once triggered the circuit latches in the on state. The alarm or other controlled equipment is operated by RLA1.

SW2 can be used to break the supply to the relay, and thus reset the circuit. SW1 is merely the on/off switch. C4 is the compensation capacitor for IC1 and D3 is the normal protective diode. Current is 1-40mA.

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Hobby Chit~Chat

In this month's 'Chit-Chat' Ray Marston takes a look at LEDs and LED displays

ONE OF THE MOST POPULAR types of project amongst HE readers are LED display circuits, in which one or more LEDs (light-emitting diodes) repeatedly turn on and off in some pre-determined sequence and thereby generate a visually interesting pattern. These projects are so popular that we've decided to devote the whole of this month's 'Chit-Chat' feature to the topic and to present a variety of practical 'display' circuits.

BASIC LED CHARACTERISTICS

The most obvious thing about a LED is that it glows a pretty colour (either RED, ORANGE, YELLOW or GREEN) when current is passed through it. The brilliance of the glow increases with the current magnitude. In most practical applications, currents of 10 to 30 mA give adequate illumination. Approximately 2 volts are generated or 'lost' across the LED when it is passing forward current.

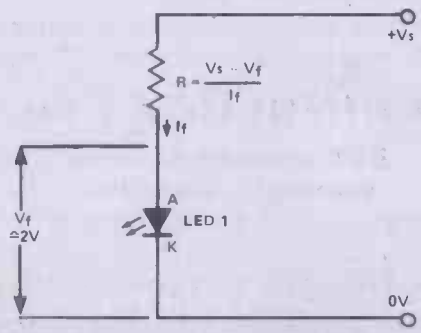


Fig. 1. Method of working out the 'R' value for a given Vs and If.

When you use a LED, you have to wire some form of current-limiting device in series with it, to set it's operating current to the correct level. Fig 1 shows how to work out the value of resistance needed to give a particular current from a specific supply voltage. In practice, 'R' can be connected in either the anode or the cathode side of the LED.

You can use a LED as an indicator in an AC circuit by wiring a diode in inverse parallel with it, as shown in Fig 2, to prevent the LED being reverse biased. For a given brightness, the value of 'R' should be halved relative to that of a DC circuit.

One practical problem that you'll encounter when

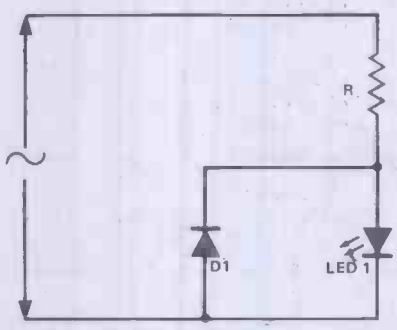


Fig. 2. Method of using a LED as an indicator in an AC powered circuit.

using a LED is that of identifying it's polarity. Most LEDs have their cathode (K) identified by a notch or flat on the package, or by a short lead. This practice is not universal, however, so the only sure way to identify a LED is to test it in the basic circuit of Fig. 1. Try the LED both ways round: when it glows, the cathode is the most negative of the two terminals. It is always good practice to test a LED before soldering it into circuit. It is also good practice to check the LED's forward voltage, which should be less than 2.5 volts: a greater value than this indicates an 'out of spec' or second grade device.

If you ever need to drive a number of LEDs from a single source, note that this can be achieved by wiring a number of LED's in series, as shown in Fig 3. Note that the supply voltage used here must be significantly greater than the sum of the individual LED forward voltages. This circuit thus draws minimal total current, but is limited in the number of LEDs that it can drive. A number of these circuits can, however, be wired in parallel, so that almost any number of LEDs can be driven from a single course.

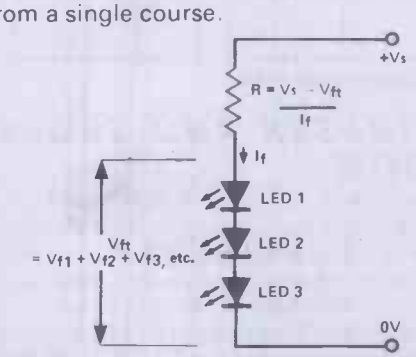


Fig. 3. Method of working out 'R' with LEDs in series.

LED FLASHER CIRCUITS

One of the simplest types of LED display is the LED flasher, in which a single LED repeatedly switches alternately on and off, usually at a rate of one or two flashes per second. A 2-LED flasher is a simple modification of this circuit, but is arranged so that one LED switches on when the other switches off, or vice versa. Fig 4 shows an IC, 2-LED flasher. This design is based on the faithful old 555 timer chip or on it's more modern CMOS counterpart, the ICM7555: the chip is wired in the astable mode with it's time constant determined by R4 and C1. The action here is such that output pin 3 of the IC alternately switches between the ground and the positive supply voltage levels, alternately shorting out and disabling one or other of the two LEDs. The circuit can be converted to single-LED operation by omitting the unwanted LED and it's associated current-limiting resistor.

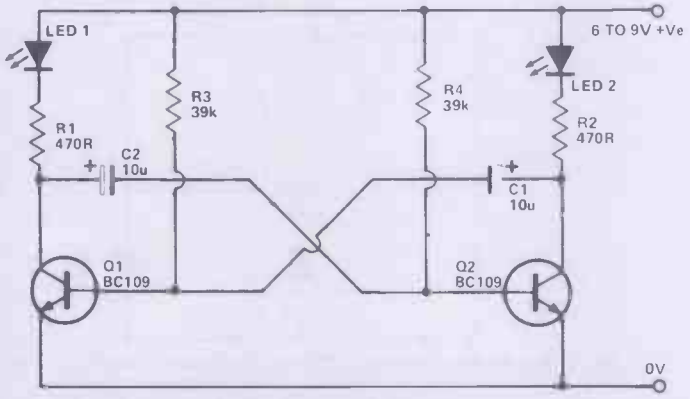


Fig. 4. Transistor 2-LED flasher circuit. (1Hz).

Fig 5 shows a useful modification of the fig 4 circuit, in which the flashing rate is made variable via RV1 and two pairs of series-connected LEDs are connected in the form of a cross, so that the visual display alternately switches between a horizontal bar (LEDs 1 and 2 on) and a vertical bar (LEDs 3 and 4 on) and forms a visually interesting display.

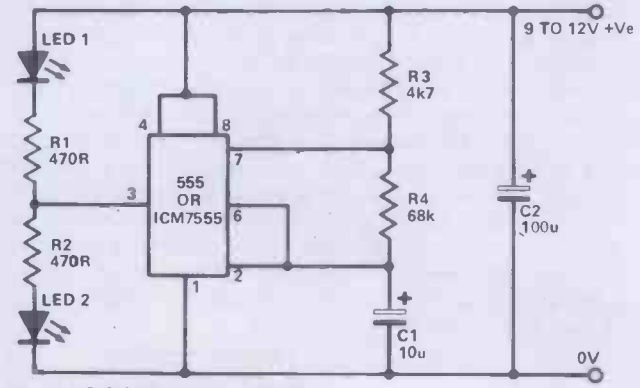


Fig. 5. IC 2-LED flasher. (1Hz).

LED CHASER AND SEQUENCER CIRCUITS

LED chasers and sequencers are circuits in which an array of LEDs are so arranged that the individual LEDs turn on and off in some predetermined time sequence. One of the most popular ICs for use in this type of application is the CD4017B decade counter with 10 decoded outputs. The action of this IC is such that, when it is 'clocked' via an external pulse generator, it's ten

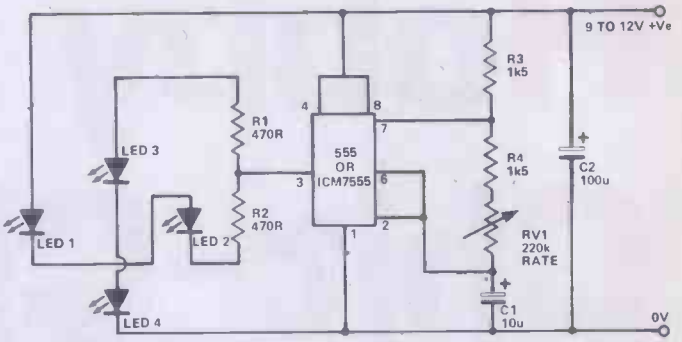


Fig. 6. 4-LED Flasher. RVI varies rate from 15-2,000 flashes per minute.

outputs (numbered '0' to '9') sequentially and repeatedly switch from the 'low' to the 'high' state at the clock rate, with only one output being high at any one time: the output drive currents are internally limited at about 15 mA.

Fig 6 shows the practical circuit of a 10-LED CD4017B-based chaser, in which IC1 is used as the clock generator. The action here is such that the display appears as a moving 'dot' which repeatedly sweeps from left (LED 0) to right (LED 9) in ten discrete steps as the outputs sequentially go high and turn the LEDs on. The LEDs do not, of course, have to be arranged in a straight line: they can, for example, be arranged as a circle, in which case the 'dot' will seem to rotate.

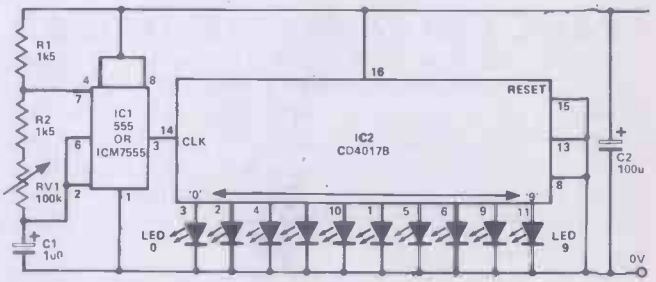


Fig. 7. 10-LED Moving-dot display.

Fig 7 shows how the above circuit can be modified to give a 'moving hole' display, in which nine of the ten LEDs are on at any one time, with single LEDs turning off sequentially. If the 10 LEDs are arranged in the form of a circle, the circle will seem to rotate.

The Fig 6 moving-dot display can be used with fewer than 10 LEDs by simply omitting the unwanted devices, but in this case the dot will seem to move intermittently, or to 'scan', since the IC takes ten steps to completely sequence and all LEDs will therefore be off during the 'unwanted' steps.

If a continuously-moving less-than-10-LED display is required, this action can be obtained by connecting the first 'unused' output terminal of the CD4017B to it's pin-15 RESET terminal, as shown (for example) in the

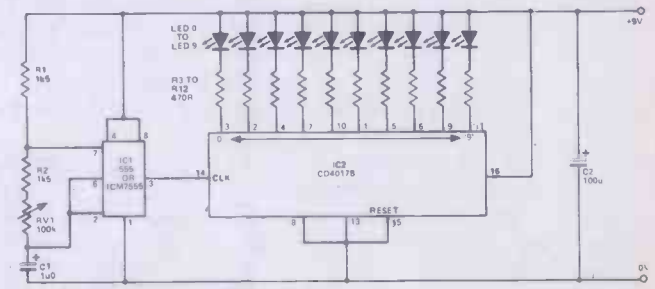


Fig. 8. Moving-hole display.

4-LED circuit of Fig 8. Alternatively, the circuit can be made to give an intermittent display with a controlled number of 'off' steps by simply taking the appropriate one of the 'unwanted' outputs to the pin-15 RESET terminal. In fig 9, for example, the LEDs 'display' for four steps and then 'blank' for four steps, after which the sequence repeats.

