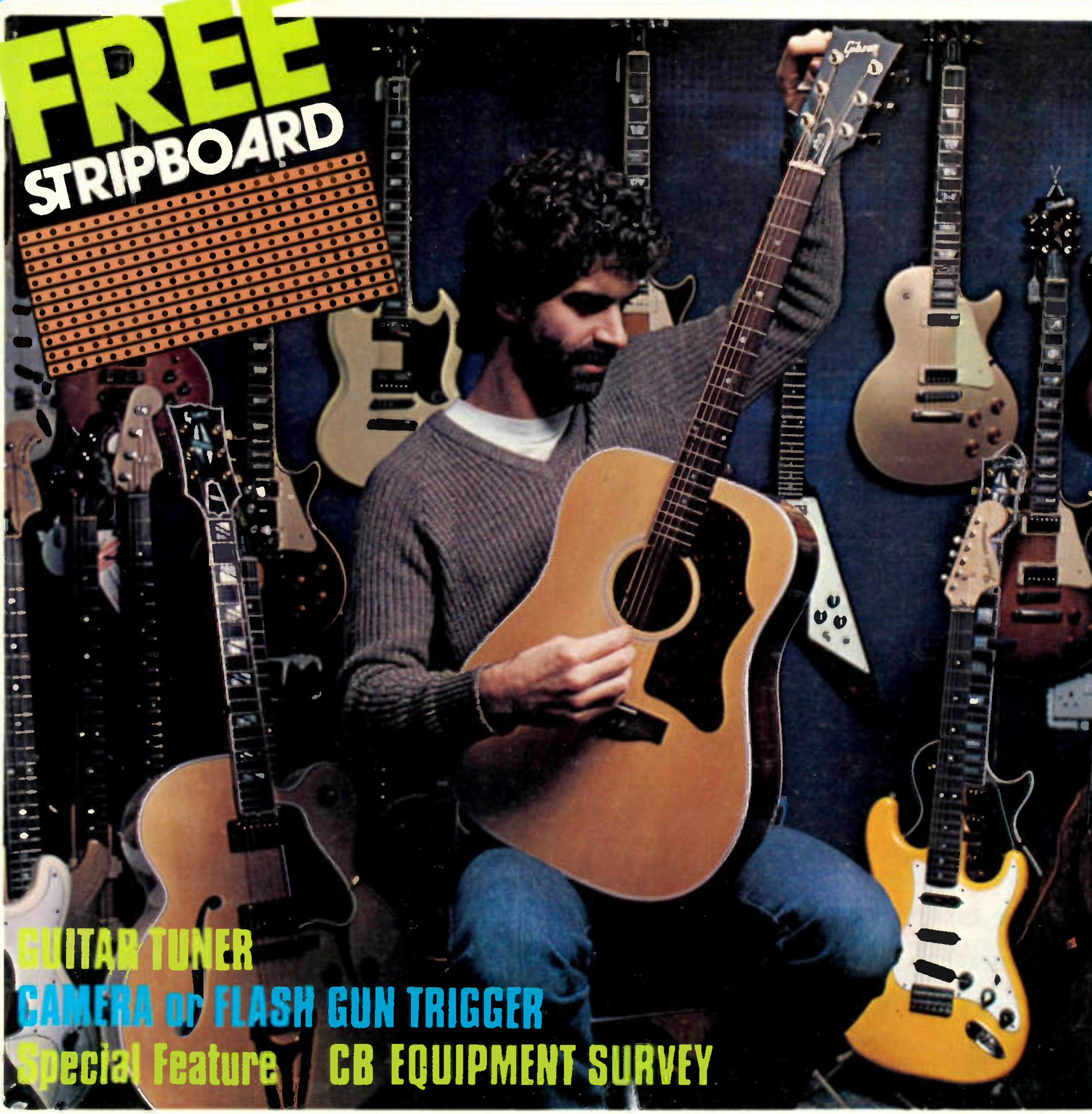
Easy to build projects for everyone

Everyday ELECTRONICS

MARCH 82
70p

FREE STRIPBOARD



GUITAR TUNER

CAMERA or FLASH GUN TRIGGER

Special Feature CB EQUIPMENT SURVEY

Australia $1·23 New Zealand $1·30 Malaysia $4·95 IR 99p (inc. V.A.T.)

ELECTRONIC IGNITION KIT

TOTAL ENERGY DISCHARGE electronic
ignition gives all the well known advantages of the best capacitive discharge systems.

PEAK PERFORMANCE ——— higher output voltage under all conditions.

IMPROVED ECONOMY ———, no loss of ignition performance between services.

FIRES FOULED SPARK PLUGS no other system can better the capacitive discharge system's ability to fire fouled plugs.

ACCURATE TIMING ——— prevents contact wear and arcing by reducing load to a few volts and a fraction of an amp.

SMOOTH PERFORMANCE —— immune to contact bounce and similar effects which can cause loss of power and roughness.

PLUS

SUPER POWER SPARK ——— 3½ times the energy of ordinary capacitive systems – 3½ times the power of inductive systems.

OPTIMUM SPARK DURATION 3 times the duration of ordinary capacitive systems – essential for use on modern cars with weak fuel mixtures.

BETTER STARTING ——— full spark power even with low battery.

CORRECT SPARK POLARITY unlike most ordinary C.D. systems the correct output polarity is maintained to avoid increased stress on the H.T. system and operate all voltage triggered tachometers.

L.E.D. STATIC TIMING LIGHT for accurate setting of the engine's most important adjustment.

LOW RADIO INTERFERENCE fully suppressed supply and absence of inverter 'spikes' on the output reduces interference to a minimal level.

DESIGNED IN RELIABILITY an inherently more reliable circuit combined with top quality components – plus the 'ultimate insurance' of a changeover switch to revert instantly back to standard ignition.

IN KIT FORM
it provides a top performance electronic ignition system at less than half the price of competing ready-built systems. The kit includes everything needed, even a length of solder and a tiny tube of heatsink compound. Detailed easy-to-follow instructions, complete with circuit diagram, are provided – all you need is a small soldering iron and a few basic tools.

AS REVIEWED IN
ELECTRONICS TODAY INTERNATIONAL JUNE '81 ISSUE
and EVERYDAY ELECTRONICS DECEMBER '81 ISSUE

FITS ALL NEGATIVE EARTH VEHICLES,
6 or 12 volt, with or without ballast

OPERATES ALL VOLTAGE IMPULSE TACHOMETERS
Some older current impulse types (Smiths pre '74) require an adaptor – PRICE £2.95

STANDARD CAR KIT £14.85
ASSEMBLED AND TESTED £24.95

TWIN OUTPUT KIT £22.94
For MOTOR CYCLES and CARS with twin ignition systems
ASSEMBLED AND TESTED £34.70

PLUS £1 U.K. P.&P.

Prices include V.A.T.

ELECTRONIZE DESIGN Dept. C

Magnus Road, Wilnecote,
Tamworth. B77 5BY
Phone 0827-281000

BARCLAYCARD
VISA

DIMENSIONS:		
	Length	12.5 cm
	Width	8.9 cm
	Height	4.3 cm
	Lead length	100.0 cm

TECHNICAL DETAILS

The basic function of a spark ignition system is often lost among claims for longer 'burn times' and other marketing fantasies. It is only necessary to consider that, even in a small engine, the burning fuel releases over 5000 times the energy of the spark, to realise that the spark is only a trigger for the combustion. Once the fuel is ignited the spark is insignificant and has no effect on the rate of combustion. The essential function of the spark is to start that combustion as quickly as possible and that requires a high power spark.

The traditional capacitive discharge system has this high power spark but, due to it's very short spark duration and consequential low spark energy, is incompatible with the weak air/fuel mixtures used in modern cars. Because of this most manufacturers have abandoned capacitive discharge in favour of the cheaper inductive system with it's low power but very long duration spark which guarantees that sooner or later the fuel will ignite. However, a spark lasting 2000μS at 2000 rev/min. spans 24 degrees and 'later' could mean the actual fuel ignition point is retarded by this amount.

The solution is a very high power, medium duration, spark generated by the TOTAL ENERGY DISCHARGE system. This gives ignition of the weakest mixtures with the minimum of timing delay and variation for a smooth efficient engine.

SUPER POWER DISCHARGE CIRCUIT A brand new technique prevents energy being reflected back to the storage capacitor, giving 3½ times the spark energy and 3 times the spark duration of ordinary C.D. systems, generating a spark powerful enough to cause rapid ignition of even the weakest fuel mixtures without the ignition delay associated with lower power 'long burn' inductive systems.

HIGH EFFICIENCY INVERTER A high power, regulated inverter provides a 370 volt energy source – powerful enough to store twice the energy of other designs and regulated to provide sufficient output even with a battery down to 4 volts.

PRECISION SPARK TIMING CIRCUIT This circuit removes all unwanted signals caused by contact volt drop, contact shuffle, contact bounce, and external transients which, in many designs, can cause timing errors or damaging un-timed sparks. Only at the correct and precise contact opening is a spark produced. Contact wear is almost eliminated by reducing the contact breaker current to a low level – just sufficient to keep the contacts clean.

TYPICAL SPECIFICATION

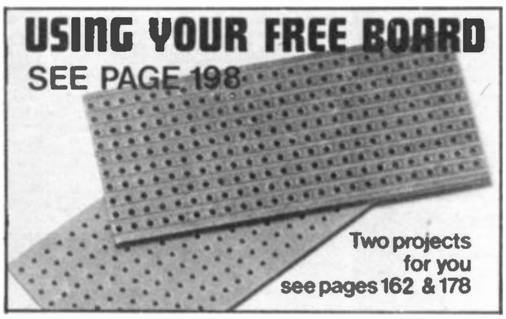
	TOTAL ENERGY DISCHARGE	ORDINARY CAPACITIVE DISCHARGE
SPARK POWER (PEAK)	140 W	90 W
SPARK ENERGY	36 mJ	10 mJ
(STORED ENERGY)	135 mJ	65 mJ
SPARK DURATION	500 μS	160 μS
OUTPUT VOLTAGE (LOAD 50pF EQUIVALENT TO CLEAN PLUGS)	38 KV	26 KV
OUTPUT VOLTAGE (LOAD 50pF + 500 KΩ EQUIVALENT TO DIRTY PLUGS)	26 KV	17 KV
VOLTAGE RISE TIME TO 20 KV (Load 50pF)	25 μS	30 μS

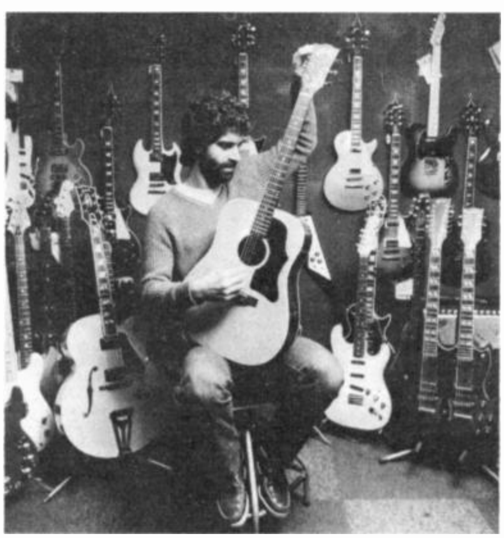
TOTAL ENERGY DISCHARGE should not be confused with low power inductive systems or hybrid so called reactive systems.

Everyday ELECTRONICS

VOL. 11 NO. 3 MARCH 1982

PROJECTS . . . THEORY . . . NEWS . . .
COMMENT . . . POPULAR FEATURES . . .





Guitar Tuner:
We are grateful to Sounds Musical Instruments of 124 Shaftesbury Avenue, London W1V 7DJ for the use of their shop and instruments featured on our front cover. The picture shows Chris Paschalides tuning a guitar.

Our April issue will be published on Friday, March 19. See page 173 for details.

PROJECTS

SERIES

FEATURES

GREENWELD

443D MILLBROOK ROAD, SOUTHAMPTON SO1 0HX
All prices include VAT—just add 50p post. Tel (0703) 772501
Goods normally despatched by return of post

AMAZING! COMPUTER GAMES PCB's FOR PEANUTS!!

A bulk purchase of PCB's from several well known computer games including Battleships, Simon, Logic 5 and Starbird enable us to offer these at incredibly low prices:

'STARBIRD'

Gives realistic engine sounds and flashing laser blasts—accelerating engine noise when module is pointed up, decelerating noise when pointed down. Press contact to see flash and hear blast of lasers shooting. PCB tested and working complete with speaker and batt clip. (needs PP3). PCB size 130 × 60mm. Only £2.95

'SIMON'

The object of this game is to repeat correctly a longer and longer sequence of signals in 3 different games. (instructions included) PCB contains chips, switches, lampholders and lamps, and is tested working, complete with speaker. Needs PP3 and 2 × HP11. PCB size 130 × 130mm Only £3·95.

'COMPUTER BATTLESHIPS'

Probably one of the most popular electronic games on the market. Unfortunately the design makes it imprectical to test the PCB as a working model, although it may well function perfectly. Instead we have tested the sound chip, and sell the board for its component value only (PCB may be chipped or cracked): SN76477 sound IC; TMS1000 u-processor; batt clips, R's, C's etc. Size 160 × 140mm. Only £1·50. Instruction book and circuit 30p extra.

LOGIC 5 PANEL

Tested Logic 5 now sold out—but we have some PCB's with 10 LED's and chip on, but no keyboard. Not tested. 50p.

'MICROVISION' Cartridges

These are a small PCB with a microprocessor chip, designed to plug in to the microvision console. Only snag is, we don't have any consoles!! However, they can be used as an oscillator with 4 different freq. outputs simply by connecting a battery and speaker. Tested and working (as an osc) with pin out data. PCB size 72 × 60 mm. only 25p each!

RELAY/TRIAC PANEL

Z537 PCB 100 × 75mm containing a wealth of components: 2 × 12V DPCO min relays, 2 × 47μF 16V tants SC146E 10A 500V triac, C122D 8A 400V SCR, 555 timer, 10 × 1N4001 diodes, 2N5061 SCR, 2 × 3mm LED'S 3 × 2N3704, R's & C's—Amazing value—if bought seperately, parts would cost around £8!! Our price for the panel, just £2·00.

200 ELECTROLYTICS £4·00

K524 Large variety of values/voltages, mostly cropped leads for PCB mntg. 1-1000uF, 10-63V. All new full spec components, not chuck-outs!! 200 £4, 1000 £17·50

COMPONENT PACKS

K503 150 wirewound resistors from 1W to 12W, with a good range of values. £1·75.
K506 20 assorted potentiometers, all types including single, ganged, rotary and slider. £1·70.
K511 200 small value poly, mica, ceramic caps from a few pF to ·02μF. Excellent variety. £1·20.
K514 100 silver mica caps from 5pF to a few thousand pF. Tolerances from 1% to 10%. £2·00.
K520 Switch pack—20 different, rocker, slide, rotary, toggle, push, micro, etc. Only £2·00.
K521 Heatshrink pack—5 diff. sizes, each 200mm. 50p.

1000 RESISTORS £2·50

We've just purchased another 5 million preformed resistors, and can make a similar offer to that made two years ago, at the same price!!! K523—1000 mixed ⅛ and ¼W 5% carbon film resistors, preformed for PCB mntg. Enormous range of preferred values. 1000 for £2·50; 5000 £10; 20k £36.

PANELS

Z521 Panel with 16236 (2N3442) on small heat sink, 2N2223 dual transistor, 2 BC108, diodes, caps, resistors, etc. 60p.
Z527 Reed relay panel—contains 2 × 6V reeds, 6 × 2S030 or 2S230, 6 × 400V rects + Rs. 50p.
Z529 Pack of ex-computer panels containing 74 series ICs. Lots of different gates and complex logic. All ICs are marked with type no. or code for which an identification sheet is supplied. 20 ICs £1·00; 100 ICs £4·00.
A504 Black case 50 × 50 × 78mm with octal base. PCB inside has 24V reed relay, 200V 7A SCR, 4 × 5A 200V rects, etc. 60p.

SWITCH BARGAIN

Push-on, push-off "table lamp" type, rated 2A 250V ac. 10p each, 15 for £1, 100 for £5.

TEACH-IN 82

Full set of parts as specified by "EE". All new goods, despatched by return of post.

★ All parts for the "MINILAB" only £17·50 + £1 post.

★ All components for first 6 parts of "TEACH-IN '82" £7·50 + 60p post.

★ All components for second 6 parts of "TEACH-IN '82" £4·00 + 40p post.

BUY ALL THREE SETS FOR £29 inc post.

FREE component identification Chart!!

FREE piece of Veroboard!!

Reprints of articles: 30p per part + 30p for Tutor Deck info. (only supplied with orders for Teach-In).

CAPACITOR BARGAINS

2200μF 100V cans 77 × 36mm dia. 75p; 10/£5·50; 220μF 10V axial 5p; 100 £2·30; 1000 £16; 400+100μF 275V 102 × 44mm dia. 75p; 10 £5·50; 200μF 350V, 100 + 100 + 50μF 300V can 75 × 44mm dia 40p; 10/£3; 100/£20 100uF 25V Axial £3/100.
0·33uF 50V rad. £1·50/100, £12/1000.
0·47uF 50V rad. £1·50/100, £12/1000. } elec
22uF 50V rad £3/100, £24/1000.

1W AMP PANELS

A011 Compact audio amp intended for record player on panel 95 × 65mm including vol. control and switch, complete with knobs. Apart from amp circuitry built around LM380N or TBA820M, there is a speed control circuit using 5 transistors. 9V operation, connexion data supplied. ONLY £1·50.

TOROIDAL TRANSFORMER

110mm dia. × 40mm deep. 110/240V pri., Sec. 18V 4A, 6·3V 1A, 240V 0·3A. Ideal for scopes, monitors, VDU's, etc. Reduced to £5·95.

OP-AMP PSU KIT

A198 All parts + instructions to make a 50mA +15, 0, —15V supply from mains input. Only £1·95.

COPPER CLAD BOARD

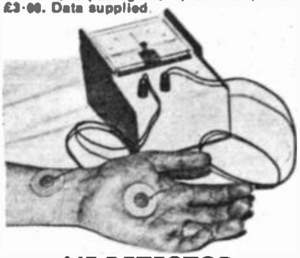
K522 All pieces too small for our etching kits. Mostly double sided fibreglass. 250gm (approx. 110 sq ins) for just £1·00.

MIXED LED PACK

All new full spec by Micro, Fairchild, etc. Red, Yellow, Green, Amber, Clear, 3mm & 5mm. Pack of 50 asstd £3·95; 250 £15.

FILAMENT DISPLAYS

Z653 7 seg display 12·5mm high. Ideal for TTL operation, taking 5V 8mA per seg. Std 14 OIL package. Only £1 each, 4 for £3·00. Data supplied.



LIE DETECTOR

Not a toy, this precision instrument was originally part of an "Open University" course, used to measure a change in emotional balance, or as a lie detector. Full details of how to use it are given, and a circuit diagram. Supplied complete with probes, leads and conductive jelly. Needs 2 4½V batts. Overall size 155 × 100 × 100mm. Only £7·95—worth that for the case and meter alone!!

CHEAP CHIPS

76477 Sound IC £1·25.
2102A RAM 8 for £3.
MK4027 shift reg. 8 for £6.
uA78MG + volt reg £1·00.
uA79MG — volt reg £1·20.

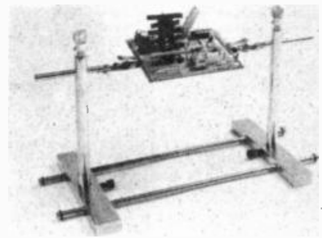
ELECTRO-DIAL

Electrical combination lock—for maximum security—pick proof. 1 million combinations!! Dial is turned to the right to one number, left to a second number, then right again to a third number. Only when this has been completed in the correct sequence will the electrical contacts close. These can be used to operate a relay or solenoid. Overall dia. 65mm × 60mm deep. Only £8·95.
Also available *without* combination—only £3·95.

PCB HOLDERS

- PCB's may be rotated through 360 degrees and locked at any angle
- simple adjustment for different board sizes
- foam pad available enabling a number of components to be inserted prior to soldering

CNC 6

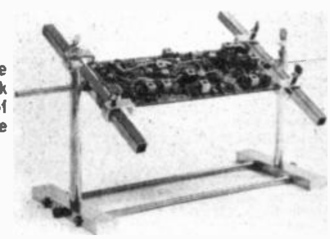


PCB Capacity: 10" × 7"

PCB's held by spring clips which also allow the holder to be used as a small soldering jig.

PRICE £13·80 INC. VAT

CNC 9



PCB Capacity: 8" × 8"

PCB's held by adjustable Vee Clamps which eliminate the risk of damage to the face sides of the PCB and allow a high degree of accessibility.

PRICE £15·95 INC. VAT

FOAM PAD

Size: 8" × 8" Clips onto Holder. **PRICE £5·50 INC. VAT**

AVAILABLE DIRECT FROM THE MANUFACTURER. PLEASE ADD £1·50 TO COVER POST AND PACKING.

PLEASE ALLOW 14 DAYS FOR DELIVERY

CARLTON NICHOL & CO. LTD.,

GOLDKEY INDUSTRIAL ESTATE, KELVEDON, ESSEX

LIMITED OFFER!

As an introduction to CRICKLEWOOD ELECTRONICS LTD., (Marshall's Old Shop), 40 Cricklewood Broadway, London NW2 3ET tel: 01 452 0161 *Whilst stocks last and only if accompanied by this Ad.*

DESOLDERING TOOL

Now every one can afford one of these superb, blue anodised aluminium high pressure hand desoldering tools at nearly half our normal price.
Normal Price £6·50 + VAT with this ad £3·85 + VAT.
Spare Teflon screw-in noses 75p + VAT.

JAPANESE TRANSISTORS May not be as hard to replace as you think. Phone our equivalent service on 01 452 0161 (everyday except Wednesdays) or write. We have thousands of Transistors, ICs, LEDS in stock, as well as every conceivable type of component—Why not make CRICKLEWOOD ELECTRONICS your personal ELECTRONICS HOBBY CENTRE? We have the goods!

Now you need no longer grope in the dark. For a miniature price you can watch those volts move! See those resistors jump to life!

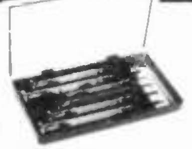
THE MIGHTY MINI MULTI-TESTER 2,000 ohms per volt. DC & AC Voltage ranges: 10v, 50v, 250v, 1000v. DC current ranges 100mA. Resistance ohms × 10, ohms × 100db from −10db to +22db. Mirror arc scale, overload protected, complete with battery, test leads & instructions. Usual price £8·65 + VAT: with this Ad: £4·95 + VAT.

ORDER FORM
Name ....
Address ....
....
.... Desoldering tools @ £3·85 = £..................
.... Spare Teflon noses @ ·75 = £..................
.... Mighty Mini Testers @ £4·95 = £..................
Postage, packing and insurance @ 60p per one device 25p for each additional device £..................
Sub total £..................
Add 15% VAT £..................
I enclose cheque no/P.O. no. .... £..................
Alternatively please credit my VISA/ACCESS no. ....
Signature ....
This offer applies to UK only. Please allow 7-10 days delivery. Overseas customers please do not add VAT but allow enough to cover postage.
TRADE ENQUIRIES WELCOME.

CRICKLEWOOD ELECTRONICS LTD.

40 Cricklewood Broadway, London NW2 3ET tel 01 452 0161

BI-PAK BARGAINS



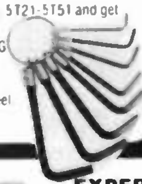
5T21 **SCREWDRIVER SET**
6 precision screwdrivers in hinged plastic case Sizes – 0.8, 1.4, 2, 2.4, 2.9 and 3.8mm **£1.75**

5T31 **NUT DRIVER SET**
5 precision nut drivers in hinged plastic case With turning rod Sizes – 3, 3.5, 4, 4.5 and 5mm **£1.75**

5T41 **TOOL SET**
5 precision instruments in hinged plastic case Crosspoint (Phillips) screwdrivers – H0 and H1 Hex key wrenches – 1.5, 2 and 2.5mm **£1.75**

5T51 **WRENCH SET**
5 precision wrenches in hinged plastic case Sizes – 4, 4.5, 5, 5.5 and 6mm **£1.75**

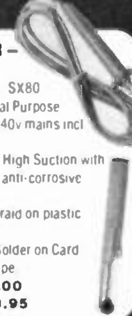
BUY ALL FOUR SETS 5T21-5T51 and get HEX KEY SET **FREE**



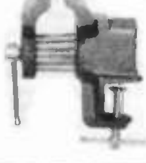
HEX KEY SET ON RING Sizes 1.5, 2, 2.5, 3, 4, 5, 5.5 and 6mm Made of hardened steel HX/1 **£1.25**

BI-PAK PCB ETCHANT AND DRILL KIT
Complete PCB Kit comprises
1 Expo Mini Drill 10,000RPM 12v DC incl 3 collets & 1 x 1mm Twist bit
1 Sheet PCB Transfers 210mm x 150mm
1 Etch Resist Pen
1 ½lb pack FERRIC CHLORIDE crystals
3 sheets copper clad board
2 sheets Fibreglass copper clad board
Full instructions for making your own PCB boards
Retail Value over **£15.00**
OUR BI-PAK SPECIAL KIT PRICE **£9.75**
ORDER NO SX81

BI-PAK SOLDER – DESOLDER KIT
Kit comprises ORDER NO SX80
1 High Quality 40 watt General Purpose Lightweight Soldering Iron 240v mains incl 3/16" (4.7mm) bit
1 Quality Desoldering pump High Suction with automatic ejection Knurled anti-corrosive casing and teflon nozzle
1.5 metres of De-soldering braid on plastic dispenser
2 yds (1.83m) Resin Cored Solder on Card
1 Heat Shunt tool tweezer Type
Total Retail Value over **£12.00**
OUR SPECIAL KIT PRICE **£8.95**



MINI VICE
This small cast iron quality made vice will clamp on to any bench or table having a max thickness of 1⅛". The 2½" jaws open to max of 1⅝". Approx size 80 x 120 x 66mm Bi-Pak's Mini Vice at a Mini Price only
£2.
ORDER NO SX82

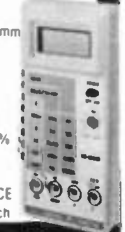


The Third and Fourth Hand...
.... you always need but have never got 'until now'. This helpful unit with Rod mounted horizontally on Heavy Base. Crocodile clips attached to rod ends. Six ball & socket joints give infinite variation and positions through 360° also available attached to Rod a 2½ diam magnifier giving 2.5 x magnification. Helping hand unit available with or without magnifier. Our Price with magnifier as illustrated ORDER NO T402 **£5.50**
Without magnifier ORDER NO T400 **£4.75**

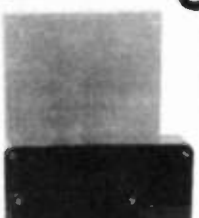
BRAND NEW LCD DISPLAY MULTITESTER.
RE 188m
LCD 10 MEGOHM INPUT IMPEDANCE
*3½ digit *16 ranges plus hFE test facility for PNP and NPN transistors *Auto zero, auto polarity *Single-handed pushbutton operation *Over range indication *12.5mm (½-inch) large LCD readout *Diode check *Fuse circuit protection *Test leads battery and instructions included

Max indication	1999 or – 1999
Polarity indication	Negative only Positive readings appear without + sign
Input impedance	10 Megohms
Zero adjust	Automatic
Sampling time	250 milliseconds
Temperature range	– 5°C to 50°C
Power Supply	1 x PP3 or equivalent 9V battery
Consumption	20mW
Size	155 x 88 x 31mm

RANGES
DC Voltage 0-200mV 0-2-20-200-1000V Acc 0.8%
AC Voltage 0-200-1000V Acc 1.2% DC Current 0-200uA 0-2-20-200mA 0-10A Acc 1.2%
Resistance 0-2-20-200K ohms 0-2 Megohms Acc 1%
BI-PAK VERY LOWEST POSS PRICE **£35.00** each



EXPERIMENTOR BOXES – ALUMINIUM – PLASTIC



ALUMINIUM BOXES
Made with Bright Aluminium folded construction with deep lid and screws

SIZE "L	W	H	Order No	Price
5¼	2¼	1½	159	**83p**
4	2¼	1½	161	**83p**
4	2½	2	163	**83p**
3	2	1	164	**57p**
8	6	3	166	**£1.68**
6	4	2	167	**£1.12**

Plastic Boxes
Coloured Black Close fitting Flanged Lid fixing screws into brass bushes

SIZE "L	W	H	Order No	Price
4	2	1	141	**£1.00**
4¾	2½	1½	143	**£1.30**
6	3¼	2	144	**£1.50**
Plastic as above but with aluminium top panel				
4	2¾	1	146	**£1.40**
Plastic sloping front				
5½	4¼	2¼ slope to 1½	148	**£2.14**

All measurements for boxes are shown in inches L = Length W = Width H = Height

MW398 **NI-CAD CHARGER**
Universal Ni-Cad battery charger All plastic case with lift up lid Charge/Test switch LED indicators at each of the five charging points

Charges –	Power –
PP3 (9V)	220-240V AC
U12 (1.5V penlite)	Dims –
U11 (1.5V "C")	210 x 100 x 50mm
U2 (1.5V "D")	**£6.95**

POWER SUPPLY OUR PRICE **£3.25**
Power supply fits directly into 13 amp socket Fused for safety Polarity reversing socket Voltage switch Lead with multi plug Input – 240V AC 50HZ Output –3, 4.5, 6, 7.5, 9 & 12V DC Rating – 300 ma MW88

"IRRESISTABLE RESISTOR BARGAINS"

Pak No.	Qty*	Description	Price
SX10	400	Mixed "All Type" Resistors	£1
SX11	400	Pre-formed ½ watt Carbon Resistors	£1
SX12	200	⅓ watt Carbon Resistors	£1
SX13	200	¼ watt Carbon Resistors	£1
SX14	150	½ watt Resistors 22 ohm-2m2 Mixed	£1
SX15	100	1 and 2 watt Resistors 22 ohm-2m2 Mixed	£1

Paks SX12-15 contain a range of Carbon Film Resistors of assorted values from 22 ohms to 2.2 meg. Save pounds on these resistor paks and have a full range to cover your projects.
*Quantities approximate count by weight

"CAPABLE CAPACITOR PAKS"

Pak No.	Qty*	Description	Price
SX16	250	Capacitors Mixed Types	£1
SX17	200	Ceramic Capacitors Miniature Mixed	£1
SX18	100	Mixed Ceramics 1pf-.5 pf	£1
SX19	100	Mixed Ceramics 68pf-0.5mf	£1
SX20	100	Assorted Polyester/Polystyrene Capacitors	£1
SX21	60	Mixed C280 type capacitors metal foil	£1
SX22	100	Electrolytics, all sorts	£1
SX23	50	Quality Electrolytics 50-1000mf	£1
SX24	20	Tantalum Beads, mixed	£1

*Quantities approximate count by weight

AUDIO PLUGS, SOCKETS AND ACCESSORIES
25 pieces of Audio Plugs Sockets and Connectors to include DIN 180° 240° Inline 3-6 Pin Speakers Phono Jack Stereo and Mono etc etc Valued at well over £3 normal Order No SX25 Our Price £1.50 per pak Guaranteed to save you money

SX26 3 Prs of 6 pin 240 DIN Plugs and Chassis Sockets
SX38 100 Silicon NPN Transistors—all perfect Coded mixed types with data and eqvt sheet No rejects Real value **50p** **£2.50**
SX39 100 Silicon PNP Transistors—all perfect Coded mixed types with data and eqvt sheet No rejects Fantastic value **£2.50**

TRIACS – PLASTIC

4 AMP – 400v – T0202 – TAG 136G			
1 OFF	10 OFF	50 OFF	100 OFF
40p	£3.75	£17.50	£30.00
8 AMP 400v – T0220 – TAG 425			
60p	£5.75	£27.50	£50.00

Everyday Electronics
Teach-in '81
Kit 1 £15.65 (Kits 1 & 2 combined
Kit 2 £ 8.94 price £23.00)
All prices include V.A.T. & postage.

IC SOCKETS
The lowest price ever.
The more you buy the cheaper they come!

Pin	10 off	50 off	100 off
8	75p	£3.00	£5
14	80p	£3.25	£5.50
16	80p	£3.25	£5.50

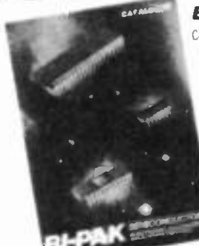
VOLTAGE REGULATORS T0220

Positive +	Negative +
7805 – 50p	7905 – 55p
7812 – 50p	7912 – 55p
7815 – 50p	7915 – 55p
7824 – 50p	7924 – 55p

(please state voltage required)
Other types LM340K – 6 volt – 18 volt – 24 volt
T03 – 40p UA723 – 14 pin DIL – 40p

MOTOROLA PIEZO ELECTRIC TWEETER
Maximum Ratings
25 volts rms which is equal to
200 watts across 4 ohms
100 watts across 8 ohms
50 watts across 16 ohms
BI-PAK SPECIAL OFFER PRICE **£4.65**
ORDER NO 1907

DOME TWEETER
Dome tweeter for systems up to 50w
Impedance 8 ohms
Frequency Response 2000-20,000Hz
Dims 98mm diam x 31mm deep
Our Price **£2.86** DMT200



BI-PAK's COMPLETELY NEW CATALOGUE
Completely re-designed Full of the type of components you require plus some very interesting ones you will soon be using and of course the largest range of semiconductors for the Amateur and Professional you could hope to find
There are no wasted pages of useless information so often included in Catalogues published nowadays Just solid facts i.e. price description and individual features of what we have available But remember Bi-Pak's policy has always been to sell quality components at competitive prices and THAT WE STILL DO.
BI-PAK'S COMPLETELY NEW CATALOGUE is now available to you. You will be amazed how much you can save when you shop for Electronic Components with a Bi-Pak Catalogue Have one by you all the time—it pays to buy BI-PAK
To receive your copy send **75p** plus 25p p&p

Guarantee Satisfaction or your money back has always been BI-PAK's GUARANTEE and it still is. All these late items are in stock in quantity and we will despatch in the same day as your order is received

BI-PAK

Send your orders to Dept **EE 3** BI-PAK PO BOX 6 WARE HERTS.
SHOP AT 3 BALDOCK ST. WARE HERTS
TERMS CASH WITH ORDER, SAME DAY DESPATCH, ACCESS, BARCLAYCARD ALSO ACCEPTED. TEL (0920) 3182 GIRO 388 7006
ADD 15% VAT AND 50p PER ORDER POSTAGE AND PACKING

Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class Mail.
Remember you must add VAT at 15% to your order Total. Postage add 50p per Total order.

VOL. 11 NO. 3 MARCH 1982

Everyday ELECTRONICS

Editor
F. E. BENNETT

Assistant Editor
B. W. TERRELL B.Sc.

Production Editor
D. G. BARRINGTON

Technical Sub-Editor
G. P. HODGSON

Art Editor
R. F. PALMER

Assistant Art Editor
P. A. LOATES

Technical Illustrator
D. J. GOODING Tech. (CEI)

Secretary
JACQUELINE DOIDGE

Editorial Offices
KINGS REACH TOWER
STAMFORD STREET
LONDON SE1 9LS
Phone: 01-261 6873

A MATTER OF INTEREST

Popular interest in electronics has grown steadily over the past years. It's a true, if trite, expression—but what do we mean by *interest*? Well, there is the superficial interest arising from a general awareness that electronics is responsible somehow or another for much of the improved standard of life now enjoyed by most people. Then there is the more profound interest that extends beyond the fascia and the user controls, and involves a technical appreciation of the circuitry and components that make the whole thing tick. Finally there is the really dedicated interest that manifests itself through active participation in designing and building electronic units and equipment.

A noteworthy point is that, of the many thousands of people who come within the second and third categories just defined, the greater number will be largely self-taught in electronic matters and will have no professional involvement with this technology.

To readers of this magazine this is not likely to be a startling revelation. Yet these facts are worth advertising, especially today when hobbies assume greater importance than perhaps ever before, because of social/economic changes affecting people in all kinds of industry and business. Unwished-for leisure unfortunately is in abundance for three million fellow citizens. There are others also with time on their hands, including disabled persons and those in retirement, to consider.

It is clear that hobbies like electronics are no longer to be seen merely as pleasurable pastimes to while away spare time; they now also serve an essential and more serious purpose in keeping minds and hands occupied in the absence of full time employment. (There are gloomy predictions that the shortage of jobs will become a permanent feature of our society in the years ahead.)

Considered in this context, the attractiveness of electronics soon becomes obvious: convenient and not unduly demanding in outlay (electronic components must represent one of the best values for money these days), with an endless variety of useful projects that can be built. But most important of all for some of those victims of current economic policies will be the basic training for a new career that can be derived from a "pastime" such as this.

Fred Bennett.

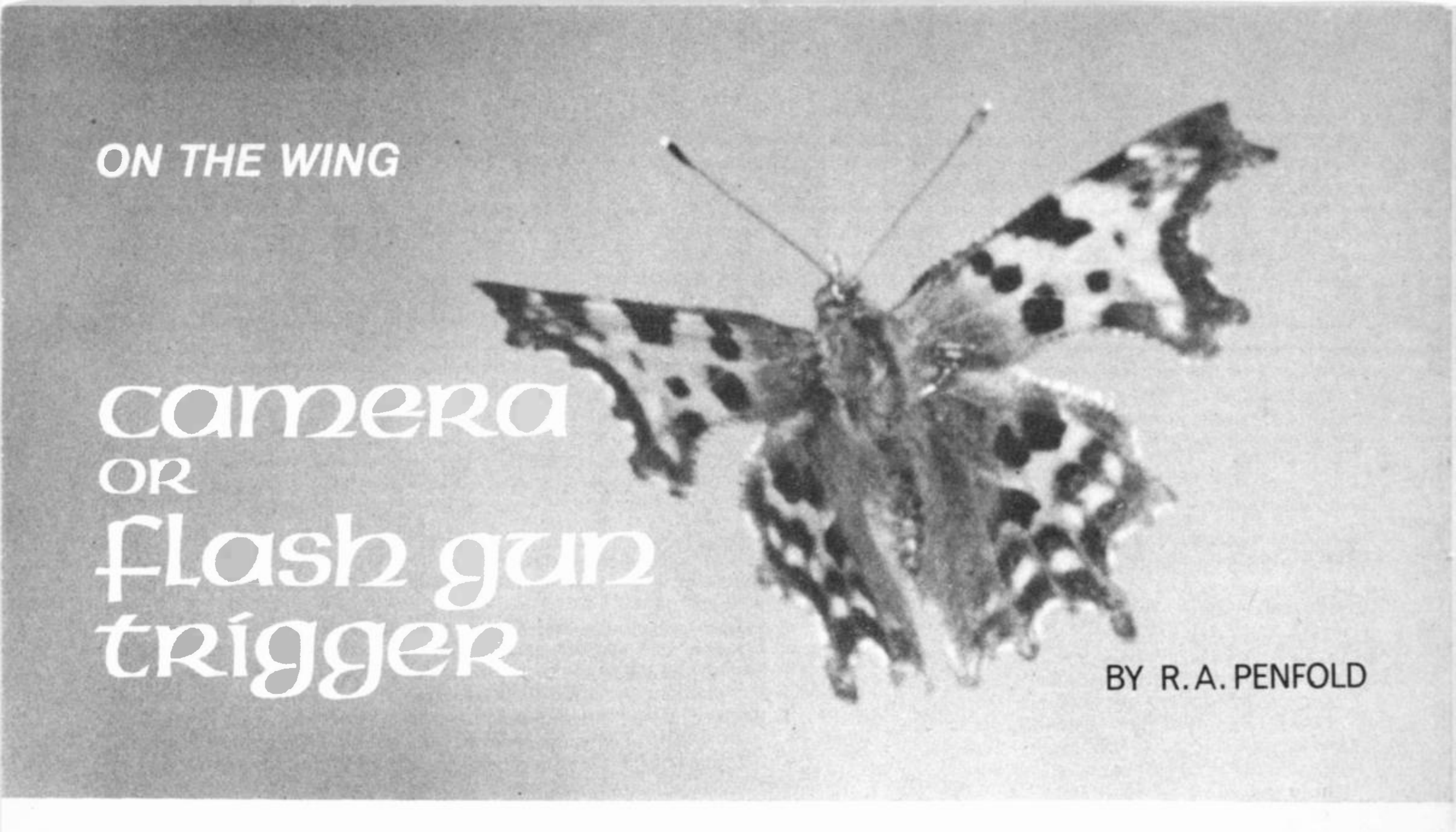
Advertisement Manager
R. SMITH
Phone: 01-261 6671

Representative
R. WILLETT
Phone: 01-261 6865

Classified Supervisor
B. BLAKE
Phone: 01-261 5897

Make-Up and Copy Department
Phone: 01-261 6615

Advertisement Offices
KINGS REACH TOWER
STAMFORD STREET
LONDON SE1 9LS



ON THE WING

camera or flash gun trigger

BY R. A. PENFOLD

WITH some types of action photography it is impossible for a human operator to act fast enough to take a satisfactory photograph. It is then necessary to use some form of automatic triggering of the camera or a flashgun in order to obtain a fast enough response time to take the photograph before the subject moves out of frame.

A sound triggered flash unit is a common example of an automatic triggering device of this type, and a number of designs have been published in the technical press in the past. This is not the only type of automatic trigger though, and sound triggered flash units are unsuitable for certain types of action photography.

For example, a sound triggered flash is unlikely to be usable for photographs of insects or birds in flight. This type of action photograph is normally taken with the aid of a broken light beam trigger unit, and a trigger of this type can also be used for other types of action photography.