Finally, Fig 10 shows a rather unusual and very attractive 4-LED 5-step sequencer, in which all four LEDs are initially on but then turn off one at a time until eventually (in the 5th step all four LEDs are off: sequencing details are given in the table of Fig 11. Note in this circuit that the LEDs are effectively wired in series and that the basic circuit can not be used to drive more than four LEDs.

HE

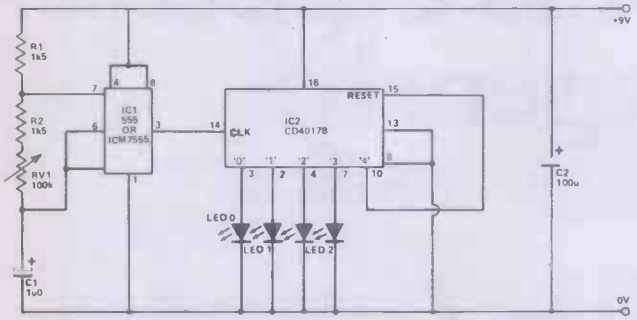


Fig. 9. 4-LED continuous Moving-dot display.

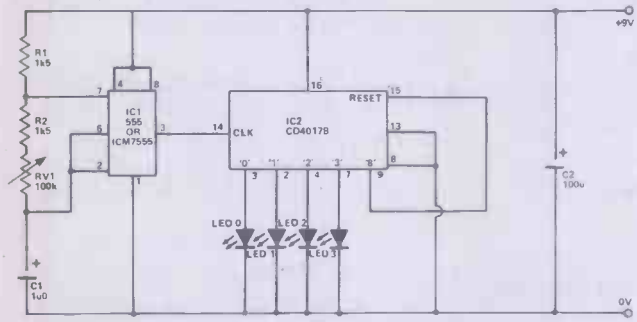
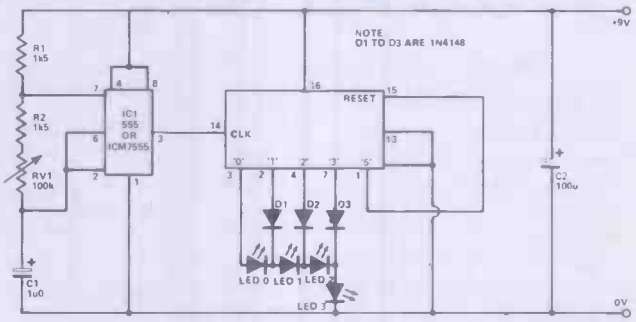


Fig. 10. 4-LED Intermittent Moving-dot display with 50% blank period.



LED 0	ON	OFF	OFF	OFF	OFF	ON
LED 1	ON	ON	OFF	OFF	OFF	ON
LED 2	ON	ON	ON	OFF	OFF	ON
LED 3	ON	ON	ON	ON	OFF	ON
STEP NUMBER	1	2	3	4	5	1

Fig. 11. Circuit and performance table of a 4-LED, 5-step sequential turn-off display.

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M18 Ladies quartz LCD Fashion Watch

Highly functional, but beautifully designed watch, suitable for those special occasions.

Displaying hours, mins, secs, day and date, the watch also has an auto calendar and a backlight.

The slim but strong bracelet is fully adjustable and is available in a silver or gold finish.

M64 Mans dual time quartz alarm chronograph with 6 digits, 5 indicators and 22 functions.

For business people with overseas contacts and responsibilities this is the ideal watch.

Local time is always visible, but in addition the watch can be set, and recall, a second time zone, in either 12 or 24 hour formats, and displays a day and date for each zone.

The chronograph/stopwatch displays up to 12 hours, 59 minutes and 59.9 seconds.

On command, the stopwatch display freezes to show intermediate (split/lap) time while the stopwatch continues to run and neither function affects the normal timekeeping.

The alarm can be set to any time within a 24 hour period.

To complete the functions, there is also a 4 year calendar and a fully adjustable stainless steel strap.

£9.95 inc p&p

M15 Ladies quartz LCD Day Watch

This slender watch displays hours, mins, secs, day and date and has an auto calendar and a backlight.

Only 25mm × 20mm × 6mm thick this elegant watch has a bracelet, in silver or gold finish, and is fully adjustable to suit very slim wrists.

M17 Ladies quartz LCD Cocktail Watch

Only 6mm thick, the watch displays hours, mins, secs, day, date and has an auto calendar and backlight.

The fully adjustable bracelet has a bronze/gold or silver finish.

M30 Mans dual time melody alarm chronograph with count-down timer, 34 functions

A very impressive new watch at a superbly low price and with so many useful functions.

There are 5 independent working modes; normal watch, count-down alarm, alarm, dual time zone, 1/100th sec. chronograph.

In addition, the watch can display the day of the week in French, German or English.

The count-down timer can be used for a variety of applications from boiling an egg to reminding you your parking meter time has expired. Both the count-down alarm and the normal alarm have a clear musical tone.

For the businessman the time zone feature could be a real advantage. Just programme the second time zone and it will be permanently recorded for easy reference.

And as a stop-watch here's a great timepiece for sporting events and for timing recordings.

There's the conventional stop/start counter plus a lap timer which enables first and second places to be timed.

Longer timing intervals, such as journey times can be recorded while the watch is reading its normal time.

M3 Mans quartz LCD with 6 digits and 11 functions

Only 7mm thick and with a fully adjustable stainless steel bracelet, this watch is ideal for all ages.

The normal functions are hours, mins, secs, day, date, and day of week.

But as a stop-watch, which does not affect normal timekeeping you also have 1/100th and 1/10th secs., split, lap and journey timing, a four year calendar and a backlight.

Also available is a solar version.

This is the same watch but incorporated is a solar energy panel which converts normal daylight into electricity.

During periods of darkness the watch instantly operates by battery without losing its accuracy.

M4 Mans quartz LCD alarm with 6 digits and 9 functions

A very useful watch with an effective, loud alarm but still only 8mm thick.

The normal functions are hours, mins, secs, date, day of week, four year calendar and a backlight.

In addition, there is a 24-hour alarm, a 5-minute snooze feature and a 4 second pre-alarm conference bleep.

The conference signal is a bleep, 4 seconds before main alarm to give advance warning and the option to cancel.

After the main alarm stops the snooze repeater alarm sounds 5 minutes later, unless previously cancelled.

To complete the functions, there is also a 4 year calendar and a fully adjustable stainless steel strap.

M16 Mans dual time quartz alarm chronograph with 6 digits, 5 indicators and 22 functions.

This watch has the same functions as M64 except the time is in the 24 hour format only.

A solar version is available.

This is the same watch but incorporated is a solar energy panel which converts normal daylight into electricity.

During periods of darkness the watch instantly operates by battery without losing its accuracy.

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Miniboards

2 WATT AMPLIFIER

A low-cost general purpose Mid-Fi amplifier that can deliver 2 watts into an 8 ohm speaker when powered from a 12 to 18 volt supply. Why not connect it up to the Fog Horn project this month and really annoy the neighbours.

THIS COMPACT AND INEXPENSIVE UNIT has a variety of uses. It can be used as the basis of a first-class 'bench amplifier' for the workshop, or can be used as a really versatile general-purpose power amplifier in a multitude of experimental music and special-effects applications. It can even be used to replace existing output stages in cheap radios and grams.

The unit is really very simple, and consists of a high-impedance FET (field effect transistor) input stage, followed by an IC power amplifier output stage. The completed unit has an input impedance of 10 megohms and can deliver 2 watts into an 8 ohm speaker when powered from a 12 to 18 volt supply.

CONSTRUCTION AND USE

The unit is built on a 1 inch x 2½ inch strip of Veroboard, as shown in the photographs. Construction of the unit should present no problems so long as care is taken to observe the polarities of all electrolytics and of Q1 and IC1. IC1 should be soldered directly to the Veroboard panel, without the use of an IC holder, as the copper Veroboard strips act as an effective heat sink for the IC in this particular application. Take special care not to damage the IC by overheating it when soldering it into place. Note that C6 and RV1 are not mounted on the Veroboard panel.

When construction is complete, double check all wiring and then connect RV1 and C1 and the speaker into place. You can then connect the unit to a 12 to 18 volt battery supply, connect up a suitable input signal (from the output socket of a radio or tuner, etc) and give the unit a functional check. We think you'll be favourably impressed with the results.

Note that the unit must *not* be used with speaker impedances less than 8 ohms. Also note that, because of the very high input impedance of the circuit, input signals should be connected via a suitably screened lead.

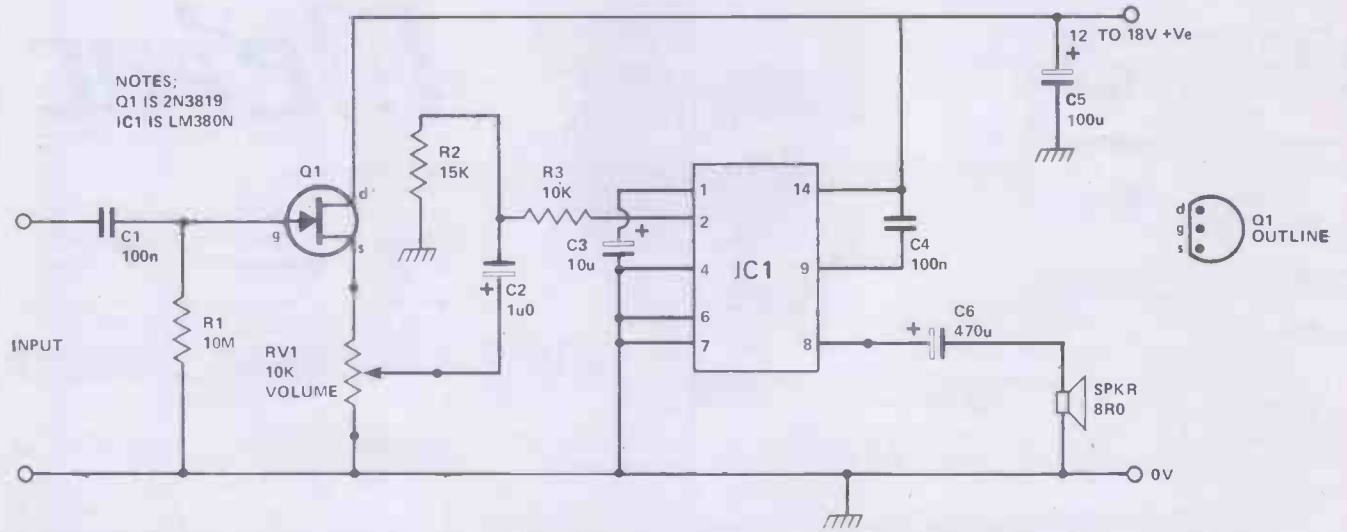
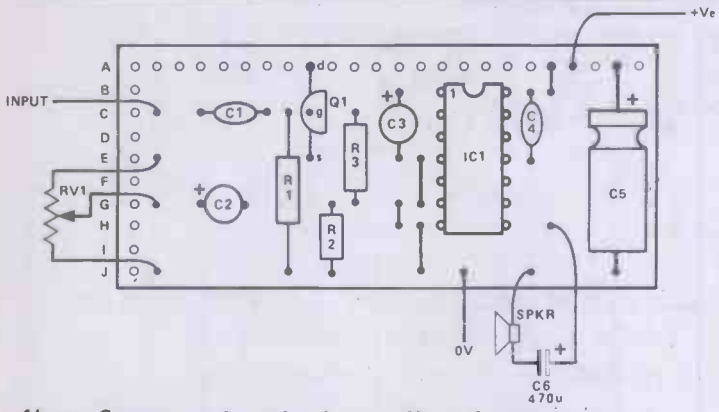


Fig. 1. Circuit diagram of the Miniboard 2 watt Amplifier. None of the components should be difficult to obtain, ensure all polaraties are observed, particularly with Q1.

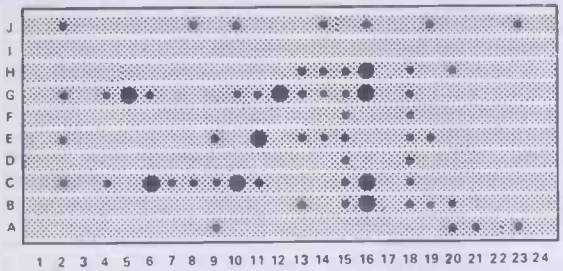
How it Works

There really is not a great deal we can say here, as the circuit is so simple. Q1 is a high-impedance FET (Field Effect Transistor) and is used as a unity-gain buffer amplifier. Its output is fed to the input of IC1 via volume control RV1. IC1 is a 2-watt power amplifier, with an integral heat sink that is coupled to the three centre pins on either side of the IC package. The output of the power amplifier is passed on to the external 8 ohm speaker via blocking capacitor C6. That's all there is to it!



Above. Component insertion layout. Note the orientation of Q1 and IC1

Below. Underside of the Miniboard Amplifier. Ensure that cuts in the track are made in the correct places.



More Miniboards coming soon! Watch HE for details. If you have any suggestions for Miniboard circuits then why not let us know.

HE

Parts List

RESISTORS (All ¼W, 5%)

R1	10M
R2	15k
R3	10k

POTENTIOMETER

RV1	10k LIN

CAPACITORS

C1, 4	100n polyester
C2	1u0 25 V electrolytic
C3	10u 25 V electrolytic
C5	100u 25 V electrolytic
C6	470u 25 V electrolytic

SEMICONDUCTORS

Q1	2N3819
IC1	LM380N

MISCELLANEOUS

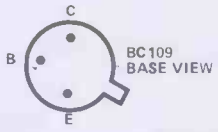
Speaker	8RO
1" x 2½"	Veroboard panel

Buylines

All the components used in this project are readily available

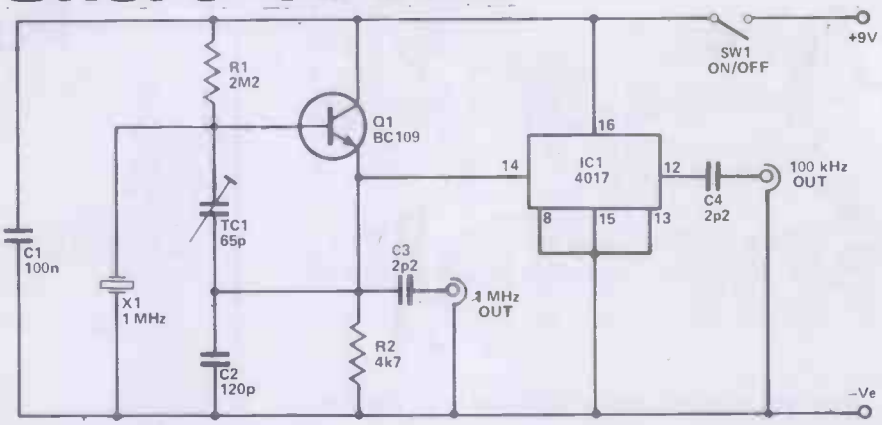
Short Circuit

CRYSTAL CALIBRATOR



A problem with home-constructed short wave receivers is that of providing the finished unit with an accurately calibrated tuning dial. A crystal calibrator solves this problem by providing numerous calibration signals that emable the various dial frequencies to be marked on with good accuracy. A crystal calibrator is also useful for checking the calibration of a short wave receiver that has been in use for some time.

The calibrator circuit shown here has fundamental outputs at 1MHz and 100kHz. However, it does not merely provide calibration signals at these frequencies, but also at harmonics of these frequencies. Harmonics are merely multiples of the fundamental frequencies. The 1MHz output therefore provides calibration signals at 2MHz, 3MHz, 4MHz, etc., while the 100kHz output provides signals at 200kHz, 300kHz, 400kHz, etc..



These additional frequencies are produced because the circuit is designed to give an output signal that is not a sinewave, but instead has a very rapid rise time and is virtually a square wave. This gives a signal which is rich in harmonics at frequencies up to many megahertz. This circuit provides harmonics that are readily detectable up to 30MHz (the upper limit of the short wave spectrum) on any reasonably sensitive receiver.

Q1 is used in a simple 1MHz crystal oscillator, and it operates in the emitter follower mode. TC1 and C2 effectively form a tap on the crystal which acts as a parallel tuned circuit. The output of Q1 is coupled into this tapping, and this gives the positive feedback path needed to produce oscillation. The circuit oscillates at the resonant frequency of the crystal since there is only an efficient feedback path at this frequency. There is a voltage step-up through the tuned circuit which ensures that there is sufficient feedback to produce strong oscillation and an output rich in harmonics. A crystal is used in the unit rather than an ordinary L-C tuned circuit as a crystal gives better accuracy and stability. The 100kHz output is obtained merely by feeding the 1MHz signal to a CMOS 4017 divide by ten circuit.

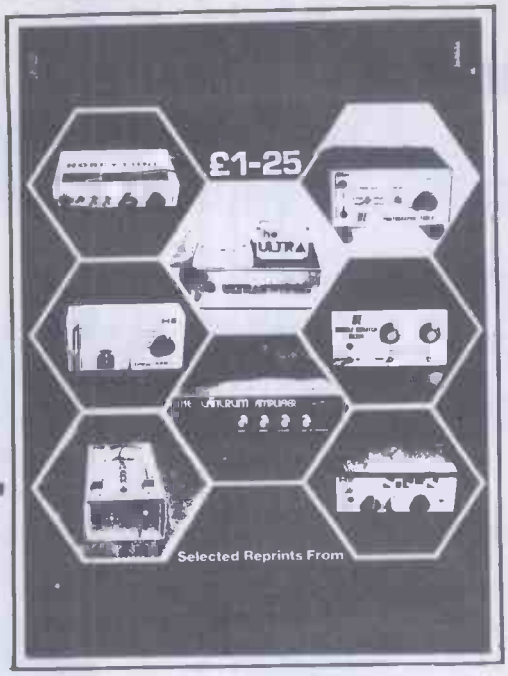
TC1 must be adjusted to give optimum accuracy from the unit, and this is easily achieved by connecting a short lead to the 100kHz output and placing near to a radio tuned to the BBC LW 200kHz transmission. This will produce a low frequency beat note (heard as a cyclic rise and fall in the volume of the station), and TC1 is simply adjusted for the lowest attainable beat note. A beat rate of well under one per second should be easily obtained.

The current consumption of the circuit is about 4 mA.

Projects Special

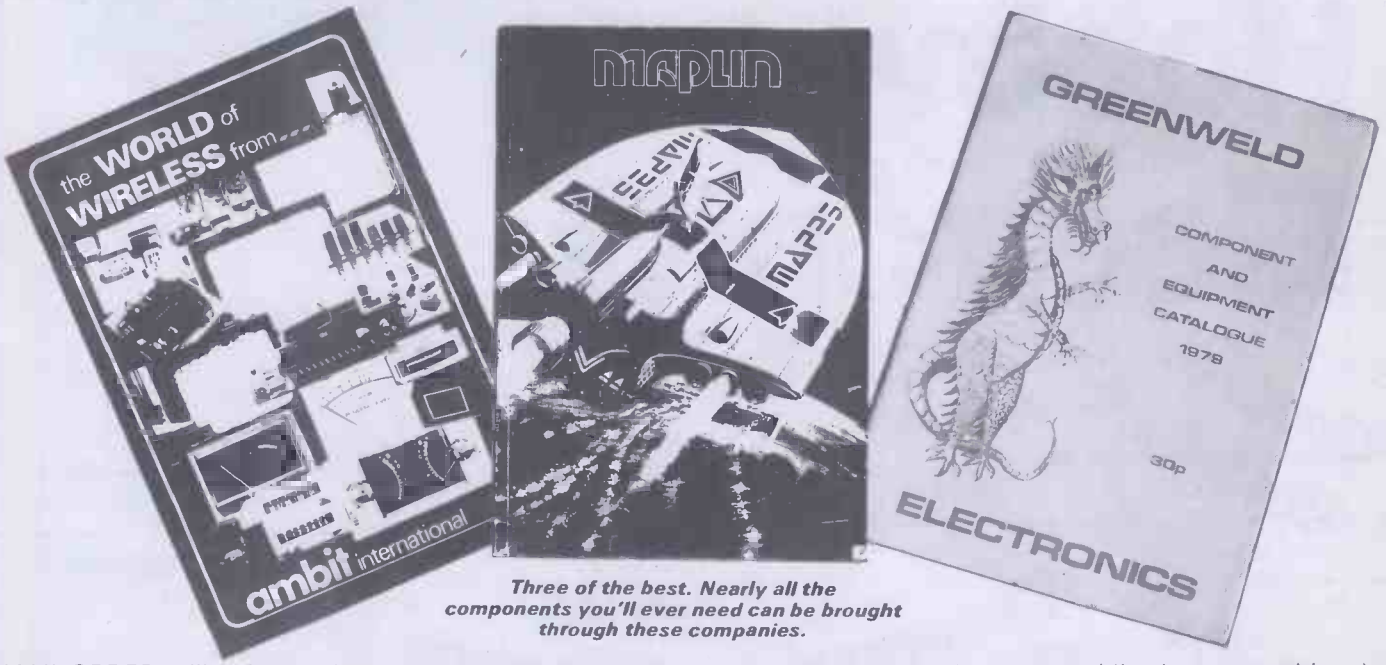
from

Hobby Electronics



Catalogue Survey

Time again for our annual catalogue survey. Is it cheaper to buy mail-order, who is the cheapest — find out now.



Three of the best. Nearly all the components you'll ever need can be brought through these companies.

MAIL-ORDER selling is a rapidly growing industry, the purpose of which is to supply goods to you, the customer, as swiftly and easily as possible. The Mail-Order Catalogue serves both seller and buyer. It enables a company to give a more comprehensive guide to its products than an advertisement alone could show, and it provides detailed information from which the prospective purchaser may make his choice.

Just as there is enormous variety between the size of companies and the range of goods they offer, so this is reflected in the kind of catalogues they produce. In all cases, however, the function of the brochure is the same — to entice and inform.

Last April we conducted a survey of several mail-order companies who advertised in HE. We invited them to send us an example of their current catalogue and we compared these in terms of number of pages, cost, guarantee/exchange etc. We thought it would be worthwhile to repeat the exercise again this year and to offer a quick and practical summary of the kind of catalogue available.

As is to be expected, the size and presentation of the catalogues varies considerably. The format ranges from a few duplicated sheets to a publication approaching the proportions of a magazine. This, of course, is reflected in the price. Quality of reproduction does not necessarily mean that the goods advertised are in anyway superior, although the clearer and more informative the catalogue the more attractive the product may seem. It is more helpful if a photograph accompanies description and in each case this was so although the clarity did vary.