BROKEN LIGHT BEAM

The trigger unit described in this article is of the broken light beam type, and it can be used to operate either a flashgun or a camera. Of course, the camera can only be triggered by the unit if it is a type having an electro-magnetic shutter release for which a suitable trigger cord is available, or if the camera is equipped with an automatic winder or motor drive which has a remote control socket.

The prototype has been tested with a Minolta XD7 (which is triggered directly) and with a Pentax LX (which is operated via the autowinder) and worked perfectly with both of these. Automatic operation is possible with most modern S.L.R. cameras, and the unit should function properly with any that have this facility. It should also work properly with any normal electronic flashgun.

The accompanying photographs give some examples of the type of shot that can be taken with the aid of this unit.

BLOCK DIAGRAM

Fig. 1 shows the basic arrangement of the trigger unit in block diagram form, and as can be seen from this there are actually two units in the system; the transmitter and the receiver. The unit uses a pulsed infrared beam rather than a steady visible light beam, and the only reason for employing this system is that it gives improved reliability.

A d.c. coupled visible light system would be susceptible to spurious triggering due to changes in ambient light level and shadows falling on the sensor, even if precautions were taken against this. A steady beam with an a.c. coupled receiver seems to be just as susceptible to spurious operation as a simple d.c. circuit.

TRANSMITTER OSCILLATOR

The system finally adopted has proved to be 100 per cent reliable, and attempts to induce spurious operation proved to be fruitless. The

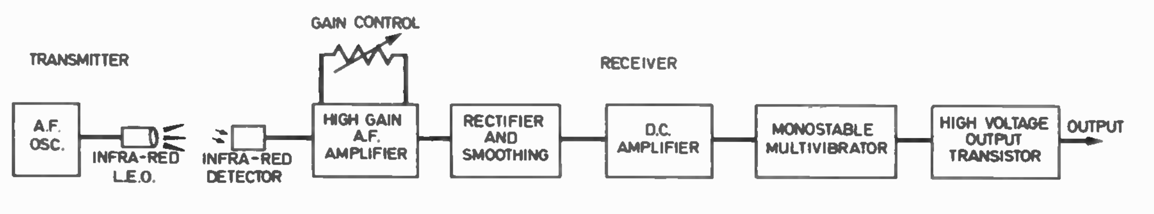


Fig. 1. Block diagram of the Camera/Flash Trigger.

transmitter is just an oscillator operating at a frequency of a few kilohertz and driving an infra-red l.e.d. so that the beam of light from the transmitter is actually a series of brief infra-red pulses.

Although of no practical significance, it should perhaps be pointed out that there is no visible light output from the l.e.d. because infra-red radiation cannot be seen by human vision, and there is no significant output from an infra-red l.e.d. at the shorter wavelengths of the visible light spectrum.

RECEIVER

The receiver uses an infra-red photodiode to detect the infra-red pulses, and as the diode has a built-in infra-red filter it does not respond to other types of light.

The voltage pulses produced by the photodiode circuit are quite small, being probably no more than a few millivolts even if the system is used at short range. A high gain audio amplifier is therefore used to boost these pulses to a few volts peak to peak, and they are then fed to a rectifier and smoothing circuit which produces a strong d.c. signal.

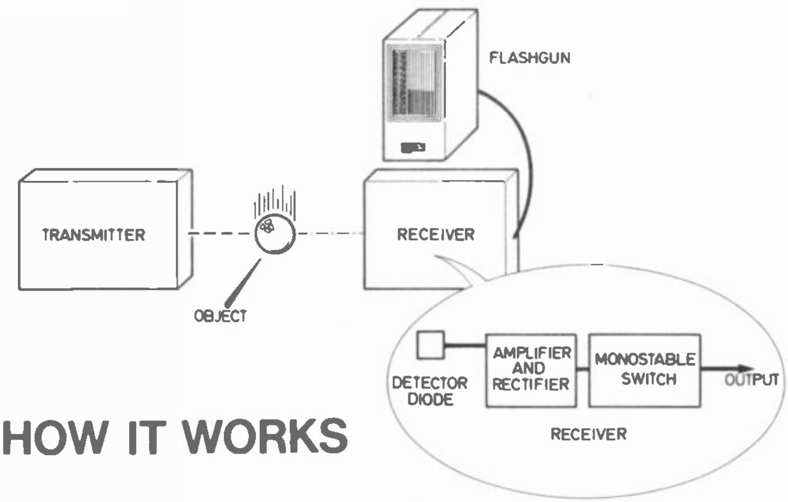
This signal is used to operate a monostable multivibrator via a d.c. amplifier stage, and the monostable is normally held in the off state.

If the beam is momentarily broken a number of pulses will be prevented from reaching the receiver, causing the d.c. output of the smoothing circuit to rapidly decay and trigger the monostable. The monostable then produces an output pulse of a little over one second in duration which is used to switch on a high voltage power transistor which operates the camera or flashgun.

POWER TRANSISTOR

It is necessary to use a high voltage power device at the output since the unit will need to handle a high voltage when used with an electronic flashgun, and fairly high currents when operating a camera via an autowinder or motor drive. The output pulse of the monostable is longer than is absolutely necessary, but the relatively long output pulse length helps to avoid unwanted multiple operations of the flashgun or camera (especially when photographing insects which sometimes fly along the beam).

A gain control is fitted in the amplifier section of the receiver, and this is adjusted so that the infra-red beam produces a signal which only just prevents the unit from triggering under normal conditions. This helps to give the unit a fast response time and enables quite small and fast-moving objects to trigger the receiver.



HOW IT WORKS

The transmitter merely consists of an oscillator driving an infra-red l.e.d. so that a rapid series of brief infra-pulses are produced. These pulses are normally picked-up by a detector diode at the receiver which converts the received infra-red pulses into minute voltage pulses. An amplifier and rectifier circuit processes this signal to produce a strong d.c. bias which normally holds a monostable circuit in the off state.

If the infra-red beam is momentarily broken (as by a passing object) the pulse signal is briefly lost, and the d.c. bias rapidly subsides so that the receiver monostable is triggered. This operates the flashgun (or camera) via a switching transistor, and automatically takes a photograph of the object which broke the beam.

TRANSMITTER CIRCUIT

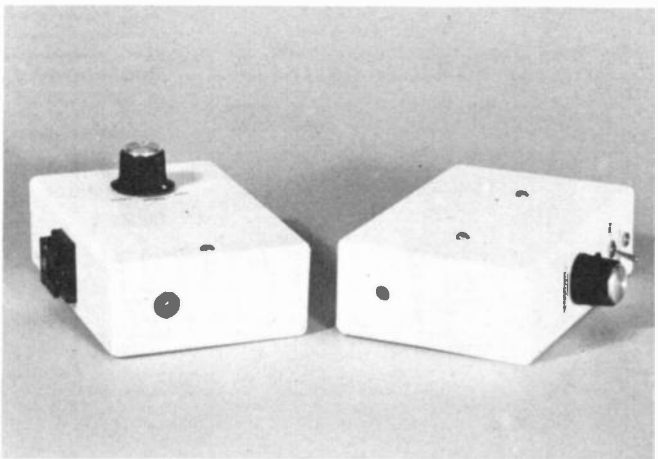
The circuit of the transmitter is shown in Fig. 2, and this part of the unit is based on the popular 555 timer device used in the astable mode. This device is ideal for this application since it has a fairly high output current capability and can provide the required rectangular pulse output waveform.

The values of R1 and R2 set the mark space ratio of the output signal at about 5·5 to one, so that infra-red l.e.d. D1 is switched off for more than 80 per cent of the time, and switched on for less than 20 per cent of the time. This enables strong pulses of current to be applied to D1 but keeps the current consumption of the circuit down to a reasonable level.

HIGH/LOW POWER

S1 is the on/off switch, and it additionally enables two output powers to be obtained. In the "high" position R4 is switched in as the current limiting resistor for D1, and this gives an l.e.d. current of over 100mA and an average current consumption of

The completed transmitter and receiver.
The mounting adaptor can be seen on the side of the transmitter.



INFRA-RED TRANSMITTER

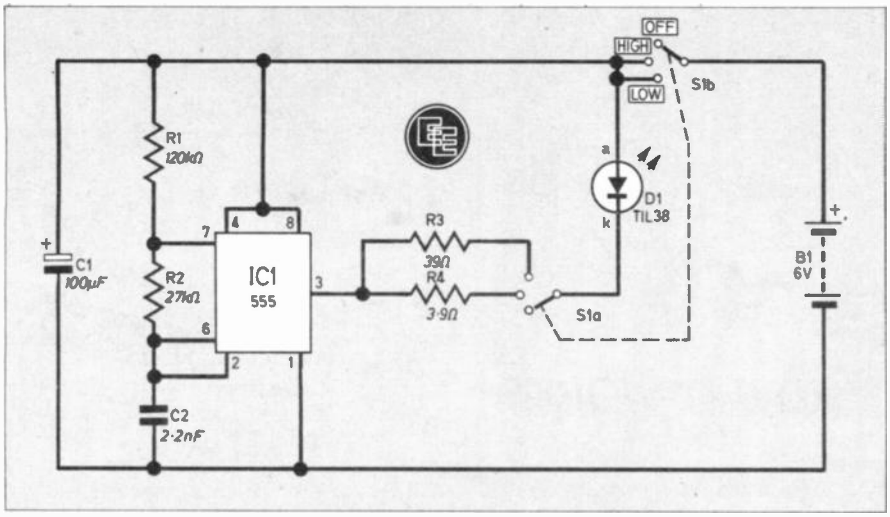


Fig. 2. Camera/Flash Trigger: transmitter circuit.

COMPONENTS

See **Shop Talk** page 171

Resistors
- R1 120kΩ
- R2 27kΩ
- R3 39Ω
- R4 3·9Ω
- All ¼W carbon ±5%

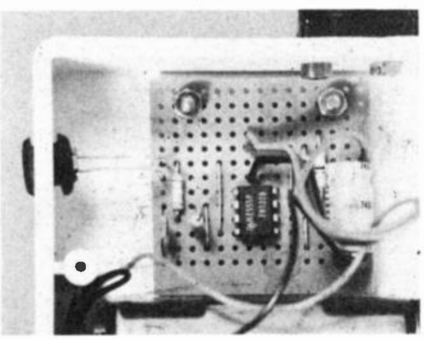
Capacitors
- C1 100µF 10V elect.
- C2 2·2nF ceramic plate

Semiconductors
- IC1 555 timer i.c.
- D1 TIL38 infra-red l.e.d.

Battery
- B1 Four AA (HP7) size batteries and plastic holder to suit PP3 type battery connector

Switch
- S1 3-way 4-pole rotary

Miscellaneous
Plastic box about 114 × 76 × 38mm (type PB1 or similar); 0·1in. matrix stripboard, 13 strips × 15 holes; control knob; panel holder for D1; tripod bush; wire, solder.



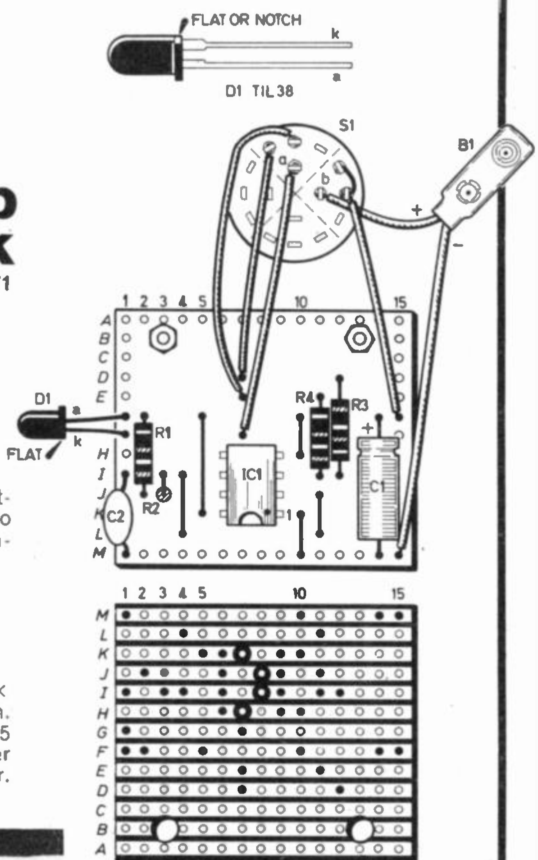


Fig. 3. Constructional details of the transmitter.

COMPONENTS approximate cost £3·50

approximately 38mA. This produces a maximum operating range of about 2 metres which is often far greater than is needed. In such cases S1 is switched to the "low" position and this gives a maximum range of a little under one metre with an l.e.d. current and average current consumption of about 11mA.

C2 sets the operating frequency of IC1 at around 5 to 6kHz, and C1 is the supply decoupling capacitor. Power is obtained from four AA (HP7) size batteries which gives a nominal 6 volt supply.

CONSTRUCTION starts here

TRANSMITTER CONSTRUCTION

The transmitter components can be housed in a plastic box measuring about 114×76×38mm. S1 is mounted on the removable lid of the case, at one end, leaving space for the batteries and the component panel at the other end of the case.

The component panel is a 0·1in matrix stripboard which has 13 copper strips by 15 holes, and Fig. 3 provides details of this board and the wiring of the transmitter.

The board is constructed in the usual manner. Start by cutting out a board of the specified size, drill the two 6BA clearance (3·2mm diameter) mounting holes, make the four breaks in the copper strips, and finally solder in the components and link wires leaving IC1 and D1 until last.

The leadout wires of D1 are not trimmed, so that with the component board bolted to the base panel of the case D1 can be fitted into a panel holder mounted in one end panel of the case.

Complete the wiring to S1 and the battery clip before finally installing the component panel.

The battery clip is a PP3 type, and this connects to the output terminals of a plastic battery holder which is used to connect the four AA size batteries in series. The prototype is powered from NiCad cells which are almost certain to be the most economical power source in the long term, but the circuit can be powered from ordinary HP7 cells if preferred.

MOUNTING BUSH

It is useful to fit the case with a tripod mounting bush, and a suitable bush can be taken from a flash adaptor of the type used to fit a flash-gun on a tripod.

The two rivets are drilled out so that the top and bottom sections of the adaptor can be separated, and the base section is then bolted to the case by fitting the bolts through the holes which were formerly occupied by the rivets. The unit can then be mounted on an accessory shoe or on a tripod since the adaptor has an accessory foot as well as a standard ¼in tripod bush.

RECEIVER CIRCUIT

The circuit diagram of the receiver is given in Fig. 4.

D1 is the photodiode and it is reverse biased by R1. The infra-red pulses from the transmitter produce an increase in the leakage current of D1, giving a series of small negative pulses at the junction of R1 and D1. These pulses are coupled by C2 to a straight forward common emitter amplifier based on TR1, and the output of TR1 is coupled by C3 to a volume control type variable attenuator, VR1.

The signal is then taken to a second common emitter amplifier TR2 by C4. C5 attenuates the high frequency response of the second common emitter stage slightly, and this is done in order to prevent instability.

C6 couples the output of TR2 to a rectifier and smoothing circuit which is comprised of D2, D3 and C7. Under normal conditions this produces a negative bias which is strong enough to bias TR3 into conduction so that its collector terminal is at virtually the positive supply potential.

MONOSTABLE

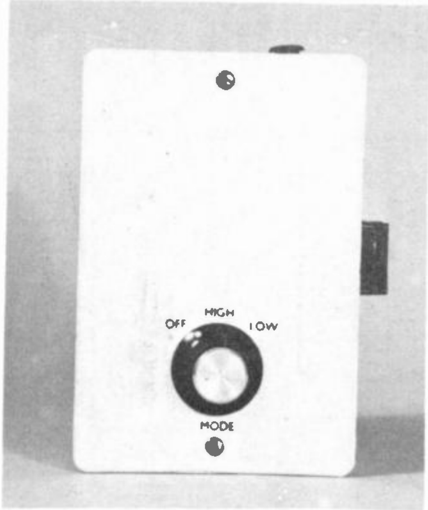
The monostable is a conventional 555 i.c. type, and R7 plus C8 set the output pulse duration at a nominal 1·1 seconds.

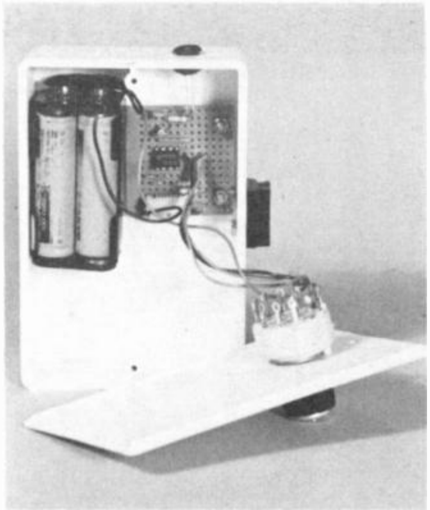
In order to trigger IC1 its input at pin 2 must be taken below one third of the supply voltage, and this will happen if the input to the unit ceases even briefly as the charge on C7 will then rapidly decay and TR3 will switch off.

R8 then takes pin 2 of IC1 to the negative supply voltage, and the positive output pulse is produced at pin 3 of IC1. This switches on TR4 as it receives a heavy base current via R9; the large base current being necessary to ensure a low voltage drop across the collector-emitter terminals of TR4.

Indicator D4 is also switched on when IC1 is triggered, and this is helpful when setting the unit up ready for use.

The current consumption of the unit is about 9mA under stand-by conditions, and around 55mA during the output pulses from IC1. A NiCad PP3 is used to power the prototype, but an ordinary PP3 is also a suitable power source.





The transmitter—exterior and interior views.

CONSTRUCTION starts here

RECEIVER CONSTRUCTION

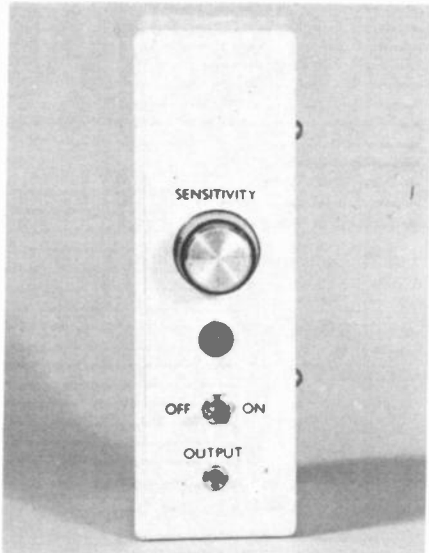
The receiver uses the same type of case as the transmitter, and the general layout of the unit can be seen from the accompanying photographs. VR1, D4, S1, and SK1 are mounted on one of the 114×38mm sides of the case which then becomes the top panel of the unit. A tripod bush is fitted on the base panel of the case.

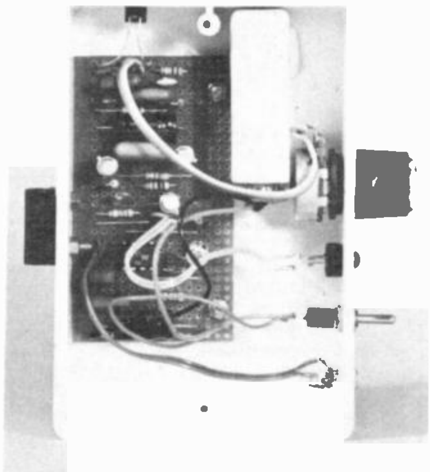
Fig. 5 shows the component layout of the 0·1in matrix stripboard panel which accommodates the other components except the battery. The board has 15 strips by 30 holes and it is constructed using the normal techniques.

The leadouts wires of D1 are left long so that with the board mounted in the case, D1 can be positioned with its sensitive surface behind a hole about 6 or 7mm in diameter drilled in the case. The sensitive surface is the large one which does not carry the type number of the device.

Fig. 5 shows the wiring to the off-board components, and this is all perfectly straight forward apart from the connections to SK1 which must have the correct polarity if the unit is to function properly.

The receiver—exterior and interior views.





INFRA-RED RECEIVER

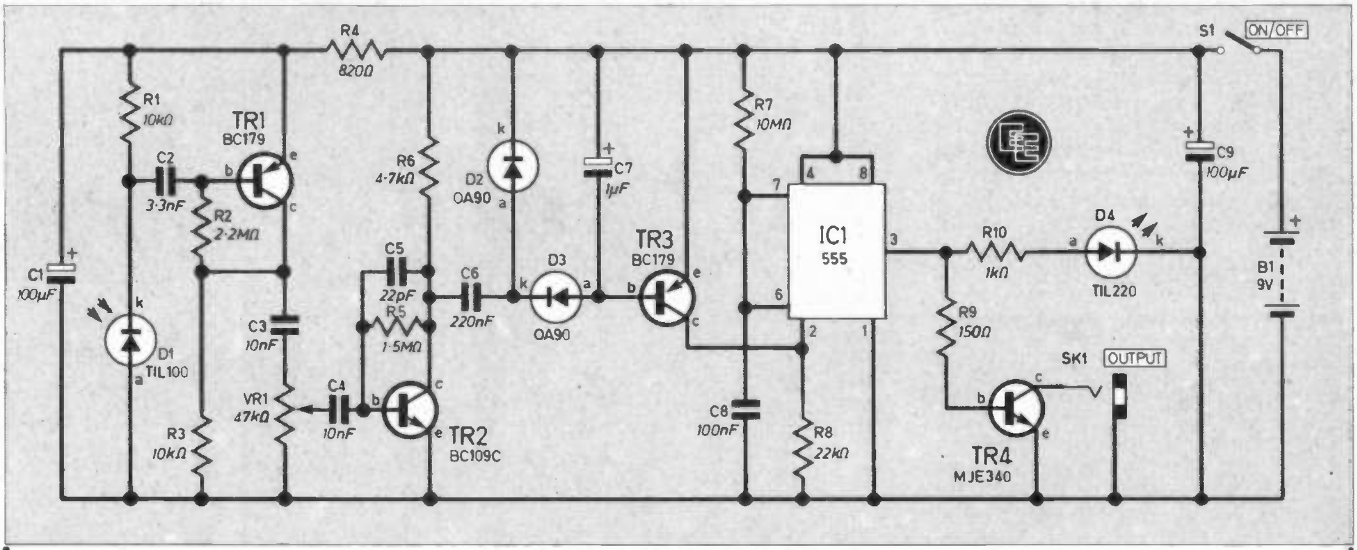


Fig. 4. Camera/Flash Trigger: receiver circuit.

COMPONENTS

Resistors

R1 10kΩ	R5 1·5MΩ	R9 150Ω
R2 2·2MΩ	R6 4·7kΩ	R10 1kΩ
R3 10kΩ	R7 10MΩ	
R4 820Ω	R8 22kΩ	

All ¼W carbon ±5%

Potentiometer

VR1 47kΩ log. carbon

Capacitors

- C1 100µF 10V elect.
- C2 3·3nF ceramic plate
- C3 10nF polyester (C280)
- C4 10nF polyester (C280)
- C5 22pF ceramic plate
- C6 220nF polyester (C280)
- C7 1µF 63V elect.
- C8 100nF polyester (C280)
- C9 100µF 10V elect.

Semiconductors

- IC1 555 timer i.c.
- TR1 BC179 *pnp* silicon
- TR2 BC109C *npn* silicon
- TR3 BC179 *pnp* silicon
- TR4 MJE340 *npn* silicon plastic power transistor
- D1 TIL100 infra-red photo-diode
- D2 OA90 germanium diode
- D3 OA90 germanium diode
- D4 TIL220 0·2in. red l.e.d.

Battery

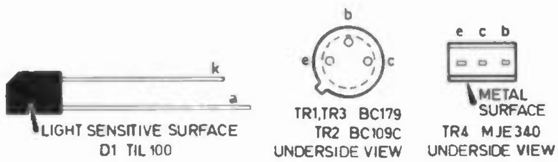
B1 PP3 battery and connector to suit

Switch

S1 S.P.S.T. miniature toggle type

Miscellaneous

Plastic box about 114 × 76 × 38mm (type PB1 or similar); 0·1in. matrix stripboard, 15 strips × 30 holes; control knob; Panel holder for D4; output lead; tripod bush; wire, solder; 2·5mm jack socket (SK1).



COMPONENTS approximate cost £6·50

See **Shop Talk** page 171

Erratum
Break at L9 is not required.

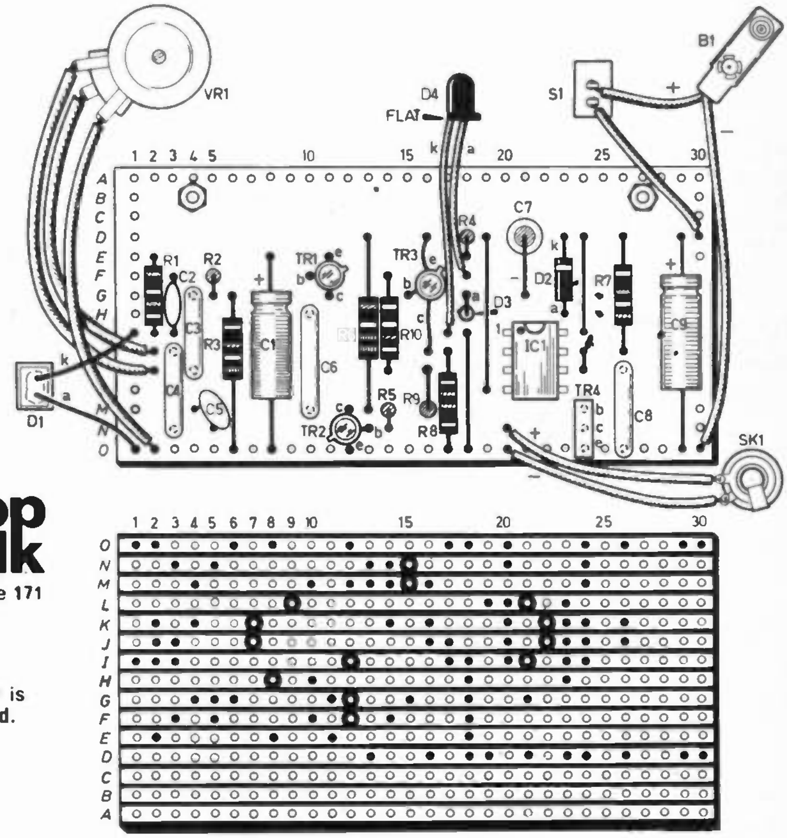
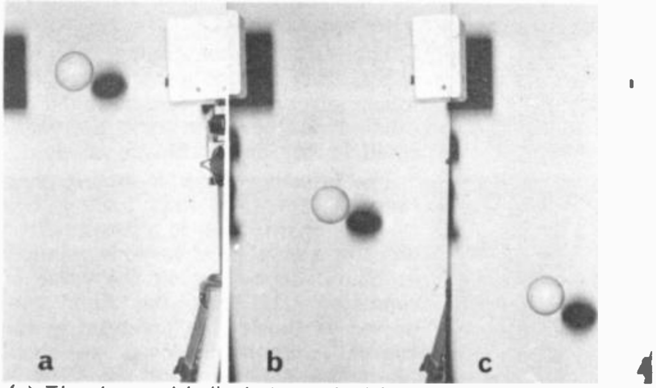
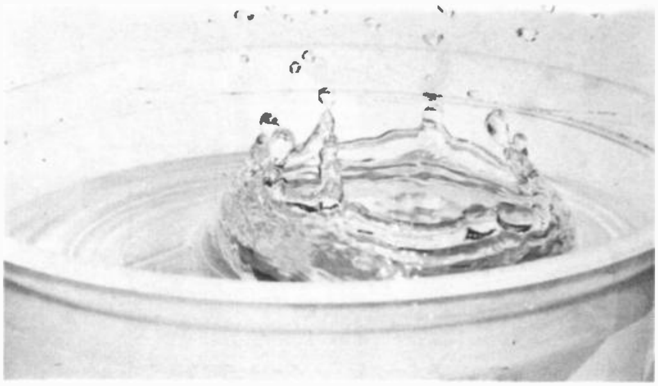


Fig. 5. Constructional details of the receiver.



(a) The dropped ball photographed by triggering the flashgun. (b) There is a small delay if the camera is triggered and the mirror lock-up is used. (c) A longer delay is evident if the mirror lock-up is not used.



Water splash created by dropped marble.

FLASHGUN CONNECTION

If the unit is to be used with a flashgun this can be connected to the receiver via a flash extension lead having the normal plug removed, and a 2·5mm jack plug fitted instead. With this plug connected to SK1 and the flashgun switched on, a voltmeter set to read 250 volts or more at full scale deflection can be used to check the polarity of the voltage across SK1. With the plug removed, the two leads from the component panel are connected to SK1 accordingly.

If the unit is to be used to operate a camera or winder, a remote control lead of the appropriate type can be used to make the connections to the receiver. The push-button switch is removed from the lead and replaced with a 2·5mm plug which connects with SK1. As before, a multimeter (set to the 10 volt d.c. range in this case) is used to check the polarity of the voltage across SK1 so that the leads from the component panel can be connected with the correct polarity.

An alternative method of making the connections from the camera or winder to the receiver is to use the appropriate lead for the "Kenlock Beacon" remote control device. These leads are ready-fitted with a 2·5mm jack plug.

If the unit is to be used with a flashgun and a camera or winder, make sure that all the leads are connected with the right polarity.

USING THE SYSTEM

The exact set-up used must obviously depend upon the type of shot being taken, but the transmitter and receiver must be carefully arranged so that the object to be photographed breaks the beam at the correct point in the frame, and in the plane of perfect focus.

With many shots it is possible to simply have the beam running straight across in front of the camera with transmitter and receiver units just out of frame. In other cases it may be better to have the receiver unit mounted on a flash bracket at the side of the camera and angled across in front of the lens, with the transmitter mounted on a tripod and sited on the other side of the camera just out of frame.

When dropping objects through the beam it is usually quite easy to ensure that they break the beam at the correct point, but with insects the standard method is to use a simple tapering flight tunnel to guide the insect to the correct point.

The beam from the transmitter should be reasonably accurately aimed towards the detector at the receiver, and S1 of the transmitter should only be set to the "high" position if inadequate range is obtained with it set to the "low" position.

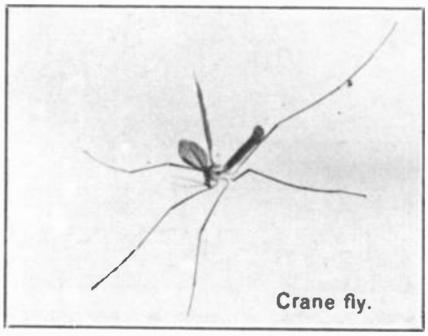
The l.e.d. indicator on the receiver switches on each time the unit is triggered, and glows continuously if the two units are too far apart or VR1 of the receiver is backed-off too far. Do not be tempted to back-off VR1 to the point where the unit barely has sufficient range as this will give poor reliability by making the unit prone to spurious triggering. Advancing VR1 slightly from this point will not seriously reduce sensitivity and will give good reliability.

FLASHGUN OPERATION

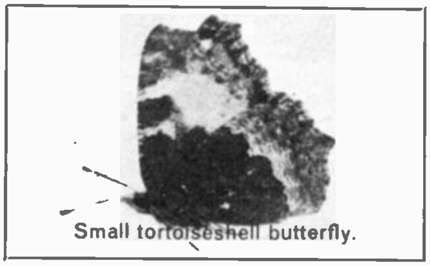
As the accompanying test shots show, the system has a virtually instant response time if it is used to trigger the flashgun. The disadvantage of this system is that it is necessary to open the shutter (using the "B" or "T" setting), activate the system, and then close the shutter. The photograph must be taken under fairly dark conditions so that the ambient light does not ruin the shot.

CAMERA OPERATION

Using the unit to operate the camera or winder is more convenient since the ambient light level is no more of a problem than with normal flash photography. There is typically a delay of about a tenth of a second before the flash fires which can sometimes be awkward, but is often of no real consequence and can even be used to advantage with some types of shot. The delay can be substantially reduced using the "mirror lock-up" on cameras that have this feature.



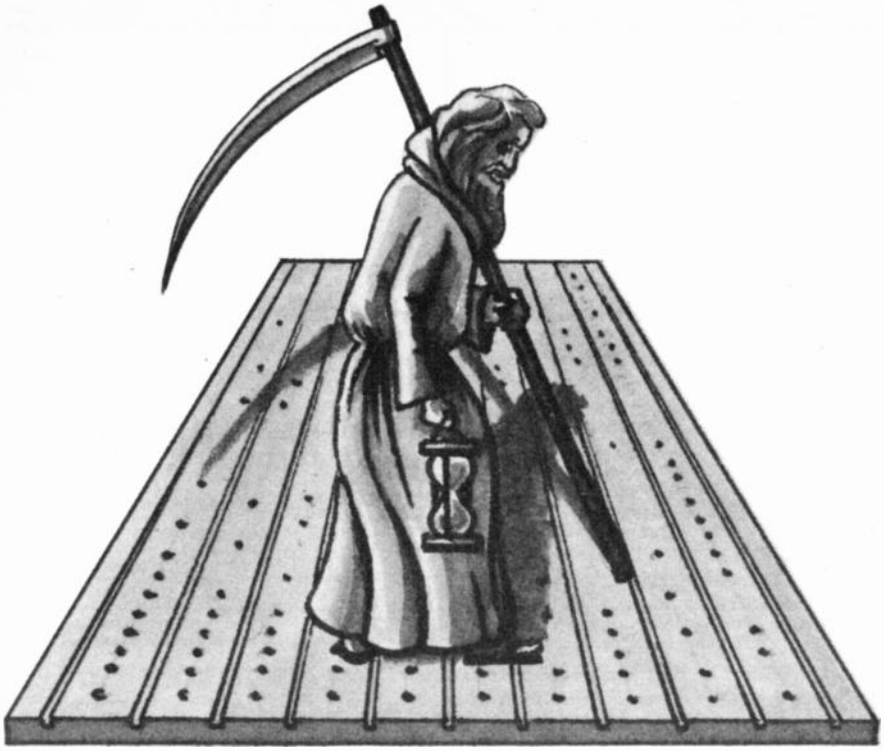
Crane fly.



Small tortoiseshell butterfly.

Most electronic flashguns give a flash duration of about 0·5 to 1 millisecond, which is short enough to "freeze" most action. Sometimes a shorter flash duration is needed, and this can be obtained using an automatic flashgun close to the subject, or using a manual flashgun having a variable power control which is set well back. This typically gives a flash duration of only about 0·05 to 0·1 milliseconds which is short enough to "freeze" virtually any action.

One final point is that it is advisable not to connect the receiver to the camera or auto-winder (if this method is used) before switching on the receiver and transmitter as this could lead to unwanted triggering of the system. Similarly, switching off the transmitter and receiver before disconnecting the lead to the camera or auto-winder could produce an unwanted triggering. ⌑



POCKET TIMER

A project for your FREE piece of stripboard

THIS pocketable fixed-period timer employs only two active semiconductor devices yet, by a suitable choice of timing capacitor, can be made to cover periods ranging from a few seconds to several hours.

It has many applications such as timing moves in games, an egg timer or a parking-meter reminder.

Tucked in the top pocket of a jacket or shirt, it is inconspicuous, yet the warning lamp is easily visible in that particularly sensitive region at the edge of your field of vision.

CIRCUIT DESCRIPTION

The circuit diagram for the Pocket Timer is shown in Fig. 1 and uses a field effect transistor, TR1, and silicon controlled switch, CSR1.

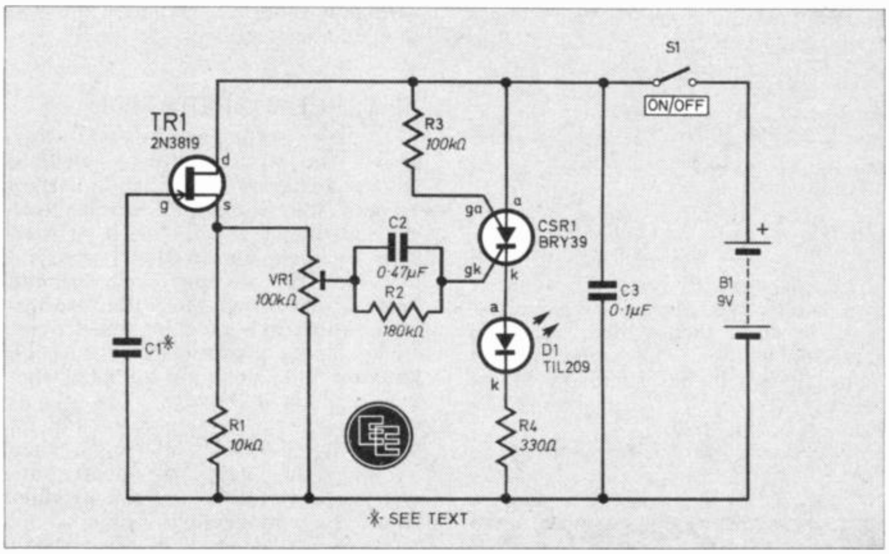
From the moment the circuit is switched on, the f.e.t. generates a slowly rising potential at its source terminal. When this potential reaches a predetermined value it triggers CSR1, which switches on the warning light, D1.

The slowly rising potential is a consequence of the slow rise of gate potential. This rises slowly because of the extremely small current that flows into the gate of an f.e.t. The smallness of the gate current also has the important consequence that we can use a timing capacitor of relatively low value.

Table 1. Value of C1 for timing ranges

Maximum time required	Value of C1
4 minutes	10,000pF
50 minutes	0·033μF
3 hours	0·22μF

Fig. 1. Circuit diagram for the Pocket Timer.



TIMING CAPACITOR

The value of the timing capacitor is less than 1μF, so we can use silver mica, polycarbonate, tantalum bead or other types of capacitors; these are small in size and stable in value.

The effective drain to-source resistance of the f.e.t. falls from a few kilohms at switch-on to a few hundred ohms in a number of seconds, minutes or hours, depending on the value of capacitor C1. With the f.e.t. connected as shown, the potential at the source is about 3·5V at switch-on when the resistance of the f.e.t. is somewhat greater than that of R1. As the resistance of the f.e.t. falls, the potential across it falls in proportion, giving a correspondingly greater potential-drop across resistor R1. In short, the potential of the source gradually rises from around 3·5V towards 9V. The exact values obtained depend on the characteristics of the individual f.e.t. used.

The potential at the source is too high for triggering CSR1, which needs only about 0·4V at its *gk* terminal. The variable resistor VR1 thus acts as a variable attenuator and sufficient current can be drawn from this to trigger CSR1.

By varying the setting of VR1 we can adjust the time at which triggering occurs, over a limited range, see Table 1 for C1 value.

ASSEMBLY

The recommended layout of the components on the stripboard is shown in Fig. 2. The piece of stripboard given free with this issue will need to have two tracks cut from it to allow it to fit inside the specified case with the PP3 battery.

Drill the case end to accommodate D1 and S1. Fit the latter. The wires on D1 will need to be extended by soldering on about 25mm of insulated stranded wire. Use sleeving to cover the connection. Make the necessary breaks along the tracks on the underside of the board using a spot face cutter or small drill bit.

Assemble the components according to Fig. 2 leaving the semiconductors until last. Wire up the battery connector and switch. The l.e.d. can now be fitted in its clip on the case and wired to the board. A little foam sponge either side of the board in the case will hold it steady alongside the PP3 battery.

TESTING AND ADJUSTING

Set VR1 fully anticlockwise and switch on. With *gk* of CSR1 thus grounded, the l.e.d. should not light. Switch off and set VR1 fully clockwise and switch on. With the potential at the wiper at 3·5 volts, the l.e.d. should light immediately.

Switch on and off, gradually moving the wiper of VR1 anticlockwise. After switching off after each test allow about 10 seconds before switching on again, as charge stored on the capacitors may cause unwanted and premature triggering of CSR1. This delay between switching off and on should also be observed in use when operating the device.

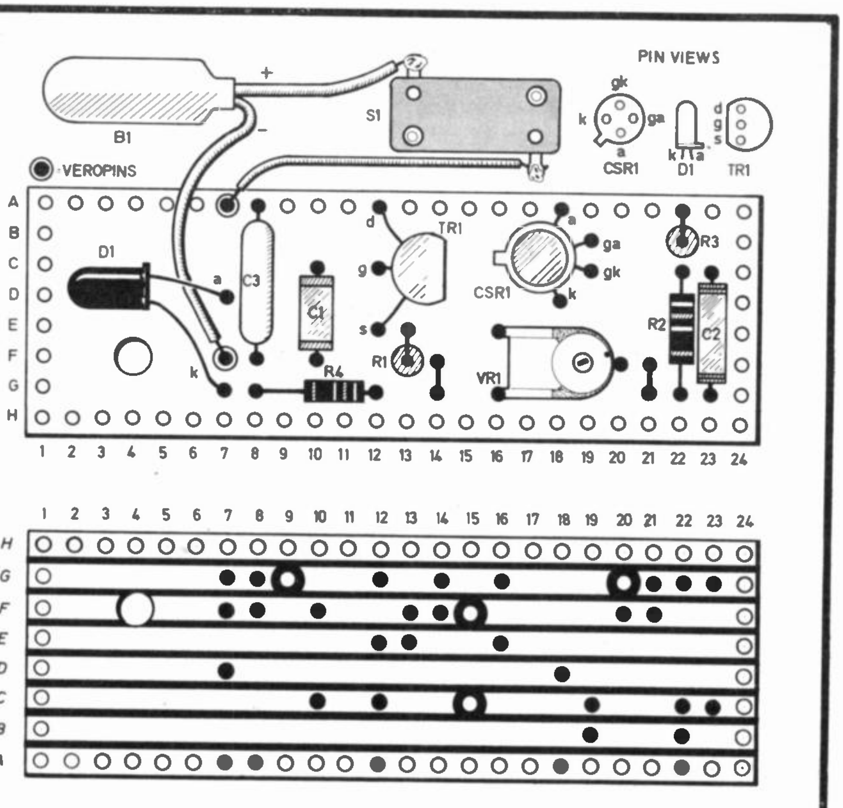


Fig. 2. Circuit board component layout, interwiring and underside of the stripboard showing breaks in the copper tracks.