The size of the catalogues surveyed, ie the number of pages, also varied according to the size of the company and the range of components on sale. It should be borne in mind, however, that a catalogue, as well as giving information, needs to be well presented visually. A page of writing alone is neither as attractive, nor indeed as useful, as writing accompanied by illustration. The best of the larger catalogues included both.

The price of a catalogue will obviously depend on its size and the quality of its photographic content. Nevertheless, do not dismiss something merely because it is free — the information is still valid. Another thing to watch is VAT. Catalogues that include VAT in the price give a more accurate picture of just how much you can really expect to pay for your project or component. Some

One of the latest entries to the mail-order catalogue field, this looks most promising.

Three more of our favourite publications. Henry's above are particularly good at supplying 'unusual' or hard-to-get components and devices.

Electrovalue, above, specialists for semiconductors and other electronic components. This new catalogue is crammed full of useful IC pin-out data.

SUPPLIER	FORMAT C = CATALOGUE L = LIST	NUMBER OF PAGES	COST OF CATALOGUE	VAT INC PRICE	POST & PACKING	GUARANTEE EXCHANGE	ADDITIONAL DATA	TRANSISTOR PIN-OUTS	NOTES	COMMENTS
AUDIO ELECTRONICS	L	40	SAE FREE	YES	NO	YES	NO	NO	–	AUDIO EQUIPMENT PLUS ACCESSORIES
AMBIT INTERNATIONAL	C	–	–	NO	–	YES	YES	NO	1	THREE SECTIONS
CATRONICS	C	20	–	YES	–	YES	YES	YES	–	
CONTINENTAL SPECIALITIES CORP.	C	36	FREE	NO	NO	YES	ON PRO-JECTS	–	–	INCLUDES MANY COLOUR LEAFLETS
ELECTROVALUE	C	128	–	NO	YES	YES	YES	–	–	VERY GOOD SELECTION & KEEN PRICES
GREENWALD	C	52	40p	YES	NO	NO	SOME	SOME	–	GOOD SELECTION, FAIR PRICES
HENRYS	C	118	£1.00	YES	NO	YES	NO	NO	–	BUMPER ISSUE PACKED WITH INFO
HAMLIN ELECTRONICS	C	72	–	–	–	–	–	–	–	EXCELLENT CATALOGUE
LOWE ELECTRONICS	C	72	–	–	–	–	–	–	–	BASIC INFO ON RANGE FOR TOP QUALITY RADIO PRODUCTS
MAPLIN	C	280	75p	YES	FREE OVER £2	–	–	–	–	SUPERB CATALOGUE, BEST THERE IS
MARSHALLS	C	48	40p	YES	YES	YES	YES	YES	–	VAST SELECTION AT COMPETITIVE PRICES

TABLE 2 Comparison of prices of two recent projects from Hobby Electronics

SUPPLIER	PROJECT 1	PROJECT 2	COMMENTS
AMBIT INT.	£15.27	£3.49	All prices are not inclusive of Value added tax. So please add 15% to all totals
CHROMASONICS	£15.42	£3.78	
ELECTROVALUE	£15.39	£3.22	
GREENWELD	£15.53	£3.24	
MAPLIN	£15.47	£3.56	
MARSHALLS	£15.48	£3.36	
WATFORD ELECTRONICS	£15.71	£3.39	

NOTE:
PROJECT 1; DIGITAL FREQUENCY METER
PROJECT 2; TOUCH SWITCH
(not including PCB's, cases & knobs etc.)

companies in the survey included VAT, some did not.

There was variation in the amount of post and packing added to the cost of an item. Some companies make no charge at all, others make no charge on orders over a certain amount. Some quote a P&P charge on each item. Again, if the exact charge is clearly shown, you will have a better and more immediate picture of total cost.

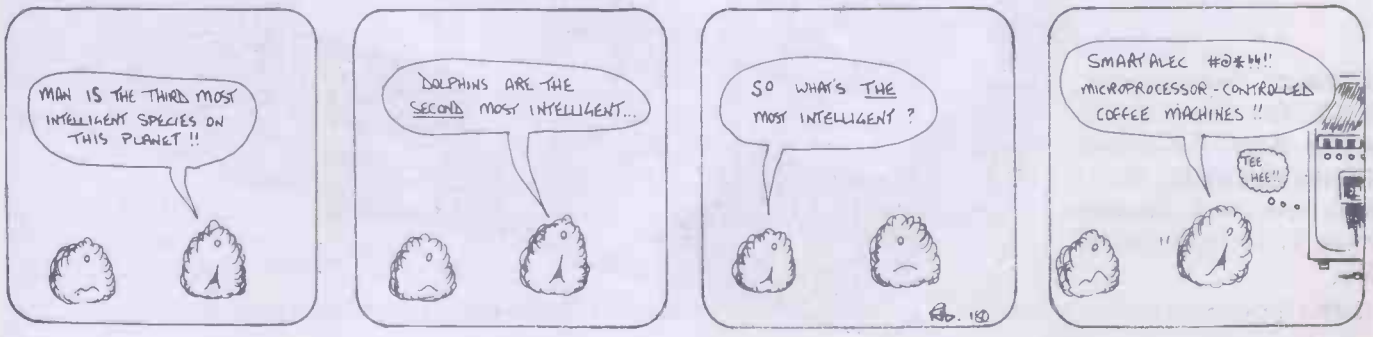
Not only is it important that the catalogue gives a clear and accurate indication of cost, but it is also essential that it gives as much information as possible about the product. Photographs are very helpful, and really should be obligatory, but in some cases, more detail is needed. This ought to, and in some cases did, mean pin-out diagrams of transistors and ICs as well as additional data.

As in last year's survey, we decided to conclude with a comparison of prices charged by the different companies. We did this by costing two projects from recent issues of HE and the results are shown in table 2. They should be taken as a rough guide to the companies' overall price structure, and are pretty well self-explanatory.

CONCLUSION

The mail-order catalogues we examined varied in size and price, and some were quite clearly better than others. However, we found all of them to be useful sources of information and worthwhile reading for anyone interested in buying. If you look at our tables you will get a pretty good idea of how and where the catalogues differ, as well as what kind of prices to expect from each company. We hope you find them helpful, but if you have any comments of your own to add, please let us know. **HE**

BEASTIES BY AH



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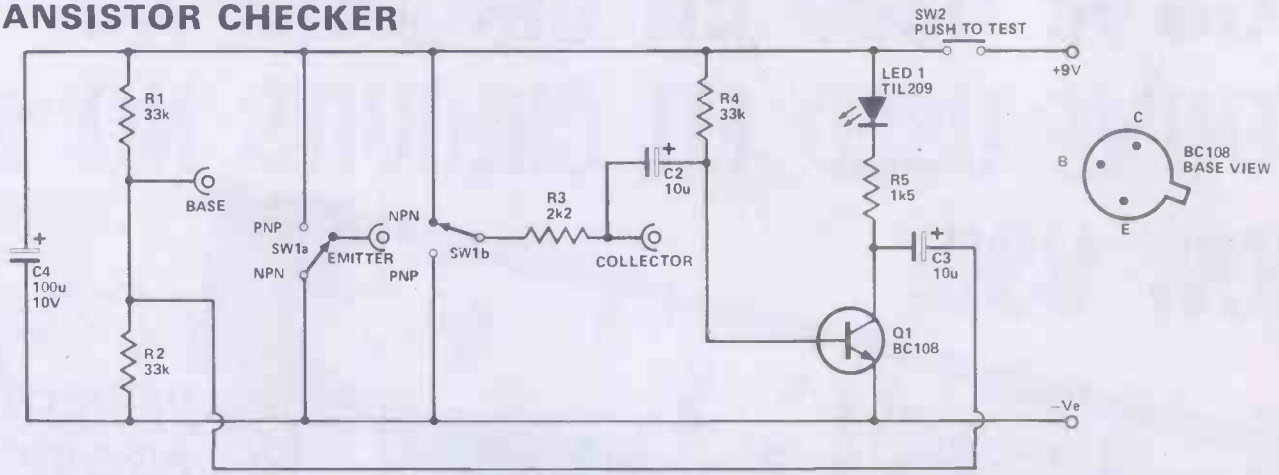
Short Circuit

TRANSISTOR CHECKER



This device enables transistors to be quickly tested, and shows whether or not they are serviceable. To test a device it is first connected to three sockets on the front panel, ensuring that each lead connects to the correct socket, a switch is set to the PNP or NPN mode, as appropriate, and then a push button switch is depressed. If the test device is functional, a LED indicator will flash on and off at a rate of about two or three times per second. The LED will simply light up for the duration that the push button is pressed if the test device is a dud.

If we consider the circuit in the NPN mode first, it is basically just a standard astable multivibrator, with the test transistor acting as one of the transistors in the circuit. The test device is biased by R1 and has R2 as its collector load resistance. R2 shunts the base emitter terminals of the test device, but is too high in value to have any significant effect on the circuit. Q1 is used in the other section of the multivibrator, and it is biased by R4. LED indicator D1 and current limiting resistor R5 acts as its collector load. C2 and C3 provide the cross coupling between the two stages.

If the test device is functional, the circuit will of course oscillate, and the specified values give an operating frequency of about 2 to 3 Hertz. As Q1 switches on and off, D1 will be seen to flash on and off. If the test device is faulty, R4 will simply bias Q1 into conduction, resulting in D1 remaining switched on while SW2 is depressed and power is supplied to the circuit.

With SW1 switched to the "PNP" mode, the supply to the test device is altered to the correct polarity. R2 now biases the test device, and it is R1 that has no significant effect on the circuit. Although a multivibrator would not normally use one PNP and one NPN device, the circuit operates very much as before.

The current consumption of the unit is about 6 mA. Three small wander sockets mounted in a triangular arrangement can be used as the test sockets, and provided they are mounted very close together, most small transistors will then plug into these without difficulty. A set of three test leads terminated in crocodile clips can be used to connect the unit to those that will not.

SW2 is a push-to-make switch.

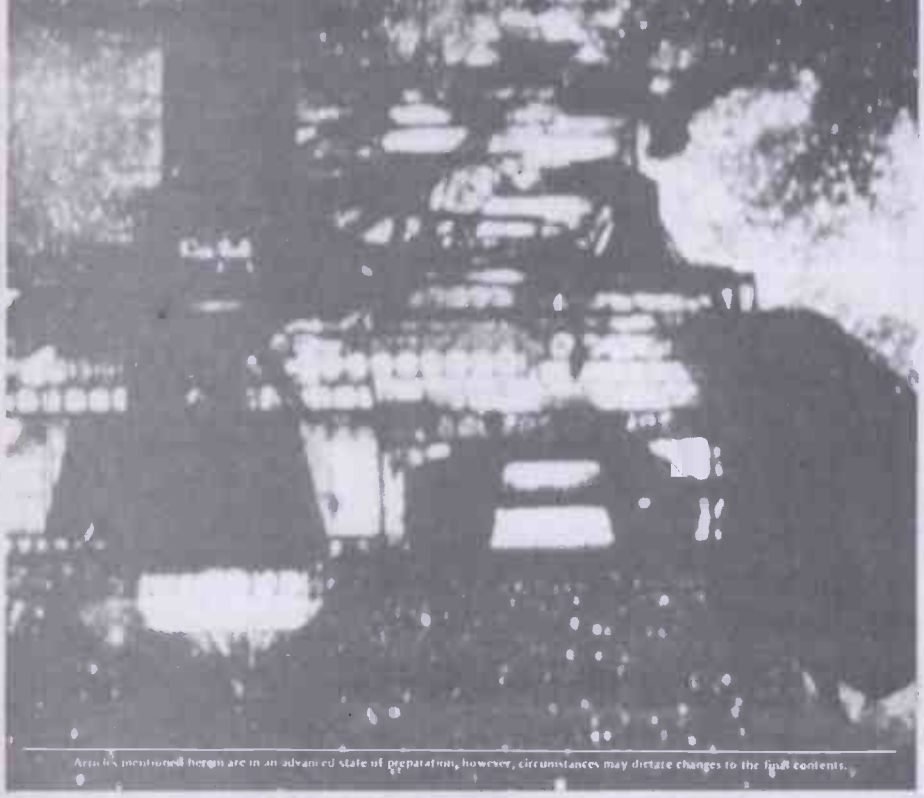
ETI JULY 1980

WHAT TO LOOK FORWARD TO IN OUR JULY ISSUE! ON SALE JUNE 6TH.

Next month ETI presents the definitive history of the spacecraft. Ian Graham – our permanently high spaceman – talks us through the hardware of the fastest man-made vehicles to date and takes a look at those which take flight only in our imaginations. For everyone who has looked up at the stars and longed.

Also next issue we have the long awaited Image Co-ordinator which will allow you to do things with your stereo image that your mother wouldn't approve of! Moreover Tim Orr follows up his Handbook of this month, with an article in similar vein, this time on his favourite subject, Active Filters – find out how to design them yourself in the July issue of ETI.

For the audio men there is a first look at one of the rising stars of hi-fi, the [illegible] system. It can be bought as a [illegible] fully built and working piece [illegible] example of their range [illegible] and the 204 (110W p[illegible] by your speakers.



Articles mentioned herein are in an advanced state of preparation, however, circumstances may dictate changes to the final contents.

INVASION FROM ANOTHER WORLD

Detail of the Contents Page

All across the nation ordinary citizens have been intrigued by the appearance of thousands of blue and silver folders. These folders first appear on the shelves of newsagents and quickly they find their way into the hands of innocent shoppers. These (previously normal) individuals have since reported the emergence from the folder of a colourful magazine-like object with the markings "ETI 1999" clearly visible in front aspect. Further inspection has shown a polyfolio structure with pages of fascinating articles and pictures from another world — a world both strange and uncannily familiar.

The latest development in the ETI 1999 story is the aggregation of a few thousand of the alien objects, withdrawn into their protective folders, at the Hobby Electronics office. Further, we have received a demand for thousands of pounds and instructions to send units of "ETI 1999" to anyone who sends £1.50 + 30p (P&P) to Sales Office (Specials), Hobby Electronics, 145 Charing Cross Road, London WC2H 0EE.

Detail of the Contents Page

Fog Horn

Connect this little circuit up to our Miniboard Amplifier and you'll be able to lose all your friends in under one minute — you have been warned.

IF YOU LIVE ON the shores of a busy harbour, you have probably been woken occasionally in the early morning by the sound of a ship's fog horn. Before the advent of radar, fog horns were the only means ships' captains had of avoiding collisions. The distance and direction of the low-pitched sound gave an indication of another craft's position. Despite radar, many boats and ships still have fog horns in active service.

This project won't wake the household (or the neighbours!) but it certainly makes a realistic sound.

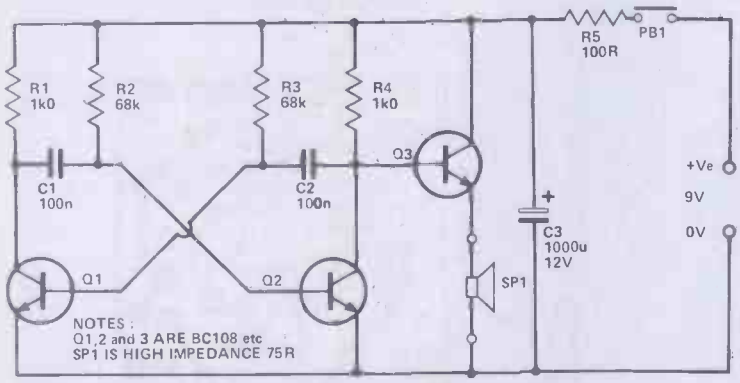


Fig. 1. Circuit diagram of the 'deafening' HE Fog Horn.

CONSTRUCTION

This circuit is simple enough to be constructed on matrix board or tag strips. However, we have used a printed circuit board. If you are not yet confident of getting all the connections right, we suggest you construct this project as we have.

No matter what method of construction you elect to use, as always, take care with the orientation of the transistors and the polarity of the battery connections. The speaker we used is rather an unusual item. Small speakers commonly have an impedance of either eight or 16 ohms. The one used here has an impedance of 75 ohms.

You can modify the sound of the fog horn if it is not quite to your satisfaction — normal component variations will produce differing results. You can vary the basic sound produced by the multivibrator by varying C1 and C2. Changing these by one standard value higher or lower will produce quite a gross variation in pitch. Smaller variations can be obtained by having several capacitors in parallel. Use a large value — close to that specified — and connect a smaller value capacitor in parallel, for each of C1 and C2.

The rising and falling pitch and volume is controlled by R5 and C3. The value of R5 can only be practically varied a small amount. You get a much more satisfactory result by varying the value of C3 or varying its discharge

How it Works

The fog horn consists of an oscillator, which generates the basic sound, and a speaker driver. The oscillator we used is known as a "multivibrator". This type of circuit is widely used — in one form or another — in electronics, it is one of the 'building blocks' used in many complex circuits.

The multivibrator here consists of Q1, Q2, C1, C2 and R1 to R4. To understand how it oscillates, we must first make an assumption: let us assume Q2 turns on when the push-button, PB1, is operated. One or other of the transistors, Q1 or Q2, will turn on first as no two devices are *exactly* the same.

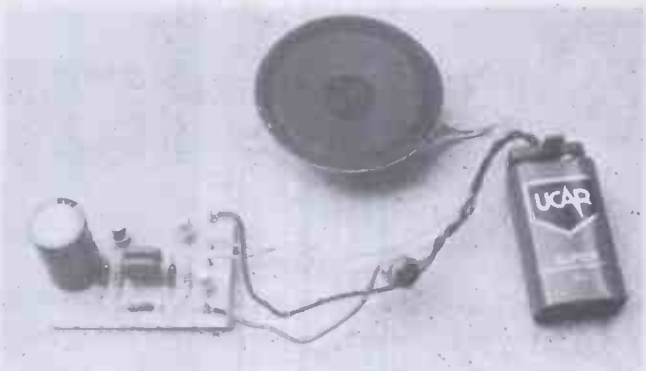
Now, when PB1 is pushed, Q2 conducts and Q1 will be 'cut off' (not conducting). The collector voltage on Q1 will be at the supply voltage (about +9V) and the base of Q1 almost at zero volts as C1 will not be charged and the collector voltage on Q2 will be close to zero (as Q2 is on). C2 will charge via R1 and the base of Q2, keeping Q2 on while it charges. C1 will begin to charge via R2, and when the base voltage on Q1 has risen suffiently, Q1 will commence to conduct. The collector voltage on Q1 will rapidly fall. This will cause the charge on C2 to reverse-bias the base of Q2, immediately turning it off. Thus, the collector voltage on Q2 will jump to the supply voltage and C1 will begin to charge via R4 and the base of Q1, holding it on while C1 charges.

However, C2 will begin to charge — in the opposite direction to which it was first charged — and the negative voltage on the base of Q2 (from C2) will decrease, pass through zero and rise in a positive direction. When it has risen sufficiently for the base of Q2 to conduct once more, Q2 will turn on.

And the whole business begins again. The charge on C1 will reverse bias Q1 which turns right off, C2 will charge via R1, driving Q2 further on . . . until C1 charges (via R4) sufficiently to turn Q1 on again, etc.

Thus, the collector voltages on Q1 and Q2 will alternately rise, stay up for a period, fall and stay

Close-up of the 'business end'.



The HE Fog Horn connected up to the speaker, battery and switch.

time. You can decrease the 'die away' period by putting a low-value resistor in parallel with C3, increasing the discharge current. Start experimenting with something like 680 ohms.

Parts List

RESISTORS (All ½W, 5%)	
R1	1k
R2, R3	68k
R4	1k
R5	100R
CAPACITORS	
C1, C2	100n
C3	1000μ, 12 V electro
SEMICONDUCTORS	
Q1—Q3	BC548, BC108, DS548 or similar
MISCELLANEOUS	

SP high impedance speaker, greater than 40 ohms.
PB1 push-to-make momentary push button.
9 V battery or suitable battery eliminator.

Buylines

All of the components are readily available. The mercury switch can be obtained from either Maplin or Watford Electronics for around 50 pence.

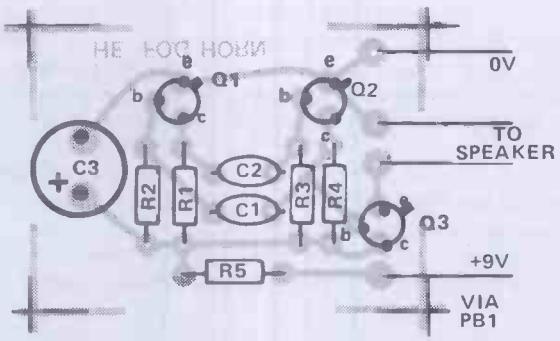
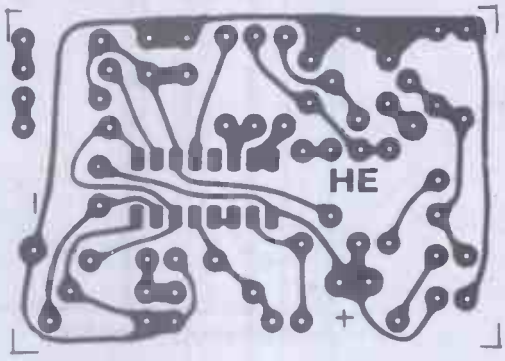


Fig. 2. (Above). Overlay diagram of the Fog Horn.

Fig. 3. (Below). PCB design.



down for a period, then rise again – a square wave.

That's your basic, or common-garden-variety, multivibrator. The frequency of oscillation is dependent on the values (and thus the time-constant) of R1, C2 and R2, C1. An output can be taken from the collector of either Q1 or Q2. The signal on one collector will be the opposite phase to that on the other collector (while one collector is up, or 'high', the other collector is down, or 'low').

The output from the oscillator will not be able to drive the speaker directly. This is because the oscillator has a high impedance output and cannot supply enough current to drive the relatively low impedance of the speaker. To increase the available current, and lower the output im impedance, we use an emitter follower, where the input is fed to the base of a transistor, Q3, and the output is taken from the emitter. The voltage output from the emitter follower is very close to the input voltage, but the current is amplified sufficiently to drive the speaker.

But what about the R5 and C3. Well, these help to give the oscillator its characteristic sound. The multivibrator generates the basic low pitch of the fog horn. But, if you listen carefully to a real fog horn, you will notice that the pitch and volume vary slightly as it sounds. Now, the frequency of a multivibrator depends on the supply voltage to a large extent. The lower the supply, the lower the frequency, and vice-versa. Also, the output, and thus the volume, is lower at lower supply voltages – vice-versa.

When PB1 is pushed, C3 will take a short while to charge and therefore the voltage supply to the oscillator (and speaker driver) will take a short while to rise. Thus, the sound from the speaker will have the characteristic rising pitch and volume of the first part of a fog horn's blast. When PB1 is released, C3 will take a short while to discharge and the sound level and pitch will die away.