COMPONENTS

See Shop Talk page 171

Resistors
R1 10kΩ
R2 180kΩ
R3 100kΩ
R4 330Ω
All ¼W carbon ± 10%

Potentiometer
VR1 100kΩ sub-miniature horizontal preset

Capacitors
C1 See Table 1
C2 0·47μF polyester
C3 0·1μF polyester

Semiconductors
TR1 2N3819 *n*-channel f.e.t.
CSR1 BRY39 silicon controlled switch
D1 TIL209 red light emitting diode

Miscellaneous
B1 9V PP3 battery
S1 s.p.s.t. toggle switch
Stripboard 0·1 inch matrix, 8 strips by 24 holes; battery clip; Veropins as required; Vero General Purpose plastic box type 202-21025K or similar size, 70 × 50 × 25mm; connecting wire; solder.

£2·60

You will eventually find a position at which the l.e.d. does not light at switch-on. The timer is now set for its minimum period of operation.

You may find that the l.e.d. flashes once at switch-on, due to current surges, but this can be ignored. It is best to approach a maximum setting gradually, testing and timing at each step, for if VR1 is turned too far, the potential of its wiper never reaches the triggering threshold.

THE TIMER IN USE

Whilst running, the average current consumption of the circuit is only about 1mA, so a PP3 battery will provide many hours of use. However, once the l.e.d. has been triggered, current consumption increases to 20mA or more, so the unit should be switched off as soon as the warning has been noted.

This is not a precision timer. High precision is too much to expect from such a simple circuit. For periods within the range up to one hour, its reliability seems to be better than 5 per cent, which is more than adequate for the applications that have been mentioned.

If you are using it for periods in excess of one hour it is probably just as well to adjust it to run for a slightly shorter time than you actually require. For a two-hour period, for example, adjust it to trigger at around 1 hour 50 minutes. This gives you time to spot the warning lamp and still get down to the parking meter in good time to avoid the wrath of the traffic warden. ☐

PLEASE TAKE NOTE

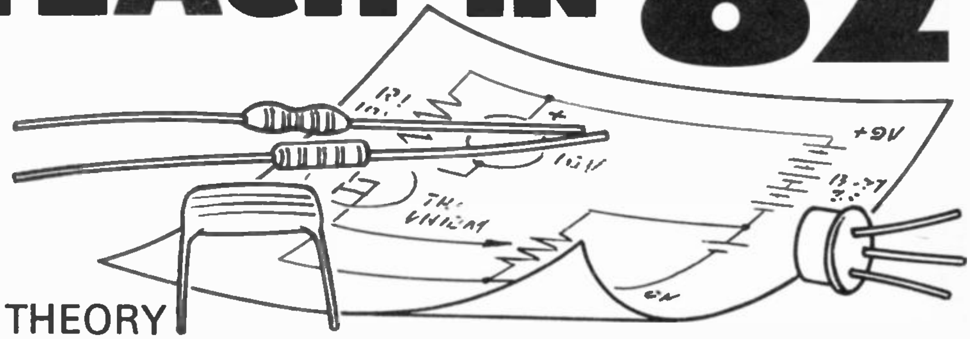
Capacitance Meter (*October 1981*)
In Fig. 2, page 692, move one end of resistor R12 from point *H*13 to *I*13 and one end of R13 from G17 to *H*17.

Cine Interval Timer and Frame Counter (*February 1982*)
Readers using the relay remote operation circuit, Fig. 2, should insert a protection diode across the relay coil.

A suitable type is the 1N4148, the cathode (k) should connect to the +9V line and the anode (a) to the coil/collector junction.

EE TEACH-IN 82

PART 6
BY O.N. BISHOP



BASIC ELECTRONIC THEORY WITH EXPERIMENTS

CAPACITORS AND PULSE GENERATORS

BEFORE we go on to discuss this month's main topic, we shall consider the subject of capacitors.

CAPACITORS

A capacitor consists of two plates of metal with an insulating layer (the **dielectric**) between them, see Fig. 6.1. Dielectrics include plastic film, mica, waxed paper and air.

In Fig. 6.2a the positive terminal of the cell attracts electrons from one plate, leaving it positively charged. The positive charge attracts electrons from the negative terminal. Currents flow until the p.d. between the plates is equal to the e.m.f. of the cell (Fig. 6.2b). The capacitor is now charged.

Note that a current flows out of one plate and an equal current flows into the other plate. *In effect*, a current has passed around the circuit even though there is a layer of insulating material in it.

The cell may now be removed from the capacitor (Fig. 6.2c). Capacitors store electrical charge. Though the charge may be conducted away slowly through the air or through the dielectric, a capacitor stores charge for several hours.

In Fig. 6.3a plate *X* is at 4·7V, *Y* is 3·3V. There is a p.d. of 1·4V between them. This circuit is perfectly stable. Suppose that for an instant point *A* is connected to the 6V line (Fig. 6·3b). The increased potential at *A* attracts electrons from *X*, giving it a potential of 6V. *X* attracts more electrons into *Y*. The capacitor maintains the 1·4V p.d. between its plates.

An increase of 1·3V at *X* brings about an increase of 1·3V at *Y*. Its potential increases to 3·3 + 1·3 = 4·6V. This attracts electrons from *B* to plate *Y*. By the time this has happened the brief pulse at *A* will probably have ended. Potential at *A* returns to 4·7V, electrons flow from *X* to *A*, potential at *Y* returns to 3·3V, electrons flow from *B* to *Y*. Everything is now as it was before.

The effect of these events is that a brief high pulse at *A* has appeared as a brief high pulse at *B*, just as if *A* and *B* were connected by a wire. In effect, the capacitor might just as well not be there so far as a pulse is concerned.

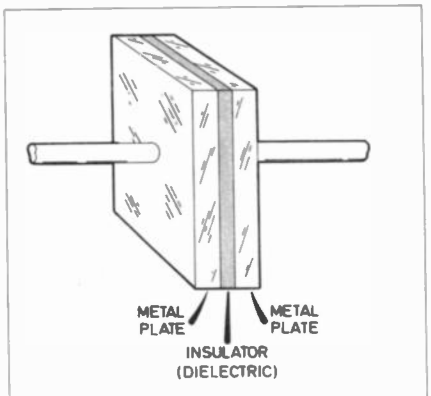


Fig. 6.1. A simple parallel plate capacitor

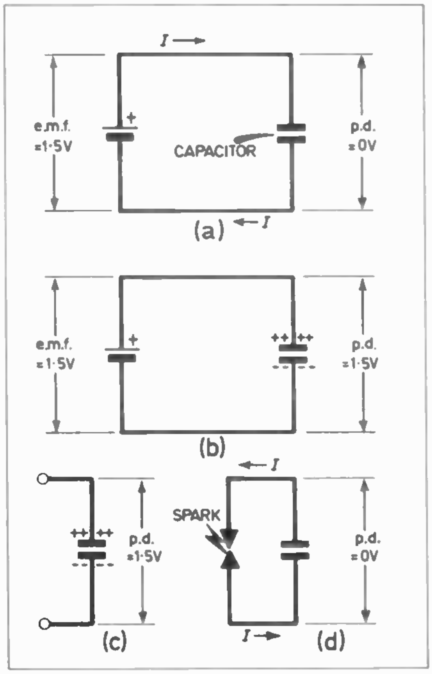


Fig. 6.2. Charging and discharging a capacitor; *I* shows direction of conventional current flow.

COUPLING WITH CAPACITORS

In Fig. 6.4 the microphone produces an e.m.f. of only a few tens of millivolts. The potential at terminal *A* alternates between about +100mV and −100mV and its average is 0V.

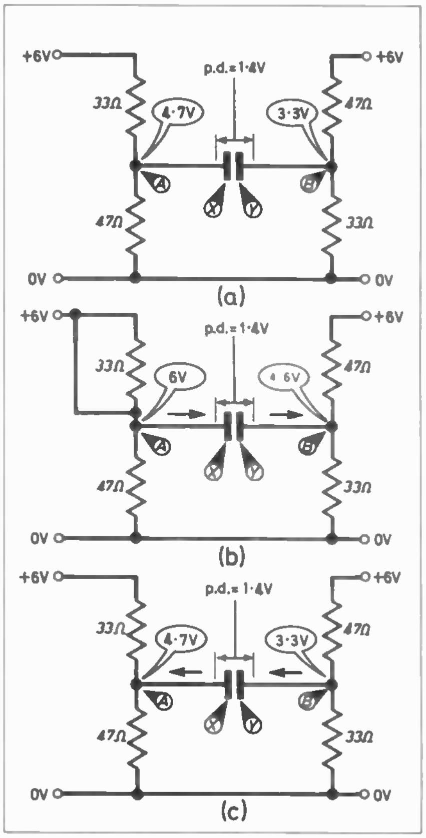


Fig. 6.3. Using a capacitor to couple two parts of a circuit: (a) steady d.c. conditions (b) pulse applied at *A* passes to *B* (c) after pulse passes. Arrows indicates direction of conventional current flow.

The transistor is biased by R4 and its base is at 0·6V, as is plate *Y*. With no sound there is a p.d. of 0·6V between *X* and *Y*. This is just the same as in Fig. 6.3: we have a steady p.d. across the capacitor. As before, the capacitor acts to maintain this p.d. For example, an increase of 20mV at *X* (from 0V to 0·02V), causes an equal increase at *Y* (from 0·6V to 0·62V). The capacitor is used to **couple** the microphone to the transistor.

It has a steady but different potential on either plate, yet transmits a varying or alternating potential from one place to the other. In other words, it does not pass d.c. potentials but readily passes a.c. potentials. The loudspeaker in Fig. 6.4 is another example of capacitive coupling.

The by-pass capacitor in last month's stabilised amplifier is used to maintain a steady potential at the emitter. Any attempt to change the p.d. between emitter and the 0V rail is resisted. Alternating voltages at the emitter are readily passed through the capacitor to the 0V line, where they are lost.

CAPACITANCE

If a capacitor stores *Q* coulombs of charge when the p.d. between its plates is *V* volts, its **capacitance** is defined as:

Capacitance, $C = Q/V$ coulombs per volt

The unit for "coulombs per volt" is called the farad (symbol F). This unit is too large for practical purposes. We use its sub-multiples, such as the **microfarad** ($1\mu F = 10^{-6}$ F), the **nanofarad** ($1nF = 10^{-9}F$) and the **picofarad** ($1pF = 10^{-12}F$).

Capacitance depends on various factors, such as the area of the plates (larger area gives greater *C*), the distance between them (closer together gives greater *C*), and the kind of material used as dielectric. Most types of capacitor have several interleaving plates, giving a large area in a compact form, see Fig. 6.5a. Some have the plates rolled with a sheet of plastic between them as shown in Fig. 6.5b.

The aluminium **electrolytic** capacitors, Fig. 6·5c, have relatively large capacity. They are physically larger than most other types and have rolled plates. The surfaces of the plates are roughened to increase the surface area even more.

The plates are separated by a sheet of paper soaked in an electrolyte paste. This layer is conductive. It is not a dielectric but is effectively part of a plate. In manufacture a p.d. is applied to the plates causing a *very* thin layer of aluminium oxide to be built up on one plate. This is the dielectric and being very thin it gives high capacitance.

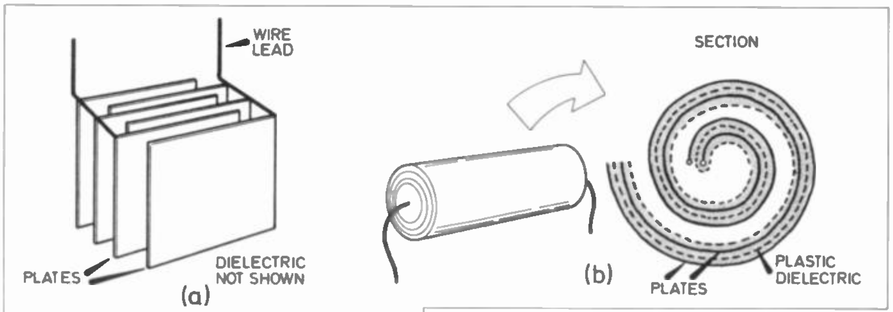
If such capacitors are connected in a circuit in the reverse direction this layer is destroyed. This is why an electrolytic capacitor is marked to show its polarity.

Variable capacitors are used in tuning circuits of radio sets. In the rotating vane type (C1 in *Minilab*), the plates are in two alternating sets. One set can be turned so that the amount by which it overlaps the other can be varied between no overlap and full overlap. The greater the overlap the greater the capacitance.

In compression types, the plates are separated by films of plastic. The pressure on the pile of plates and plastic can be varied to alter the distance between the plates. The greater the pressure, the closer the plates and the higher the capacitance.

CAPACITORS IN PARALLEL

When capacitors are joined in parallel, that is, connected as in Fig. 6.6, their total capacitance is the sum of their individual capacitances. This is a useful way of making up capacitance of a value which is not available in the standard range.



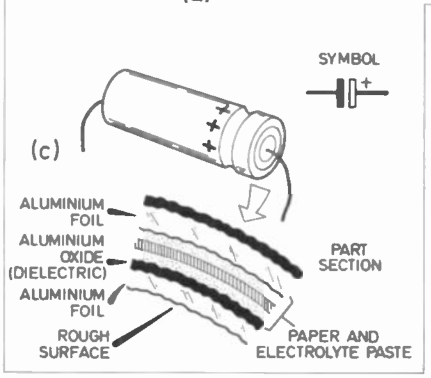


Fig. 6.5. Types of capacitor: (a) parallel plates as in polyester capacitors (b) rolled plates as in polystyrene capacitors (c) aluminium electrolytic polarised capacitor and its circuit symbol.

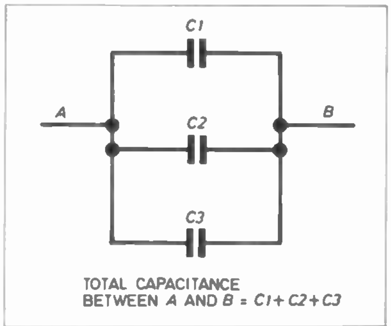


Fig. 6.6. Capacitors connected "in parallel".

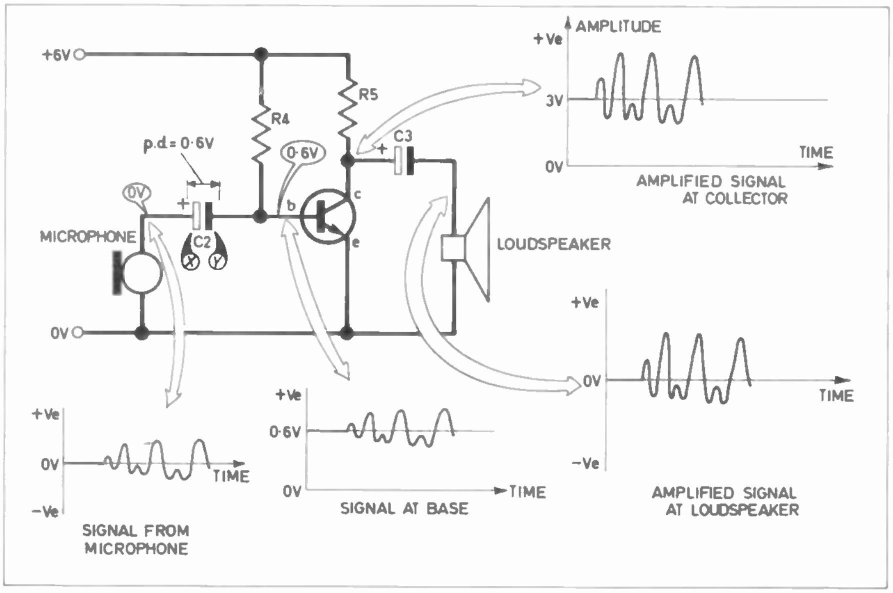


Fig. 6.4. Showing how capacitors are used to couple parts of a circuit while allowing different d.c. levels in each part.

PULSE GENERATORS

Last month we saw how two transistors can be cross-connected by resistors, switching each other on or off. The circuit was called a flip-flop. It is also called a bistable because it is stable in one of *two* states. What happens if we add a capacitor or two to this circuit?

EXPERIMENT 6.1
Monostable circuit

In Fig. 6.7 a capacitor couples the collector of TR1 to the base of TR2. To begin with, TR1 is off, giving 6V at its collector, so D1 is out. Plate *A* of C2 is at 6V, plate *B* is at 0·6V, and TR2 is on. This gives 0·6V at the collector, so a current flows through D2, making it light.

Press S1 for *an instant*. This turns off TR2, so D2 goes out. The collector voltage of TR2 goes to 6V, turning TR1 on. D1 lights. Now wait. After about 2 seconds, D2 comes on again and D1 goes out.

What has happened is that when TR1 was turned on, the potential at its collector fell sharply to 0·6V. A drop at plate *A* of C2 means an equal drop at plate *B*. This holds TR2 off, even though you have stopped pressing S1. However, a current flows through R5, gradually charging plate *B*. Its potential rises at a rate depending on the value of R5 and the capacitance of C2. After about 3 seconds, when the potential reaches 0·6V. TR2 is turned on. Its collector potential rises and turns TR1 off.

This circuit is stable in only one of its states (TR1 off, TR2 on), so we call it a **monostable** circuit.

Put capacitors of other values in place of C2. See what effect they have on the length of time D2 stays off. Circuits such as this are useful for generating single pulses of fixed length.

EXPERIMENT 6.2
Astable circuit.

Now we modify the circuit still further so that the transistors are coupled both ways by capacitors, see Fig. 6.9. Set the layout on the Verobloc according to Fig. 6.10. There is no need for you to do anything after connecting the battery. As one transistor is turned off (l.e.d. out), its collector potential rises turning on the other transistor. The falling potential at the collector of the other transistor is passed by the capacitor to the base of the first transistor, holding it off. As the capacitor charges, the potential at the base of the first transistor rises. Eventually it reaches 0·6V and the transistor is turned on again.

The process is repeated the other way about and so on, indefinitely. The transistors turn each other on and off at a regular rate. The circuit is not stable in either state —it is **astable**.

With 220μF capacitors the circuit changes state about eight times a second, giving four complete cycles per second, a frequency of 4Hz. Try replacing one or both of the capacitors with other values.

EXPERIMENT 6.3
Using the 555 I.C.

The 555 timer i.c. is used here to build a monostable circuit. It needs far fewer components than the previous circuit, see Fig. 6.11. We begin with C2 charged to a p.d. of one-third of the supply voltage (that is charged to 2V in this instance). Current passing through R6 flows into the i.c. at pin 7, so C2 remains at one-third of the supply voltage.

A low pulse to the trigger input (S1 pushed briefly) causes pin 7 not to accept current. The current passing through R6 now increases the charge on C2. The potential at pin 6 rises until it reaches two-thirds of the supply voltage that is (4V).

Pin 6 is connected internally to a circuit which senses when this level has been reached. When reached, the capacitor is immediately discharged through pin 7 returning very rapidly to a charge of one-third of supply voltage again.

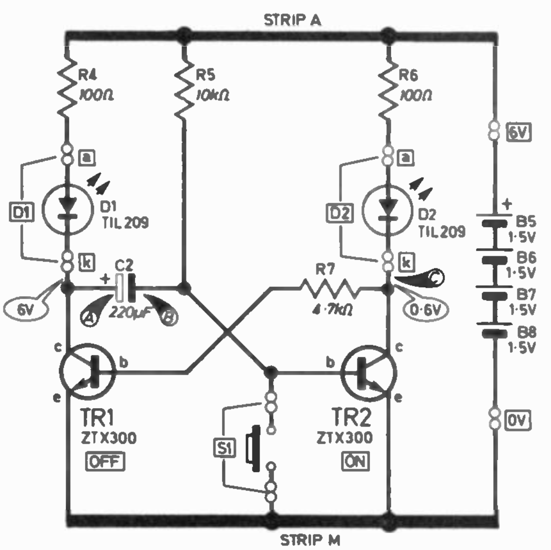
The output at pin 3 is normally 0V, but rises sharply to the supply voltage level when the i.c. is triggered.

It stays high until C2 is discharged after charging up to two-thirds supply voltage. We get a single high output pulse, the length of which is determined by the values of R6 and C2.

Wire up the Verobloc for this experiment as shown in Fig. 6.12. With the values shown, the output pulse should last about 24 seconds. Try the effect of altering th values of R6 and C2.

EXPERIMENT 6.1

Fig. 6.7. Circuit diagram of the monostable to be investigated in Expt. 6.1. Another circuit could be coupled to this by a capacitor connected to point *C*.



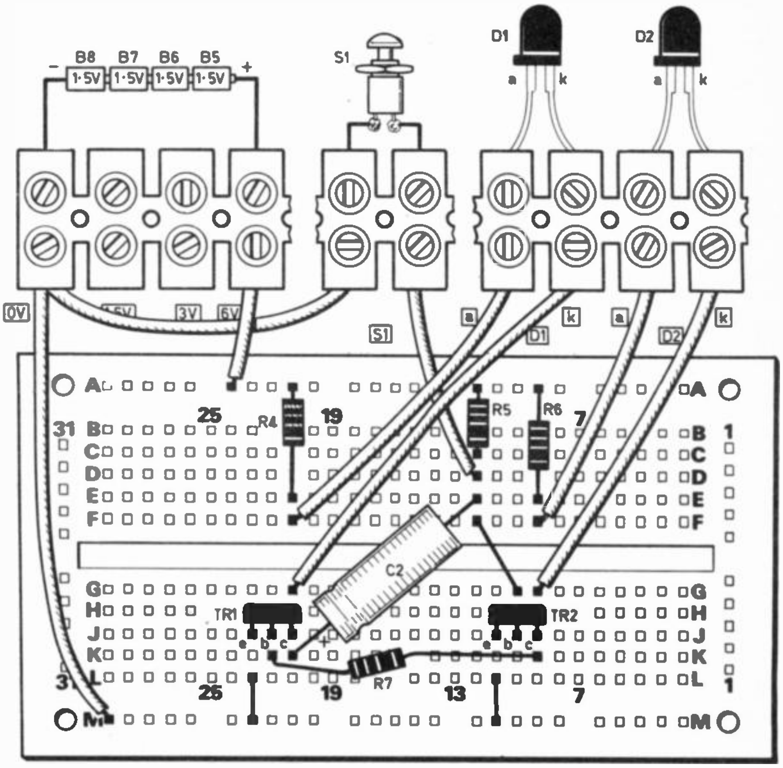


Fig. 6.8. The layout and interwiring for the circuit in Fig. 6.7.

EXPERIMENT 6.2

Fig. 6.9. The circuit of an astable multivibrator to be investigated in Expt. 6.2.

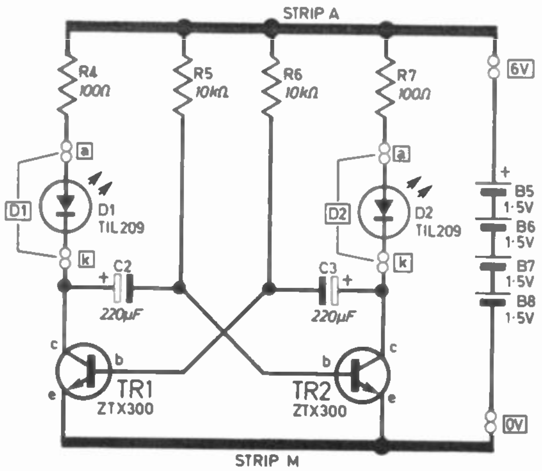
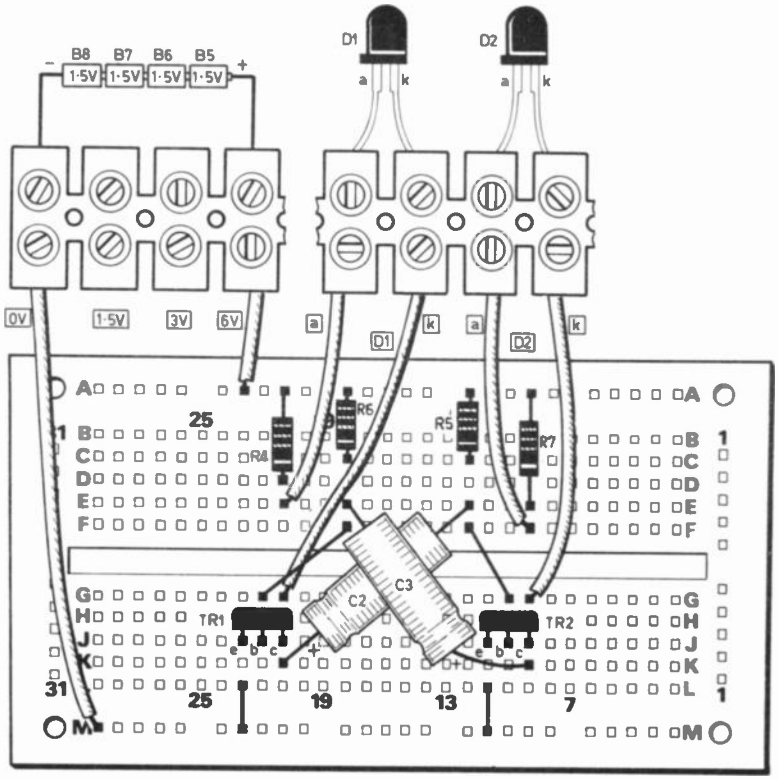


Fig. 6.10. The layout and interwiring on the Verobloc for the circuit in Fig. 6.9.



EXPERIMENT 6.3

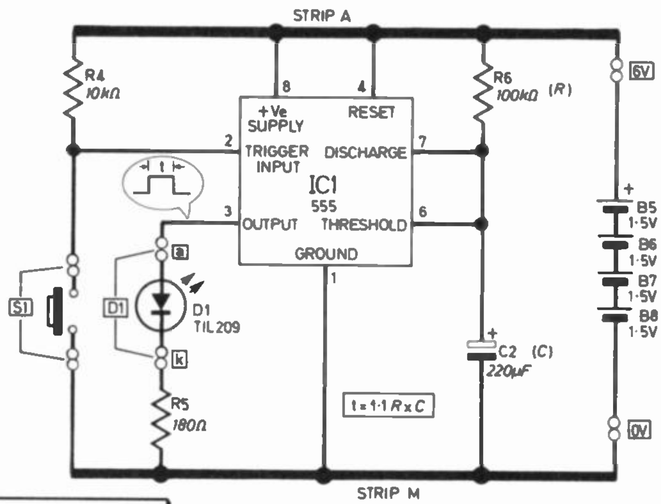


Fig. 6.11. A monostable circuit based on the 555 timer i.c.

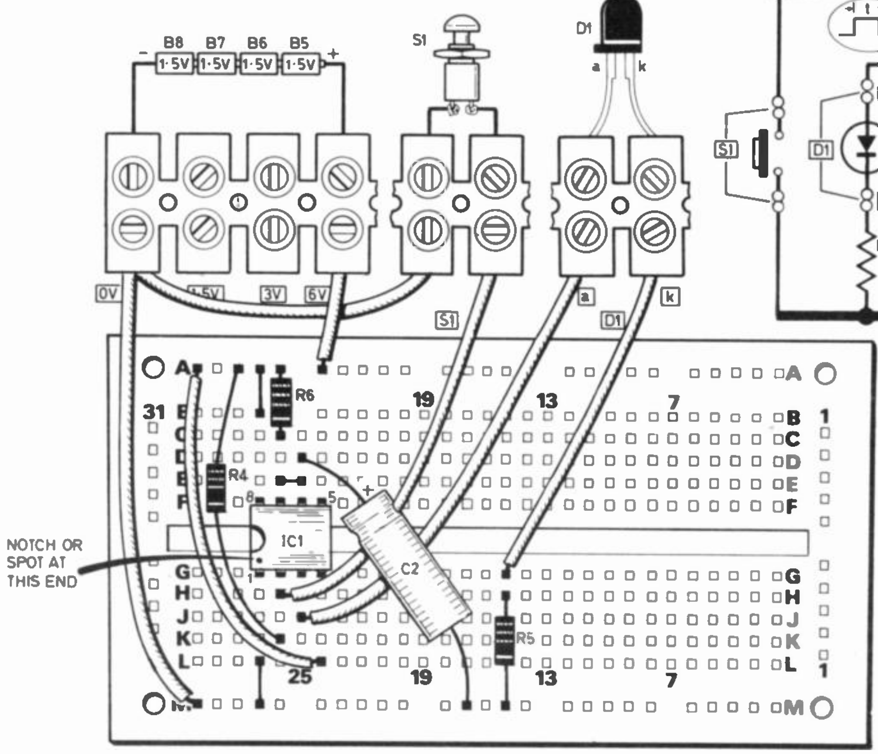


Fig. 6.12. The layout and interwiring of the circuit in Fig. 6.11.

In Expt. 6.1 a higher supply voltage gives a shorter period. The 555 timer is independent of this. It charges C2 from V/3 to 2V/3, an increase of V/3. The charging current is proportional to V, but the amount by which the charge has to be increased is also proportional to V, so the time taken is the same.

Confirm this by connecting the circuit to 4·5V, 9V and 12V. Replace R6 with a 470Ω resistor. For the latter two voltages, measure the pulse length at each voltage.

EXPERIMENT 6.4
An astable 555 circuit

In this circuit the trigger input is connected to the threshold pin, see Fig. 6.13, so the i.c. is triggered again at the end of every pulse and produces pulses indefinitely. C2 charges through R5 and R6, but discharges through R6 only, so the time of charging (high output) is longer than the time of discharging (low output).

With the values given, the circuit produces pulses at about 1·6Hz and the l.e.d. flickers steadily. Carry out the experiment using the Verobloc layout in Fig. 6.14.

Now replace components as follows:

C2—replace with a 47nF capacitor.
D1—replace with a 10μF capacitor. +ve lead to *J25*, —ve lead to *G15*
R4—replace with wires going to the loudspeaker.

Connect the battery and listen. The fact that C2 now has smaller capacitance increases the frequency to about 1012Hz (C″ on the piano). The 10μF capacitor couples the output of the i.c. to the loudspeaker and you hear a high-pitched note.

Answers to Part 5

5.1. One which involves two types of charge carrier, electrons and holes.
5.2. One which depends on an *pn* junction for its action.
5.3. The l.e.d. could be made to turn on when PCC1 is covered.
5.4. 4500μA = 4·5mA.
5.5. h^{FE} is concerned with *steady* currents, h_{FE} is concerned with *changes* in currents.
5.6. 0·1V (base-emitter p.d. remains constant).
5.7. Base draws only a small current; emitter current can be large; that is it has high input impedance and low output impedance, just as an f.e.t. does. Useful for getting a low-impedance output when we do not need to amplify the voltage.
5.8. Increase in I_C = 200μA, so I^C becomes 1·2mA.
5.9. The l.e.d.s light alternately. When *Y* is touched, D1 comes on, D2 goes out. When *Z* is touched, the reverse happens.
5.10. A flip-flop or bistable (works rather like Fig. 4.17, the transistors acting as NOT gates).

Astables can be used for flashing l.e.d.s, producing audio frequency notes and for many other purposes. Try wiring VR1 (10kΩ)—use centre tag and one other—in place of R5 or R6 and listen to the effect as you alter its resistance (turning its control knobs).

ASTABLE MODULE

The first of the modules to be added to the *Minilab* is the astable module. This is a square wave generator or oscillator. You will need it for experiments in Part 8, and it is useful in many other ways too.

The circuit for this module is almost the same as that of Fig. 6.13, except that C2 has been replaced by a bank of four capacitors selected by a rotary switch, see Fig. 6.15. The output frequencies are approximately 0·1Hz (with C2), 1 Hz (C3) 100Hz (C4) and 10kHz (C5). To obtain other frequencies you can add two more capacitors to this circuit as the specified rotary switch has six positions. Room exists on the board for these additional components. In fact there is enough room for at least one other module should you wish to add to your *Minilab* facilities.

EXPERIMENT 6.4

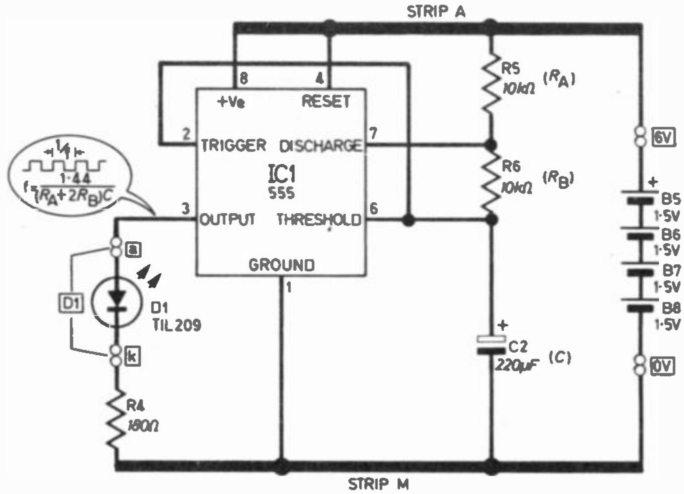
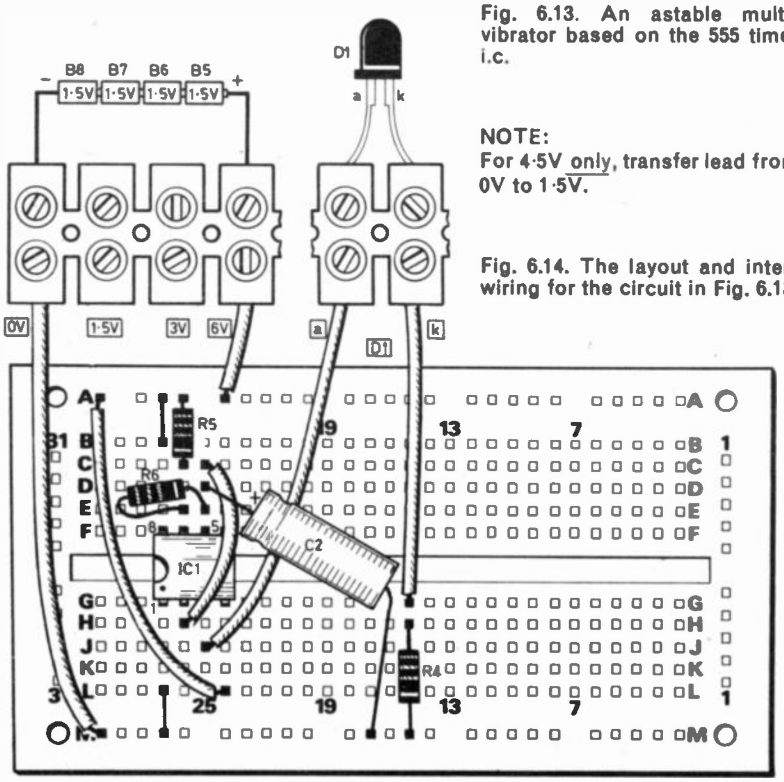


Fig. 6.13. An astable multivibrator based on the 555 timer i.c.



NOTE:
For 4·5V only, transfer lead from 0V to 1·5V.

Fig. 6.14. The layout and interwiring for the circuit in Fig. 6.13.

ADDITIONAL CAPACITOR

You will need to obtain a 4·7µF 6V electrolytic or tantalum capacitor to complete the ASTABLE module. We used a tantalum type in our module as can be seen in the photo and Fig. 6.16. The capacitor did not appear in LIST 2 in the October 1981 issue.

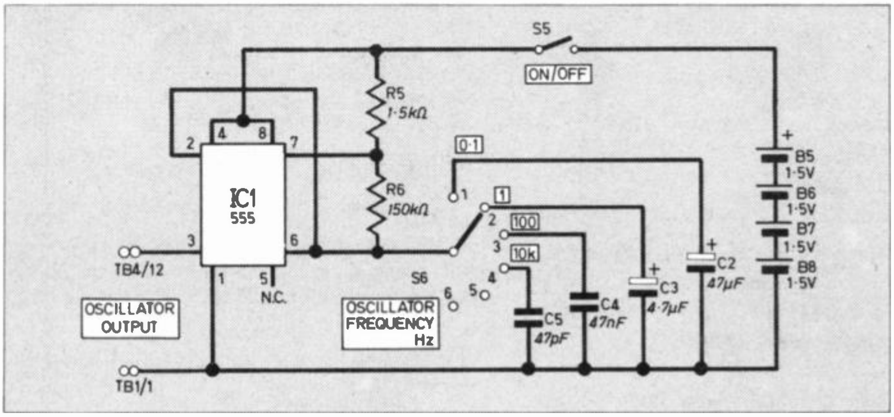
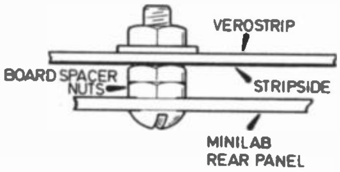
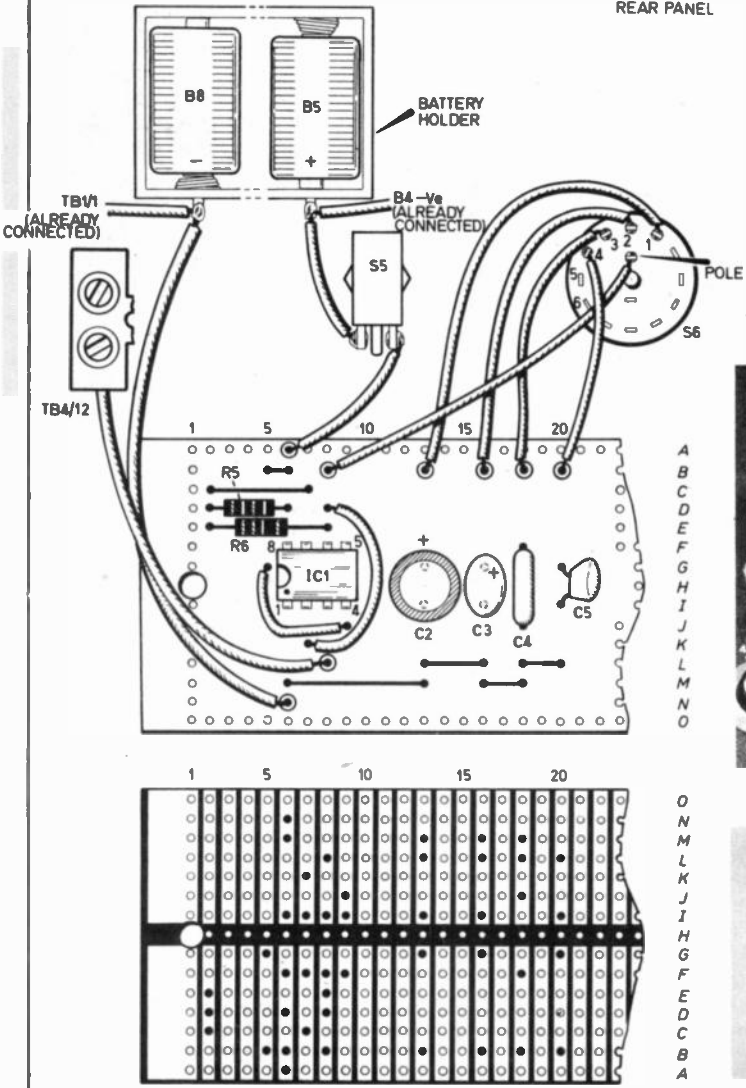


Fig. 6.15. The complete circuit diagram for the ASTABLE module to be fitted in the *Minilab*

Fig. 6.16. The layout of the components on the Verostrip for the ASTABLE module and wiring to the *Minilab*. This Verostrip has a matrix of 81 strips and 15 holes.





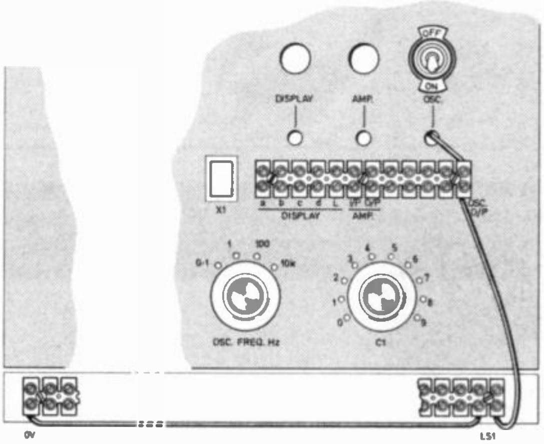
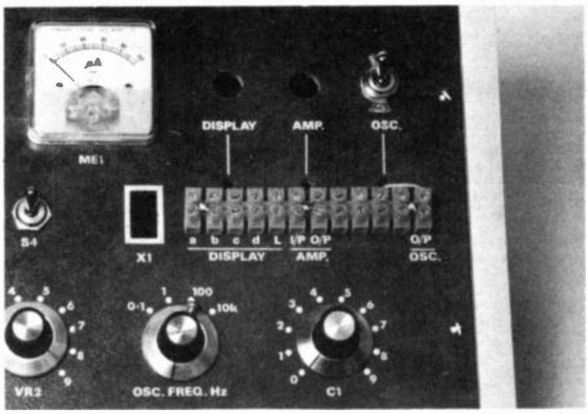
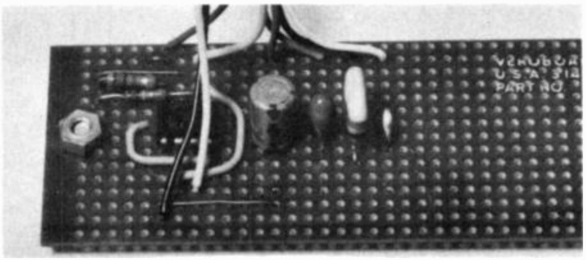


Fig. 6.17. The ASTABLE module wired up for testing. Three sets of 6BA nuts bolts (25mm) and washers are needed to fix the terminal strip.