In this way, the circuit simulates the characteristic sound of a ship's fog horn.

All these advantages...

- Instant all-weather starting
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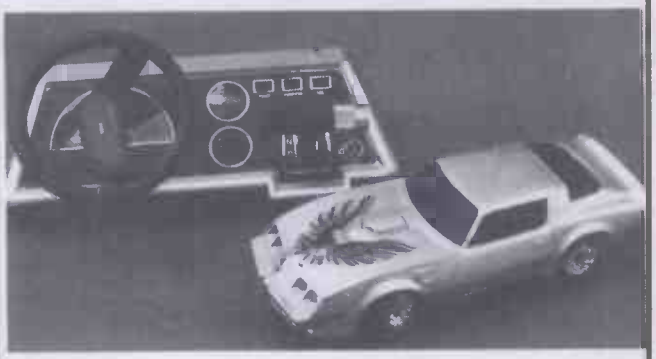

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Into Electronics Construction

PART 5

BY IAN SINCLAIR

Only one more month to go, by now you should have grasped the rudiments of electronics but now the one skill you have to master — soldering.

UP TILL NOW we've been building all of our circuits on the Eurobreadboard which lets us keep using the same components over and over again, and also allows us to experiment with changing component values without needing major surgery to the circuit. Every now and again, though, there's a circuit that you'll want to use permanently and which must then be built on a solderboard of some sort. That means soldering, and soldering is the subject of this part of the series.

Soldering means joining metals together with another metal, one which melts at a low temperature. There are all sorts of solders for all sorts of purposes, but the one which is of most interest to us is made from a mixture of sixty parts of tin to forty parts of lead. This is a type of solder which has a particularly low melting-point, and is the most suitable for electronics use. We have to avoid solders which have high melting points, because electronic components are easily damaged by high temperatures. The solder we use gets quite hot enough, and we certainly wouldn't want to use anything which melts at a higher temperature. Fortunately, we don't have to worry too much about details, since we don't have to make our own solder. We just buy a suitable "electrical" grade solder, and use it!

The important part of the soldering operation which has to be repeated over and over again is to join a component leadout wire to a strip of copper. The copper strip will be on some sort of solderboard — we'll look at these later in this Part. What we're trying to do is to make hot molten solder flow on to both of these metals (the leadout wire and the copper) so that it joins them, mechanically and electrically, then to let the solder solidify so that the metals stay joined.

HOT STUFF

Difficulty number one is to make the hot solder flow. Like water on a greasy plate, solder has an annoying habit of forming into little round drops which don't flow on to anything. All molten metals do this, in fact; it's caused by an effect called surface tension, and it's enemy number one as far as soldering is concerned. Fortunately, this problem has been licked — but you have to know how, else you'll never know how to solder really well.

The solution to the problem is similar to the solution to getting water to flow on a greasy plate — you add a "detergent". Now I wouldn't suggest that you should dip your soldering iron into Super Family Sudso (the fumes might choke you), but it's the same sort of thing. I've even used a cake of soap as a way of making solder flow before now when nothing else was to hand, but that's another story. The material which helps to make solder flow on to component leads and to the copper strips of solderboards is called flux, and the correct flux is as important a part of soldering as the solder itself.

Time was when you had to buy flux separately, and coat everything you were going to solder with this thick goo. Those days are gone, and I still have a tin of flux I bought in 1948, because when you buy the genuine solder for electronics use it has the flux inside it. Yes — I said inside it — like the lettering in Blackpool Rock, the flux is a core inside the metal of the solder. Under a microscope it looks a bit like the drawing in Fig. 5.1.

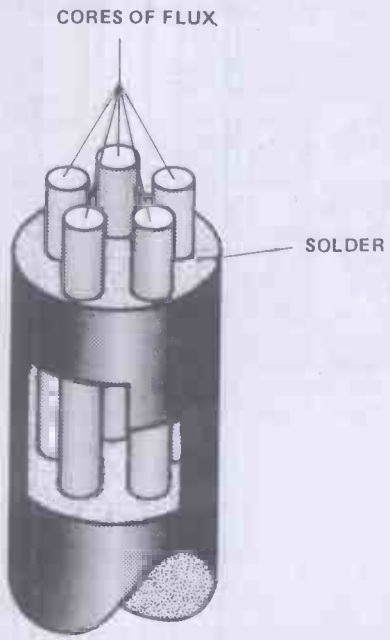


Fig. 5.1 A magnified view of a piece of five-cored solder. The five cores of flux will melt when the solder is heated.

Now if all that the flux did was to help the solder flow on to the joint (the two metals we want to join), that would be reason enough to be grateful, but it does another job as well. Solder is a mixture, as we've said, of the metals tin and lead, and both of these metals are attacked by the oxygen in the air. One effect of this attack, called oxidation, shows when you melt these metals. The bright surface of the molten metal soon becomes covered with a dull film of metal oxide. These oxides (of tin and of lead) don't conduct electricity too well in this form (though there is one conducting form of tin oxide), and they certainly don't stick to other metals, so that we need to avoid this oxidation of our hot solder. The flux does just that, by flowing over the surface of the solder and protecting it from the air. If you insist on keeping solder hot for a long time, though, the flux will burn away, leaving the solder unprotected, and that can spell disaster to your hopes of a good connection.

KEEP IT CLEAN

Of course there's not much point in having the solder kept clean and beautiful by the flux if the metals you're going to join are in a grotty state. Solderboards should be clean and free from grease; a wipe with a rag moistened with white spirit, dry cleaner fluid or lighter fuel will clean grease off, but be careful with all of these liquids. Component leadout wires sometimes benefit from being pulled through a bit of folded wet-or-dry emery paper (yes, that's what you ask for in the shop, wet-or-dry rubbing-down paper.). Apart from aluminium, which needs special solders and fluxes, the nickel-chromium-steels which are used for transistor leadout wires are the only metals which can present problems, and they need the most careful cleaning — but don't pull the leads out from the transistors!

The steps in making a good soldered joint are:

1. Heat the materials which you're going to join,
2. Melt the solder and its flux directly on to the place where you're making the joint.
3. Keep the lot hot until the solder has flowed properly,
4. Cool the joint down again before the flux burns away.

It all sounds pretty straightforward, so let's see how we go about it in practice.

GETTING STARTED

First of all, you'll need a soldering iron. Nowadays, with components getting smaller and smaller, a big old-fashoned iron is useless, and you'll need a miniature iron with a power rating of somewhere between 10 and 20 watts, preferably with a selection of interchangeable "bits", as the business end is called. People have their own preferences — mine is for a very nice little iron, the SRB, manufactured by SR Brewster of Plymouth, and widely advertised in the electronics magazines. It has enough power to cope with the occasional larger job, a good selection of different plug-in bits and, most important of all, a three-core cable so that it can be properly earthed through a three-pin plug and socket. I often work alone, and nothing will ever persuade me to use any electrical equipment which is not properly earthed — end of safety message.

Let's suppose, then, that we have an iron plugged in and getting hot, and a component leadout wire which is laid against a piece of solderboard. How do we go about soldering this lot? To start with, we have to make sure that the bit of the iron is not clogged up with gungy old solder. The cleaning method is simple — a quick wipe with a damp cloth (and that's why I like the iron to be earthed!) Don't file or sandpaper the bits; they usually have a thin coating of iron nowadays, which will be removed if you file them, and that will greatly reduce the life of any bit. In addition, the damp-cloth method is much less messy. The cloth shouldn't be *wet*, just damp enough to steam slightly when the iron is touched against it.

With the bit of the iron clean, place it on to the joint. Ideally, the bit should touch both the component leadout wire and the copper track of the solderboard. Let them heat for a second (no more, otherwise the dreaded oxide will strike again), and then touch the end of the solder-wire against the bit of the iron just where it touches the copper track. There will be a puff of smoke from the flux, and after a little bit of hesitation, the solder will start to flow onto the copper and around the leadout wire. You can sometimes help it on its way round the wire by turning the iron around the wire, keeping the bit in contact all the time. Whenever the solder coats the wire and the coper track evenly (Fig 5.2), take the iron away — the joint has been made and heating it any longer will just cause oxidation. Now blow on the joint until the solder is cool, and take a good look. There should be an even coating of solder, no great blobs or gaping holes, and the surface should be reasonably bright, with no trace of burning. It doesn't matter if there's a brittle coating of something that looks like old varnish — that's the flux.

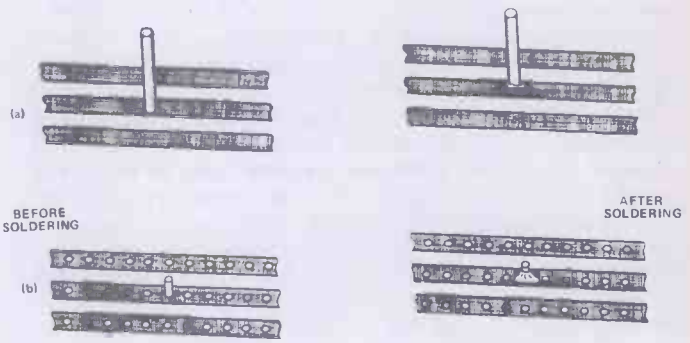


Fig. 5.2 Soldered joints. (a) Shows a joint made on to a plain board, such as the Euro 2298, (b) shows a joint made to a perforated board such as Veroboard.

Easy isn't it? What can possibly go wrong? One thing that can go wrong is that the leadout wire of the copper track is dirty, so that the solder simply refuses to flow. Another thing that can go wrong is that no flux gets to the joint, because you've melted some solder on to the iron and then carried it to the joint. You can also wreck a perfectly good joint by keeping the iron on for so long that the flux burns away, the solder oxidises, and the copper coating of the board becomes so hot that it pulls away from the board.

Now you've probably noticed that the procedure as laid down in these last few paragraphs needs a lot of hands, because with the iron in one hand and the solder in the other, it's a bit difficult to hold the solderboard and the component. There are several ways around this. Way

number one is to use some sort of clamp or jig for holding the solderboard and the component. It doesn't have to be very elaborate, a small vice, or C-clamp, even a Bulldog clip, and a lot of Blu-Tak works wonders.

The other way is a bit more subtle and needs more practice — it relies on the idea of tinning the board and the component leadout. 'Tinning'' just means coating with solder, so that you put a film of solder onto the leadout wire and the copper strip before you try to solder them together. It's easy enough, just place the iron against the wire or track, touch the solder onto the place and wait until the molten solder spreads. Only two hands are needed, because the solder board can lie flat on the bench, while you hold the iron in one hand and the solder in the other; when you tin a component wire, the solder can lie coiled on the bench and the iron and component can be brought up to the solder.

Once both have been tinned, they'll solder together just by placing them together and applying the iron for one second, no more. If tinning the board has sealed up the hole through which the lead-wire has to come, just keep the wire pushed into the hole, it'll go through whenever the solder melts. This method often looks time consuming, but it makes sure that each part which has to be soldered is coated properly with solder, and that's the important part of soldering. Some printed circuit boards come ready-tinned, so that if the component leadout wires are also tinned, soldering is exceptionally easy.