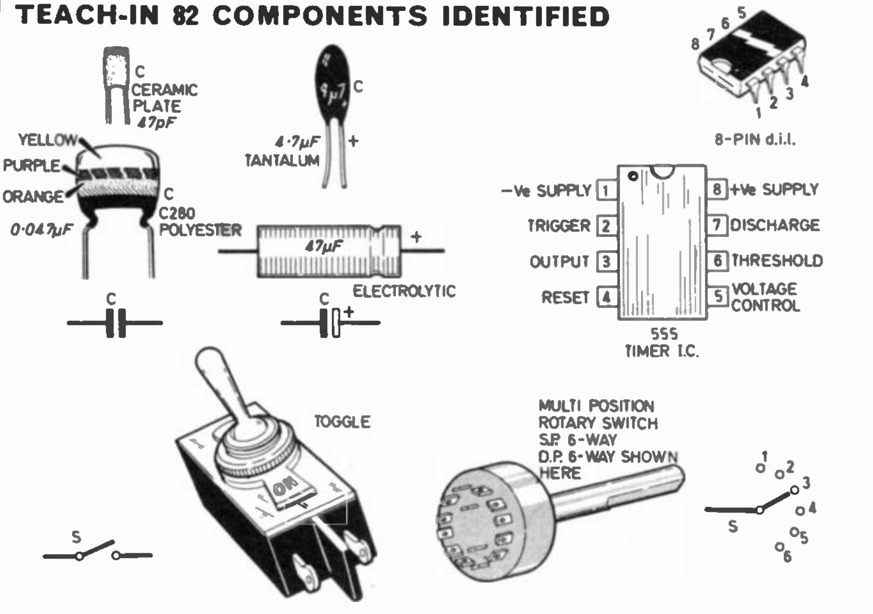


Section of the Minilab front panel showing Astable controls and space for two future additions.



Astable components mounted on one end of the Verostrip.

TEACH-IN 82 COMPONENTS IDENTIFIED



COMPONENTS required for Experiments during Parts 7 to 12. Complete kits of these (LIST 3) may be obtained from the retailers listed on page 171.

Resistors

Quantity	*Value*
1	56 ohm
1	82 ohm
1	150 ohm
1	220 ohm
2	270 ohm
8	390 ohm
1	1 kilohm
1	1·5 kilohm
1	3·3 kilohm
2	10 kilohm
1	12 kilohm
1	18 kilohm
1	56 kilohm
4	100 kilohm
1	330 kilohm
1	470 kilohm
1	820 kilohm
2	1 megohm

All ¼W or ⅛W carbon ±5% tolerance.
Types prepared for p.c.b.s with short preformed leads are not suitable.
All leads on components to be between 0·5 and 0·8mm diameter to fit specified breadboard (Verobloc).

Potentiometer

Quantity	*Value*
1	100 ohm horizontal mounting sub-miniature carbon preset.

Must be suitable for mounting directly on 0·1 inch matrix breadboard.

Capacitors

Quantity	*Value*
1	6·8pF ceramic plate or disc.
1	180pF silvered mica.
2	4·7nF ceramic plate or disc.
5	0·1μF metallised polyester, Mullard C280, ITT PMT2R or similar.
1	4·7μF electrolytic 16V type preferred, radial or axial leads. Short lead types should not be supplied.

All to be suitable for working at 12V. Very large types should not be obtained.

Semiconductors

Quantity	*Type*
1	TIL38 infra-red light emitting diode.
2	ZTX300 silicon *npn* transistor.
1	OA91 germanium diode.
1	BZY88C5V1 5·1V 400mW Zener diode.
1	DL704 0·3 inch common cathode 7-segment display. Litronix, RS 586-778 or other identical pin-out type.
1	741 differential op-amp (8-pin d.i.l.).
1	4511 CMOS b.c.d./7-segment decoder.

Miscellaneous

Quantity	*Description*
2	**Toggle Switch** standard size s.p.s.t. (same as type obtained in LIST 2).
2	**IC Sockets** 1 off 16-pin d.i.l. low profile type. 1 off 14-pin d.i.l. wire wrap type.
1	**Ferrite Rod** 8mm diameter, 100mm long.
1	**Filament Lamp 6V 60mA** wire ended type.
20m	**Miniature Stranded Wire** p.v.c. covered 10/0·1mm preferred.
4m	**Enamelled Copper Wire** 28 s.w.g.

QUESTION TIME

6.1. A 4·7nF capacitor is wired in parallel with a 1000pF capacitor. What is their combined capacitance?

6.2. Name some of the uses of capacitors.

6.3. A 2·2μF capacitor is charged from 3V to 4·5V. How much extra charge becomes stored in it?

6.4. Here is a list of materials used as dielectrics, but there is one which should not be there. Which is the odd one out? List: polystyrene, aluminium oxide, mica, carbon, waxed paper, air.

6.5. A 555 i.c. is connected as an astable (Fig. 6.13); R5=100kΩ, R6=47kΩ, C2—100nF. What is the frequency of oscillation produced?

The astable module is to be built at one end of the length of Verostrip with the amplifier module (described in Part 7) in the centre. Drill holes at each end to accept 4BA bolts.

The third module (7-segment display) is to be constructed on a small piece of Veroboard. It will in fact be the piece given free with this issue; add it to your stock of Teach-In components for use later.

Follow the layout of the components according to Fig. 6.16. Connection of flying leads to the board are made using Veropins, so the assembled board may now be screwed to the internal face of the *Minilab* rear panel.

Fit the required switches and terminal strip to the *Minilab* Control Panel. The toggle switch at the top right hand corner and its reference is S5. The rotary switch fits between C1 and VR2 and its reference is S6. The terminal block sits below S5.

Next make the interconnection between module strip and *Minilab* components. Finally replace the rear and control panels to complete the installation.

TESTING THE MODULE

To test the module for satisfactory operation, wire up according to Fig. 6.17. with S6 set to "0·1". Switch on at S5. Clicks should be heard from the loudspeaker at a rate of approximately one per 5 seconds. Rotate S6 clockwise to hear clicks at a rate of one per half-second. The next two positions of S6 will cause a buzzing tone and a high pitched tone to be heard. If this occurs your module is functioning satisfactorily. Turn off at S5.

The remaining two unconnected positions on the rotary switch may also produce high pitched tones even though there are no capacitors actually connected. There is stray (small value) capacitance between the leads to the switch which in effect is placed across IC1 pin 6 and 0V. The value may be low enough to produce an audible frequency output.

To be continued

By Dave Barrington

Catalogues Received

One of the first of this year's mail order components catalogues to be received is the Ace Mailtronix 1982 edition.

Although containing only 12 pages, they have been fairly selective and included most items that the constructor is likely to want. As they say in the catalogue "You will certainly not find every component you seek in any catalogue", but they are prepared to try and find those special items on receipt of a sae.

New additions include low leakage electrolytics, more cases and considerable expansion of the l.e.d. range to include rectangular, triangular and bargraph types. The switch range now includes keyboard switches and complete keyboards.

For those readers who like to make their own printed circuit boards they stock a full range of Alfac etch resistant transfers.

Copies of the Ace 1982 Mail Order catalogue are available from Ace Mailtronix Ltd., Dept EE, 3a Commercial Street, Batley, West Yorks WF17 5HJ, price 30p.

New Address

We have been informed that Tempus have moved premises and their new address is: Tempus, 38 Burleigh Street, Cambridge, CB1 1DG.

CONSTRUCTIONAL PROJECTS

Camera or Flashgun Trigger

The only component problems likely to be encountered when building the *Camera or Flashgun Trigger* is the supply of the infra red emitter and detector devices.

The only stockist we have been able to locate for the supply of *both* the TIL100 and the TIL38 "matched" infra-red detector and emitter is Maplin Electronic Supplies. These are listed as stock numbers YH70M and YH71N. Some advertisers stock the TIL100 photodiode but do not seem to carry the TIL38 device.

Guitar Tuner

The tone generator integrated circuit used in the *Guitar Tuner* project could cause readers purchasing problems. This is the MO83 i.c. and seems to be only available from Maplin. The miniature output transformer is also stocked by them.

Ice Warning

The thermistor used in the original circuit for the *Ice Warning* was a THB11 type. We have been unable to locate a source for this device and have substituted it with a suitable equivalent.

This is the bead thermistor type GL16 which has a typical resistance of 1 Megohm at 20°C.

The GL16 thermistor should be stocked by numerous component suppliers, but if difficulties are experienced then it is available from Maplin as the G16; stock number WH23A.

Pocket Timer

The silicon controlled switch type BRY-39 used in the *Pocket Timer* should be available from most suppliers. It is certainly listed by Bi-Pak, Electrovalue, Watford and Rapid Electronics.

Car Probe

The only unusual component in the *Car Probe* is the bi-state l.e.d. Although this is a fairly new device it seems to be stocked by several dealers. It is also available from RS Components suppliers and is listed as RS type 586-728.

The housing for the prototype *Car Probe* was an old pocket penlight and was chosen for ease of mounting the bulb and probe tip. Any similar casing, such as an old torch of solder dispenser, would suffice.

House Register

We have been unable to find a supply of the red, green and white miniature push-to-make release-to-break switches S1 to S9. However, any one of the many miniature push-button switches can be used and the bush-button capped with a coloured disc or "hat" for identification.

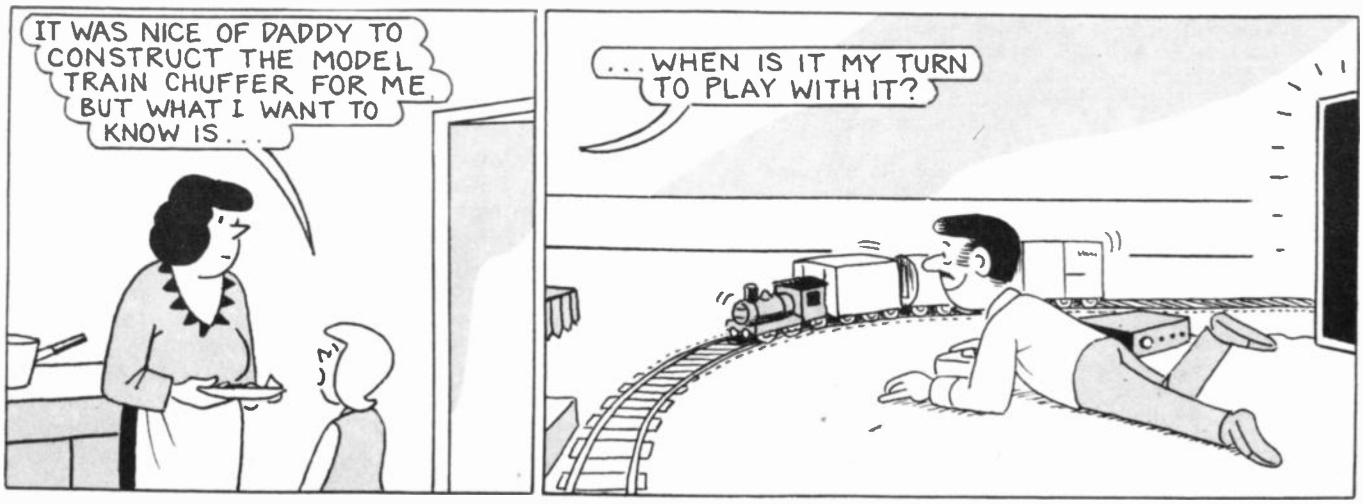
TEACH-IN 82 KIT SUPPLIERS

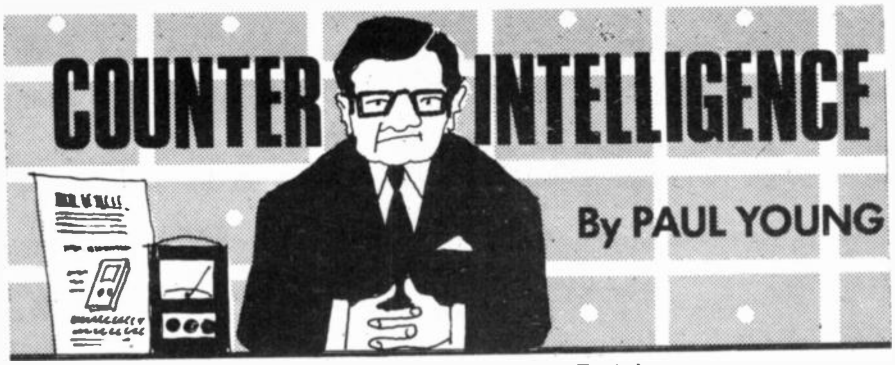
Supplier	LIST 1	LIST 2	LIST 3	LISTS 1, 2 & 3
Bi-Pak (*p. 151*)	£15·65	£8·94	NR	NR
Electrovalue (*p. 206*)	£16·56	£6·32	£5·70	£27·49
Greenweld (*p. 148*)	£18·50	£8·10	£4·40	£29·00
Magenta Electronics (*p. 152*)	£16·40	£9·34	£6·48	£30·98
A. Marshall Ltd	£17·00	£12·50	NR	NR
T. Powell (*p. 208*)	£19·75	£10·50	£6·35	£27·50
T.K. Electronics (*p. 146*)	£15·52	£8·62	£5·63	£27·02
Watford Electronics (*p. 147*)	£18·08	£9·33	NR	NR

All prices are inclusive of VAT, postage and packing. NR = Not Received.
For suppliers full address refer to page number following company name.

JACK PLUG & FAMILY...

BY DOUG BAKER





Hot Air

The sudden cold spells always show up the weaknesses in the internal combustion engine, and I expect many readers have found themselves in the same position as I was two Sundays ago, with two cars and not a sign of life in either of them. I hate to say it, but what do we always suspect first, the electrics, and with good reason. The spark is the weakest link in the chain.

Now here's a tip for fellow motorists. Most of the trouble connected with non-starting is due to damp in the distributor cap. There are one or two firms which sell inexpensive de-frosting guns, designed to get ice off windows.

If you experience the touble mentioned above, plug in your gun, push back the two spring clips holding the distributor cap, lift the cap clear of the rotor arm, squirt the hot air into the cap for about two minutes, and you're away. If you hold the cap over the gas as I used to, there is a danger of it melting.

Graham Farish

Glancing quickly through the pages of "Practical Wireless", I suddenly thought I was caught up in a time warp. There on page fifty was an advert of an h.f. choke covering the Medium and Longwave band, price two shillings, and something called an "Ohmite" resistor, with the words underneath it "Better than wire-wound", price one shilling and sixpence.

Looking at the top of the page I realised it was part of an obituary notice for the late Graham Farish and the advert was a reproduction of one of his advertisements of 1932. His was a name in the components market well known to the older generation. Later he went into model railways.

Just a word

What a difference a word can make! A customer recently wrote and asked me to quote him for a mains transformer giving an output of 12-0-12 volts because he wanted to make a battery *charger*. I wrote and asked what current he wanted to draw from it and back came the answer, 4 amps.

Naturally I assumed he wanted to charge up two 12 volt car batteries. Once more I had to write and say, that if this was his intention, he would need a transformer that gave 4 amps at an off load voltage of around 17-0-17 volts.

When he replied he sent me the circuit, taken from one of the magazines. It was a circuit for a Battery *Eliminator* to replace a PP9!!

Crystal Gazing

In spite of the myriad of the most sophisticated electronic toys imagineable, the sales of them were greatly exceeded by a non-electronic toy, the infuriating Rubrik Cube. I was also pleased to note that we sold over five hundred of the humble crystal sets. It never fails to please the youngsters and is a good stepping stone to more serious projects.

I do hope that many readers spotted the series of lectures by The Royal Institution on BBC Television. They are always first rate. This year the lecturer was Professor R. V. Jones, F.R.S., and he called his series "From Magna Carta to Micro-chips".

Some of the facts he told us were astonishing, for example, did you know that Wheatstone (the bridge man) invented the mouth organ? The good Professor not only told us about it but produced one and proceeded to play it very competently. What an all rounder!! Larry Adler had better look to his laurels!

BOOK REVIEWS

PUBLIC ADDRESS HANDBOOK (2nd edition)

Author Vivian Capel
Price £7·95
Size 220 × 140mm, 238 pages
Publisher Keith Dickson Publishing Ltd
ISBN 0 907266 02 9

For anyone involved with public address amplification, this book is a must. Written in an easy to understand style it is full of good practical information much of it only obtained after years of experience in the trade. It ranges from basic principles through microphones and amplifier systems, indoor and outdoor installations, practical problems, testing and fault finding, and special equipment. And to finish, a section on practical installations with worked examples.

A few basic circuits are described but the book mainly concentrates on the practical aspects of public address installations, for example, the correct type of microphone and/or polar diagram required for a particular installation, and loudspeakers, and their location avoiding feedback. Examples of actual systems for from about 100 people up to a stadium of 15,000 with requirements for speeches, interviews, forums as well as community singing led by taped music are given. A section on the legal aspects is also included.

The section on loudspeakers covers the 100 line system in detail with sections on matching, phasing, power tapering, frequency tapering and weatherproofing.

E.A.R.

PRACTICAL OSCILLOSCOPE HANDBOOK (Second edition)

Authors Howard Bierman, Paul Bierman and Rufus Drew.
Price £7·00
Size 320 × 150mm, 170 pages
Publisher John Wiley & Son Ltd
ISBN 0 8104 0851 1

This book should prove to be an ideal companion for all users of oscilloscopes. It covers the subject from first principles and the operation of the various types of controls found on modern scopes right through to the more advanced type of measurement. Only the minimum of calculation and theory are given where these are relevant to the practical use being described. The whole aspect of this book is on the *practical* and the drawings given are among the clearest this reviewer has seen for some time.

The many drawings show not only the method of connecting the oscilloscope up into practical circuits but also the types of waveform to expect. Typical control settings are also given for many of the measurements shown. In the section on audio measurements for example, there are no less than fourteen examples of square waves obtained during the testing of an amplifier showing the effects of poor frequency response, phase shift, and miscellaneous effects. Receiver alignment curves are also shown for both TV (American system) and radio and there are diagrams showing how to check transmitter modulation.

Written in plain English this book will enable the reader to understand not only how oscilloscopes work but how to put them to practical use. Anyone contemplating building or buying as well as using an oscilloscope should have a copy. Highly recommended.

E.A.R.

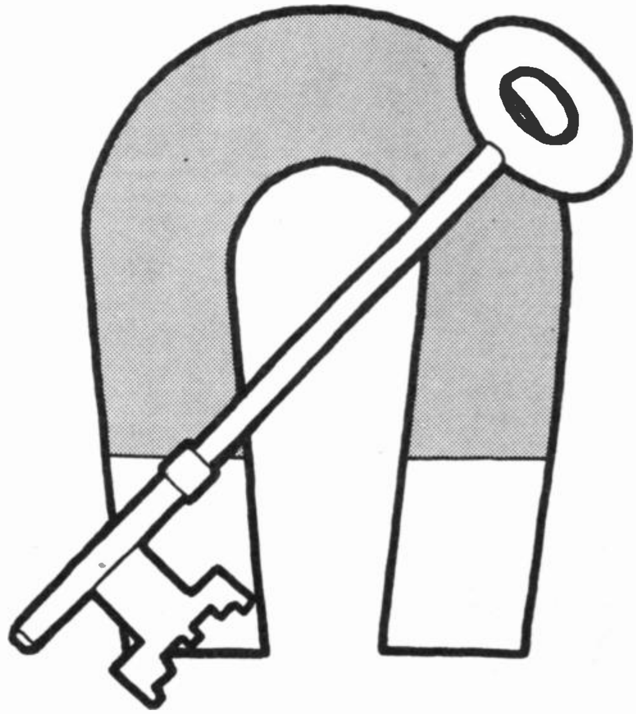
Everyday ELECTRONICS

APRIL FEATURES

A Security Problem?

Perhaps we have the answer with this

MAGNETIC LOCK



Mains powered circuit incorporating four Hall Effect semiconductor devices; these can be activated only by a special magnetic key. Virtually impossible to "crack". The lock that doesn't betray its presence. Ideal for hidden compartments.

Music on Wheels

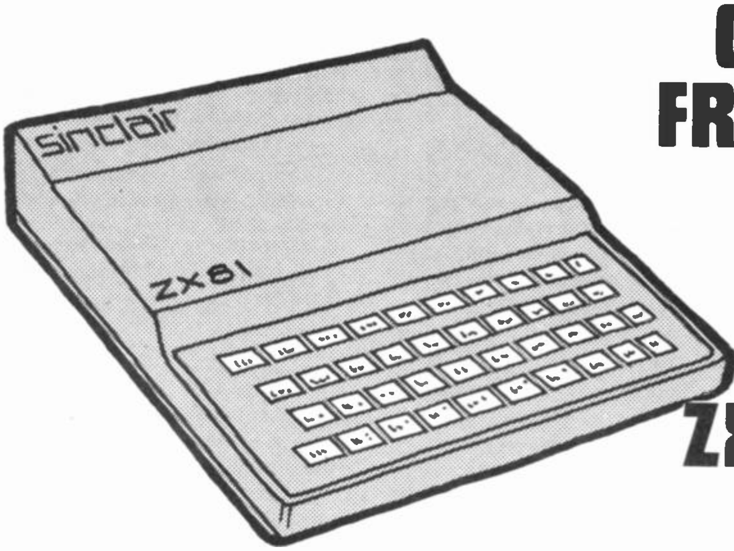
IN-CAR POWER SUPPLY

Provides 6, 7 or 9V d.c. from 12V car battery at a turn of a switch. Ideal for powering portable cassette recorders, torches, battery shavers and radios.

Good Measure

CAPACITANCE & FREQUENCY METER

Handy dual-purpose instrument for the constructor. Range: Capacitance 400pF to 10μF; Frequency 50Hz–1MHz. Uses calculator type digital display.



More Memory

ZX81 2K RAM PACK

Increase the data storage capacity of your ZX81 Personal Computer to 3Kbytes by plugging in this inexpensive, easy to construct module. Resides inside a cassette tape case.

APRIL 1982 ISSUE—ON SALE FRIDAY, MARCH 19

GUITAR TUNER

For all those guitar owners who do not possess a piano, organ or the innate ability to help in the tuning of it, this instrument will be of use. All six notes of the guitar strings are reproduced by the circuit described in this project.

No precision calibration or tuning is necessary, though it can be tuned to another instrument if this is desired.

CIRCUIT DESCRIPTION

The full circuit diagram is shown in Fig. 1. The heart of the instrument is IC2, an M083. This i.c. divides an input signal into thirteen different frequencies representing all the notes in an octave from C to C.

The six notes of the guitar strings are as follows: E (82·5Hz); A (110·0Hz); D (146·7Hz); G (195·9Hz); B (247·0Hz); E (329·8Hz). The nominal frequencies of the notes are shown in brackets. As this range of frequencies spans two octaves, further frequency division of the output frequencies from IC2 must be done.

Dividing the frequency of a note by two, causes a drop in pitch of one octave. So, for example, as the highest E string is two octaves above the lowest E string, it has a frequency four times greater. It will be seen from Fig. 2 that a nominal clock frequency of 124994·2Hz is needed to produce the required output frequencies.

CLOCK OSCILLATOR

This clock frequency is generated by IC1a, b, and c, three quarters of a CMOS quad 2-input NAND gate, the 4011. These three NAND gates are connected together as an oscillator, the frequency of which can be adjusted by VR1. This potentiometer, along with R1 and C1, form the timing components of the oscillator. The signal is fed into the clock input of IC2, pin 2.

From pin 7 of IC2 comes TOP E, which on depressing S6, is fed to the audio amplifier section. Notes B, G and D come from pins 14, 10 and 5 respectively by pressing S1, S2 and S3. However, as these three notes lie in the octave below TOP E, it is necessary to divide the frequencies by two.

This is done with IC3b, half a CMOS 4013 dual D type flip-flop. By connecting the Q output to the D input, that is connecting pin 5 to pin 2, the flip-flop will divide by two.

Notes A and BOTTOM E are obtained from pins 12 and 7 respectively. However, these lie in the octave below that of notes B, G and D, and two octaves below TOP E, and hence must be divided by four. This is achieved by passing the signal through and additional flip-flop, IC3a, also connected as a divide-by-two.

COMPONENTS

See Shop Talk page 171

Resistors

R1, 2, 3	18kΩ (3 off)
R4, 5	68kΩ (2 off)
R6	2·7kΩ

All ¼W carbon +5%

Capacitors

C1	270pF ±2% polystrene
C2, 3, 5	680pF polystyrene (3 off)
C4	0·022μF polyester

Semiconductors

IC1	4011 CMOS quad 2-input NAND gate
IC2	M083 MOS tone generator
IC3	4013 CMOS dual D-type flip-flop
TR1	BC108 silicon *npn*

Switches

S1-6	push-to-make non-latching (6 off)
S7	s.p.s.t. miniature toggle

Miscellaneous

B1	9V PP3 battery
LS1	miniature 4Ω speaker, 57mm dia
T1	miniature output transformer, 1·2kΩ primary, 3·2Ω secondary
VR1	15kΩ miniature vertical pre-set (see text)

Stripboard: 0·1in matrix, 25 strips × 33 holes; case, 120 × 80 × 35mm (Vero type 202-21390D); 16 pin d.i.l. holder; 14 pin d.i.l. holder (2 off); p.v.c. sleeved 7/0·2 equipment wire; battery clip; Veropins (12 off); epoxy resin adhesive; mounting hardware (M2·5 or 6BA); tinned copper wire (for links).

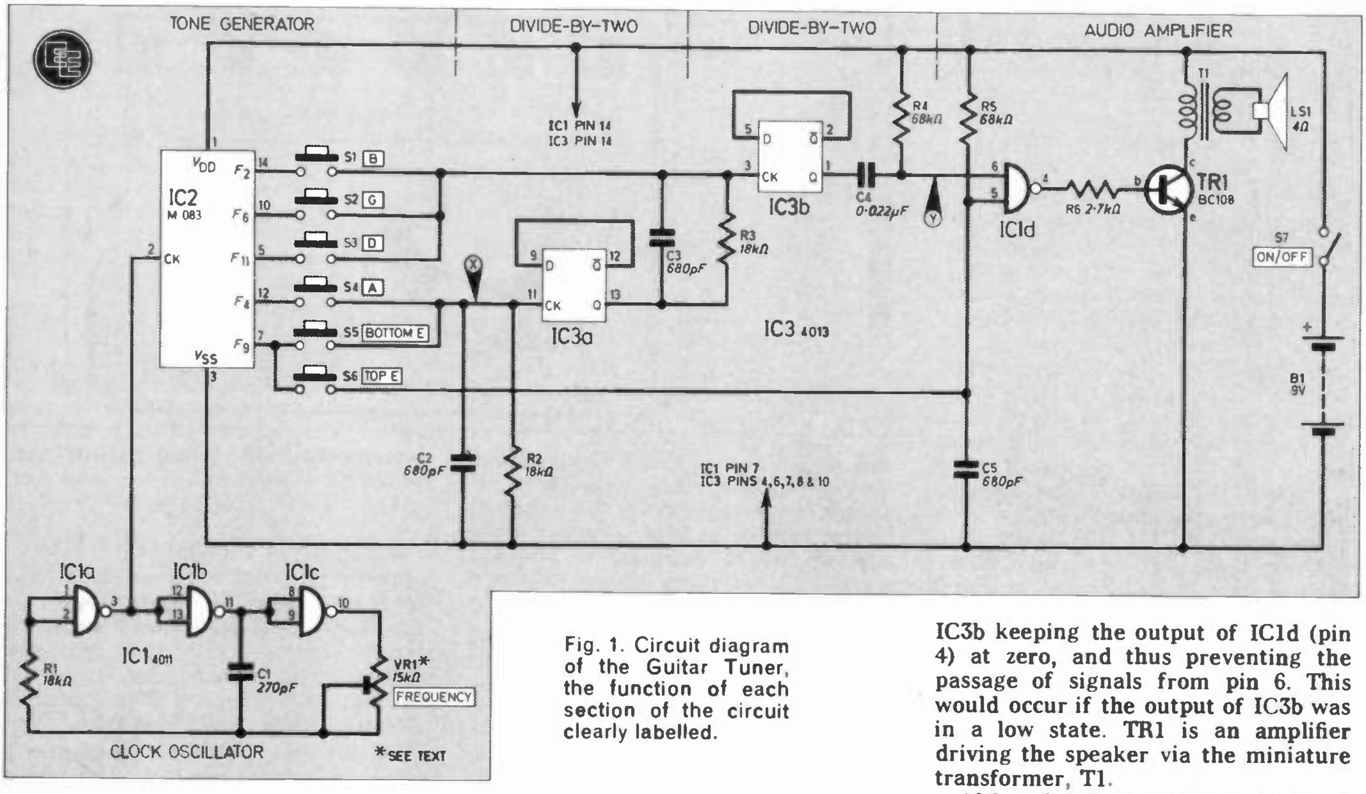


Fig. 1. Circuit diagram of the Guitar Tuner, the function of each section of the circuit clearly labelled.

C2, C3, R2 and R3 are included to fulfil the output loading requirements of IC2 and R3 also acts as a buffer between output pins 14, 10 and 5 of IC2 and the Q output, pin 13, of IC3. The signals are then fed into pins 5 and 6 of NAND gate IC1d as shown. C4 prevents any unwanted d.c. bias from IC3b keeping the output of IC1d (pin 4) at zero, and thus preventing the passage of signals from pin 6. This would occur if the output of IC3b was in a low state. TR1 is an amplifier driving the speaker via the miniature transformer, T1.

Although IC2 is specified to run off of 10 to 12 volts, the most convenient power source is a 9 volt PP3 battery, and the i.c. functions well at this voltage. S7 is the main ON/OFF switch.

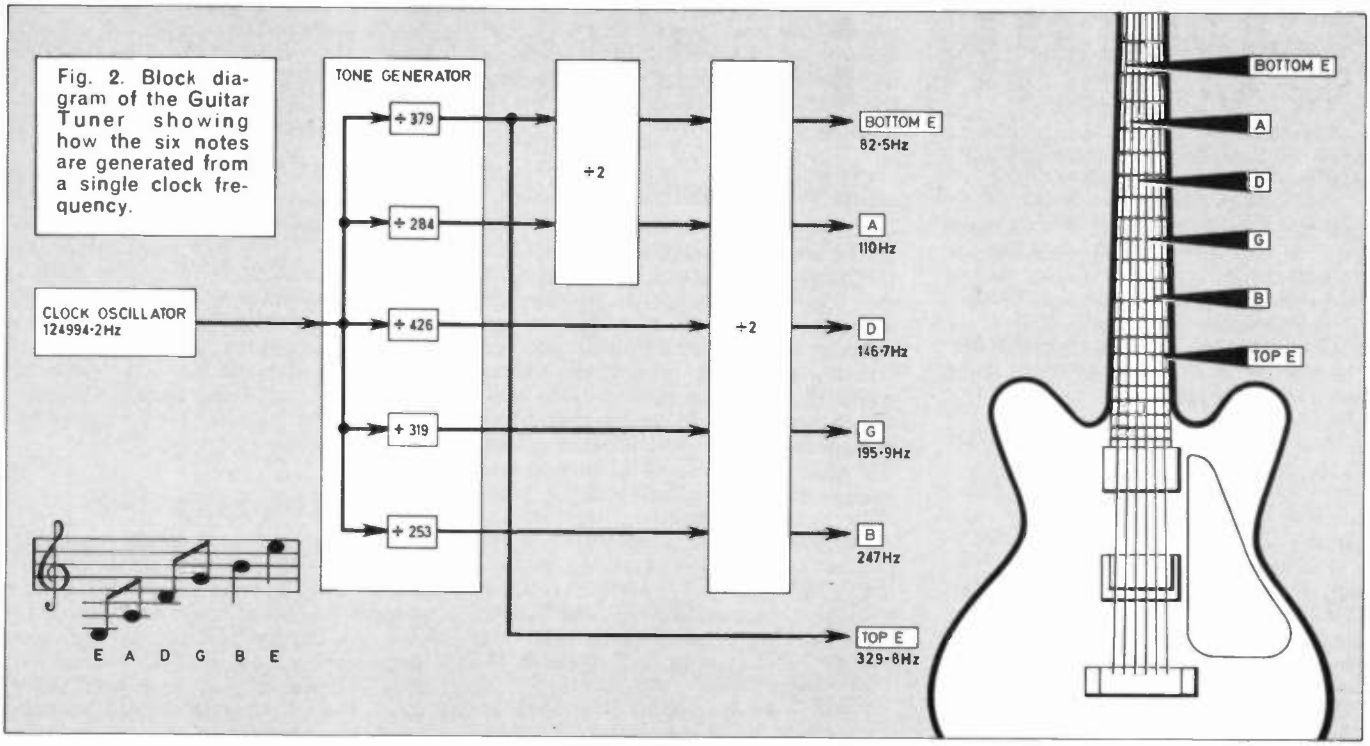


Fig. 2. Block diagram of the Guitar Tuner showing how the six notes are generated from a single clock frequency.

CONSTRUCTION starts here

CIRCUIT BOARD

The original prototype circuit board was built on Vero V-Q board but due to the ready availability and simplicity of use of standard stripboard, we have transferred the layout to 0·1in matrix Veroboard, 25 strips by 33 holes (shown in Fig. 3). The design requires the use of quite a large number of track breaks, 38 in all, and these must be positioned with great care.

Proceed to assemble the components onto the board, using i.c. holders for all i.c.s, especially IC2 which is quite an expensive device. None of the capacitors are polarity concious but the orientation of TR1 and miniature output transformer, T1 must be observed.

22 wire links are required and the longer ones, spanning say four holes or more, should be sleeved or made from insulated wire to prevent them flexing and shorting out against one another. Finally all connections from the board to the switches etc, should be made to Veropins as the continuous flexing of these wires which inevitably occurs during construction often leads to wires breaking, and repairs are easier to effect when pins are used.

CASE

The unit is built into a plastic moulded box, approximately 120 x 80 x 35mm with a removeable lid.

All seven switches are mounted into the base of the case as shown in Fig. 4. S1 to 6, the push-button switches, are equally spaced along one side of the case, fixed into 7·4mm diameter holes (for the switches we used, yours may be different) and S7 the ON/OFF toggle switch is mounted in a 6·4mm diameter hole in the position shown.

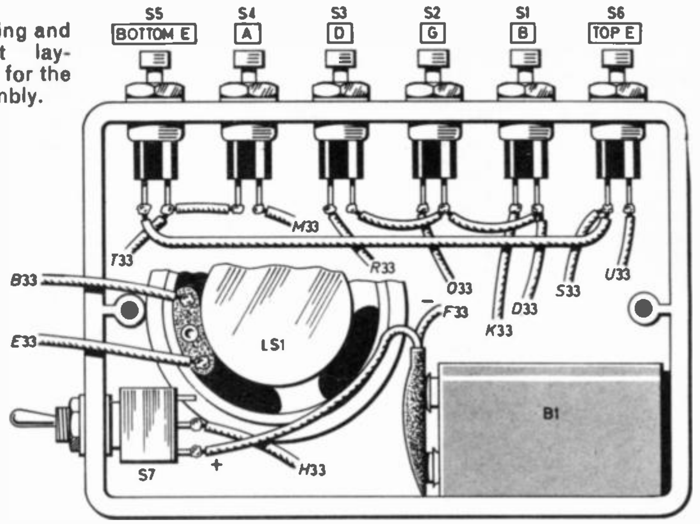
The speaker is glued into position in the base with epoxy resin adhesive, after first drilling a pattern of holes beneath it to form a "grille" (see photo).

The circuit board is secured to the lid of the case with two M2·5 (or 6BA) screws approximately 13mm long. To space the board away from the lid, two extra nuts, one on each screw, should be screwed on first.

When positioning the board on the lid, bear in mind the relative position of T1, the highest component, and the magnet of LS1 and ensure they do not foul each other. It is best to do this before glueing down the speaker.

The battery is held in place with a double sided sticky tab or alternatively by using foam rubber "sponge" to fill the space.

Fig. 4. Wiring and component layout details for the final assembly.



FINAL ASSEMBLY

Wire the board to the case mounted components with the 7/0·2 p.v.c. sleeved wire as shown in Fig. 4. Wire numbers refer to a strip/hole reference from Fig. 3, the stripboard layout diagram.

Having completed this assembly stage, it is a good idea to mark switches S5, 4, 3, 2, 1 and 6 with E, A, D, G, B, and E respectively, using dry print "rub-down" transfers. The words BOTTOM and TOP, used to differentiate between the two E's were not thought necessary, since pressing the buttons will immediately determine this!

USING THE TUNER

As previously discussed, IC1 will divide the input frequency into all the notes of an octave, irrespective of the input frequency. So, if for exable, the frequency of TOP E is not exactly 329·8Hz then this is not too critical, since the other frequencies will still be in the correct ratio relative to each other to enable the guitar to be tuned. However, adjusting VR1 will alter the oscillator frequency and enable the instrument to be calibrated against another instrument, for example, a piano. However, if no calibration source is available, replacing VR1 with a 12 kilohm resistor will give approximately the right pitch for the notes. If doing this, this resistor along with R1 should be ±2 per cent types.

Finally, do not sound two notes at the same time, since, if for example, S1 and S2 were pressed, the output of B would be feeding directly into that of G.

ALTERNATIVE CALIBRATION

In the event of no musical instrument or trained ear being available to the constructor, and he still wishes to set the tuner to a reasonably accurate standard, an alternative method of calibration is to use a test transmission tone from a television set.

During test card transmissions on BBC2, a 440Hz signal (middle A) is broadcast for a period of four minutes on the hour. Although the BBC cannot guarantee this signal to be absolutely accurate, it will be sufficiently close to middle A for our purpose.

However as the A string on the guitar is at 110Hz, that is two octaves below the transmission signal, on our tuner we must take the output directly from pin 12 of IC2 into the audio amplifier section, thus by-passing the two divide-by-two stages, IC3a and b.

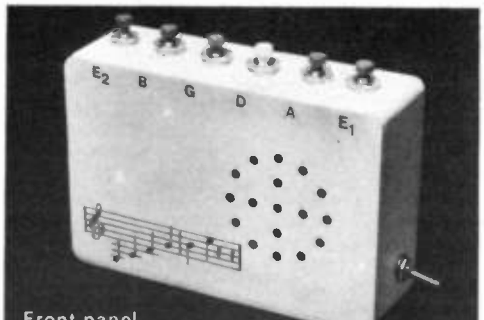
To achieve this, a temporary link must be made between pin 11 of IC3a and pin 6 of IC1d (point X, ref *M*15 and point Y, ref *T*12 respectively on Fig. 3) resulting in a 440Hz output from the speaker when S4 is pressed.

Now the clock oscillator can be tuned by adjusting VR1 until the output signal matches the test transmission signal. All other notes will automatically be in tune. Remove the link on completion.

TONE GENERATOR CHIP

It may be apparent to the constructor that the full potential of the M083 has not been exploited in this project. In fact it could be adapted to give the appropriate pitches for any instrument which requires tuning. So with the aid of Fig. 5, a brief data sheet, the constructor should be able to modify the circuit to suit his own needs and musical instruments. ⌑

GUITAR TUNER



Front panel lettering and speaker "grille".

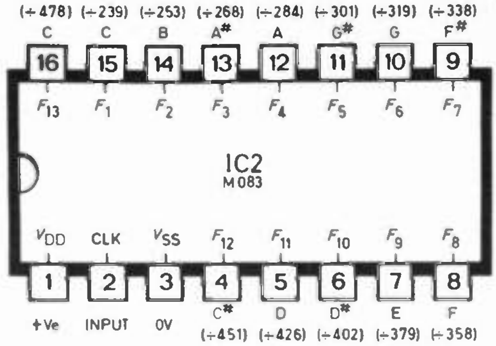


Fig. 5. Pin function diagram of the M083 tone generator i.c.