HAVE A GO

That deals with the soldering, then. Now for what we're going to solder on to — the solderboards or PCB's themselves. PCB means printed circuit board — a board which is ''printed' with a pattern of copper tracks which give the correct connections for your circuit. At this stage, there's quite a lot of choice for you of readymade PCB's, or various stages of circuit board construction The easiest (and most costly) method is to buy a ready-made board for the circuit you're going to build, or to buy a kit which includes the board ready to use. All you have to do then is to cut the component leads to the correct lengths, bend them so as to fit the board and solder them into place. It's too easy, really, a bit like shooting a sitting duck.

A less costly and more interesting method is to make use of your favourite magazine's Hobbyprints. The Hobbyprint is a method of producing a very professional looking PCB by your own efforts, and there's a Hobbyprint for most of the projects featured in HE. Hobbyprints produce a PCB in very much the same way as your ready-made boards are produced, by etching away the copper from a copper-coated board using an acid solution. The raw material is a plastic board (a material called SRBP — synthetic resin bonded paper) which is coated with copper. The board is often called 'laminate' and most of the component suppliers will sell you chunks of this material. You clean the surface free of dirt or grease, dry it thoroughly (watch for fingerprints — get a fingerprint on the board and you'll have to wipe it off with a rag moistened in lighter fuel), and then apply the Hobbyprint.

What's the Hobbyprint, I hear you ask? It's a dry transfer, in the exact pattern you need for a printed circuit, and you apply it to the copper in the same way as you apply any other dry transfer, by slapping it face

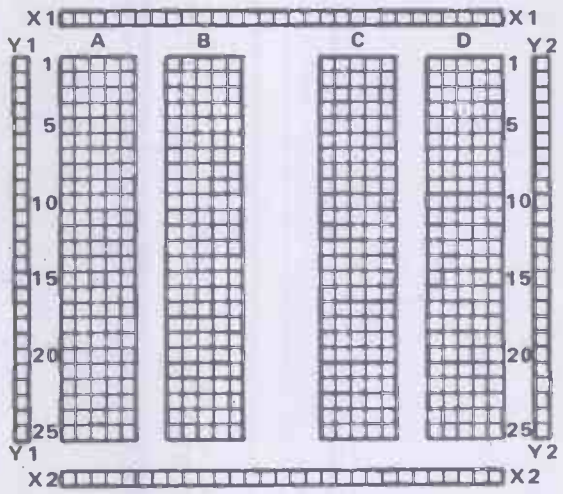


Fig. 5.3 The layout of the Euro 2298 board. This matches perfectly with the layout of the Eurobreadboard, so that you can make all your circuits in permanent soldered form.

down on the copper (ouch!) and rubbing the back all over with a pencil. You can use a soft pencil with a broad lead — I use a carpenter's pencil myself — to make sure that you have pencilled all over the back of the Hobbyprint. When you slowly and carefully remove the backing paper, you are left with a pattern of your PCB on the copper and a piece of paper which you can now throw away. Don't panic if it looks as if a bit hasn't stuck to the copper, just rub the back a bit more where the point is not transferring. If the worst happens and a piece refuses to stick (are you sure you cleaned the copper thoroughly?), then there's a repair kit with each Hobbyprint — they think of everything, these guys!

Now this is no ordinary dry transfer, because the material which is used for the Hobbyprint is acid-proof. Result is that if you now dip the whole sheet into an acid, the copper which is *not* covered by the Hobbyprint will be etched away and will disappear, but the copper which is covered by the Hobbyprint pattern is protected and will stay in place. This wouldn't work well if we used a really strong acid, so we don't, we use a weakly acid material — ferric chloride. Ferric chloride is a solid, reddish brown lump which dissolves in hot water to make up a solution which dissolves copper at a reasonable rate and doesn't affect the transfer material. The ferric chloride solution will work cold, but only very slowly. Make it up with hot water, as much material as possible in the amount of water you are going to use. Remember that the solution will have to cover the laminate board, and that you'll need to keep it in something. A cast iron pot is ideal, because it's unaffected by ferric chloride, but I wouldn't like to use it for cooking afterwards because stray copper isn't too good for you. I etch my boards in a photographic developing tray, and keep the solution hot by shining a 100W reflector lamp on it. I don't like working with ferric chloride on the cooker — the workshop is the place for this sort of thing!

With concentrated hot solution, the etching is complete in ten to fifteen minutes, and the PCB is ready whenever all the uncoated copper has just disappeared. The next step is hard work — you have to wash the board and then scrub off all the coating. Good ol'fashioned Vim and elbow-grease is the only way.

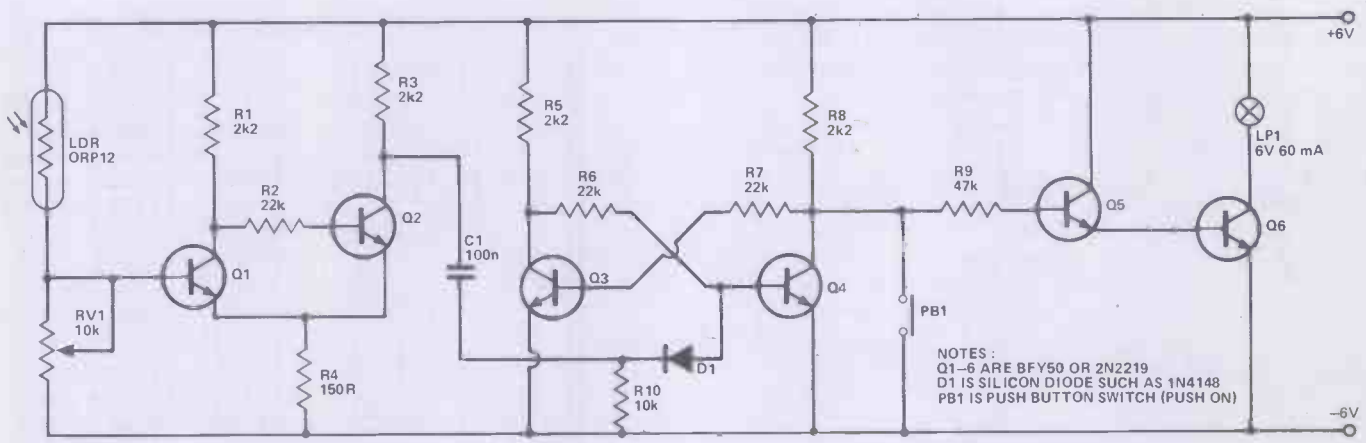


Fig. 5.4 The light alarm circuit. All the transistors are NPN types.

DO-IT-YOURSELF

All you have to do now is to drill the holes for the component lead out wires and remove any burns around your drill holes. It's an advantage if you have a small drill — a carpenter's brace is decidedly useless for this job. Result — one perfect PCB!

Suppose you don't have a Hobbyprint for the particular circuit you have? Don't panic, there are still lots of ways left. One way is to draw the pattern on the copper for yourself. You can use felt-pens which contain acid resistant varnish, or you can use draftsman's indian ink — some of the neatest work I've seen was done with a Rotring pen using indian ink. If you're not wildly keen on that sort of thing you can buy sheets of dry transfer lines, circles, and other shapes, and by cutting the bits you want end up with a transfer pattern which is just the shape of printed circuit you need. You can even buy rolls of thin sticky-tape which is a bit more durable.

Suppose you want to copy a circuit layout which you've used for the Eurobreadboard? Easy enough, you simply use a Eurosolderboard, or as they call it, Euro 2298. The Eurosolderboard is a solderboard which is etched in exactly the same pattern as the Eurobreadboard, and with the same numbering and lettering. Because the pattern is identical, you can use exactly the same layout of components, and to make life easier, the Eurosolderboard is used one way round, with no holes drilled through the tracks.

The idea is that you mount components onto the board in pretty much the same way as you work on the Euroboard. The plain side of the board is placed on the bench, the component lead-wires are tinned, and then the ends of the leads are held touching the correct strips of the board, with the leads point at right angles to the board. A drop of solder will then join the two together, as shown in Fig. 5.2(a), and the job is done. This is the only board you can buy which is lettered and numbered and even if you haven't tried out the circuit on the Eurobreadboard, the Eurosolderboard is a treat to work on.

Now for a really free-range idea. Take a piece of laminate board, a thick straight strip of steel, and a triangular file or a tile-cutter. Using this equipment, you can cut gaps in the sheet to make a board with lots of parallel copper lines. You can then number and letter them, and use them without drilling, just solder the ends of the leads to the board on the same side as the track (Fig. 5.2(b) if anything you get a better soldered joint than when the component wire has had to come through a hole. When you make your own circuit boards this way, you can choose how close you want the tracks to be — your're not stuck with the 2.5 mm or 3.5 mm that all the manufactured strip boards turn out at.

So far, we've had a pretty heavy session of soldering, and it's time now to look at a circuit, just one this month. It's a lot more elaborate than anything you've built so far, though, so you'll have to take your time over the Eurobreadboard layout.

The circuit is of a light-operated alarm — but one which is triggered by a light beam and which has to be reset by a switch. It's the basic circuit of a light-detecting burgular alarm, but for our purpose the alarm bell is replace by a 6 V bulb so that we can see the action without summoning the police and fire-brigade.

The circuit is shown in Fig. 5.4; it uses six transistors, all NPN types, along with the LDR for light detecting and a 6 V 60 mA bulb for indicating what is happening at the output. It's easier to follow if we look at the transistors in pair, because each pair of transistors forms a circuit that we've used before.

Q1 and Q2 form a trigger circuit, the type called the Schmitt trigger. With no volts on the base of Q1, Q2 is kept conducting because of the current from the 6V supply through R1 and R2 into the base of Q2 a bit above zero, somewhere around 0.4 V. The collector voltage of Q2 will be low, around 0.6 V, because Q2 is conducting so easily.

Now because the emitters are connected together, the emitter voltage of Q1 is the same as the emitter voltage of Q2, around 0.4 V. If we keep the base voltage of Q1 low, then, Q1 won't conduct — remember that you need to have the base voltage of an NPN transistor something like 0.5 V higher than its emitter voltage before it conducts. Because the emitter voltage of Q1 is around 0.4 V, we'll need to have the base voltag at around 0.9 V before Q1 can start to conduct.

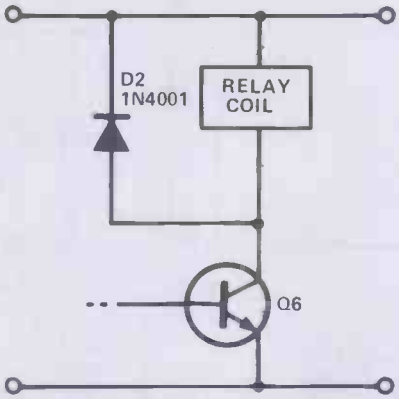


Fig 5.5 Connecting a 6 V 100 mA relay into the alarm circuit.

The base voltage of Q1 depends on how much light hits the LDR though. In darkness, the LDR resistance will be very high, and the voltage across RV1 will be very low, much less than 0.9 V. That makes sure that, in darkness, Q1 stays off and Q2 stays on. When a torch beam hits the LDR, or a light is switched on near it, however, its resistance drops to a much lower value, low enough to hoist the voltage across RV1 (depending on the setting of RV1) to something a bit above 0.9V.

The effect of that will be to switch Q1 on, making Q1 a good conductor, and causing its collector voltage to drop down to about 0.6V. There isn't enough voltage now at the collector of Q1 to keep current flowing into the base of Q2 because the emitter voltage is still at 0.4 V (the current through Q1 ensures that) and we would need something like 0.9 V at the collector of Q1 to switch Q2 on. With the light on, then Q2 stops drawing current.