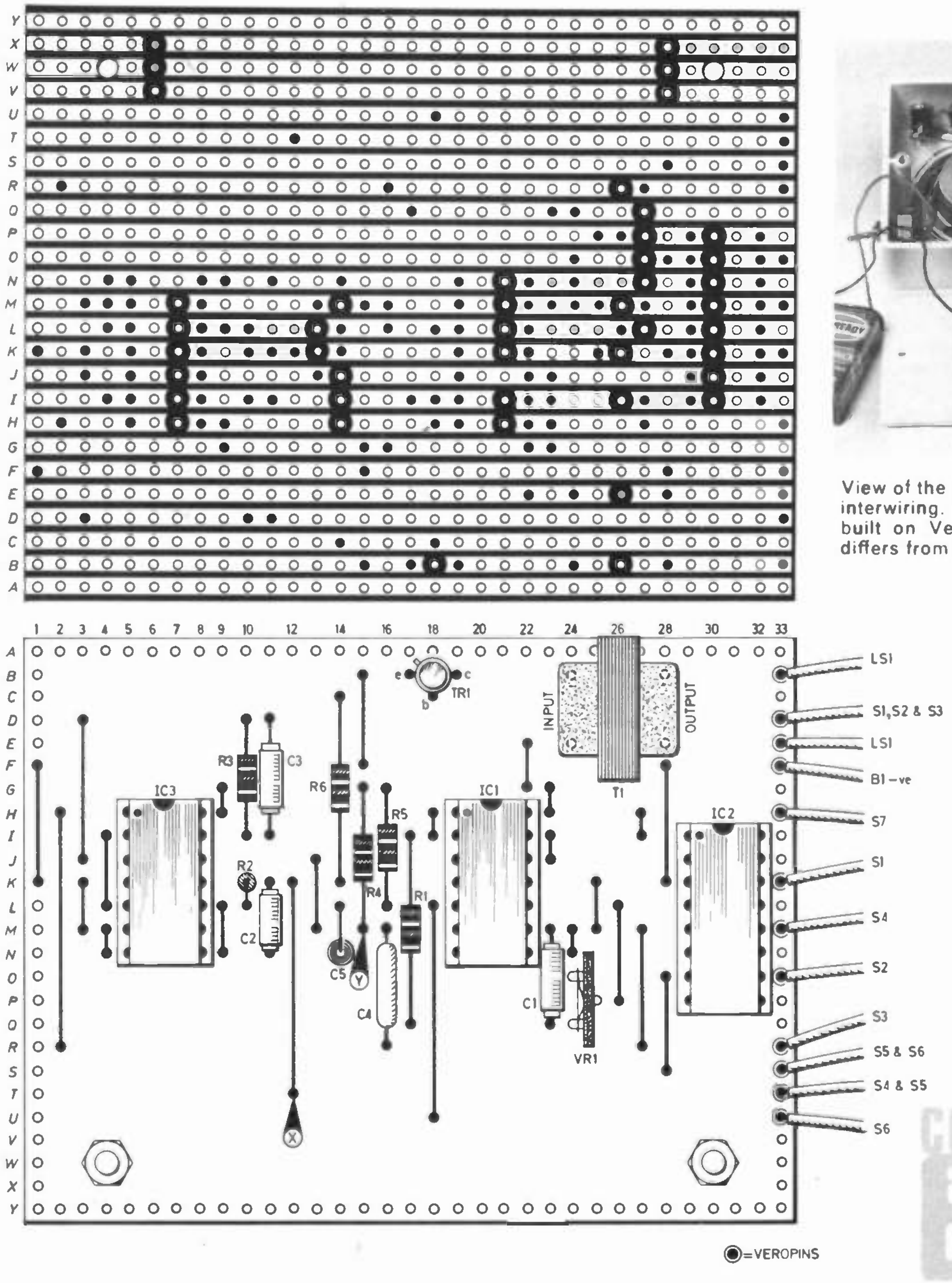
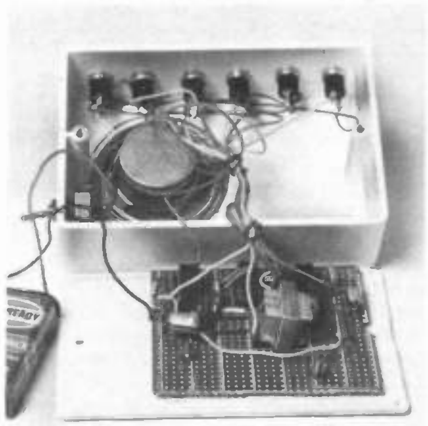


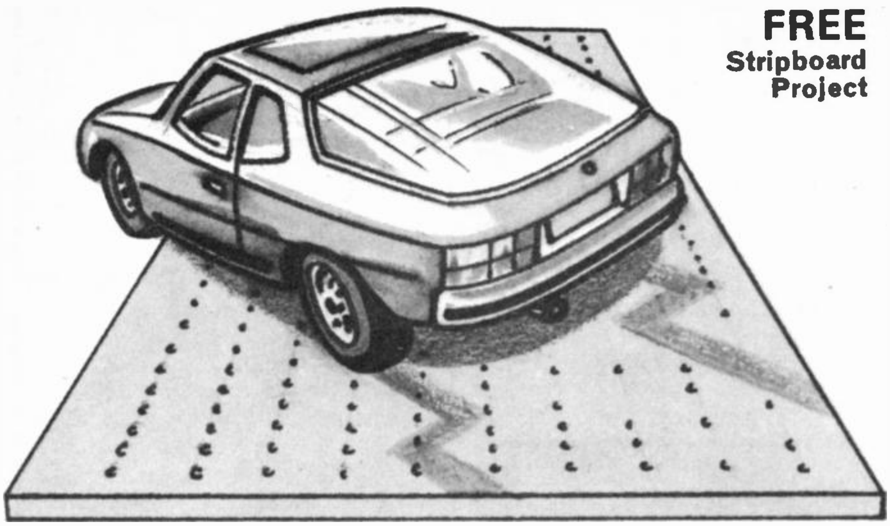
Fig. 3. Stripboard layout of the Tuner with the track view (top) showing all the necessary breaks.



View of the unit with lid removed showing interwiring. Note that the prototype is built on Vero V-Q board and therefore differs from the layout shown in Fig. 3.

COMPONENTS approximate cost £15·50

FREE
Stripboard Project



ICE WARNING for CARS

THIS article describes how to use a thermistor as a transducer in a circuit which repeatedly flashes a lamp when the temperature of the thermistor has fallen to a preset temperature —in this case 0 degrees Celsius. Thus the circuit can be used to warn the driver of a car that icy roads are likely.

The thermistor is a glass-encapsulated negative-temperature-coefficient (n.t.c.) bead type. Its small size enables it to respond rapidly to temperature changes. Note that an n.t.c. thermistor has an electrical resistance which increases with temperature fall.

THE CIRCUIT

The complete circuit diagram of the alarm is shown in Fig. 1. The design shown is powered by a 12V car battery, although should the circuit be used for other applications a 9V battery could be used.

The circuit consists of two distinct parts: (1) a temperature-sensitive Wheatstone bridge, the output from which is sensed by the op-amp acting as a differential amplifier and (2) a two-transistor oscillator which flashes the l.e.d. when the thermistor reaches a predetermined temperature.

WHEATSTONE BRIDGE

The Wheatstone bridge consists of resistors R1 and R2 which set the voltage at the inverting terminal of the op-amp, IC1, at about 8V with respect to the negative line (for a 12V supply). The preset resistor VR1 and the thermistor RTH1 form the other arms of the bridge.

Since the thermistor is an n.t.c. type, as its temperature falls its resistance increases, and the voltage at pin 3 rises. When this voltage just exceeds that at pin 2, the voltage at the output of the op-amp goes from near-zero to near +12V. The temperature at which the output goes sharply positive can be selected by adjustment of the preset resistor VR1.

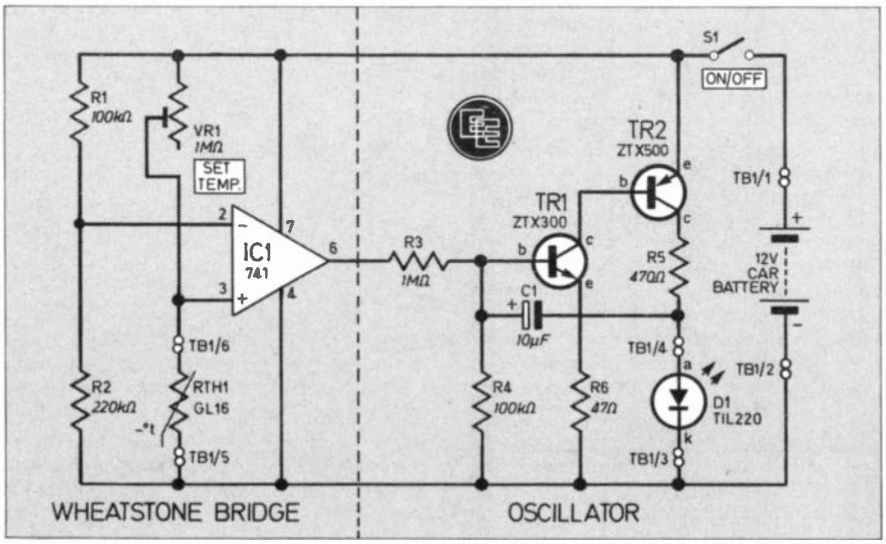
The high voltage at the output of the op-amp switches on the oscillator by coupling the "high" voltage to the base of TR1 through R3. The capacitor C1 provides the positive feedback which is necessary to maintain the low-frequency oscillations.

TR2 has the l.e.d. in its collector circuit with series resistor R5 which limits the current passing through the l.e.d. to a safe value.

The frequency of the flashes of the l.e.d. are determined partly by its own resistance and C1 value.

Transistors TR1 and TR2 should be a complementary pair if the circuit is to work satisfactorily. The pairs 2N2926/2N3702 and BC182L/BC212L are suggested alternatives to the types specified in the component list .

Fig. 1. The circuit diagram of the Ice Warning alarm.



COMPONENT ASSEMBLY

All the components, except battery, switch and l.e.d., can be mounted on a piece of 0·1 inch stripboard size 10 strips by 24 holes as shown in Fig. 2.

Make the necessary breaks on the underside of the stripboard as shown in Fig. 2. Use a spot face cutter or a small (3mm) drill bit. Position and solder the components to the topside of the board leaving the semiconductors until last. Attach sufficient

COMPONENTS

Resistors
- R1 100kΩ
- R2 220kΩ
- R3 1MΩ
- R4 100kΩ
- R5 470Ω
- R6 47Ω
- All ¼W± 5% carbon

See **Shop Talk** page 171

Capacitor
- C1 10µF elect. 15V

Semiconductors
- IC1 741 Op. amp 8-pin d.i.l.
- TR1 ZTX300, 2N2926, or BC182L silicon *npn* (See text)
- TR2 ZTX500, 2N3702 or BC212L silicon *pnp* (See text)
- D1 TIL220 red light emitting diode
- RTH1 GL16 glass bead thermistor

Miscellaneous
- S1 s.p.s.t. switch or car ignition switch
- Stripboard 0·1 inch matrix, 10 strips × 24 holes; insulated stranded connecting wire; suitable small plastic case, approx. 75 × 30 × 30mm—Verobox type 202-2102K or similar; 6-way (2A screw) terminal strip.

Approx. cost Guidance only £4·50

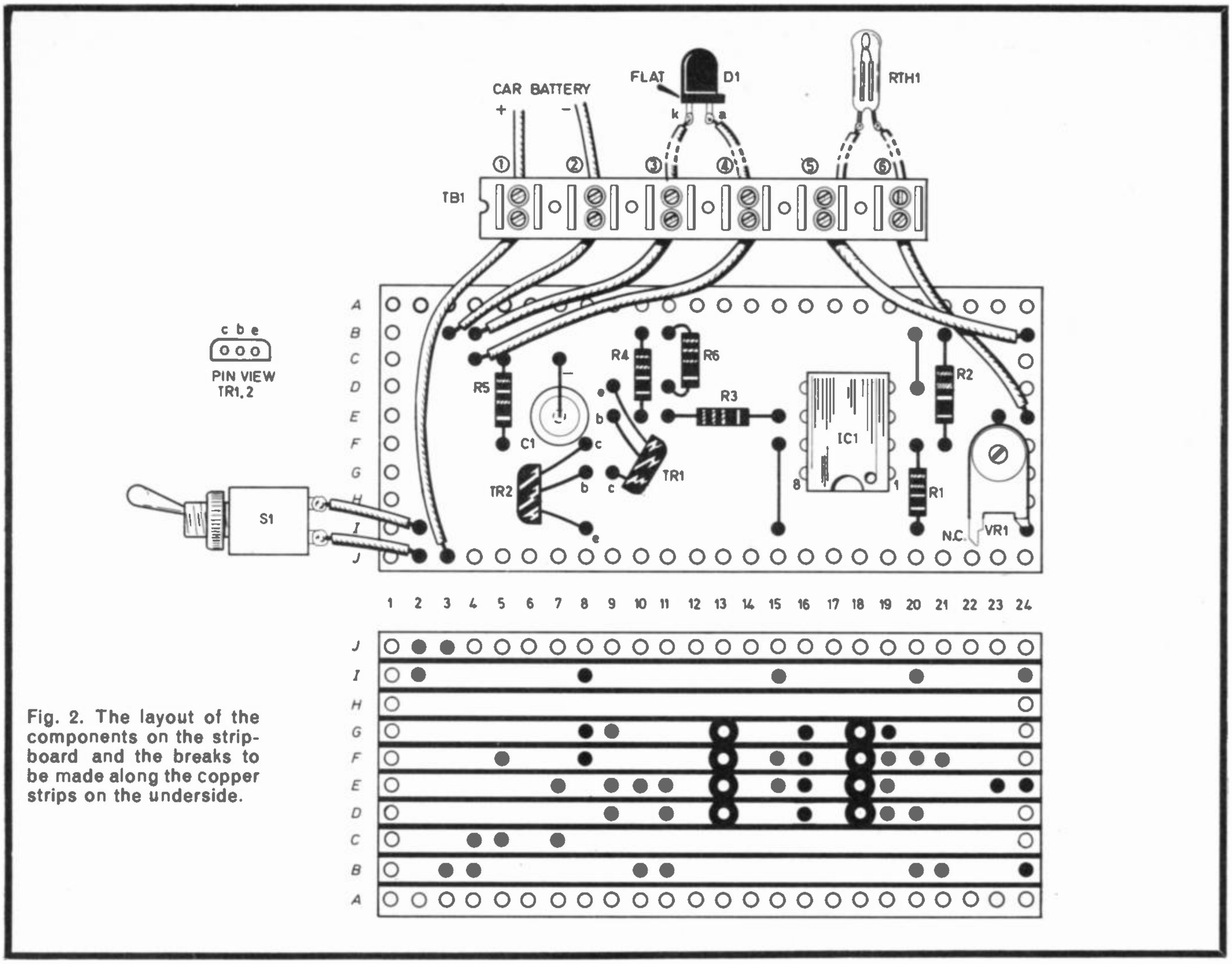


Fig. 2. The layout of the components on the stripboard and the breaks to be made along the copper strips on the underside.

lengths of flying leads to the board to reach the screw terminal block fitted on the outside of the case. The wire feed hole on the case should be fitted with a rubber grommet for protection. The board may be held in place in the case by wrapping it in foam sponge after calibration. This will dampen any vibration resulting from the running of the car. Wire up the switch and terminal block to the board and then calibrate as instructed below.

CALIBRATION

Before fixing the unit to the car, it must be set to respond to an air temperature of 0 degree Celsius.

Crush some ice in a container until it is "slush". Ensure that the ice is melting, for then it is at 0 degree Celsius (the ice point) but check the temperature with a thermometer if you have one available. Immerse the thermistor in the melting ice and adjust the preset resistor until the l.e.d. just begins flashing. Take the thermistor out of the iced water and as it warms up the l.e.d. will cease to flash.

THERMISTOR POSITION

The thermistor must be sited in a position where it cannot receive heat from the engine. It must be close to the ground since the conditions for ground frost, giving icy patches on roads, cannot be predicted a few feet above the ground.

The thermistor must also be protected from contact with water splashes and rain, for the cooling produced by water evaporating from the thermistor will cause it to fall to a temperature below the true air temperature. A good position for the thermistor may be behind the front bumper although the best position will be determined by the type of car it is to be used with.

Having decided on the best position for the thermistor, you will need to estimate the length of flex required between the thermistor and the circuit. Care should be exercised in soldering the flex to the thermistor since the soldered joints should be insulated with sleeving to prevent them coming into contact with water or the car body; heat-shrinkable sleeving is ideal for this purpose.

The thermistor should then be glued into the end of a short length of plastic tubing so that although air can circulate round it, it is protected from water splashes.

Any small plastics box may be used to house the circuit board which can then be mounted unobtrusively behind the dashboard of the car, in the glove compartment or even fitted to the parcel shelf using double sided foam pads. Choose a position on the dashboard where it is easy to see the flashing l.e.d.. Drill a hole to take the l.e.d. so that it can be fixed by pushing it into its plastic fixing clip. If this is unacceptable, the l.e.d. may be attached directly to the terminal strip and the assembly positioned in easy view of the driver.

IN USE

In use it is interesting to note, as one drives along during a frosty evening, the indication given by the device. The likely conditions for ice to form on the roads is clearly indicated—under trees or other sheltered places, in hollows where cold air collects and even a change from cloudy to clear sky.

INTRODUCTION TO LOGIC

PART 11 BY J. CROWTHER

APPLICATION OF LOGIC TECHNIQUES

(3) The Half Adder

The purpose of a **Half Adder** is to add together two binary digits of a binary number.

Suppose we call the two binary digits to be added A and B, the Truth Table will be:

A	B	*Sum*	*Carry*
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

From the Truth Table it can be seen that the module must have two outputs, a *sum* which goes into the register, and a *carry* which is passed on to the next column.

We only require a *carry* if A and B are 1, the Boolean Equation for this is:

$AB = S$

This is given by an AND gate as shown in Fig. 11.1.

If we take the case where the sum = 1, the Boolean Equation for the sum output becomes:

$\bar{A}B + A\bar{B} = S$

In Boolean Algebra we can add any Identity which is equal to 0, to an equation without altering its value.

Add $A\bar{A}$ and $B\bar{B}$ to the above equation and we get:

$A\bar{A} + \bar{A}B + B\bar{B} + AB = S$

$\bar{A}(A + B) + \bar{B}(A + B) = S$

$(\bar{A} + B)(A + B) = S$

$\overline{AB}(A + B) = S$

This represents an AND gate fed with $(A + B)$ and $\overline{AB}$ as shown in Fig. 11.2.

$(A + B)$ is obtained from an OR gate.

It will be noticed that $\overline{AB}$ is the inverse of the carry, and can be obtained by passing the carry through a NOT gate, so the complete module for the half adder becomes as seen in Fig. 11.3.

(4) The Full Adder

Since the half adder has no provision for a carry from a previous stage it can only add the first column of a binary number where there is no carry from a previous stage. To add any other column except the first we must use a **Full Adder**. This consists of two half adders; the first adds the two binary digits and the second adds the carry from the previous stage to the sum from the first half adder. This arrangement would give two carries, one from each half adder, but there can only be a carry if the two inputs are 1, in which case there would be no sum, therefore there can only be a carry from the first or second stage but not from both. Because of this we can pass the two carries through an OR gate, and so obtain one carry as shown in Fig. 11.4.

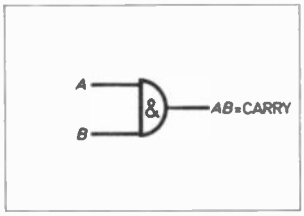


Fig. 11.1. Producing a "carry" in binary addition of A and B.

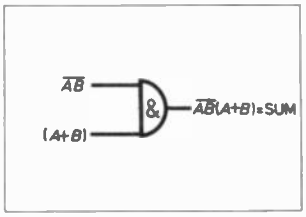


Fig. 11.2. Deriving the "sum" in binary addition of A and B.

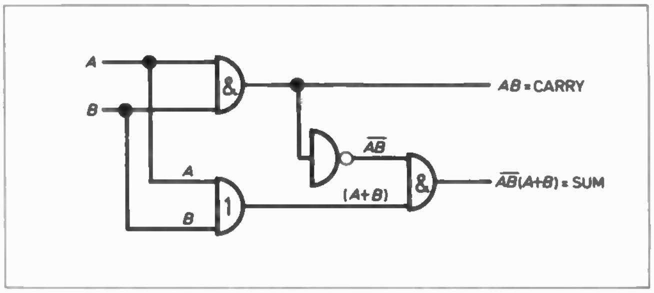


Fig. 11.3. Complete logic module for a half-adder.

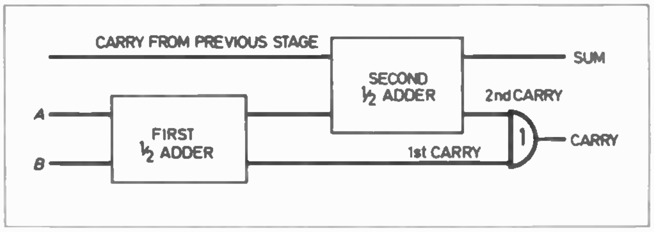


Fig. 11.4. Logic module of a full-adder.

OTHER GATES FROM NAND GATES

(1) The NOT gate

Suppose the two inputs of a NAND gate were strapped together. Both inputs would be fed with A, and the output S would be given by:

$$\overline{AA} = S$$

Since $AA = A$ (Boolean Identity 1) we get

$$\overline{AA} = \bar{A} = S$$

This is the equation for a NOT gate. Therefore we can make a NOT by strapping the inputs of a NAND gate together as shown in Fig. 11.5.

A NOT gate may also be made from a 2-input NAND gate by strapping one input to logic 1.

(2) The OR gate

Suppose we feed $\bar{A}$ and $\bar{B}$ into a NAND gate, the output S would be given by:

$$\overline{\bar{A}\bar{B}} = S$$

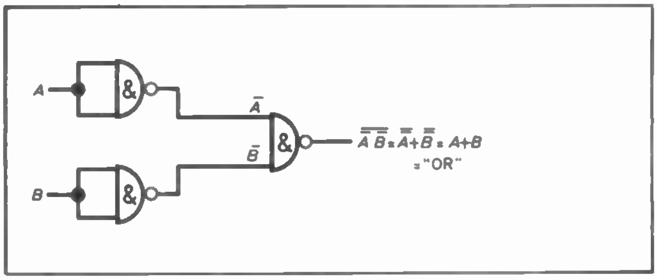


Fig. 11.6. An OR gate using NAND gates.

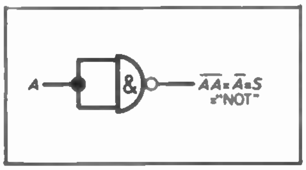


Fig. 11.5. A NOT gate using a NAND gate.

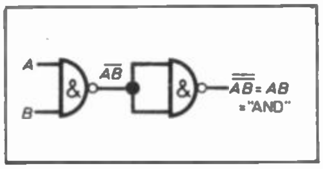


Fig. 11.7. An AND gate using NAND gates.

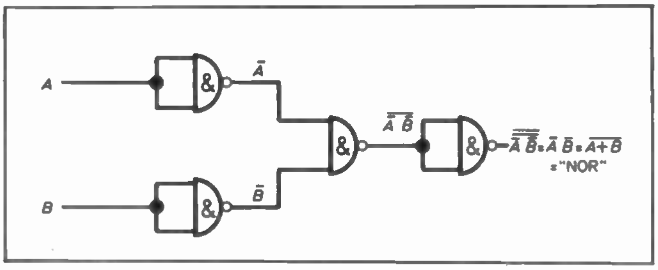


Fig. 11.8. A NOR gate using NAND gates.

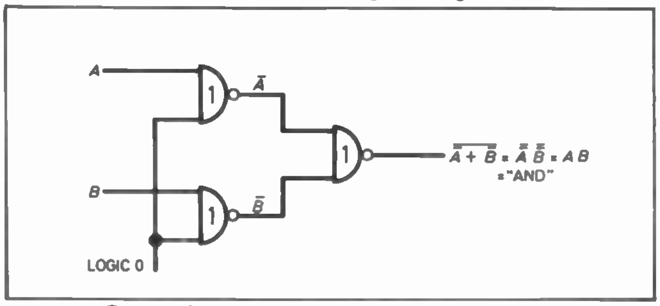


Fig. 11.10. An AND gate using NOR gates.

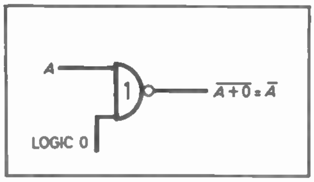


Fig. 11.9. A NOT gate using NOR gate.

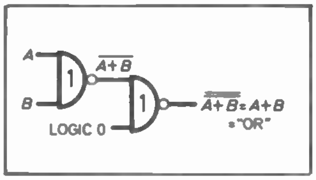


Fig. 11.11. An OR gate using NOR gates.

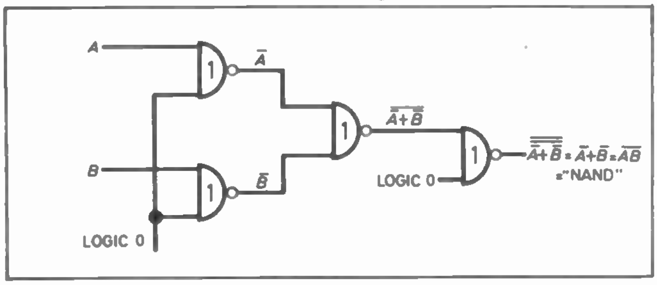


Fig. 11.12. A NAND gate using NOR gates.

If we now apply Demorgan's theorem to this equation we get:

$$\overline{\bar{A}\bar{B}} = \bar{\bar{A}} + \bar{\bar{B}} = A + B = (A \text{ OR } B)$$

$\bar{A}$ and $\bar{B}$ can be obtained by passing A and B each through a NOT gate, and using NAND gates to form NOT gates we obtain the logic module shown in Fig. 11.6.

(3) The AND gate

NAND means NOT AND, that is, the inverse of AND. Therefore it follows that AND is the inverse of NAND. So an AND gate is a NAND gate followed by a NOT gate. If we use a NAND gate for NOT gate we arrive at the logic module shown in Fig. 11.7.

(4) The NOR gate

The NOR gate is the inverse of the OR gate, so if we pass the output of an OR gate through a NOT gate we get a NOR gate. By combining the OR gate in Fig. 11.6 with the NOT gate in Fig. 11.5 we get the arrangement shown in Fig. 11.8.

OTHER GATES FROM NOR GATES

(1) The NOT gate

Consider the NOR Truth Table shown below left.

A	B	S
0	0	1
0	1	0
1	0	0
1	1	0

Suppose that the B input was permanently connected to logic 0, then lines 2 and 4 in the truth table left would not exist. The truth table thus becomes:

A	B	S
0	0	1
1	0	0

It can be seen now that if A is 0, S is 1, and if A is 1, S is 0. So it is inverting A and acting as a NOT gate. Therefore a NOR gate connected as in Fig. 11.9 will act as a NOT gate.

A NOR gate with both inputs strapped together will also act as a NOT gate, see lines 1 and 4 in the NOR Truth Table above.

(2) The AND gate

Suppose we fed $\bar{A}$ and $\bar{B}$ into a NOR gate, the output would be given by:

$$\overline{\bar{A} + \bar{B}} = S$$

If we apply Demorgan's theorem to this equation we get:

$$\overline{\bar{A} + \bar{B}} = \bar{\bar{A}}\bar{\bar{B}} = AB = (A \text{ AND } B)$$

$\bar{A}$ and $\bar{B}$ can be obtained by passing A and B each through a NOT gate, and using NOR gates as NOT gates we obtain the logic module shown in Fig. 11.10.

(3) The OR gate

NOR means NOT OR, that is, the inverse of OR. Therefore it follows that OR is the inverse of NOR, so an OR gate is a NOR gate followed by a NOT gate. If the latter is constructed using NOR gates, we obtain the logic module shown in Fig. 11.11.

(4) The NAND gate

The NAND gate is the inverse of the AND gate so if we pass the output of an AND gate through a NOT gate, we get a NAND gate. By combining the AND gate of Fig. 11.10, with the NOT gate of Fig. 11.9, we get a NAND gate using NOR gates only. See Fig. 11.12.

TO BE CONTINUED

Everyday News

THE AGE OF THE TRAIN

British Rail takes on the airlines with a less than 4½ hours travelling time from London to Scotland

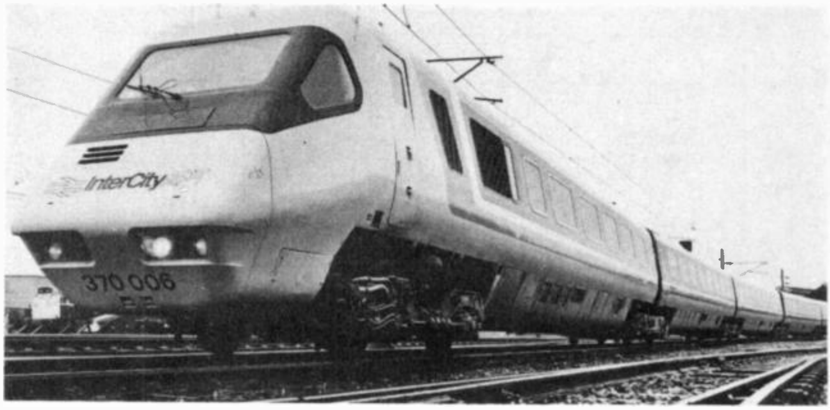
BR "zooms into the 80's" with the APT *(their words not ours)*

★ Speeds in excess of 125mph cut journey time by 15 to 20 per cent

★ Glasgow to London in 4 hours 15 minutes.

Amid all the ballyhoo about locked tilt mechanisms, "sea sickness" from sway and sensor malfunctions due to extreme cold, it must be remembered that the new APT high-speed tilting train, which covered the Glasgow to London run in 4 hours 14 minutes (including stops at Motherwell and Preston), is still a pre-production prototype built to evaluate the new design.

The Advanced Passenger Train is a high-performance, electric powered train with tilting coaches for passenger comfort when the train traverses curves at speed. First conceived in 1969, it was designed by BR engineers and built by British Rail Engineering Ltd to operate at speeds up to 125mph and more on existing tracks and within the present system.



Why APT?

Nearly 50 per cent of the major rail network is on curves so average speeds and point-to-point journey times are primarily governed by permanent speed restrictions at these points.

To enable conventional trains to go round curves faster tracks are canted, the outer rail raised above the level of the inner. Even with this arrangement only comparatively low speeds are possible.

Instead of the costly exercise of straightening out the most severe curves, BR's answer is the APT.

How It Works

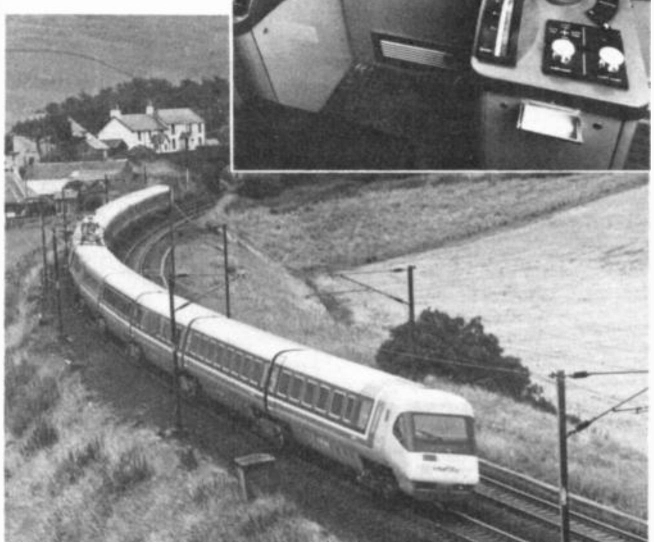
Using an entirely new suspension design it allows the train to take curves 20 to 40 per cent faster than conventional rolling stock. Tilting the coach bodies by as much as 9 degrees passenger comfort is maintained.

Also, test running had shown that a tilt failure would be rare, it was decided to fit a device to lock a coach in the upright position in the event of a failure.

BR would not divulge all the technical details, but we understand that electronic monitoring of the various systems is used extensively.

The prototype 4000hp Power Car contains most of the monitoring equipment, power equipment and braking and tilt sensing equipment. It is hoped to fit this into a driving power car including the driving cab.

The APT instrument and control panel layout of the driving cab. Surprisingly, no tilt angle dial or indicator could be seen.



The APT taking a curve at high speed.

Hot Camera

An experimental solid state infra red camera that detects small variations in heat and creates recognizable television pictures of warm objects in a room totally dark to the human eye was demonstrated by RCA researchers recently.

During the demonstration, the camera was able to discriminate veins in a human hand and detect residual thermal prints on objects that had been touched by a hand for a second or less.

The heart of the camera is a high performance imager, about the size of a "dime" or half-pence, containing over 8,000 infra red sensitive elements. While picture quality is less than commercial TV standards, present progress indicates that the technology has the potential for full-television resolution.

—ANALYSIS

ON THE RECORD

When, one hundred and five years ago, Thomas Alva Edison made the first ever recording of sound he could hardly have foreseen what was to follow. His crude but highly original tin-foil phonograph signalled the start of a whole new industry although some fifty years were to elapse before sound recording and reproduction started to approach the levels of realism and fidelity now taken for granted.

For the real enthusiast, however, the search for perfection continues in pickups, turntables, amplifiers and speakers. Who a few years ago would have imagined that the domestic user would be offered a player unit in which the record is firmly attached to the turntable by suction, or another in which a turntable weighing 20 kg runs on a cushion of air supplied from an external pump; Or that keen types could be found willing to fork out £10,000 for a pair of speakers?

The hi-fi industry is awash with gadgets and gimmicks. One of the latest is digital time-lag to give the illusion of altering the size of your living room to suit the sound, from an intimate night club to a full-sized auditorium.

It is surprising that the classical disc record has lasted so long with its spiral groove impressed with an anlogue recording track mechanically in contact with the pickup stylus. Much of the technology has been devoted to overcoming the inherent problems in such a system.

Digital recording on compact discs will dispense with the delicate mechanical intricacies of conventional pickups and the heavy engineering of turntables, both very expensive. By using laser scanning of stored digital codes on a sealed disc there is no physical contact and therefore no wear on the record or laser "pick-up", no rumbles or crackles and an hour of hi-fi can be packed into a disc smaller than today's single.

Should we therefore pause before buying "old-fashioned" records, turntables and pickups and wait, perhaps for only a year or so, for digital discs and laser scanning? Not really, says the hi-fi industry. Analogue systems, they say, are still being improved and the weakest link now in the hi-fi chain is the speaker which digital technology can not alter.

Brian G. Peck

RADIO SURVEY

The British National Oil Corporation is conducting a survey of microwave radio reception over the North Sea with a view to pinpointing periodic deterioration of signals.

A Microdata M1600L portable data logger is being installed on a drilling platform in the Beatrice oil field. It will automatically record field strength, date, time of day and other relevant information for subsequent computer analysis on-shore.

Nearly all oil platforms in the North Sea depend for telecommunication either on line-of-sight microwave links or tropospheric scatter links for contact beyond the horizon.

The BBC has produced its first Digital SECAM to PAL transcoder, using the CCIR recommended digital sampling standard.

Tandy Corporation (Branch) UK have announced the signing of the world famous science writer Isaac Asimov for extensive advertising and product promotion.

WIN £1000

British Telecom's Prestel world viewdata service is offering a £1,000 prize to the designer of the best Prestel adaptor for the Sinclair ZX81 personal computer.

The prize will be awarded to the adaptor which best combines low price, elegant design and practical robustness. The working design submitted must be capable of being modified to receive approval for attachment to the telephone network.

Closing date is March 14 and details, specification and entry forms are available from Prestel Headquarters, Telephone House, Temple Avenue, London EC4 0HL.

British Telecom's suggestions box led to a £6,000 award divided between David Atkins and Tim Walker for their idea of an automatic scanner for testing electronic telephone exchanges.

It does the work in a single night which formerly occupied a skilled engineer for a week. Known as WAM—the Walker Atkins Multitester—it is now being used at exchanges throughout the UK.

BETTER VHF RADIO RECEPTION IN SOUTH-EAST

Vertical Polarised Transmissions give improved VHF service for motorists and users of portables.

THREE new high power VHF transmitters came operational at Wrotham, Kent, early last December. The new transmitters radiate BBC Radio 1 and 2, Radio 3, and Radio 4 including some educational programmes. This station serves nearly 13 million people in London and South East England.

A new mast has been built alongside the old one which was originally used for early experiments in VHF broadcasting thirty years ago. The new mast is 177 metres high and carries aerials specially designed to radiate both horizontal and vertical polarisations. The total power radiated has been doubled.

Vertically polarised signals are required for good reception with portables and car radios.

Listeners with fixed roof or loft horizontal aerials for receiving Wrotham stereo transmissions will be unaffected by the addition of the vertical radiation.

This new system should help the BBC's campaign to encourage wider use of VHF. Medium wave reception is already poor in some areas and deteriorates at night; this situation will get worse with additional European stations coming into operation. The answer, the BBC says, is VHF—which provides interference-free reception and permits higher quality and stereo transmissions.

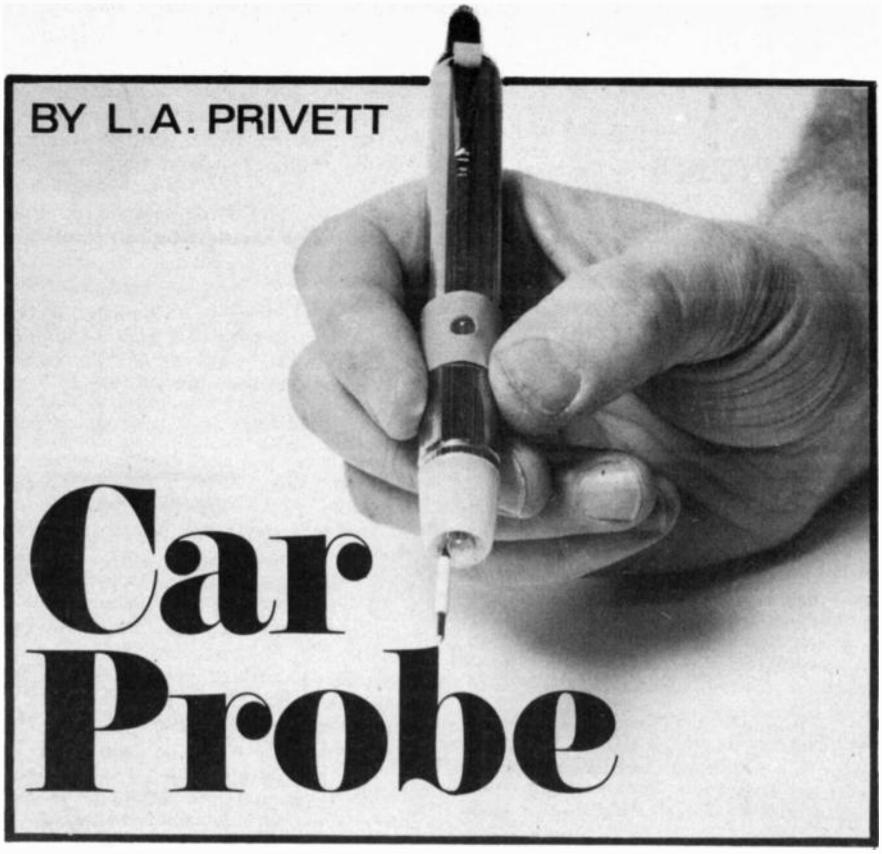
● Wrotham is the first high-power VHF radio station in the country to radiate both horizontal and vertical polarisations.

Improved reception for v.h.f. portables using vertical whip aerials and v.h.f. car radios is promised from the re-equipped v.h.f. sound radio transmitters at Wrotham, Kent. As well as six new 20kW Marconi transmitters the radiating elements now have vertical as well as horizontal polarisation.

Other v.h.f. stations will have vertical polarisation added as they take their turn in the modernisation programme.

Car Probe

BY L.A. PRIVETT



When the probe tip is placed on a connection with a positive potential, a current (conventional) will flow through the RED half of D1, a RED/GREEN bi-colour l.e.d., then through D3, R2 being the current limiting resistor. D2 prevents any current flowing into the other branch of the circuit. See Fig. 2a.

Fig. 2b shows the direction of current flow (conventional) when the probe tip is placed on a negative or 0V connection. That is, from the +12V terminal of PL1, through D2 and current limiting resistor R1 then through the GREEN half of D1.

A.C. VOLTAGES

Should the probe tip be placed on a connection with an alternating voltage the two halves of D1 would each turn on and off in rapid succession thus resulting in an amber colour, enabling the probe to indicate a further state, that of an a.c. signal being present.

The 12V lamp LP1 has been incorporated to indicate that the probe is connected to the car battery supply and also, perhaps more importantly, to illuminate those dark corners

WHEN testing the electrics, tracing cables or simply adding new accessories to the car, it is often desirable to know the polarity of a wire or connector at a point where it is impossible to determine this by the colour or destination of that wire.

It was for these reasons that this probe was designed to give an instant indication of the unknown polarity with the use of a bi-colour l.e.d. If it glows red, the potential is positive and green indicates 0V (chassis on negative earth cars).

CIRCUIT OPERATION

The principle of operation of the probe is really quite simple, using only six discrete components and the circuit diagram is shown in Fig. 1.

The probe is powered from the car battery circuit via PL1, which in the authors case was an accessory plug of the type which fits the cigar lighter socket.

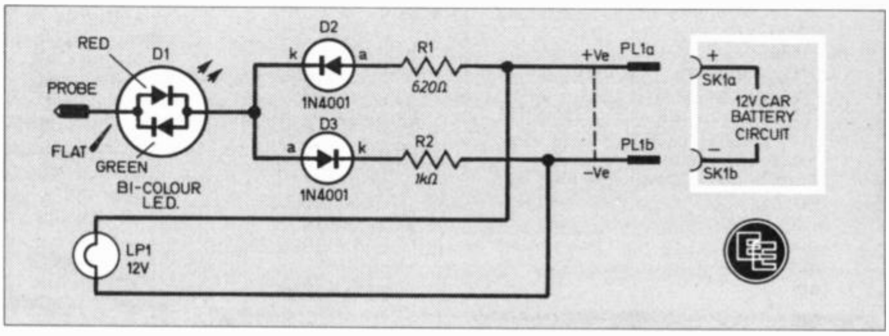


Fig. 1. Complete circuit diagram of the Car Probe. Note that SK1 is the cigar lighter socket.

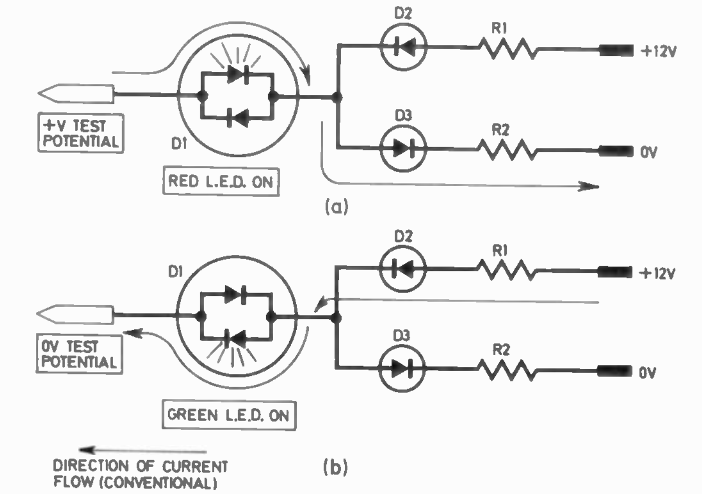
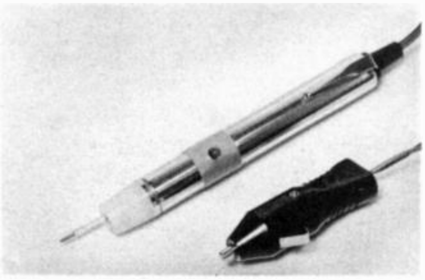


Fig. 2. (a) shows the conventional current flow when testing a positive potential and (b) gives the flow of current when the probe tip is on the 0V side of the supply.



Finished probe with the car accessory plug, PL1, alongside it. A coloured band was added around the case to enhance the appearance.

under the bonnet and beneath the dashboard when looking for the right wire.

PROBE ASSEMBLY

Finding a case for the probe requires careful consideration, as it has to be both hand held and fairly robust for the kind of environment in which it will be used. The prototype was built into an empty "light pen" holder which fortunately had a screw-in bezel to hold LP1 and the tip.

However, many tubular containers such as a large cigar tube or small torch housing could be adapted. A further alternative would be to build it into a hand held control box (such as the Vero 202 21026G) with the probe tip protruding from one end.

COMPONENTS

Resistors
R1 680Ω
R2 1kΩ
All ¼W carbon ±5%

See Shop Talk page 171

Semiconductors
D1 bi-colour l.e.d. red/green
D2, 3 1N4001 1A silicon or similar (2 off)

Miscellaneous
LP1 miniature 12V bulb, L.E.S. or flange
PL1 car accessory plug, for cigar lighter socket
Probe case (see text); brass rod 45mm long, 1·2mm diameter (for probe); sleeved grommet; epoxy resin adhesive; p.v.c. sleeved wire; 3·5m twin cored cable; heat shrink sleeving (or electrical tape).

Approx cost Guidance only £3 excluding case

WIRING

The twin-cored cable is fed into the probe housing through a sleeved grommet and soldered directly to the leads of R1 and R2. As the components are all soldered together in a "spider's web" fashion it is important to make a good mechanical joint before soldering. All joints and bare metal component leads must be insulated preferably with heat-shrink sleeving but electrical insulating tape will suffice, particularly if the probe is to be in a metal housing.

The wiring of the components is shown in Fig. 3.

The probe tip itself was made from a brass rod, approximately 1·5mm diameter and this was glued with epoxy resin adhesive into a hole drilled into the bezel. The end was fashioned into a point and a sleeve was slipped over the protruding length to prevent an accidental short circuit.

D1 was also glued into a hole in the probe body and LP1, an L.E.S. or flange type bulb was soldered directly to two wires from R1 and R2. The base of the bulb was then bound with tape to form a large enough ferrule to remain captive in the probe bezel.

PLUG

The power for the probe is picked up via PL1 and as discussed before, this is a plug designed to fit a cigar lighter socket. This was found to be the most convenient method for use on a car as it is fused and controlled by the ignition switch but an alternative method of connection may be used.

When wiring PL1, remember that the positive connection on *negative earth wired* vehicles will be the spring loaded tip of the plug and the chassis or negative connection is the spring on the side of PL1. These connections must be reversed for *positive earth wired* automobiles.

IN USE

To test the probe, simply insert it into the cigar lighter and try it on connections of known polarity, the most obvious being the battery itself! The positive terminal should result in D1 glowing red and the negative terminal resulting in D1 showing green.

If these results are reversed, D1 may be soldered in incorrectly; remember that the anode (a) of the red l.e.d. within D1 is indicated by a "flat" on the body and it is this lead which is connected directly to the brass probe tip. Another possibility is the terminals of PL1 have been reversed.

The probe can also be used to examine power supply conditions on both digital and analogue circuits, provided that the probe power is taken from the board under test.

It must not, however, be used for high voltages or mains. ⌑

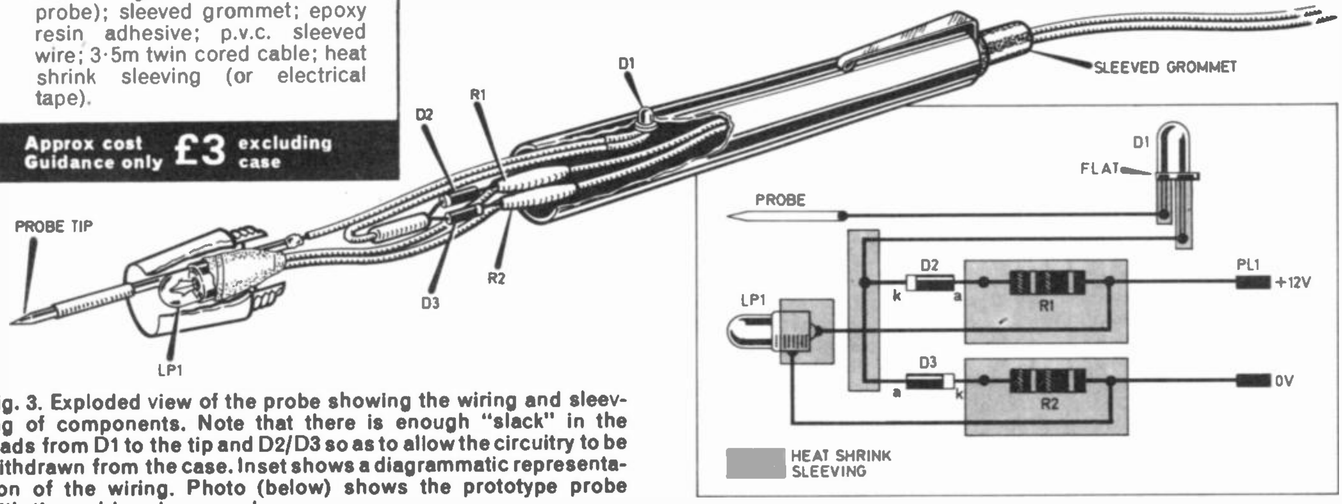
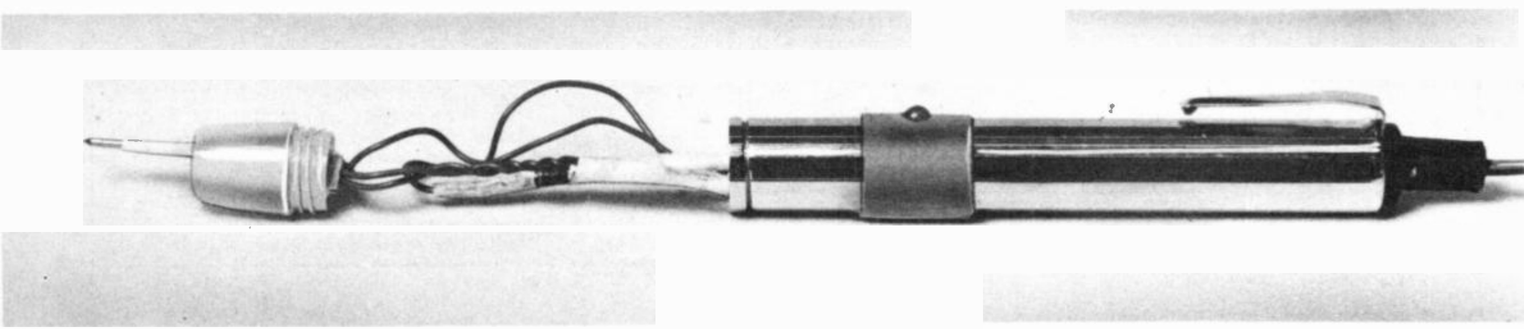


Fig. 3. Exploded view of the probe showing the wiring and sleeving of components. Note that there is enough "slack" in the leads from D1 to the tip and D2/D3 so as to allow the circuitry to be withdrawn from the case. Inset shows a diagrammatic representation of the wiring. Photo (below) shows the prototype probe with tip and bezel removed.



RADIO WORLD

By Pat Hawker, G3VA

Gas Radio

MR. W. E. CAUGHEY, G12DZG of Belfast recently drew to my attention some fascinating correspondence in *The Sunday Telegraph* about the way in which radio listeners used to run their radio sets from gas using thermoelectric techniques. It seems worth adding a little background information. Such systems, still used for some specialised purposes, make use of the fundamental principle that when the junctions between two dissimilar metals are at different temperatures a small amount of electricity is generated, the so-called Peltier effect which is, in practice, more often used for refrigeration than for electrical generation.

In the late 1920s and early 1930s the "national grid" electricity supply mains still did not reach very many homes, and of the homes that did have electricity quite a few were supplied with direct-current (it was not until after World War II that d.c. disappeared from some London districts). Most early domestic radio sets, other than crystal sets, were intended for use with "high-tension" (h.t.) batteries, which were typically 90 or 120 volts with round Leclanché cells (it was not until the 1940s that layer-type batteries came into wide use), and "low-tension" filaments were powered from 2V lead-acid rechargeable "accumulators" which when discharged were taken along to a local radio shop or garage for recharging.

Many sets also needed a 9V grid-bias battery although very little current was drawn from this. The h.t. batteries were not particularly cheap and mains-operated "battery eliminators" were popular in the late 1920s using metal rectifiers but often with poor ripple filtering.

An early gas-powered unit was the Thermattaix introduced in 1927 as a substitute for the l.t. accumulators and contained thermocouples heated by small gas jets. An example can still be seen in the Science Museum in Kensington, London. Later Milnes Radio Co Ltd. of Bingley marketed a complete radio incorporating a thermo-electric generator and published a booklet "radio for the gas user".

In the 1950s, Philips of Eindhoven developed a thermo-electric generator for homes without either electricity of gas supplies. This was powered by an oil lamp and may have been the inspiration for an even later unit of Chinese manufacture that supplied 60 volts h.t. and 1·5 volts l.t. when placed on top of a hurricane lamp; an example of this device can also be seen in the Science Museum.

Rechargeable h.t. batteries

Thermo-electricity was by no means the only technique used in the early days to lower the cost of listening. The same Bingley firm, Milnes Radio, also marketed a rechargeable h.t. unit which they recommended particularly for use with sensitive short-wave receivers as a virtually "silent" source of energy, without mains hum. This consisted of a battery of alkaline cells with nickel-cadmium plates.

The unit had an internal switch that changed the cells from being series connected into banks of four cells in series-parallel so that the battery could then be recharged from a large 6V accumulator. Such units were available up to 200 volts though I am not sure if they were ever widely used.

It was once my experience to work for a while in a radio station where about a dozen powerful receivers, mostly the famous National HRO type, were all operated entirely from a large bank of batteries as no mains supplies were available. At the other end of the scale I remember obtaining in 1945 one of the small hand torches made by Philips that incorporated a small rotary generator that was turned by squeezing a paddle with the palm of one's hand—though mine soon stripped its gear. Perhaps it was one of the products made in the Eindhoven factory during the occupation of Holland that were deliberately made none too reliable since they were mostly destined for the "grey mice" occupation forces.

As a final note on this subject, modern thermo-electric generators run from propane gas have been quite widely used for communications equipment, particularly on some American railroads: unfortunately the economics generally make them unattractive where other types of supply can be used.

Picture quality

In the latter part of 1981, the Royal Television Society held a discussion meeting that turned out to be of unusual interest. Entitled "Picture Quality—the Aesthetic and Technical Arguments" it succeeded in bringing together two very different strands of television broadcasting: famous drama producers and the engineers who are concerned with the technical quality of the transmitted pictures. It soon became clear that these two aides look at things very differently and often use the same words to mean different things.

Producers tend to like working with film because they believe it is more suitable for capturing "moods"—engineers often dislike film because of the scratches, blemishes and colour tints that can often be seen. They find it inconceivable that producers sometimes shoot a whole production with a gauze placed in front of an electronic camera when they could get the same effect (if really needed) by narrowing the depth of focus.

What really seems to be needed is for producers to discover how to use electronic systems to best advantage and for engineers to recognise, perhaps rather more, the seething resentment of producers when they find their carefully composed shots are graded "poor". Both sides seek the same thing—good television; both sides need to learn to speak the same language.

Getting on 10.1 MHz

The changing pattern of amateur radio equipment over the past decade or so has, rather regretfully, brought it casualties. One of these has been the virtual disappearance of the "junk-box" transmitter built in a couple of evenings on the kitchen table. There are a few exceptions. The very low-power (QRP) enthusiasts still tend to roll their own—and those who venture up into the microwave bands seldom have any alternative.

Then again there are still relatively simple transmitters covering a limited number of h.f. bands, or those constructed from kits or with the help of bought-in printed circuit boards (although a p.c.b. is often unsuitable for random junk-box components). But most amateurs, today, at least when first licensed, tend to buy a factory-made 144MHz or h.f. transceiver. It would indeed be irresponsible to suggest that many newcomers could hope to design or build units as complex or as compact as many of those now on the market.

But the small black boxes can be rather inflexible. The opening on January 1, 1982 of the new 10·1 to 10·15MHz band (permission for British amateurs to use the new 18 and 24MHz bands has been deferred) brought a problem to amateurs other than those who have recently bought the new "9-band" models. Fortunately some older models can be adapted quite simply by those prepared to delve inside the black boxes. The popular FT101-series, for instance, already have a 10MHz standard-frequency (WWV) reception facility and it is not difficult to make the equipment transmit in the new band. The American Drake models also seem relatively easy to adapt and a friend tells me that he has successfully converted an oldish Heathkit HW101.

My own (temporary) solution was to dust off a very old home-made transmitter complete with 40-year-old 807 valve and modify this for 10·1MHz instead of 7/14-MHz. In a matter of hours the old blooper was in action on morse c.w. with about 20 watts input on the new band—for which in any case European amateurs have been asked not to use telephony in view of the limited frequency space.

Certainly in early January many hundreds of amateurs were active on the new band and finding it useful for local, medium-distance and long-distance contacts. As for the nearby 31-metre broadcast band there is every reason to believe that this will be an excellent frequency for working ("via long path") stations in Australia and New Zealand. A very valuable acquisition even though only 50kHz wide!

CITIZENS' BAND RADIO IN THE UK

By G. Baskerville

According to the world's first Citizen Band user and manufacturer, one Al Gross from the East Coast of America, CB or Open Channel radio has its origins in the UK. This startling revelation came during a meeting with this revered sexagenarian on the day that CB radio became legal in this country, November 2, 1981.

Apparently Al was working for the British Government during World War 2 and was the instigator of a limited range transceiver for the use of the ground resistance forces on the continent to contact the pilots of the famous Mosquito fighter/bombers.

Be this as it may, nothing further was done in this country about this simple two-way communication idea until the oil crisis eight years ago. Not that this brought CB into use. It is just that with all the media coverage of American truckers communicating with each other to find the petrol they so badly needed to maintain their business, interest was aroused in the UK in this novel form of person to person communication.

What happened in the USA is well documented—the biggest CB boom the world has ever seen, with endless films and songs featuring this communications medium. Concurrent with this craze the governing body of the American airwaves, the Federal Communications Commission (FCC), changed the number of available channels from 23 to 40, due to the overcrowding of the air in the more densely populated areas.

Little happened in the UK during the following five years . . .

ILLEGAL ENTRY INTO BRITAIN

The year was 1978 and large quantities of the new 40-channel AM rigs went on sale in the USA. Unfortunately with the effects of the aforementioned channel crowding the craze had by then passed and the market had all but collapsed. Over supply then led for a search of an English-speaking nation that knew all about the CB folklore, and was a willing marketplace.

So from 1978 onwards the FCC type CB equipment came into the UK in their illegal thousands. Informed opinion put the number of operating illegal transceivers to be almost a million at the peak of the under-the-counter trade. However illegal it was, no Government can ignore that number of voters who are willing to defy the then law of the land.

CB BECOMES LEGAL

The government was forced into action and a Green Paper published in August 1980 outlined the basis of a British "Open Channel" service. It came to the conclusion (not, unnaturally) that there was a strong case for CB radio and favoured a much higher operating frequency around 928MHz, and seemed to favour FM modulation, along with our European cousins.

This created fairly considerable political activity from many vested interests, in the main opposed to the higher frequency. But in spite of all this the Home Office Radio Regulatory Department produced two performance specifications in April 1981. They were MPT1320 and MPT1321 and specified equipment for use on 27MHz and 934MHz respectively. The fact that the specifications were for angle modulated equipment brought uproar from the more responsible AM users who after all had lobbied for a British CB service and quite naturally had wanted their American AM FCC sets legalised.

In reality the Home Office had to choose a system that would not interfere with either broadcast or emergency service frequencies, and by making the specifications very "tight" would make for better quality.

The Home Office was able to draw on the experience gained with Private Mobile Users and knew that the better voice quality and range of FM equipment would meet all the basic requirements of a British CB system.

October 1981 saw the change to the Wireless and Telegraphy Act to allow the use of this new equipment with the appropriate licence as from November 2, 1981.

CB EQUIPMENT

Transmitting/receiving equipment for Citizens Band divides into three main groups: mobile, handheld and base station. A variety of mobile equipments are available and as this is the type of equipment most in demand, at least initially, by newcomers to CB we have concentrated on mobile transceivers in the following introductory survey of commercial equipments.

Mobile transceivers now on the market fall broadly into two classes: the less expensive basic models costing around £70 and the more sophisticated models costing £90 and upwards. We have tried out a model from each class and hope our comments will assist those who are about to make their choice from the bewildering range of models on offer.

The accompanying table sets out the most important features of CB equipment currently available, and covers mobile, handheld and base station models. As this table shows, only a limited number of base station equipments are at present available, although several firms have indicated their intention to market models.

A similar situation exists with handheld equipments. There is potentially a large market for such "walkie-talkies", but early reports indicate that some of the cheaper handheld transceivers are disappointing in their performance. Technical improvements are to be expected in this area —and we at present withhold detailed comment on this type of instrument.

What can be said is that almost all CB equipment listed is designed and produced in the Far East. Many undoubtedly share a common circuit technique and, whatever their Brand name, will differ principally in the more superficial matters and in external details and presentation.

MAKING A CHOICE

Assuming that you require a transceiver for mobile use what do you look for? All the legal 27MHz units are stamped with CB 27/81 on the front facia; any unit that does not have this is either an illegal AM unit or a continental FM set that operates on totally differing frequencies.

Basic units such as the Fidelity CB1000, Amsrad CB900, Binatone Speedway and Audioline PT340 are all imported by reputable companies and sell for around £70. For this outlay you obtain the transceiver, a PTT (push to talk) microphone, wiring, and installation brackets and instructions.

As an example of this kind of basic transceiver we tested the M2 unit from CB radio specialists John Woolfe Racing. This transceiver has, in common with all units in this price sector, a rotary 40 channel selection switch with l.e.d. readout, an on/off volume switch and squelch control, and a signal strength and power meter.

The first two controls are self explanatory, however the squelch control may be a little unfamiliar. Basically the squelch control allows the user to cut out atmospherics and weak signal noise thus only hearing the stronger and more local transmissions. Best position for this control is just past the point where the worst of the interference is blanked out.

The signal strength and power meter allow you to monitor the power you are transmitting and the strength of the incoming signal. You can find out how much power you are transmitting by asking another CB user what the reading is on his meter. Experience will tell you whether it is adequate allowing for the range required.

INSTALLATION

If you are installing the unit yourself then a few rules must be adhered to. First, never try and transmit with the antenna disconnected. Secondly, always match the set to the antenna.

Power source is taken directly from the car battery.

Having got power to the unit the

Representative selection of CB transceivers for the UK market. **A** JWR model M2 mobile. **B** JWR purpose built base station. **C** Transcom GBX4000 mobile. **D** Audioline PT340 mobile. **E** Midland 3 channel handheld. **F** British made Tenvox mobile.

next job is to match your antenna. This is simply done by using a Voltage Standing Wave Ratio meter (SWR meter for short) connected between the set and its antenna. By pressing the microphone lever you will obtain a reading on the meter. This must be lower than 2:1 (and preferably less than 1·5:1) and is obtained by altering the length of the antenna whip following the manufacturers instructions.

If your antenna is not matched with the unit you will (a) have a poor transmission range and (b) harm the unit as power is "reflected" back into the transceiver as heat.

LEGAL CB TRANSCEIVERS AND THEIR FEATURES

NAME (Distributor)	MODELS	MOBILE	BASE STATION	HAND HELD	R.F. GAIN	MIC. GAIN	CHANNEL 9 PRIORITY	PUBLIC ADDRESS FACILITY	TONE CONTROL	ROGER BLEEP	TYPICAL SELLING PRICE
ACADEMY											
(Academy	501	✓									£69·95
Electronics)	502	✓			✓			✓			£79·95
ALBA											
(Alba Electronics	CBM1	✓					✓				£74·00
Ltd)	CBH 1			✓ 2 Channel							£23·00
	CBH 2			✓ 40 Channel			✓				£65·00
AMSTRAD											
(Amstrad Consumer	CB 900	✓			✓				✓		£75·00
Electronics)	CB 901	✓			✓		✓	✓		✓	£85·00
AUDIOLINE											
(Harry Moss	PT 340	✓									£90·00
International)	PT 341	✓			✓	✓		✓	✓		£110·00
BINATONE											
(Binatone	Speedway	✓									£79·95
International)	Route 66	✓						✓			£89·95
	Five Star	✓			✓	✓		✓	✓		£99·95
	Breaker-phone	✓				✓		✓	✓		£109·95
	Long Ranger 6			✓ 6 Channel							£59·95
	Long Ranger 12			✓ 12 Channel							£69·95
COLT											
(Shellpost Ltd)	295	✓									£85·00
CYBERNET											
(Goodmans Ltd)	BETA 1000	✓									£72·00
	BETA 2000	✓						✓	✓		£80·00
	BETA 3000	✓			✓		✓	✓	✓		£95·00
DNT											
(Radiotechnic Ltd)	M 40 FM	✓									£85·00
	B 40 FM		✓								£95·00
	HF 12/3 FM			✓ 3 Channel							£41·35
	HF 13/40 FM			✓							£70·82
FIDELITY											
(Fidelity Radio Ltd)	CB 1000	✓									£69·95
	CB 2000	✓			✓	✓	✓	✓	✓		£89·95
	CB 3000		✓		✓	✓	✓	✓	✓		—
GRANDSTAND											
(Bee-Ware Ltd)	Buzzing Bee	✓			✓						£70·00
	Hawk	✓			✓						£80·00
	Bluebird	✓					✓				£99·00
	Gemini	✓			✓			✓			£120·00
	Base		✓		✓			✓	✓		£279·00
	Interceptor			✓ 2 Channel (14 & 19)							£29·00
	Communicator			✓ 40 Channel							£69·00

OPERATING

Having correctly installed your unit, switched on and set the squelch control, what then?

Although there are 40 channels three of these have specific functions.

Channel 9 is for emergencies only, designated for use where life or property are considered to be at risk.

Channel 14 is the communication or "breaking" channel.

Channel 19 is the mobile or "truckers" channel where motorists can obtain up to the minute traffic reports from other road users.

After selecting channel 14 what usually happens is that people become "mic shy" .and literally can't

LEGAL CB TRANSCEIVERS AND THEIR FEATURES (continued)

NAME (Distributor)	MODELS	MOBILE	BASE STATION	HAND HELD	R.F. GAIN	MIC. GAIN	CHANNEL 9 PRIORITY	PUBLIC ADDRESS FACILITY	TONE CONTROL	ROGER BLEEP	TYPICAL SELLING PRICE
HARVARD											
(Harris Overseas)	400 M	✓			✓		✓			✓	£80·00
	402 MPA	✓			✓		✓	✓			£80·00
	420 M	✓			✓		✓	✓	✓		£100·00
	410 T			✓	✓	40 Channel					£80·00
	0-2-0			✓		2 Channel					£20·00
JWR											
(John Woolfe Racing)	M 1	✓						✓			£65·00
	M 2	✓						✓			£86·00
	Diplomat 40		✓		✓		✓		✓		£200·00
MIDLAND											
(Plustronics Ltd)	2001	✓						✓			£69·95
	3001	✓			✓			✓	✓		£79·95
	4001	✓			✓	✓		✓	✓		£89·95
	79-200		✓								£149·95
	Ready Rescue			✓			✓				£72·95
	75-720			✓	3 Channel						£59·95
RADIOMOBILE											
(Radiomobile Ltd)	CB 201	✓									£100·00
	CB 202	✓			✓		✓	✓	✓		£120·00
	CB 203		✓		Details not finalised						£149·00
	CB 204		✓								£230·00
REALISTIC											
(Tandy Corporation)	TRC 2000	✓			✓	✓		✓			£99·95
	TRC 2001	✓						✓			£79·95
	TRC 1001			✓	40 Channel						£119·95
ROTEL											
(Rotel Hi Fi Ltd)	RVC 220	✓									£70·00
	RVC 230	✓			✓			✓	✓		£80·00
	RVC 240	✓			✓	✓	✓	✓			£90·00
TENVOX											
(Voxson Audio)	Tenvox CB	✓					✓				£110·00
		N.B.—This is British made with Plessey components.									
TRANSCOM											
(Transcom International)	GBX 2000	✓									£69·95
	GBX 4000	✓			✓		✓	✓	✓	✓	£89·95
UNIDEN											
(Wallace Tele-communications)	UNIACE 100	✓						✓			£99·00
	UNIACE 200	✓			✓	✓		✓	✓		£119·00
YORK											
(Sulkin (UK) Ltd)	JCB 861	✓							✓		£69·00
	JCB 863	✓			✓	✓	✓	✓	✓		£94·00

speak. We recommend installing the unit and listening to other CB users for a couple of days before engaging anyone in conversation. Calling up on channel 14 can be done by saying either "breaker 1-4 for a copy" or "is the channel free/anyone listening"—the preference is yours.

After making contact with another "breaker" or CB user you mutually pick another channel, say 27 and move off the breaking channel to continue your conversation.

TEST REPORTS

Our first FM tranmsmission using the John Woolfe M2 transceiver made us realise that the voice quality and distance of transmission were greater than expectations and we feel that no one will be disappointed by the performance of their unit. Contrary to what is said by the diehards of the illegal AM sets, FM units work better and their transmission go further. As regards the John Woolfe M2 unit we feel this is a good value-for-money transceiver and ideal for the "first time" buyer.

The second set tested was the Transcom GBX4000 which sells for around £90. This set has a pleasant brushed alumininum finish facia which makes a change from some of the bright chrome that is featured on so may units.

As you would expect for the price the Transcom GBX4000 has several useful "extra" features, such as channel nine priority switching, and a PA switch that allows the use of an externally mounted speaker thus turning the transceiver into a mini Public Address system (not such a good idea). Rotary controls are provided for tone (rather more use with an extension speaker) and for r.f. gain control which alters the sensitivity of the receiver. This can be extremely useful when the calling channel becomes conjested, as turning down the sensitivity will cut out all the weaker transmissions in the area.

The Transcom unit is also fitted with a "Roger Bleep", a noise known to thousands as the astronauts hand-over signal when talking to Mission Control. The "bleep" is emitted when the mic lever is released, thus letting everyone know that the transmission has been handed over. We have noticed that some units have a bleep override switch in case the "bleep" is not to the user's taste; however we like it as it has a definite use.

Not fitted to the Transcom unit but to be found on a lot of sets of this price is a mic gain control. This allows users to set the sensitivity of the microphone to suit their own voice level. Well that's the theory—in practise everyone turns the gain on to full and leaves it there, and our experiments have shown that when using a CB rig people tend to speak more loudly anyway.

To sum up, if you are looking for a unit that gives you more flexibility and a better transmission, then units like the GBX4000 will suit you. As with all consumer electrical products quality is usually equated to price. Other units that are in this price range are the Fidelity CB2000, Binatone Five Star, Rotel RVC240 and the Radiomobile CB202.

Two points that are worth mentioning are the use of the attenuator switch fitted to each set by law, and the use of extension speakers.

ATTENUATOR SWITCH

The −10dB attenuator drops the output of the transceiver from 4 to 0·4 watts, and is required if the unit is used with an antenna more than 7 metres off the ground. It can however be used to cut down your transmitting power when talking to other local CB users, say up to two miles way.

By decreasing the power you will get just as good a transmission whilst allowing the use of that channel for another user on the fringe of your transmission. This use of the attenuator saves power and makes for good RT practice.

EXTENSION SPEAKER

As we have already said that each CB unit has an integral speaker it might seem rather strange to advise fitting a second extension speaker.

The fact is however, that the quality of sound obtained from the built-in speaker is not exactly high. An improvement can usually be obtained through the use of a special CB boxed speaker or by mounting an 8 ohm chassis speaker in the dashboard, using the manufacturers recommended position if possible. Voice quality is likely to be instantly improved: a definite benefit with FM as it has inherently a wider frequency range than the older AM sets.

ANTENNA

Having chosen the transceiver or "rig" one further item that will dictate how well your unit will perform is the antenna. Many importers of rigs have a reasonably priced antenna that they sell along with SWR meters and extension speakers; however, many will recommend a range of antennas to suit their equipment.

In theory an antenna is best at radiating energy when its length is just one half of the wavelength of the signal fed into it. One wavelength at 27MHz measures over 36ft, so an ideal antenna length would be 18ft. As this is impracticable for mobile use a quarter wave antenna of 9ft is used.

However the Home Office specification calls for a "single element rod or wire antenna with a base mounted loading coil, overall length shall not exceed 1·5m". How then can anything like ideal performance be obtained from an antenna of 59in in length?

LOADING COIL

Fortunately an antenna of this length can have some of its length made up of wire wound into a coil at the base, called loading a short whip. To give the full effect of a full quarter wave the whip relies on the ground plane, usually the reflected metal of the car body.

A lot of energy can be absorbed by the wire winding in the antenna so the better the design and manufacture the more power it will transmit. A cheap base load antenna with an anti-shock coil spring will cut down the effective radiated power by as much as 50 per cent. Most antenna of this type are copies of car radio-phone antenna and are usually called "telecom type".

ANTENNA TESTS

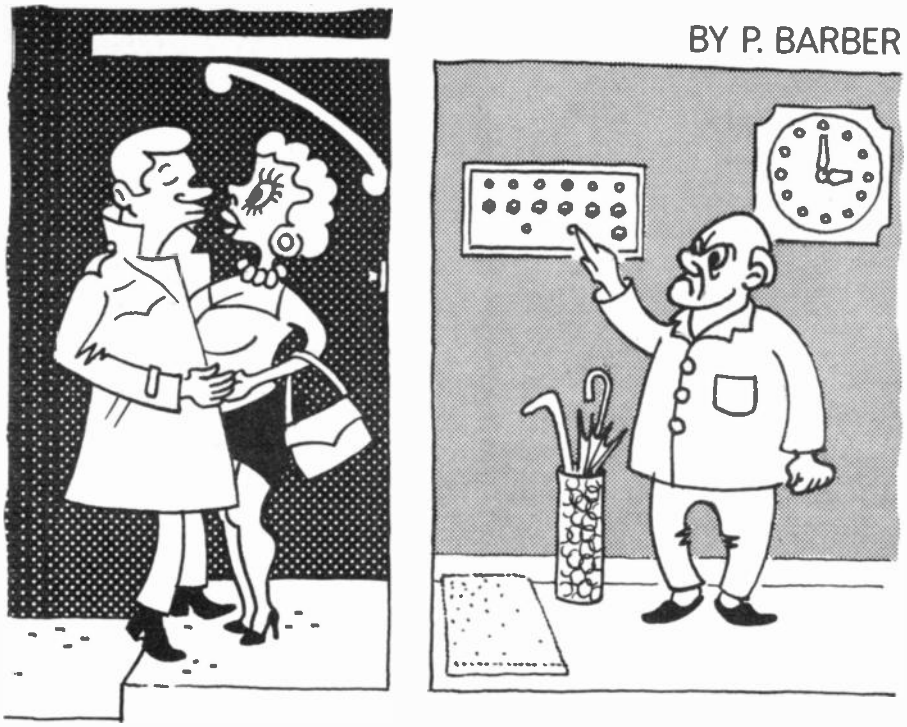
With our set reviews we have tried two types of antenna, the American Antenna K40 and Antenna Incorporated Persuader, both from over the Atlantic and priced between £30 and £40 depending on the type of fixing used. We chose a magnetic mount as it helped in our tests in terms of easy removal. There are usually two further fixings available: the clamp or clip-on type that can be fitted on the boot or hatchback rear door, and the wing fitting type that requires drilling of the bodywork.

Both the K40 and the Persuader antenna come from companies very experienced in producing CB and professional communications equipment and should give close to a 1·2:1 reading on a SWR meter with some small adjustment of the wire whip as per their own individual manufacturers instructions. It has been calculated these types of antenna give an effective radiated power of around 3W which is as near the theoretical limit as you can get with such a short 1·5m whip.

Two further antenna we have tested (although not as fully as the ones already mentioned) and seem to work well are the Antenna Specialists MR125 and the British Panorama CB27.

Well that covers the major points in the selection, fitting and use of CB equipment.

It just remains for us to say that using CB is both fun and informative and we have tabulated all the known legal transceivers and their features to enable prospective users to see what is available and at what price. ⌑



BY P. BARBER

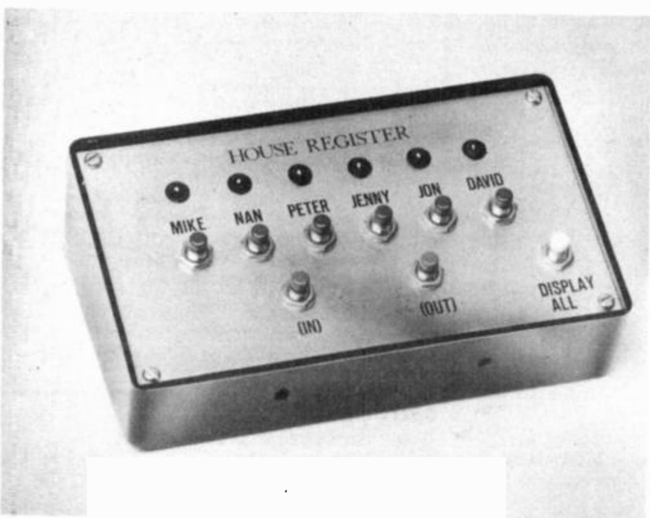
House Register

THE idea of a "register" was originally conceived because of the problem of keeping track of people who were in the author's house at any one time. This was especially so late at night, when various members of the household found themselves locked out following trips to the pub!

At first the problem was solved by having a notice board by the back door, and people "signed" themselves in or out—the last one in at night locking the door. The circuit to be described here provides the same facilities in a smaller, neater way.

The project can be built to cater for any number of people and it is envisaged that it could be adapted for use in an office or a block of flats!

The House Register was designed using CMOS logic gates for simplicity and economy, the latter reason arising from the fact that the circuit would have to be switched on at all times, thus the low power consumption of CMOS was ideal. While the project is fairly straightforward both to build and understand, it also provides a good example of using simple binary logic.



SYSTEM DESIGN

Each person is allocated their own individual switch "Name" switch. In addition to these switches there are three further ones: "Master In", "Master Out", and "Master Display". Each person is provided with a small light beside their Name switch.

In order to assertain whether a person is in, his or her name switch is pressed. If the light goes on it indicates that he or she is in. It would be extremely uneconomical to allow the light to remain on at all times, hence the need to press the switch. A further feature is the master Display switch, which allows an inquiry on the complete household by switching on the lights of everyone who is in.

For this device to be effective, however, it is necessary for each person to remember to "clock in" and "clock out". This is carried out as follows: To clock in, a person presses his or her Name switch and at the same time presses the master In switch. The person's light will go on until the name switch is released. To clock out the procedure is the same, except that the master Out switch is used instead of the master In switch.

It does require some practice to get used to clocking in or out, but once it has become almost second nature this device is simple and useful.

CIRCUIT DESCRIPTION

The circuit diagram is shown in Fig. 1. There are six "logic modules" on the prototype (as the circuit shows) and allows up to six people's comings and goings to be monitored. All modules are identical in operation and the full circuit for each is shown in the first module, labelled MIKE.

MEMORY LOGIC

IC3b and IC3a form a binary memory (bistable latch), the state of which is controlled by gates IC1b and IC2c. The latter can switch the memory on (logic 1 at its output), and IC1b can switch it off (logic 0 at its output). Note that neither can perform the reverse function.

If S7 (the IN switch) and in this case S1 (the NAME switch) are pressed simultaneously, the output of IC2c goes high and sets the memory on (IC3b at logic high). This is the "clocking in" procedure.

If S8 (the OUT switch) and S1 are pressed together, both inputs to gate IC1b go high and therefore the output goes low and resets the memory through D1 (IC3b at logic low).

The output from the memory goes to one input of the l.e.d. enabling gate, IC1a. D4 will only turn on if the output of IC1a is low. As IC1a is a NAND gate, both inputs must be high for this to occur. D2 and D3 effectively form an OR gate to the second input of IC1a. Therefore D4 will only light if the output from the memory is high (it has been set) and either S1 or S9 (the DISPLAY ALL switch) is pressed. Resistors R2, R19 and R20 keep the inputs to gates IC1b, IC2a and IC1a normally low.

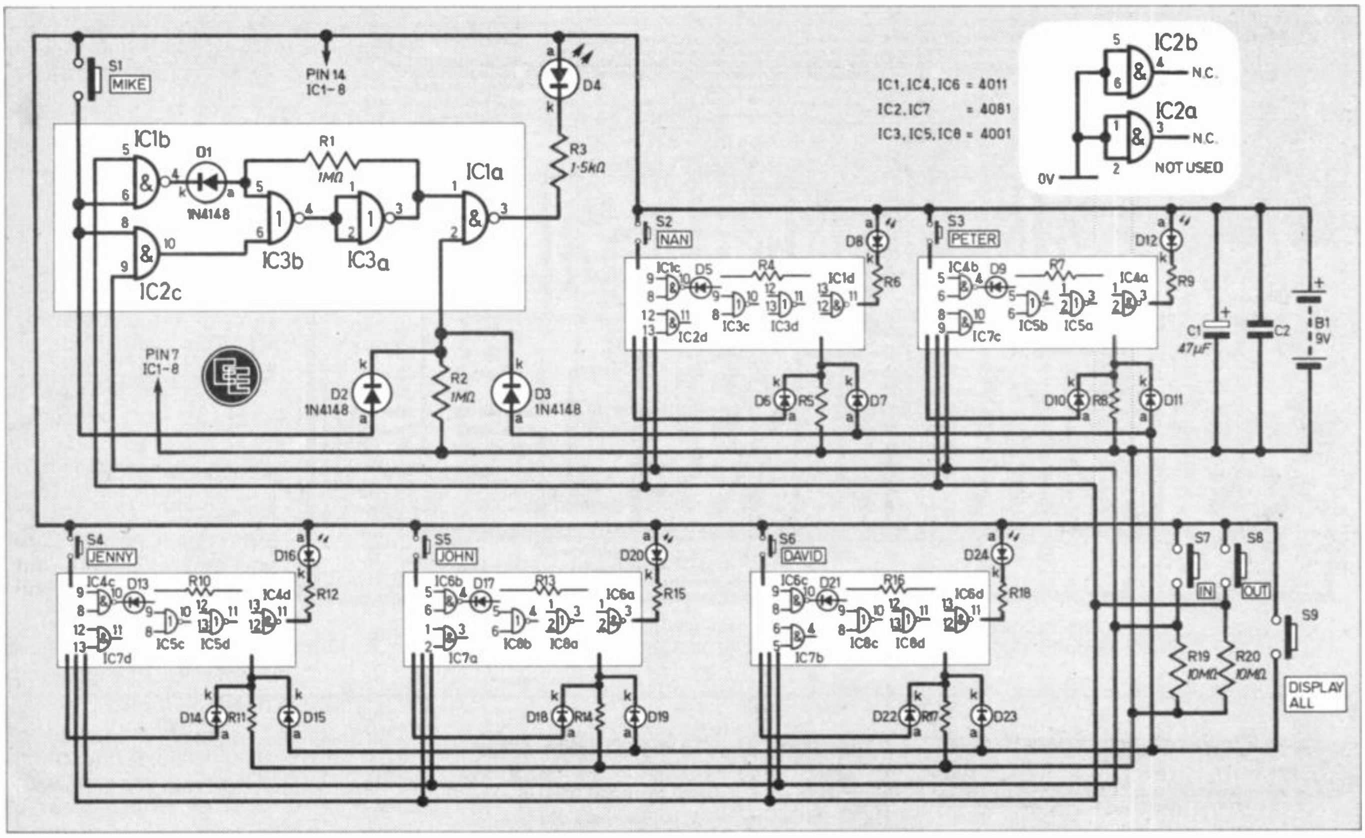


Fig. 1. The circuit diagram for the House Register. This circuit caters for six persons.