This 'stop' is pretty sudden, so that the voltage at the collector of Q2 rises suddenly — what does that do to Q3 and Q4? These two are connected as a bistable which has been set by closing K1 and opening it again. When K1 was closed, the voltage at the collector of Q4 dropped to zero, so that no current could flow in Q3. With no current through Q3, the 6 V supply can pass current through R5 and R6 into the base of Q4, keeping this one switched on. When K1 is released, Q3 and Q4 stay as they are, there's no reason for them to change.

Now what happens when light hits the LDR? Nothing! When light hits the LDR it makes the voltage at the collector of Q2 shoot up. Because of C1, the voltage at the cathode of D1 will also shoot up, but D2 doesn't conduct — it's the wrong way round for that, so that C1 just charges quietly through R10, and the base of Q4 is unaffected.

The real action takes place when the lights go off. By this time your actual burglar has decided that the place is safe and there aren't any alarms, but when the light goes off the LDR, the voltage at the collector of Q2 comes down with a thump. Result is a negative voltage at the base of Q4, and that will cause the voltage at the cathode of D1 to shoot down, go negative. This time the diode conducts, the voltage is the right way round, and so the base voltage of Q4 gets pulled down as well, and that shuts off Q4.

Current now flows through R8, R7 into the base of Q3, turning this transistor on. With Q3 conducting well, the voltage at its collector is low, so there's no voltage to keep Q4 on, and Q4 stays off.

There's another effect too. With Q4 off, current through R8 will also flow through R9 into the base of Q5, and so turn on Q6. Q6 will light the bulb Lp 1 which we're using to indicate an alarm. There's nothing to make Q4 switch back again — if the light goes on again, the voltage rise at the collector of Q2 can't switch Q4 on because D1 blocks current flow in this direction. Lp 1 will stay on until SW 1 is operated to stop the 'alarm' and reset the circuit. For a real alarm, you'll want Q 6 to operate a relay, and the circuit is then modified a bit, as shown in Fig. 5.5. It's quite a cunning circuit, because the alarm doesn't sound until the light has been switched on and then off again, and the alarm can't be stopped by switching on again.

Next month — a little bit of theory, something on amplifiers — and the end of the series! **HE**

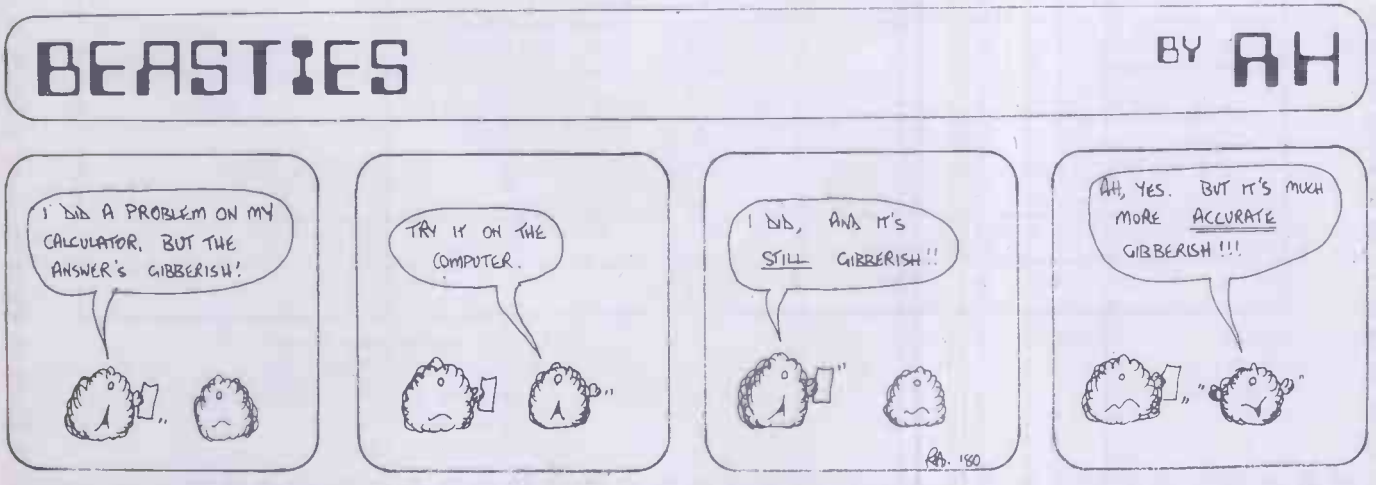
ADDITIONAL SHOPPING LIST FOR PART 5

Resistors:

2 x 2k2
1 x 22 k

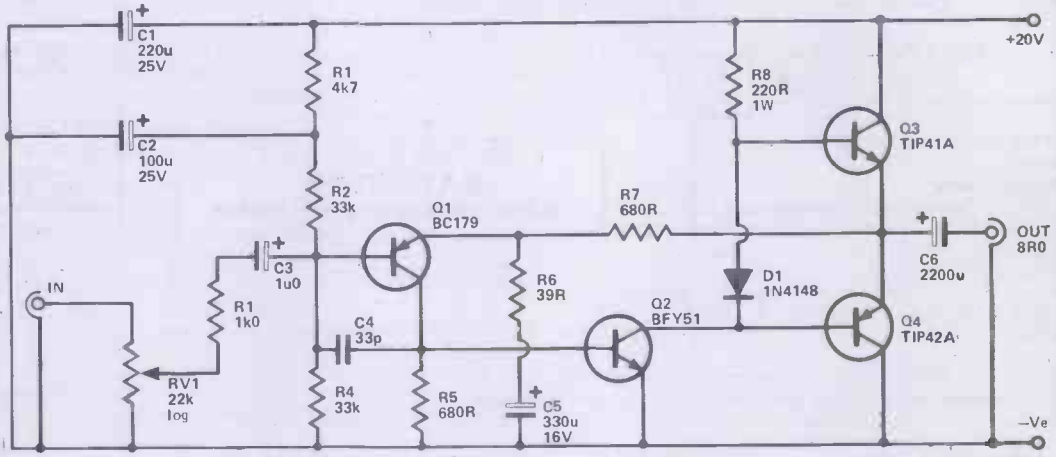
Semiconductors:

3 x Silicon NPN transistors BFY50 or 22N2219 (or equivalents)



Short Circuit

CASSETTE-RADIO BOOSTER



This amplifier was primarily designed for use as a booster to enable output powers of around 4 to 5 watts RMS to be obtained from a radio/cassette unit. Using a portable radio or cassette unit as a signal source will not provide a Hi-Fi results, but using this set up in conjunction with a speaker of reasonable quality and efficiency gives quite good results at low cost. Of course, the amplifier is also suitable for other applications. It has an input sensitivity of approximately 350 mV. RMS into 10k for maximum output, and an output intended to feed an 8 ohm load.

The circuit uses a well known configuration which has common emmiter input stage (Q1) direct coupled to common emitter driver stage (Q2), which is in turn direct coupled to the complementary emitter follower output stage (Q3—Q4). R7 provides virtually 100% negative feedback at DC, giving the circuit approximately unity voltage gain at DC. R1, R2 and R4 form a potential divider which bias the input of the amplifier to about half the supply potential, and the output is also biased to about this level due to the DC unity gain. This bias level gives the optimum unclipped output voltage swing. R1 and C2 filter out any hum or noise which might otherwise be coupled from the supply lines to the input via the bias circuit. R6 and C5 are used to decouple some of the feedback at audio frequencies, and thus give the unit a useful voltage gain at these frequencies.

D1 is used to give a small standing bias to the output transistors, and together with the fairly substantial amount of negative feedback used reduces cross-over distortion to an unnoticeable level. The emitter follower output stage gives the circuit a low output impedance so that the low impedance load can be efficiently driven with the high output currents involved here. Q3 drives the speaker during positive going output excursions while Q4 drives the speaker during negative output excursions. C6 provides DC blocking at the output, and C3 provides the same function at the input. R1 and C4 aid the stability of the circuit. RV1 is a volume control, and in the amplifiers intended application, results will probably be best if the volume control on the cassette radio is set for a fairly high output (but not so high as to cause clipping), and the volume is adjusted using RV1.

The circuit requires a stabilised supply of about 18 to 22 volts, and capable of providing up to 400 mA. Q2 should be fitted with a clip on TO-5 size heatsink. Q3 and Q4 are both fitted with commercially made, finned, bolt-on heatsinks.

AD INDEX

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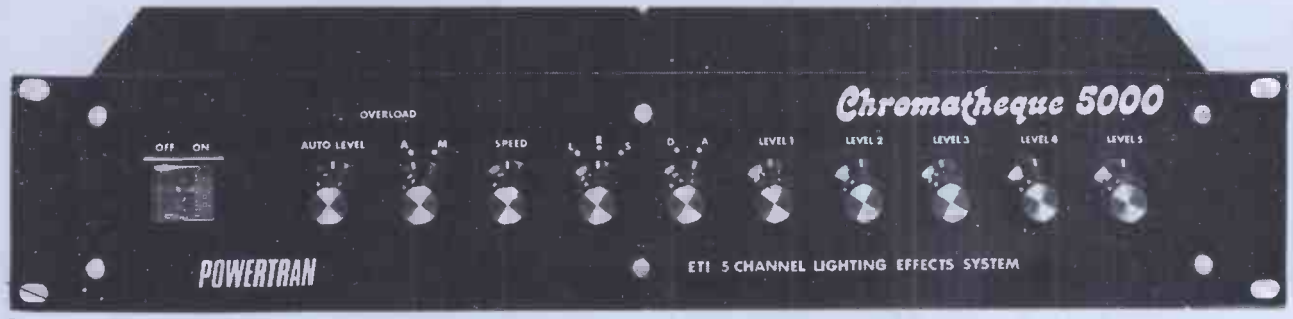
Chromatheque 5000

ETI 5 CHANNEL LIGHTING EFFECTS SYSTEM



Panel size 19.0" x 3.5". Depth 7.3"

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all the lights at a speed dependent upon music level or front panel control or use the internal digital circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward.

Kit includes fully finished metalwork, fibreglass PCB controls, wire, etc. — Complete right down to the last nut and bolt!

COMPLETE KIT ONLY £49.50 + VAT

BLACK HOLE

As Featured in ELECTRONICS TODAY INTERNATIONAL May issue

The BLACK HOLE designed by Tim Orr is a powerful new musical effects device for processing both natural and electronic instruments, offering genuine VIBRATO (pitch modulation) and a CHORUS mode which gives a 'spacey' feel to the sound achieved by delaying the input signal and mixing it back with the original. Notches (HOLES), introduced in the frequency response, move up and down as the time delay is modulated by the chorus sweep generator. An optional double chorus mode allows exciting antiphase effects to be added. The device is floor standing with foot switch controls, LED effect selection indicators, has variable sensitivity input, has high signal/noise ratio obtained by an audio compander and is mains powered — no batteries to change! Like all our kits everything is provided including a highly superior, rugged steel, beautifully finished enclosure.

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MPA 200

100 Watt Mixer-Amplifier

Panel size 19.0" x 3.5". Depth 7.3"

Featured as a constructional article in ETI, the MPA 200 is an exceptionally low priced — but professionally finished — general purpose high power amplifier. It features adaptable input mixer which accepts a wider range of sources such as microphone, guitar, etc. There are wide range tone controls and a master volume control. Mechanically the MPA 200 is simplicity itself with minimal wiring needed making construction very straightforward.

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