CONSTRUCTION starts here

COMPONENT ASSEMBLY

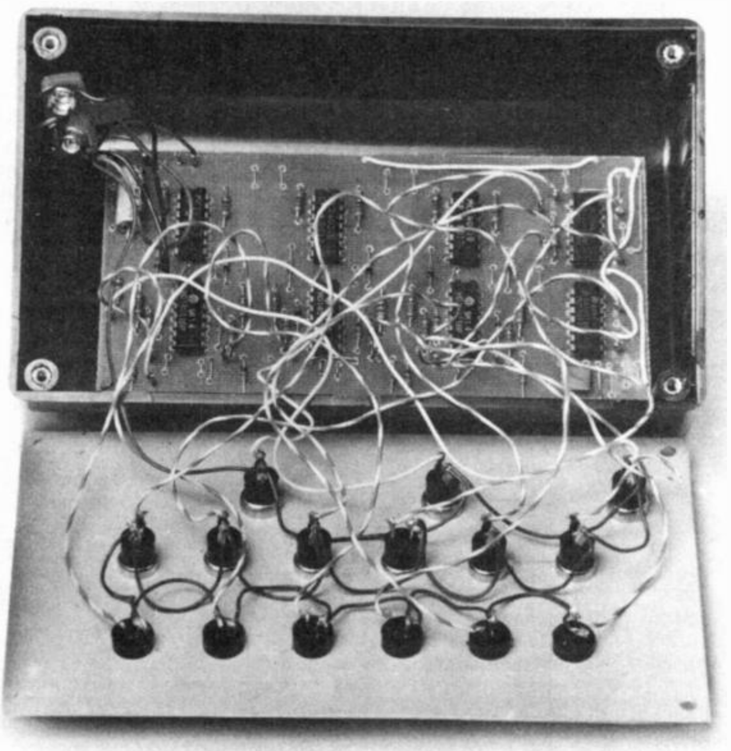
The prototype was built on a printed circuit board size 137×75mm which fits comfortably inside the specified case. There are pillars on the base of the case which align with the fixing hole positions on the p.c.b.

The board has been designed to cater for six people, but there is no theoretical limit to the number of people who can be catered for. However, it is left to the constructor to extend the existing board or produce another for more than six people.

The full-size master of the p.c.b. pattern is shown in Fig. 2. The black areas represent the copper to remain after etching.

The author did not use i.c. sockets for mounting the CMOS i.c.s. but we recommend that they be used as these devices are easily damaged during soldering.

Inside the prototype unit with the front panel hinged back. The position of a few components and the number of link wires will differ from the layout in Fig. 3. This has been carried out to aid construction.



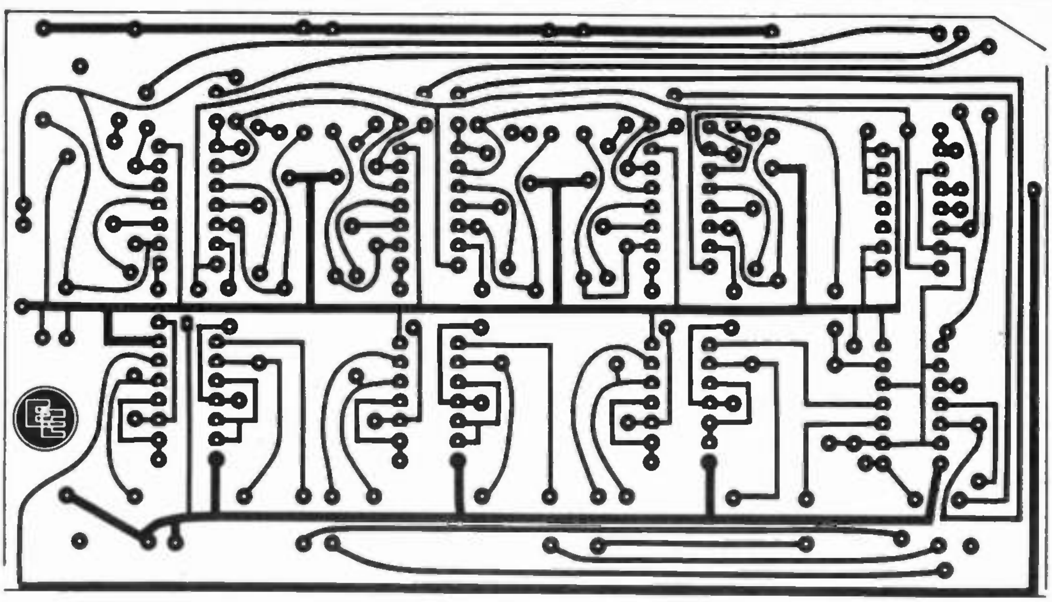
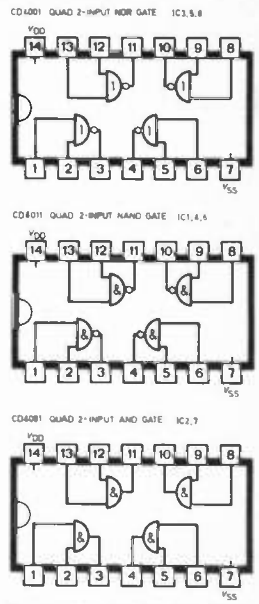


Fig. 2. The full-size master p.c.b. pattern viewed from the copper side. Black regions represent the copper tracks to remain after etching.



Pinning details for the three types of CMOS gates used in this design.

COMPONENTS

Resistors
- R1, R2, R4, R5, R7, R8, R10, R11, R13, R14, R16, R17, R19, R20 — 1 MΩ (14 off)
- R3, R6, R9, R12, R15, R18, — 1·5kΩ (6 off)

All ¼W carbon ±5%

See Shop Talk page 171

Capacitors
- C1 47μF 10V elect
- C2 15nF ceramic plate

Semiconductors
- D1, D2, D3, D5, D6, D7, D9. D10, D11, D13, D14, D15, D17, D18, D19, D21, D22, D23 — IN4148 (18 off)
- D4, D8, D12, D16, D20, D24 — TIL220 (6 off)
- IC1, 4, 6 4011 CMOS Quad 2-input NAND (3 off)
- IC2, 7 4081 CMOS Quad 2-input AND (2 off)
- IC3, 5, 8 4001 CMOS Quad 2-input NOR (3 off)

Miscellaneous
- S1-S9 miniature push-to-make release-to-break (6 red, 2 green, 1 white) (9 off)
- B1 9V type PP3

Printed circuit board, single sided size 135 × 75; insulated stranded connecting wire, 7/0·2 or 10/0·1mm selection of insulation colours; case, sloping panel plastic case with metal top panel, size 160 × 100 × 60 (40)mm type BIM1005; PP3 battery clip; clips and bushes to suit l.e.d.s (6 off); 14-pin d.i.l.; i.c. sockets (6 off).

Approx. cost Guidance only £9·50

Assuming you have at this stage obtained the etched and drilled board, insert and solder all the resistors, Veropins and link wires followed by the two capacitors according to the layout in Fig 3. All flying leads to the front panel are to be made via the Veropins.

Next position and solder in place all the diodes paying attention to their polarity. Care should be exercised when soldering these devices and you are advised to use a heatshunt on their leads when carrying out soldering to reduce the possibility of thermal damage. All the i.c. sockets may now be inserted and soldered in place. Do not plug in the i.c.s at this stage.

The front panel should next be prepared to accept the switches and l.e.d.s. It would be a good idea and easier now to apply the Letraset (or other) labels. Protect with a coat of clear laquer.

INTERWIRING

Identify and label the l.e.d. leadouts and then with reference to Fig. 4 make all the interconnections between board and front panel components using insulated multistrand wire. A selection of different insulation colours would ease identification should this prove necessary at any stage.

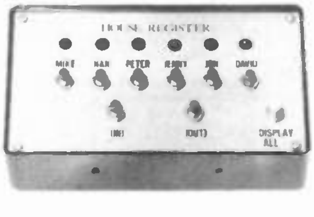
It only remains now to insert the i.c.s in their sockets. Pay special attention when doing this to ensure that the i.c.s are in the right socket and the right way round. Double check before connecting the battery. Note that the board has been laid out so that pin 1 on all i.c.s. points in the same direction.

TESTING

Plug in the battery. Hold down the IN switch and then successively press each name button. Each associated l.e.d. should light up for as long as the name switch is pressed, and go off when it is released. Release IN and press DISPLAY ALL. All l.e.d.s should light up while this switch is pressed. Now hold down OUT and successively press all the name switches. Release OUT. Press DISPLAY ALL. No l.e.d.s should light up.

If the above checks have been successful then the unit is functioning satisfactorily and is now ready for installation.

Current consumption in normal quiescent conditions was less than 0·8μA rising to 40mA with all the l.e.d.s on. Therefore, provided the l.e.d.s are not kept on for long periods of time, battery life should be considerable. ☐



House Register

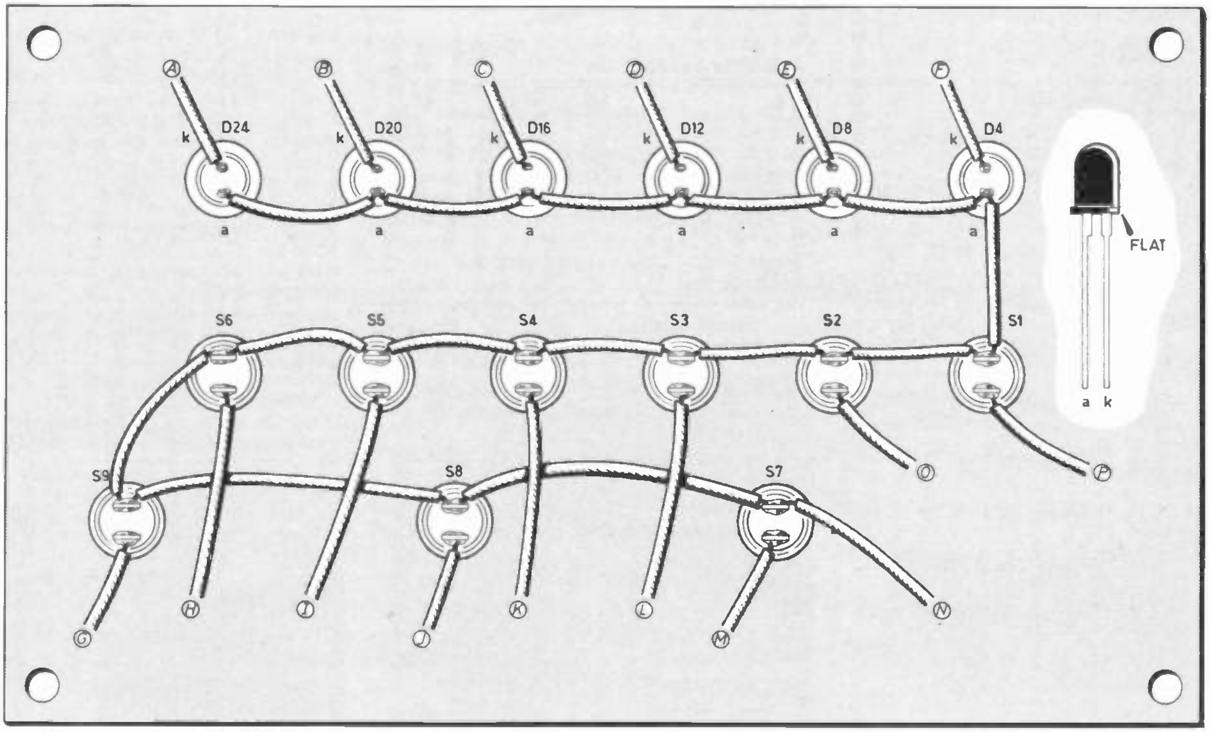


Fig. 4. The layout and interwiring of the panel mounted switches and l.e.d.s.

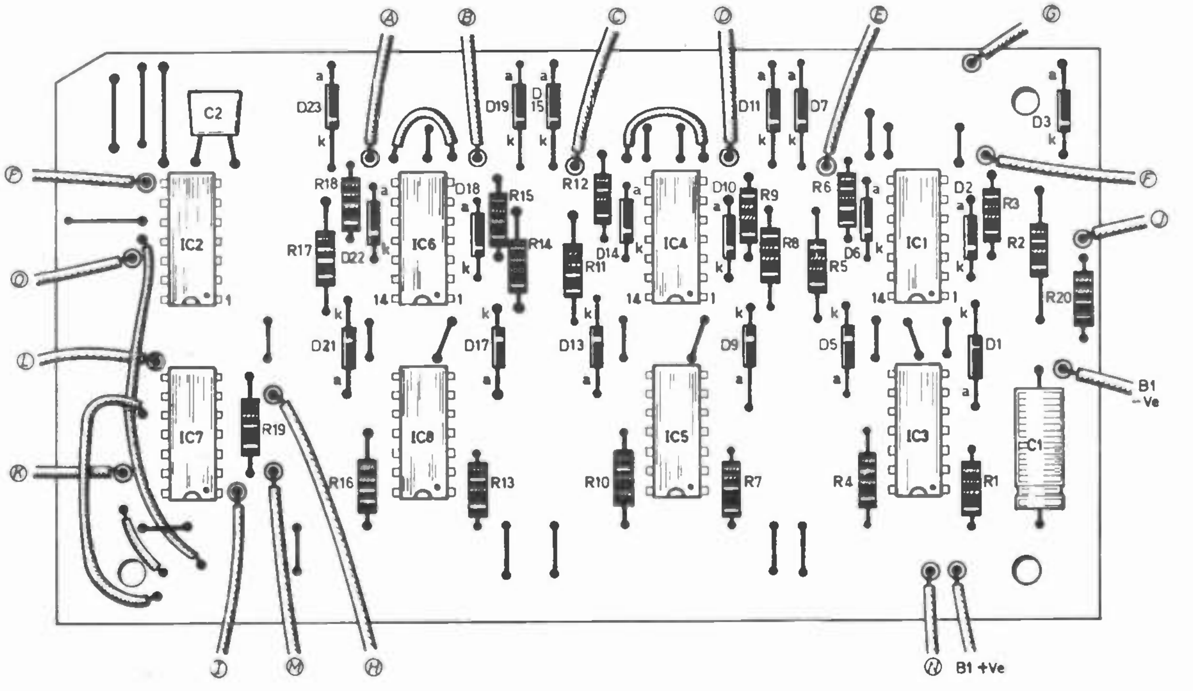
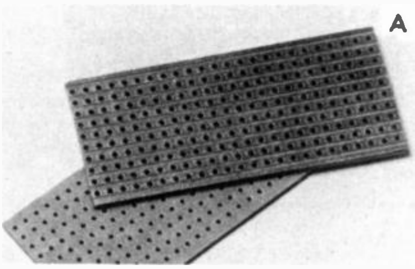


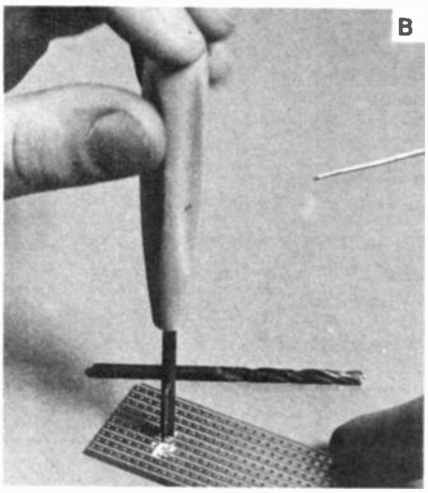
Fig. 3. The layout of the components on the topside of the p.c.b. and wiring details to the panel mounted components. Note that i.c. sockets are not shown, but their use is advised.

SQUARE one FOR BEGINNERS

WHEN the newcomer to electronics builds his first circuit, it will probably be constructed on Veroboard, a unique and very versatile prototype circuit board. Presented free with this month's EVERYDAY ELECTRONICS is a piece of Veroboard (or "stripboard" as it is often referred to) 10 strips by 24 holes and to help you on your way, we have dedicated this month's *Square One* to laying down some basic guide lines as to its use.

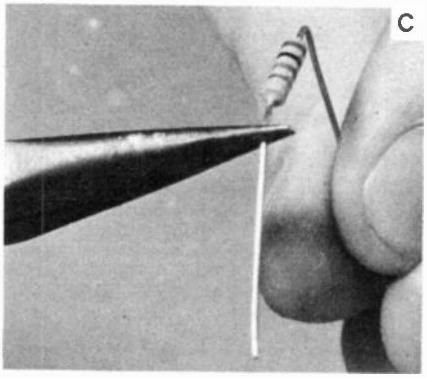


A. The board itself is made from s.r.b.p. and is drilled with a matrix of holes on a 0·1 inch (2·54mm) grid. Running horizontally along the back of the board are strips of copper linking up the rows of holes thus enabling electrical connections to be made. The 0·1 inch grid spacing of the holes permits the insertion of integrated circuits, edge connectors and other components with their leads preformed on this internationally agreed lead spacing.

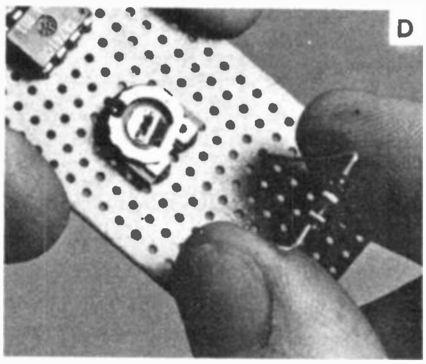


B. Before constructing a circuit, carefully study the component layout and circuit diagram of the intended project, of which incidentally, there are two, printed in this issue, and have all components to hand. You may have noticed that in EE articles, all holes are coded with a letter (the copper strip) and a number (the hole), starting from the top left hand corner. This greatly assists in locating a single point on the board. You will also have noticed that it is often necessary to make breaks in the copper strips in order to fit the circuit on the board, for example, beneath an i.c.

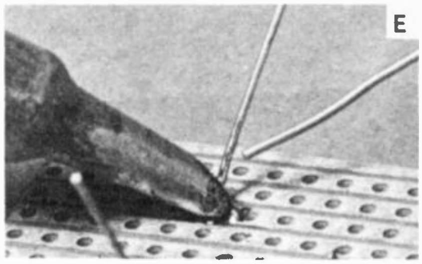
To make these breaks, a special tool is available but they can be just as easily made with a hand held twist drill, some 3 to 5mm in diameter gripped between the thumb and forefinger in a similar fashion to that shown in the photo. Insert the tool or drill into the hole at the correct location with the board supported on a flat surface and twist back and forth whilst at the same time applying light pressure. It is not necessary to drill very far into the board and care should be taken to prevent breaking into adjacent tracks. When the break has been made, it must be closely examined for any "whiskers" of copper.



C. Having made all the required breaks, the components can be inserted from the plain side and in many cases they will slot in position without modification, however axial lead components such as resistors and diodes will require their legs to be preformed. This can be done with a special gauge or simply achieved by making a neat right angled bend with a pair of long nosed pliers as shown.



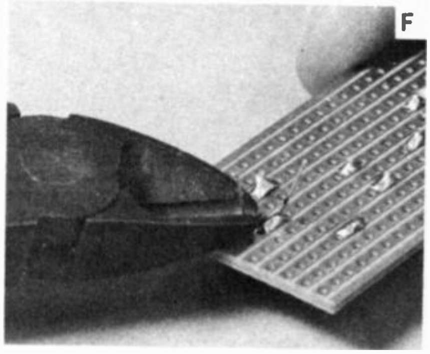
D. To hold the components in place after insertion, spread their leads out at approximately 45 degrees but do not put any undue stress on the body of the component. The board can now be soldered.



E. When it comes to soldering the components, the constructor may wish to insert all parts and then perform a single soldering operation or indeed he may prefer to solder each component as it is inserted. This is entirely a matter of personal choice.

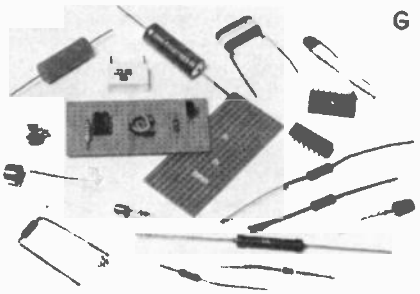
To make the actual joint, a small soldering iron bit must be used and it is strongly recommended that the inexperienced constructor practices on a piece of scrap board. Before each joint, wipe the "dross" from the tip of the iron with a damp sponge and liberally "wet" the bit with solder. Bring the iron to the joint and touch both the copper strip and the component lead and then two or three seconds later feed the solder to the joint. A smooth and shiny fillet of solder should form around the joint. If the solder looks dull or crystallised it is very likely to be "dry" and the joint will have to be remade.

Never hold an iron on the joint for more than five seconds and always use a heatsink when soldering semiconductors.



F. A successful joint having been made, the excess lead must be cropped off with a pair of side cutters. It should be neatly clipped off just above the joint but take care as some cutters have a habit of firing the cropped lead away at incredible speed!

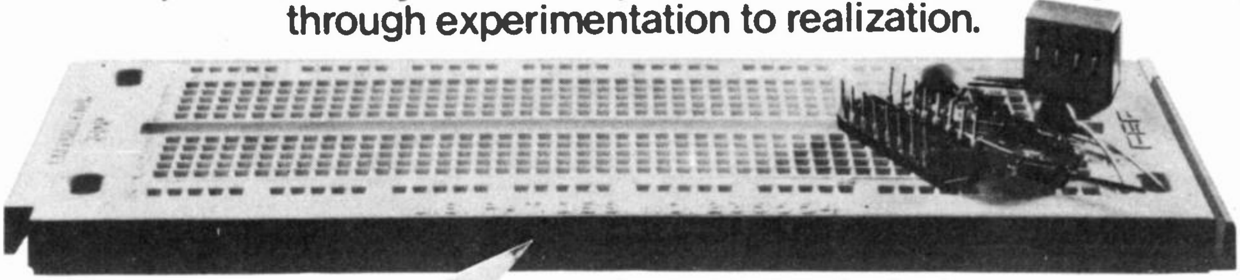
A final point. If the board layout requires wires to be soldered in to go to front panel mounted components it is advisable to attach these to Veropins as this both relieves stress on the copper strips and facilitates modification and repair.



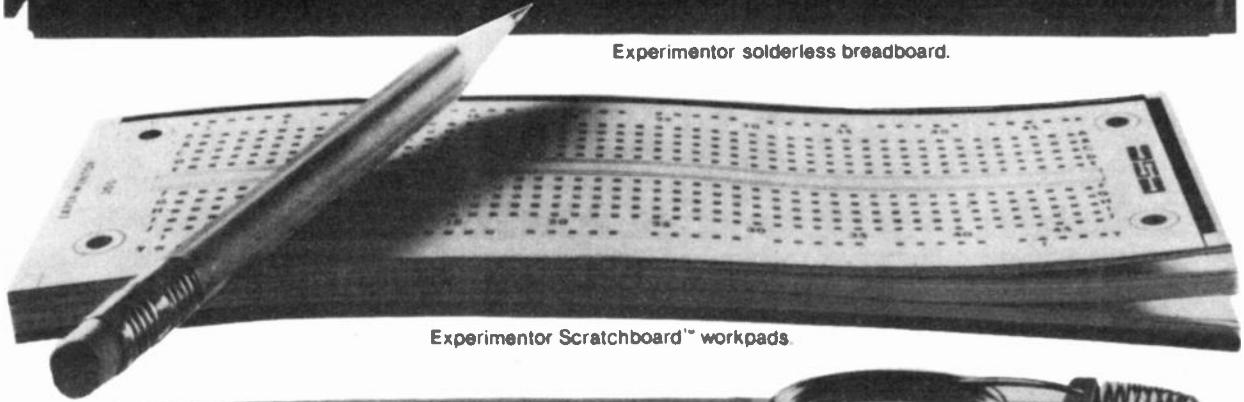
G. This photograph shows just some of the types of components that can easily be accommodated in the Veroboard. It is always advisable to use i.c. holders for integrated circuits as this not only removes the danger of damage by soldering but also means the i.c. can readily be used in another project.

You can't beat The System.

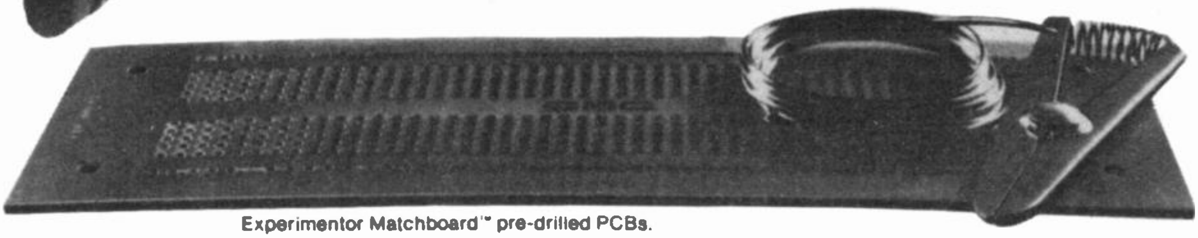
The Experimentor System™ —a quicker transition from imagination through experimentation to realization.



Experimentor solderless breadboard.



Experimentor Scratchboard™ workpads.



Experimentor Matchboard™ pre-drilled PCBs.

When you have a circuit idea that you want to make happen, we have a system to make it happen quicker and easier than ever before: The Experimentor System.

You already know how big a help our Experimentor solderless breadboards can be. Now we've taken our good idea two steps further.

We've added Experimentor Scratchboard workpads, with our breadboard hole-and-connection pattern printed in light blue ink. To let you sketch up a layout you already have working so you can reproduce it later.

With Experimentor Matchboard you can go from breadboard to the finished product nonstop! We've matched our breadboard pattern again, this time on a printed circuit board, finished and ready to build on. All for about £1.20

There's even a letter-and-number index for each hole, so you can move from breadboard (where they're moulded) to Scratchboard™ (where they're printed) to Matchboard™ (where they're silkscreened onto the component side) and always know where you are.

When you want to save time and energy, you can't beat The Experimentor System.

1. EXP-300PC, which includes one item. A Matchboard pre-drilled PCB £1.20	2. EXP-302, which includes three items. Three 50-sheet Scratchboard workpads £1.50	3. EXP-303, which includes three items. Two Matchboards and an EXP-300 solderless breadboard £7.60	4. EXP-304, which includes four items. Two Matchboards, an EXP-300 breadboard and a Scratchboard workpad £8.70

GLOBAL SPECIALTIES CORPORATION

GSC

G.S.C. (UK) Limited, Dept. 4W
Unit 1, Shire Hill Industrial Estate,
Saffron Walden, Essex. CB11 3AQ.
Telephone: Saffron Walden (0799) 21682
Telex: 817477

GLOBAL SPECIALITIES CORPORATION DEPT. 4W

Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex

Name ______________________________

Address ______________________________

Inc P&P and 15% VAT

1.EXP 300PC £2.25	Qnty.Reqd	2.EXP 302 £2.58	Qnty.Reqd
3. EXP 303 £9.80	Qnty.Reqd	4. EXP 304 £11.15	Qnty.Reqd

FREE Catalogue tick box☐

I enclose cheque PO for

£ ______________

Phone your order with Access, Barclaycard or American Express

Card No. ______________________ Expiry date ______________

Goods despatched within 48 hrs.

NEW · NEW · NEW · NEW PRODUCTS NEW · NEW · NEW · NEW

HIGH-SPEED PROBE

The LP-4 logic probe from Global Specialties Corp., is a high-speed device specifically designed to detect and indicate logic levels at the high speeds and narrow threshold differentials encountered in emitter—coupled—logic (ECL) circuitry.

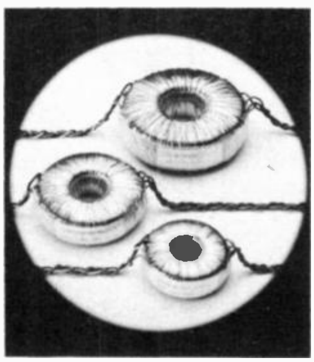
The probe responds to single pulses as short as 3ns in duration and to pulse trains with repetition rates of more than 100MHz, and also incorporates a memory mode for storing pulse events and detecting spurious signals. With memory selected, a single one-shot pulse will be stored, and the pulse indicator will remain on until it is reset by the selector switch.

The LP-4 is a portable, circuit-powered instrument that detects and indicates valid ECL logic levels using light emitting diode indicators for "high" (logic 1) and "low" (logic 0) levels. A third "pulse" indicator shows the presence of single pulses or pulse trains, and when this indicator is on, the other light emitting diodes indicate positive or negative pulse polarity.

Global Specialties Corporation, Dept EE, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.

BUDGET TOROIDS

A "budget range" of toroidal transformers, rated at 30, 60, 100, 160, 230, 330 and 530VA can now be supplied by Barrie Electronics. With 110, 220 or 240V primary windings and dual secondaries ranging from 6+6 to 50+50V, they have been selected to fulfil the requirements of both the professional and amateur electronic engineer.



The toroidal transformers, from the Cotswold Electronics "budget range", will complement the 150 laminated types already held by Barrie Electronics on an off-the-shelf basis. Each transformer is supplied with a data sheet giving technical details on the operation and installaion of the toroids, which are manufactured to the same materials standards as used in avionics, telecommunications and electromedical applications.

Barrie Electronics Ltd., Dept EE, 3 The Minories, London EC3N 1BJ.

AUTORANGING MULTIMETER

The D350 is an autoranging digital multimeter, small enough to fit into a shirt pocket, from Micro-Data Systems.

The $3\frac{1}{2}$ digit liquid crystal display has both unit and function annunciators and the meter has the usual complement of functions for a.c. or d.c. current measurements to over 20A. An added feature is an audible continuity tester facility.

The multimeter is built around a single 64-pin CMOS integrated circuit. This not only performs the analogue to ditigal conversion and drives the display, but also contains the autorange switches, the a.c. to d.c. converter amplifier and the resistance measurement source.

The D350 measures 127mm x 64mm and is only 20mm thick. The price, including accessories, is £69 plus VAT.

Micro-Data Systems, Dept EE, Coach Mews, St Ives, Huntingdon, Cambridgeshire PE17 4BN.

DOWN TO EARTH

An unusual but useful item from the OK range of products is the WRS-1 personal grounding strap.

Designed to safeguard work stations against static charges, the strap is attached to the user's wrist by a bead chain and to an anti-static work surface by a clip, thus protecting sensitive components from any static charge generated by the operator. A 1 megohm resistor built into the flexible wire strap protects operators from possible shocks.

OK Machine & Tool (UK) Ltd., Dept EE, Dutton Lane, Eastleigh, Hants SO5 4AA.

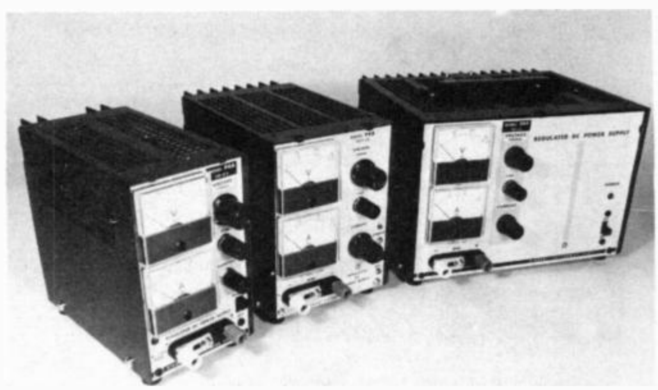
BENCH POWER

With outputs from 8V 2·5A to 350V 0·2A, the 22 models in the new Kikusui PAB series d.c. bench power supplies from Telonic Berkeley UK offer a wide range of output options.

Output voltage may be varied continuously from 0V by the use of "coarse" and "fine" adjustment controls. Continuous control of current is available from 10 per cent to 100 per cent of rated value, so the units may be operated in the constant voltage or constant current mode. Voltage and current are displayed simultaneously on separate meters. Overload protection is by constant current transfer.

Multiple units may be used in series to obtain a higher output voltage and two of the same model may be connected in parallel to double the available current.

Telonic Berkeley UK Ltd., Dept EE, 2 Castle Hill Terrace, Maidenhead, Berkshire.

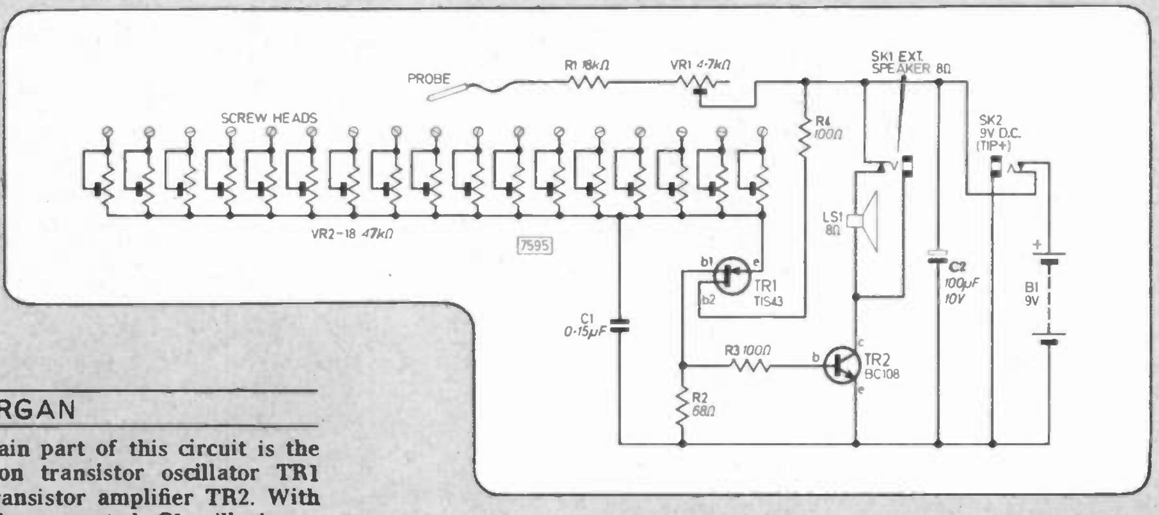


CIRCUIT EXCHANGE

This is the spot where readers pass on to fellow enthusiasts useful and interesting circuits they have themselves devised.

Payment is made for all circuits published in this feature.

Contributions should be accompanied by a letter stating that the circuit idea offered is wholly or in significant part the original work of the sender and that it has not been offered for publication elsewhere.



MINI ORGAN

The main part of this circuit is the unijunction transistor oscillator TR1 with a transistor amplifier TR2. With the supply connected, C1 will charge up via VR1, R1, the probe and one of the presets. When the transistor switches over, C1 discharges itself into the emitter of TR1. When TR1 has switched back, C1 will charge up again. The same thing happens again and these pulses are emitted by base 1, and then amplified by TR2 and fed into LS1. C1 makes sure that the peak current requirements can be met.

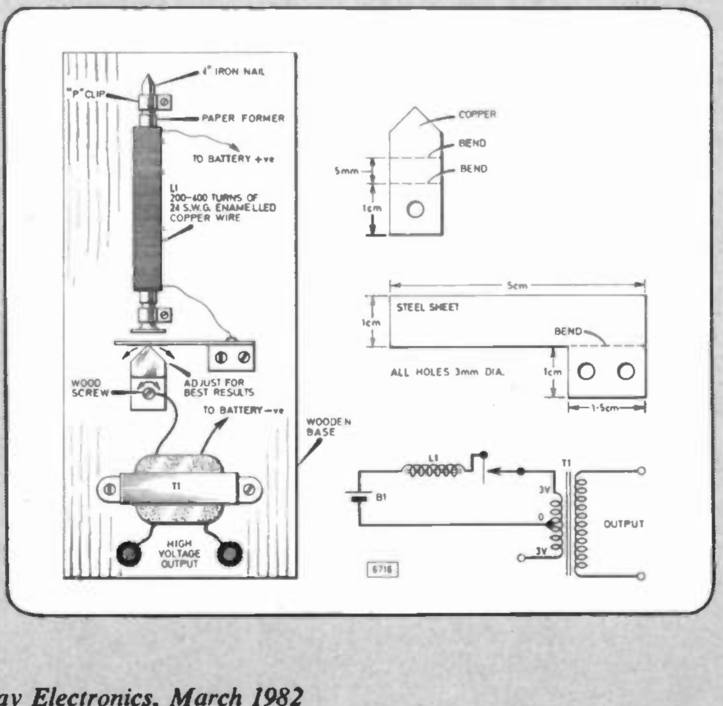
The preset potentiometers are connected to wood screws fitted to the front panel of the instrument. The probe is applied to these screw heads to produce the required sounds.

An on/off switch can be mounted in the supply if required. It is advised to fit TR2 with a small heatsink. The highest note is about A before middle C. R1 can be reduced if this is found a little low. The unit is tuned by turning the presets and comparing the output frequency with a piano or other conventional instrument.

A. Clark,
Lichfield,
Staffs.

HIGH VOLTAGE PULSER

Recently I acquired an old desk top calculator in which I found some old "Nixie" display tubes. In order to experiment with these safely, I devised the enclosed novel circuit for a high voltage pulser which may also interest your readers.



The "buzzer", made from a 4in nail and coil, supplies a broken-up d.c. voltage to a mains transformer connected the opposite way round to normal. The primary or mains input terminals forming the high voltage output or "secondary" winding.

The transformer steps up the broken d.c. and produces a series of high voltage spikes at the output terminals.

The wire for the buzzer coil was obtained from a heater winding of an old transformer. It was found that a PP9 battery provides an adequate power supply.

Warning: Avoid any contact with the output terminals of the transformer since it gives quite a kick.

H. Karmazyn,
Handsworth,
Birmingham.

CIRCUIT EXCHANGE

Sinclair ZX81 Personal Comp
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

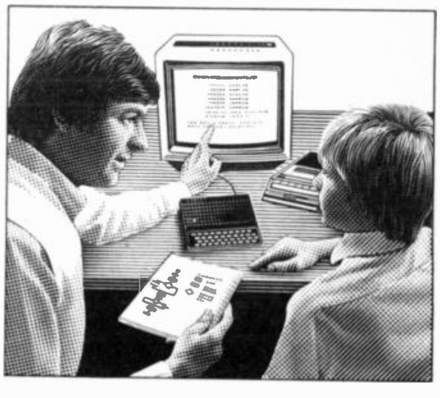
New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



ter-

Available now-the ZX Printer for only £49.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research Ltd, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	49.95	
	Sinclair ZX Printer.	27	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

☐ Please tick if you require a VAT receipt TOTAL £________

*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £________

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable. ________

Please print.

Name: Mr/Mrs/Miss ________

Address: ________

FREEPOST – no stamp needed. Offer applies to UK only. EVE 03

sinclair ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: (0276) 66104 & 21282.

CMOS

4000	0.11
4001	0.11
4002	0.12
4007	0.13
4008	0.50
4008AE	0.80
4009	0.25
4010	0.30
4011AE	0.24
4011	0.11
4013	0.25
4015	0.50
4016	0.22
4017	0.40
4019	0.38
4020	0.55
4021	0.55
4022	0.55
4023	0.15
4024	0.33
4025	0.15
4026	1.05
4027	0.26
4028	0.50
4029	0.55
4030	0.35
4035	0.67
4040	0.50
4042	0.50
4043	0.50
4043AE	0.93
4044	0.60
4046	0.60
4047	0.68
4049	0.24
4050	0.24
4051	0.55
4052	0.55
4053	0.55
4054	1.30
4055	1.30
4056	1.30
4059	5.75
4060	0.75
4063	1.15
4066	0.30
4067	4.30
4068	0.16
4069AE	0.14
4070	0.16
4071	0.16
4072	0.16
4073	0.16
4075	0.16
4076	0.55
4077	0.18
4078	0.18
4081	0.12
4082	0.18
4093	0.30
4099	0.80
4175	0.80
4502	0.60
4503	0.50
4506	0.70
4507	0.37
4508	1.50
4510	0.55
4511	0.45
4512	0.55
4514	1.25
4515	1.25
4516	0.60
4518	0.35
4520	0.60
4521	1.30
4522	0.89
4527	0.80
4528	0.65
4529	0.70
4531	0.85
4532	0.80
4534	4.00
4536	2.50
4538	0.85
4539	0.80
4543	0.80
4549	3.50
4553	2.70
4554	1.20
4555	0.35
4556	0.40
4557	2.30
4558	0.80
4559	3.50
4560	2.50
4561	1.00
4562	2.50
4566	1.20
4568	1.45
4569	1.70
4572	0.22
4580	3.25
4581	1.40
4582	0.70
4583	0.80
4584	0.27
4585	0.45
4702	4.50
4703	4.48
4704	4.24
4705	4.24
4706	4.50
4720	4.00
4723	0.95
4724	0.95
4725	2.24
40014	0.54
40085	0.99
40098	0.54
40106	0.69
40160	1.05
40161	1.05
40162	1.05
40163	1.05
40174	1.05
40175	1.05
40192	1.08
40193	1.08
40194	1.08
40195	1.08

TTL N

7400N	0.10
7401N	0.10
7402N	0.20
7403N	0.11
7404N	0.12
7405N	0.12
7406N	0.22
7407N	0.22
7408N	0.15
7409N	0.15
7410N	0.12
7411N	0.18
7412N	0.19
7413N	0.27
7414N	0.51
7416N	0.27
7417N	0.27
7420N	0.13
7421N	0.28
7423N	0.22
7425N	0.22
7426N	0.22
7427N	0.22
7430N	0.13
7432N	0.23
7437N	0.22
7438N	0.22
7440N	0.14
7441N	0.54
7442N	0.42
7443N	0.62
7444N	0.62
7445N	0.62
7446N	0.62
7447N	0.62
7448N	0.56
7450	0.14
7451N	0.14
7453N	0.14
7454N	0.14
7460N	0.14
7470N	0.28
7472N	0.27
7473N	0.28
7474N	0.28
7475N	0.35
7476N	0.30
7480N	0.26
7481N	0.20
7482N	0.75
7485N	0.75
7486N	0.24
7489N	1.05
7490N	0.30
7491N	0.55
7492N	0.35
7493N	0.35
7494N	0.70
7495N	0.60
7496N	0.45
7497N	1.40
74100	1.10
74104	0.62
74105	0.62
74107	0.26
74109N	0.35
74110N	0.54
74111N	0.68
74112N	1.70
74116N	1.98
74118N	0.85
74119N	1.20
74120N	0.95
74121N	0.34
74122N	0.34
74123N	0.40
74125N	0.40
74126N	0.40
74128N	0.65
74132N	0.50
74136N	0.65
74141N	0.45
74142N	1.85
74143N	2.50
74144N	2.50
74145N	0.75
74147N	1.50
74148N	1.09
74150N	0.79
74151N	0.55
74153N	0.55
74154N	0.55
74155N	0.55
74156N	0.55
74157N	0.55
74159N	1.90
74160N	0.55
74161N	0.55
74162N	0.55
74163N	0.55
74164N	0.55
74165N	0.55
74166N	0.70
74167N	1.25
74170N	1.25
74173N	1.10
74174N	0.75
74175N	0.75
74176N	0.75
74177N	0.75
74178N	0.90
74179N	1.35
74180N	0.75
74181N	1.22
74182N	0.70
74184N	1.20
74185N	1.20
74188N	3.00
74190N	0.55
74191N	0.55
74192N	0.55
74193N	0.55
74194N	0.55
74195N	0.55
74196N	0.55
74197N	0.55
74198N	0.85
74199N	1.00
74221N	1.00
74246N	1.50
74247N	1.51
74248N	1.89
74249N	0.11
74251N	1.05
74265N	0.66
74273N	2.67
74278N	2.49
74279N	0.89
74283N	1.30
74284N	3.50
74285N	3.50
74290N	1.00
74293N	1.05
74297N	2.36
74298N	1.85
74365N	0.85
74366N	0.85
74367N	0.85
74368N	0.85
74390N	1.85
74393N	1.85
74490N	1.85

74LSN

74LS00N	0.10
74LS01N	0.10
74LS02N	0.11
74LS03N	0.11
74LS04N	0.14
74LS05N	0.13
74LS08N	0.12
74LS09N	0.12
74LS10N	0.12
74LS11N	0.12
74LS12N	0.12
74LS13N	0.20
74LS14N	0.30
74LS15N	0.12
74LS20N	0.12
74LS21N	0.12
74LS22N	0.12
74LS26N	0.14
74LS27N	0.12
74LS28N	0.15
74LS30N	0.12
74LS32N	0.12
74LS33N	0.15
74LS37N	0.15
74LS38N	0.14
74LS40N	0.13
74LS42N	0.30
74LS47N	0.35
74LS48N	0.45
74LS49N	0.55
74LS51N	0.13
74LS54N	0.14
74LS55N	0.14
74LS73N	0.21
74LS74N	0.16
74LS75N	0.22
74LS76N	0.20
74LS78N	0.19
74LS83N	0.40
74LS85N	0.80
74LS86N	0.14
74LS90N	0.32
74LS91N	0.28
74LS92N	0.31
74LS93N	0.31
74LS95N	0.40
74LS96N	1.20
74LS107N	0.25
74LS109N	0.20
74LS112N	0.20
74SL113N	0.20
74LS114N	0.19
74LS122N	0.35
74LS123N	0.35
74LS124N	1.80
74LS125N	0.24
74LS126N	0.24
74LS132N	0.42
74LS133N	0.24
74LS136N	0.20
74LS138N	0.30
74LS139N	0.30
74LS145N	1.20
74LS151N	0.30
74LS153N	0.27
74LS154N	0.99
74LS155N	0.35
74LS156N	0.37
74LS157N	0.30
74LS158N	0.30
74LS160N	0.37
74LS161N	0.37
74LS162N	0.37
74LS163N	0.37
74LS164N	0.40
74LS165N	0.80
74LS166N	0.80
74LS168N	0.70
74LS169N	0.85
74LS170N	0.80
74LS173N	0.80
74LS174N	0.40
74LS175N	0.40
74LS181N	1.05
74LS183N	1.75
74LS189N	1.28
74LS190N	0.45
74LS191N	0.45
74LS192N	0.45
74LS193N	0.42
74LS194N	0.35
74LS195N	0.35
74LS196N	0.55
74LS197N	0.60
74LS200N	3.40
74LS202N	3.45
74LS221N	0.50
74LS240N	0.80
74LS241N	0.80
74LS242N	0.70
74LS243N	0.70
74LS244N	0.60
74LS245N	0.80
74LS247N	1.35
74LS248N	1.35
74LS249N	1.35
74LS251N	0.35
74LS253N	0.35
74LS257N	0.40
74LS258N	0.37
74LS259N	0.60
74LS260N	0.50
74LS266N	0.22
74LS273N	0.70
74LS275N	3.20
74LS279N	0.35
74LS280N	2.50
74LS283N	0.42
74LS290N	0.50
74LS293N	0.40
74LS295N	1.50
74LS298N	0.76
74LS365N	0.32
74LS366N	0.34
74LS367N	0.32
74LS368N	0.35
74LS373N	0.70
74LS374N	0.70
74LS375N	0.40
74LS377N	0.85
74LS378N	0.85
74LS379N	0.80
74LS384N	2.50
74LS385N	2.05
74LS386N	0.29
74LS390N	0.68
74LS393N	0.61
74LS395N	2.10
74LS396N	1.99
74LS398N	2.75
74LS399N	2.30
74LS445N	1.40
74LS447N	1.95
74LS490N	1.10
74LS668N	1.05
74LS669N	1.05
74LS670N	1.70

RAM

2102	1.70
2112	3.40
2114/2	1.49
4027	5.78
4116/2	1.59
4116/3	1.49
4864P	12.50
6116P-3	9.00
6116P-4	11.25
8264	12.50

74CXX

74C00	0.20
74C02	0.20
74C04	0.20
74C08	0.20
74C10	0.20
74C14	0.55
74C20	0.20
74C30	0.20
74C32	0.20
74C42	0.80
74C48	1.03
74C73	0.50
74C74	0.50
74C76	0.48
74C83	0.98
74C85	0.98
74C86	0.26
74C89	2.68
74C90	0.80
74C93	0.80
74C95	0.94
74C107	0.48
74C151	1.52
74C154	2.26
74C157	1.52
74C160	0.80
74C161	0.80
74C162	0.80
74C163	0.80
74C164	0.80
74C165	0.84
74C173	0.72
74C174	0.72
74C175	0.72
74C192	0.80
74C193	0.80
74C195	0.80
74C200	4.52
74C221	1.06
74C901	0.38
74C902	0.38
74C903	0.38
74C904	0.38
74C905	5.64
74C906	0.38
74C907	0.38
74C908	0.84
74C909	1.52
74C910	3.62
74C914	0.86
74C918	0.98
74C925	4.32
74C926	4.32
74C927	4.32

Processors

8080 series

8080AFC/2	£7.30
8212	2.30
8214	3.50
8216	1.95
8224	3.50
8251	8.21
8255	5.40

6800/6809

6800P	£2.90
68A00	4.25
68B00	4.65
6802	3.50
6809	£6.75
6810	1.25
68A10	1.85
68B10	2.04
6820	1.95
6821	1.25
68A21	2.10
68B21	2.25
6840	4.25
68A40	4.55
68B40	4.86
6850	1.50
68B50	2.13
6852	2.95
68A52	2.75
68B52	2.95
68488	5.25

Z80 series

Z80A	£3.75
Z80ADRT	7.50
Z80APIO	3.50
Z80ASIO/1	11.00
Z80ASIO/2	11.00
Z80ASIO/9	9.95
Z80CTC	4.00
Z80ACTC	4.50
Z8001	65.00

PROM

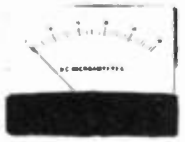
2708	2.00
2716	£3.00
2532	0A
2732	£4.00

Prices shown exclude VAT. Postage 50p per order (UK).

AMBIT international

TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM14 4SG

200 North Service Road, Brentwood, Essex



METERS: 110 × 82 × 35mm
30μA, 50μA, 100μA. **£5·90.**
Post 50p.

METERS: 45 × 50 × 34mm
50μA, 100μA, 1mA, 5mA, 10mA, 25v, 1A, 2A, 5A
5A. 25V **£2·90.** Post 30p.

METERS: 60 × 47 × 33mm
50μA, 100μA, 1mA, 5mA, 10mA, 100mA, 1A, 2A, 25v, 50v, 50-0-50μA, 100-0-100μA. **£4·76.**
VU meters. **£5·32.**
Post on above meters 30p.

Silicone grease 50g **£1·32** Post 14p.

MULTI-METER
7N 360TR
20,000 ohm/volt
DC Volts: 0·1, 0·5, 2·5, 10-150—250-1,000v.
AC Volts: 10-50, 250-1,000
RESISTANCE RANGES
X1, X10, X1K, X10K
£14·10
P.&P. 87p

TRANSFORMERS
240v Primary

3-0-3v	100mA	**82p**
6-0-6v	100mA	**87p**
6-0-6v	250mA	**£1·22**
12-0-12v	50mA	**92p**
12-0-12v	100mA	**£1·15**

Post on above transformers 48p.

9-0-9v	1A	**£1·80**
12-0-12v	1A	**£2·40**
15-0-15c	1A	**£2·60**
6·3v	1½A	**£1·80**
6-0-6v	1½A	**£2·10**

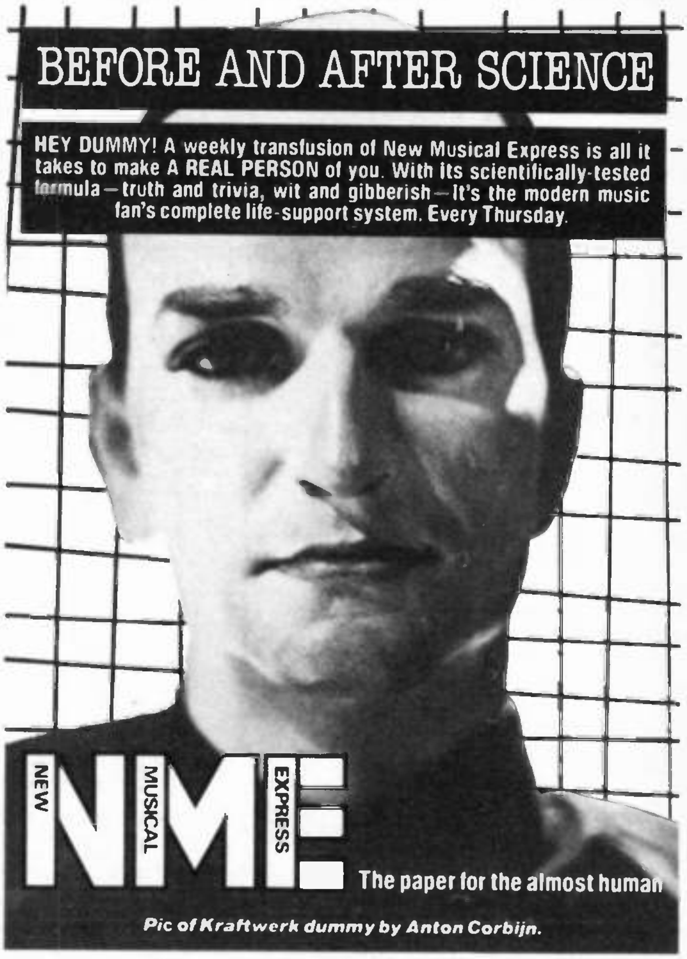
Post on above transformers 87p.

All above prices include V.A.T. Send 80p for new 1982 fully illustrated catalogue, S.A.E. with all enquiries. Special prices for quantity quoted on request.

All goods despatched within 3 days from receipt of the order.

M. DZIUBAS

158 Bradshawgate, Bolton
Lancs. BL2 1BA



Pic of Kraftwerk dummy by Anton Corbijn.

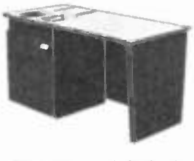
THIS MONTH'S NEW KITS

For the musically inclined	
Drum Synthesiser	£29.50
Mixer/Pre Amp	£16.00
Stylus Organ	£4.95
For the Service Engineer	
Micro Volt Multiplier	£3.95
Sign Wave Generator	£5.75
Linear Power Output Meter	£11.50
For the Ham or CB Enthusiast	
Aerial Rotator	£24.50
Aerial Direction Indicator	£5.90
For the Motorist	
Electronic Ignition Kit	£19.50
For all of you	
Electric Jigsaw Puzzle	£5.30
Blow Heater Kit	£6.45
And if you are having TV Interference Problems	
High-Pass Filter	£1.95
Low-Pass Filter	£3.45

UNIVAC KEYBOARD BARGAIN

Ideal for use with ZX80/81. Has 50 keys and many other parts for your spares box. Probably cost in excess of £100. In very good used condition — £13.50 + £2.00 post. Diagram showing how to connect to ZX80/81 — £2.00 extra.

COMPUTER DESK



Size approx. 4'x 2' x 2'6" high. These were made for hard work, the top being formica covered. Suitable for housing instruments or for use as office desks. Beautifully made, these cost over £100 each, our price only £11.50 each, however, you must arrange to collect.

EXTRACTOR FANS

Mains operated — ex. Computer.
5" Woods extractor £5.75 Post £1.00.
6" Woods extractor £6.90 Post £1.25
6" Plannair extractor £7.50 Post £1.00
4" x 4" Muffin 115v. £4.50 Post 50p.
4" x 4" Muffin 230v. £5.75 Post 50p.

INTERRUPTED BEAM

This kit enables you to make a switch that will trigger when a steady beam of infra red or ordinary light is broken. Main components — relay, photo transistor, resistors and caps, etc. Circuit diagram but no case. Price £2.30

INSTRUMENT BOX WITH KEY

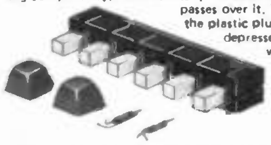
Very strongly made (ply-wood sides with hard board top and bottom). This is black grained effect, vinyl covered, very pleasing appearance. Internal dimensions 12½" long, 4⅛" wide, 6" deep. Ideal for carrying your multi range meter and small tools and for keeping them in a safe place. £2.30. Post paid if ordered with other goods, otherwise £1.00.

ROPE LIGHT

4 sets of coloured lamps in translucent plastic tube arranged to give the appearance of a running or travelling light. With variable speed control box, ideal for disco or shop window display. Complete, made up, ready to plug into mains. £36.00 + £2 post.

COMPUTER KEY SWITCHES (make your own keyboard)

These are for making up on a p.c.b. and consist of a vertical mounting computer type reed switch, which makes circuit when a magnet passes over it. The magnet is located in the plastic plunger which in turn is depressed by a push rod, to which the legended top is fixed. These are made up in banks of 6, price £2.30 per bank of 6 (including tops)

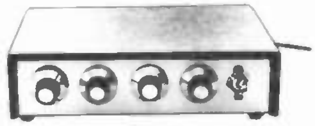


OUR CAR STARTER AND CHARGER KIT has no doubt saved many motorists from embarrassment in an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250w mains transformer, two 10 amp bridge rectifiers, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. Price £11.50 + £2.50 post.

GPO HIGH GAIN AMP/SIGNAL TRACER. In case measuring only 5¼in x 3¼in x 1¼in is an extremely high gain (70dB) solid state amplifier designed for use as a signal tracer on GPO cables, etc. With a radio it functions very well as a signal tracer. By connecting a simple coil to the input socket a useful mains cable tracer can be made. Runs on standard 4½v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp, cueing amp, etc. An absolute bargain at only £1.85. Suitable 80ohm earpiece 69p.

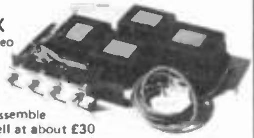
FREE OUR CURRENT BARGAIN LIST WILL BE ENCLOSED WITH ALL ORDERS.

3 CHANNEL SOUND TO LIGHT KIT



Complete kit of parts for a three-channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special snip price is £14.95 in kit form or £25.00 assembled and tested.

MULLARD UNILEX



A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone. In easy to assemble modular form this should sell at about £30 — but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £16.75 including VAT and post. FREE GIFT — buy this month and you will receive a pair of Goodman's eliptical 8"x5" speakers to match this amplifier.

THIS MONTH'S SNIP

POCKET AUDIO COMPONENT TESTER

With it you can quickly test diodes, rectifiers, transistors, capacitors, check wiring and p.c. boards for open circuits, find the anode and cathode of a diode or rectifier and whether a transistor is PNP or NPN, which are the base collector and emitter connections. Condensers, if bad, give a continuous signal, but if good, give intermittent signals of varying length depending on their value. The test current is very low (2uA) and the voltage only 1.4v, so it is also possible to check MOS devices, as well as sensitive transistors without fear of damaging them. The unit is supplied complete with internal battery, which should last many months. Price £3.45p

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc., or when fitted say in front of the element of a blow heater, the heat would trip the stat if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0 — 100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats could cost around £15.00 - however, you can have the parcel for £2.50.

6 WAVEBAND SHORTWAVE RADIO KIT

Bandspread covering 13.5 to 32 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit includes case materials, six transistors and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy if you have an amplifier to connect it to or a pair of high resistance headphones. Price £11.95.

MEDIUM & 2 SHORT WAVE CRYSTAL RADIO

All the parts to make up the beginner's model. Price £2.30. Crystal earpiece 65p. High resistance headphones (gives best results) £3.75. Kit includes chassis and front but not case.

TRANSMITTER SURVEILLANCE

Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox — all electronic parts and circuit. £2.30. (Not licenceable in the U.K.).

RADIO MIKE

Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. £6.90 comp. kit. (Not licenceable in the U.K.).

RADIO STETHOSCOPE

Easy to fault find — start at the aerial and work towards the speaker — when signal stops you have found the fault. Complete kit £4.95.

MUGGER DETERRENT

A high-note bleeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. £2.50 complete kit.

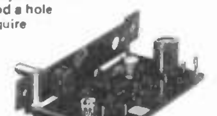
POPULAR SNIP — STILL AVAILABLE

And it still carries a free gift of a desoldering pump, which we are currently selling at £6.35p. The snip is perhaps the most useful breakdown parcel we have ever offered. It is a parcel of 50 nearly all different computer panels containing parts which must have cost at least £500. On these boards you will find over 300 IC's. Over 300 diodes, over 200 transistors and several thousand other parts, resistors, condensors, multi-turn pots, recifiers, SCR, etc. etc. If you act promptly, you can have this parcel for only £8.50, which when you deduct the value of the desoldering pump, works out to just a little over 4p per panel. Surely this is a bargain you should not miss!
When ordering please add £2.50 post and £1.27 VAT.

BURGLAR ALARM CONTROL PANEL

Contains labelled connection block, latching relay, test switch and removable key control switch. Simplifies the whole installation, all you have to do is to take wires to pressure pads and to alarm bell. Price £7.95, with complete diagram.

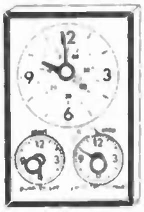
MINI MONO AMP on p.c.b., size 4"x 2"



approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of £1.15 each, or 10 for £10.00.

DELAY SWITCH

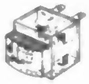
Mains operated — delay can be accurately set with pointers knob for periods of up to 2½hrs. 2 contacts suitable to switch 10 amps — second contact opens a few minutes after 1st contact. £1.95.



TIME SWITCH BARGAIN

Large clear mains frequency controlled clock, which will always show you the correct time + start and stop switches with dials. Complete with knobs. £2.50.

LEVEL METER



Size approximately ¾" square, scaled signal and power but cover easily removable for rescaling. Sensitivity 200 uA. 75p.

WATERPROOF HEATING WIRE

60 ohms per yard, this is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses — around water pipes, under grow boxes in gloves and socks.

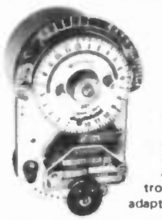
TANGENTIAL BLOW HEATER

2.5 Kw quiet, efficient instant heating from 230/240 volt mains. Kit consists of blower as illustrated, 2.5 Kw element, control switch and data all for £4.95. post £1.50.

12V SUBMERSIBLE PUMP

Just join it to your car battery, drop it into the liquid to be moved and up it comes, no messing about, no priming, etc. and you get a very good head. Suitable for water, paraffin and any non-explosive non-corrosive liquid. One use if you are a camper, make yourself a shower. Price: £8.50.

VENNER TIME SWITCH



Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95. These are without case, but we can supply metal case with window £2.95. Also available is adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30. Post any or all items £1.

12V FLUORESCENT LIGHTING

For camping — car repairing — emergeny lighting from a 12v battery you can't beat fluorescent lighting. It will offer plenty of well distributed light and is economical. We offer an inverter for 21" 13 watt miniature fluorescent tube. £3.45. (tube not supplied).

FIVE UNUSUAL SWITCHES

For inventors, experimenters, service engineers, students or in fact anyone interested in making electrical gadgets. The parcel contains: — delay switch — motor driven switch — two-way and off switch — polarity changing switch — and humidity switch. Our regular price for these switches bought separately is over £10, but this month you can have the 5 for £2.50.

SPIT MOTORS

These are powerful mains operated induction motors with gear box attached. The final shaft is a ½" rod with square hole, so you have alternative couplingmethods — final speed is approx. 5 revs/min, price £5.50. — Similar motors with final speeds of 80, 100, 160 & 200r.p.m. same price.

COMPONENT BOARD Ref. WO998

This is a modern fibreglass board which contains a multitude of very useful parts, most important of which are: 35 assorted diodes and rectifiers including 4 3amp 400v types (made up in a bridge) 8 transistors type BC 107 and 2 type BFY 51 electrolytic condensers, SCR ref 2N 5062, 25 0uf 100v DC and 100uf 25v DC and over 100 other parts including variable, fixed and wire wound resistors, electrolytic and other condensers. A real snip at £1.15.

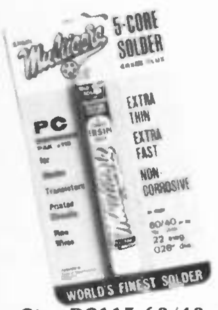
J. BULL (Electrical) Ltd.

(Dept. EE), 34 - 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 3QU. Established 30 YEARS

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £10.00, add 60p service charge. Monthly account orders accepted from schools and public companies. Access & Barclaycard orders phone Haywards Heath (0444) 54563. **CALLERS:** to Haywards Heath (closed Sat.), or 2, Bentham Road, Off Elm Grove, Brighton (closed Wed.). **BULK ORDERS:** Write for special quotation. Normally delivery is by return.

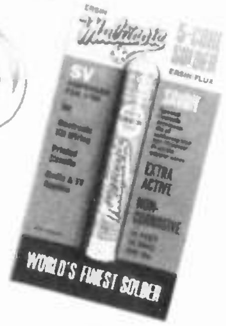
Multicore makes soldering easy fast & reliable

Ersin Multicore
Ersin Multicore, solder contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux is required.
Comes in handy dispensers and tool box reels in two different alloys 40/60 tin/lead for general purpose electrical soldering and 60/40 tin/lead ideal for small components and fine wire soldering.



Size PC115 60/40 tin/lead
£1.38 Handy pack 0.028mm dia


Size 3 40/60 tin/lead
£4.37 Per reel 1.6mm dia
Size 10 60/40 tin/lead
£4.37 Per reel 0.71mm dia



Size 19A 60/40 tin/lead
£1.15 Handy pack 1.22mm dia

Multicore Savbit
Multicore Savbit, solder increases the life of your soldering bit by 10 times, for better soldering efficiency and economy.
Comes in two handy dispensers and tool box reels.

Size 5 Savbit
£1.15 Per pack 1.2mm dia

Size 12 Savbit
£4.37 Per reel 1.2mm dia

Size SV130 Savbit
£1.73 Per pack 0.048mm dia

Multicore Alu-Sol
Multicore Alu-Sol, solder contains 4 cores of flux, suitable for most metals especially aluminium.
Comes in handy dispensers on tool box reels.

Size AL150 Alu-Sol
£2.07 Per pack 0.48mm dia

Size 4 Alu-Sol
£7.82 Per reel 1.6mm dia

All prices inclusive of VAT.
Available from most electrical and DIYs stores. If you have difficulty in obtaining any of these products send direct with 50p for postage and packing. For free colour brochure send S.A.E.

Multicore Solder Wick
Multicore Solder Wick, absorbs solder instantly from tags and printed circuits with the use of a 40 to 50 watt soldering iron.
Quick and easy to use, desolders in seconds.

Size AB10 Solder Wick
£1.43 Per pack

Multicore Tip Kleen
Multicore Tip Kleen, soldering iron tip wiping pad.
Replaces wet sponges.

Size 2 Tip Kleen
£0.92 Per pack

Bib Wire strippers and cutters
Wire strippers and cutters, with precision ground and hardened steel jaws. Adjustable to most wire sizes. With handle locking-catch and easy-grip plastic covered handles.

Size 9 Wire Strippers
£2.69 Per pair

Bib Audio/Video Products Limited
(Solder Division), Kelsey House,
Wood Lane End, Hemel Hempstead,
Hertfordshire, HP2 4RQ.
Telephone: (0442) 61291
Telex: 826437

That's how Vero began and many of you started.

Twenty years ago Vero introduced Veroboard to the designer and hobbyist market.

It was then unique in its concept and is still one of the basic boards for the electronics industry. Such is the influence that Veroboard has had, and is still having, that the very name has become part of general vocabulary. Twenty years is a long time in a new industry and Vero have been in the forefront with their standards, quality control and customer service throughout that time.

From Veroboard through Card Frames to Vero Cases, we are proud to be of service and hope that you will agree that sales of millions of Veroboards is a suitable cause to celebrate our twentieth birthday.

Please Telephone for further information about Veroboard and our other products.

Phone: Chandler's Ford
(04215) 62829

Vero Electronics Ltd., Retail Department, Industrial Estate, Chandler's Ford, Hampshire. SO5 3ZR.

CLASSIFIED

The prepaid rate for classified advertisements is 28 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £7·24 per single column centimetre (minimum 2·5cm). All cheques, postal orders, etc., to be made payable to Everyday Electronics and crossed "Lloyds Bank Ltd." Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Everyday Electronics, Room 2612, IPC Magazines Limited, King's Reach Tower, Stamford St., London SE1 9LS. (Telephone 01-261 5942).

When replying to Classified Advertisements please ensure:

(A) That you have clearly stated your requirements.

(B) That you have enclosed the right remittance.

(C) That your name and address is written in block capitals, and

(D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

Receivers and Components

300 SMALL COMPONENTS, transistors, diodes. £1·70 7lbs assorted components £4·25 10lbs £5·75. Forty assorted 74 series ICs on panel £1·70. 500 capacitors £3·20. List 20p refundable. Post 60p. Optionable insurance 20p. J. W. B. RADIO, 2 Barnfield Crescent, Sale, Cheshire M33 1NL.

TURN YOUR SURPLUS capacitors, transistors etc., into cash. Contact Coles Harding & Co., 103 South Brink, Wisbech, Cambs. 0945 4188. Immediate settlement.

NEW 1982 ACE COMPONENT CATALOGUE. Let your problems be our business. Be certain; have your components delivered quickly and efficiently and get that project working. Send 30p now for the easy to use 1982 catalogue to: ACE MAILTRONIX, Dept EE, 3A Commercial Street, Batley, West Yorkshire WF17 5HJ.

Courses

SOUND ENGINEERS

If you're following a career in Sound Engineering or interested in learning all aspects of recording studios you should attend one of our weekend studio courses. Topics covered include:

A. The basics of studio construction, wiring and materials used.
B. Types of microphone uses, techniques, and limitations.
C. Use of 2" 16 track machine, lining up, remotes, etc.
D. Use of 24 Channel Desk and all controls.
E. Effect equipment, ADT, reverb, Echo, etc.
F. Ancilliary equipment.
G. Mixing and Editing.

There are a maximum number of 8 students on each course and every one is tutored to their own level of knowledge with regard to their needs and interest. The cost is £98 for the weekend including hotel accommodation overnight. **Details: please phone 01-580 4720 or 01-636 5308 during office hours.**

Service Sheets

BELL'S TELEVISION SERVICE for service sheets on Radio, TV etc. £1·25 plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 King's Rd. Harrogate, N. Yorkshire. Tel: 0423 55885.

Any single service sheet £1/L.S.A.E. Thousands different Repair/Service Manuals/Sheets in stock. Repair data your named T.V. £6·50) with circuits £8·50). S.A.E. Newsletter, Price Lists. Quotations.

AUSEE, 76 CHURCHES, LARKHALL, LANARKSHIRE (0698 883334).

Software

SEVENTY ZX81 PROGRAMS. Listings only £4·95, Barclaycard accepted. Includes many games, utility, machine code loader, home finance, maths, chequebook, etc. Includes hints 'n' tips. SUSSEX SOFTWARE, Wallsend House, Pevensey Bay, Sussex.

Veteran & Vintage

"SOUNDS VINTAGE"

The only magazine for all vintage sound enthusiasts, packed with articles by top writers, covering gramophones, phonographs, 78s, wireless, news, history, reviews, etc.

Bi-monthly. Annual subscription £8·75 (airmail extra). Send 75p for sample copy. **28 Chestwood Close, Billericay, Essex**

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Everyday Electronics for .... insertions. I enclose Cheque/P.O. for £..............................

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Everyday Electronics)

NAME ....

ADDRESS ....

....

Send to: Classified Advertisement Manager

EVERYDAY ELECTRONICS
Classified Advertisements Dept., Room 2612, King's Reach Tower, Stamford Street, London SE1 9LS
Telephone 01-261 5942

Rate:
28p per word, minimum 12 words. Box No. 60p extra.

Company registered in England. Registered No. 53626. Registered Office: King's Reach Tower, Stamford Street, London SE1 9LS. 3/82

Personal

CHRISTIAN SINGLES. Holidays, tours, weekend houseparties. Friendship contacts —CFF Dept/N42, Edenthorpe, Doncaster.

For Sale

EVERYDAY ELECTRONICS, the first ten volumes, buyer collects. Offers to Upminster 23582.

NEW BACK ISSUES OF "EVERYDAY ELECTRONICS". Available 85p each Post Free, cheque or uncrossed PO returned if not in stock. BELL'S TELEVISION SERVICES, 190 Kings Road, Harrogate, Yorkshire. Tel: (0423) 55885.

Miscellaneous

THE SCIENTIFIC WIRE COMPANY

PO Box 30. London E.4. 01 531 1568.

ENAMELLED COPPER WIRE

SWG	1 lb	8 oz	4 oz	2 oz
9 to 29	2·76	1·50	0·80	0·60
30 to 34	3·20	1·80	0·90	0·70
35 to 39	3·40	2·00	1·10	0·80
40 to 43	4·75	2·60	2·00	1·42
44 to 47	5·90	3·40	2·39	2·00
48 to 49	15·96	9·58	6·38	3·69

SILVER PLATED COPPER WIRE

14 to 30	6·50	3·75	2·20	1·40

TINNED COPPER WIRE

14 to 30	3·85	2·36	1·34	0·80

Prices Incl. P & P vat. Orders under £2 add 20p. SAE for List of Copper/Resistance wire. Dealer enquiries welcome.

Registered Office 22 Coningsby Gardens.

DIGITAL WATCH BATTERY REPLACEMENT KIT

These watches all require battery (power cell) replacement at regular intervals. This kit provides the means. We supply eyeglass, non-magnetic tweezers, watch screwdriver, case knife and screwback case opener. Also one doz. assort. push-pieces, full instructions and battery identification chart. We then supply replacement batteries—you fit them. Begin now. Send £9 for complete kit and get into a fast growing business. Prompt despatch.

BOLSTER INSTRUMENT CO. (EE35)
11 Percy Avenue, Ashford, Middx., TW15 2PB

EVERYDAY ELECTRONICS P.C.B's
Drilled 1·5mm Glassfibre Fry's Roller Tinned

AUG 81	Wheel of fortune set of two £3·69
SEP 81	Model train control £1·58
	CMOS die £1·13
NOV 81	Electronic ignition £1·98

For full list and current pcb's send SAE.
CWO Please. Postage. Add 35p postage and packing.

PROTO DESIGN, 14 DOWNHAM RD., RAMSDEN HEATH, BILLERICAY, ESSEX, CM11 1PU
Telephone 0268-710722

SPARE PARTS FOR ALL DIGITAL WATCHES. Batteries 65p; pins; display; back lights etc. Plus reports, publications charts, send SAE for full list. PROFORDS, Copners Drive, Holmer Green, Bucks HP15 6SG.

CENTURION BURGLAR ALARM equipment, send SAE for free list or a cheque/PO for £11·50 for our special offer of a full sized signwritten bell cover to: Centurion, Dept EE, 265 Wakefield Road, Huddersfield, W. Yorkshire. Access & Barclaycard. Telephone orders on 0484 35527.

PARAPHYSICALS JOURNAL (Russian translations): psychotronic generators, Kirlianography, gravity lasers, telekinesis. Details: SAE 4 x 9in, Paralab, Downtown, Wilts.

DIGITAL WATCH BATTERIES any type £1·20 each. Send SAE or 15p with number or old battery to, DISCLEC Y, 511 Fulbridge Road, Werrington, Peterborough.

OSCILLOSCOPE repair and calibration. Quick service, competitive rates. W. I. R. Electronics, 01-367 6816.

ENAMELLED COPPER WIRE. 10 swg to 45 swg. S.A.E. for quotation by return, cheapest prices. 102 Parrswood Road, Manchester 20.

DOUBLE SIDED COPPER CLAD FIBRE-GLASS, 12in x 8in, 5 sheets £4; 10 sheets £6; 20 sheets £10 inc p&p. DAVRON TRADING, 1 Bankside, New Street, Chelmsford, Essex.

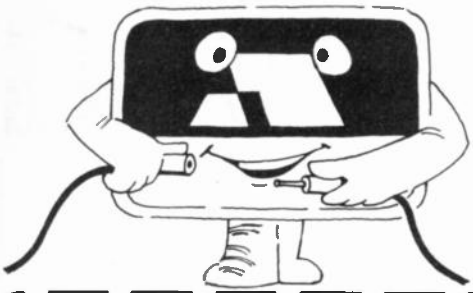
LEARN ELECTRONICS WITHOUT SOLDER

Build electronic circuits without solder on a Roden S-Dec. This has built-in contacts and holes into which you plug your components. Suitable for all ages. Can be used time after time. Ideal gift for students or experimenters. Full instructions and 2 circuit diagrams with each S-Dec.

Send cheque or P.O. to: Roden Products, Dep EE High March, Daventry, Northants. NN11 4QE

£3.85 plus 40p p.&p. each

Make the connection with Access



and receive a regular postal delivery of Everyday Electronics. It's easy, it's straightforward and it's quick. Just use the subscription order form to get your Access card account charged with the price of a subscription or order your subscription through Access on the phone: (01) 886 6433. If you pay by cheque or postal order, use the subscription order form in the usual way.

SUBSCRIPTION ORDER FORM

I wish to become a subscriber to **Everyday Electronics** for one year and enclose cheque/postal order value........................ no........................ made payable to IPC Magazines Ltd.

Complete this portion if you are using your Access card account. I authorise you to debit my Access card account with the above amount.

My Access no. is

(Block letters please)

Name

Address

Signature

Subscription Rates:

UK, Isle of Man, Channel Islands and Irish Republic £11

Overseas £12

Unless you are phoning your order, complete and post this order form to:
Everyday Electronics,
2613 King's Reach Tower,
Stamford Street,
London SE1 9LS.

MIGHTY NINETY PACKS

SUPER VALUE PACKS ALL AT 90p each

BUY SIX PACKS AND GET A SEVENTH FREE

Please add 15p per pack postage

Please allow 7 days delivery.

MN2. 200 ¼ & ½-watt Resistors.

MN3. 100 1 & 2-watt Resistors.

MN4. 50 Wirewound Resistors.

MN5. 100 metal oxide Resistors. 1%, 2% and 5%.

MN6. 12 asstd potentiometers.

MN7. 25 asstd skeleton preset Resistors.

MN8. 50 asstd Electrolytic Capacitors.

MN9. 100 asstd Ceramic Capacitors Plte, disc, tub and monolythic etc.

MN10. 100 mixed capacitors, Polyester, Polystyrene, Metallised, Radial and Axial types.

MN11. 20 asstd Silver Mica Capacitors.

MN12. 8 Tantalum Bead Capacitors (useful values).

MN13. 20 asstd Transistors, BC, 2N Series + Power etc.

MN14. 40 IN4148 Diodes.

MN16. 20 min. wire-ended Neons.

MN17. 2 12-volt Relays. Ex nearly new equip.

MN18. 3 Encapsulated Reed Relays 9-12v coil, d-pole and t-pole.

MN19. 2 24-volt Relays. Ex nearly new equip.

MN20. 1 240-110 to 12-volt. 100ma Transformer.

MN21. 1 240-110 to 24-volt 100ma Transformer.

MN22. 8 2" Led's with clips, 4 red, 2 yellow, 2 green.

MN23. 300 asstd screws, nuts, washers, self-tappers etc.

MN24. 100 asstd small springs.

MN25. 50 asstd pop rivets.

MN26. 50 asstd insulated crimps.

MN27. 200 items, grommets, spacers, cable markers, plastic screws, sleeving, tie wraps etc.

MN28. 20 asstd fuses, 1¼" 20mm etc.

MN29. 75mts equipment, wire, asstd colours and sizes.

MN30. 3 × 2m length, 3 core, mains cable.

MN31. 12 asstd trimmer capacitors, compression film. Air-spaced etc.

MN32. 15 30pF Beehive trimmers.

MN33. 20 coil formers, ceramic, plastic, reed relay etc.

MN34. 25 min glass reed switch.

MN35. 10 asstd switches, toggle, slide, micro etc.

MN36. 10 sub-min SP. C/O slide switch.

MN37. 10 asstd audio connectors. Din phono etc.

MN38. 1 PCB with triac control IC data inc.

MN39. 1 oscillator PCB loads of components (no data).

MN40. 50 Polystyrene capacitors.

MN41. 12 BC549C (plastic BC109C) transistors.

MN42. 10 BC107 Transistors.

MN43. 10 BC108 Transistors.

MN44. 10 Screwfix S.P.C.O. min. slide switches.

MN45. 35 asstd diodes Zener, rect, signal, switching.

MN46. 15 asstd Zener diodes.

MN47. 3 × 68 mfd 16v tantalum bead capacitors.

MN48. 200 items 4BA asstd length screws, nuts & washers.

MN49. 200 items 6BA asstd length screws nuts & washers.

MN50. 3 pieces of veroboard useful sizes, min total 35 sq inch.

MN51. 10 × 0 2" red LED.

MN52. 10 × 0 125" red LED.

MN53. 20 × 0 1 mfd 25v ceramic disc caps.

MN54. 20 × 0 01 mfd 25v ceramic disc caps.

MN55. 10 watt audio amp board with circuit.

MN56. 10 14 pin low profile IC skt DIL.

MN57. 10 16 pin low profile IC skit DIL.

MN58. 2 × CA723 Voltage Regulator.

MN59. 1 × LM380 2 watt audio amp IC + 555 timer IC.

MN60. 10 asstd TTL IC's.

MN61. 3 × TIP 32 Transistor.

MN62. 3 × TIP 31 Transistor.

MN63. 50 mixed polyester caps C280, Seimens etc.

MN64. 5 Press to make min switches.

MN65. 3 BF245 FETS.

MN66. Bank of 11 push switches 4 interlocked, 4 latch, 3 momentary.

MN68. 200 asstd veropins, turret tags, PCB pins etc.

MN69. 4 min push to break switch.

MN70. PCB with 3 × 250v AC 4 amp push SW with attractive chrome plastic knobs 1 × BD241, 1 × BC300, 2 × BC237, 1 × BC204, 4 × 1N4002, 2 × CMOS 4025, 200mm fuse holder + 22 resistors, capacitors, diodes etc.

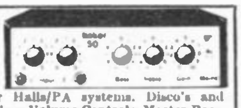
MN71. IZN414 RADIO IC.

CHORDGATE LIMITED

75 FARINGDON ROAD
SWINDON, WILTS. Tel. (0793) 33877
Retail shop at above address

BAKER 50 WATT AMPLIFIER £69

Post £2



Superior quality ideal for Halls/PA systems. Disco's and Groups. Two inputs with Mixer Volume Controls. Master Bass, Treble and Gain Controls. 50 watts RMS. Three loudspeaker outlets 4, 8, 16 ohm.
AC 240V (120V available). Blue wording on black cabinet.

BAKER 150 Watt AMPLIFIER 4 Inputs £89

DRILL SPEED CONTROLLER LIGHT DIMMER KIT. Easy to build kit. Controls up to 480 watts AC mains. Printed Circuit. £3
DELUXE MODEL Ready Built. 800 watts. £5

STEREO PRE-AMP KIT. All parts to build this pre-amp. 3 inputs for high, medium or low gain per channel, with volume control and P.C. Board. Can be ganged to make multi-way stereo mixers. £2·95

SOUND TO LIGHT CONTROL KIT MK II

Complete kit of parts, printed circuit. Mains transformer. 3 channels. Up to 1,000 watts each. Will operate from 200MV to 100 watts signal source. Suitable for home Hi-Fi £15 and all Disco Amplifiers. Cabinet extra £4·50. Post 95p
200 Watt Rear Reflecting White Light Bulbs. Ideal for Disco Lights. Edison Screw 75p each or 6 for £4 or 12 for £7·50.

MAINS TRANSFORMERS Primary 240V A.C.

		POST
250-0-250V 70mA. 6·5V. 2A	£4·50	£2
250-0-250V 80mA. 6·3V 3·5A. 6·3V A1	£5·00	£2
350-0-350V 250mA. 6·3V 6Amp C.T.	£12·00	£2
300-0-300V 120mA. 2 × 6·3V 2A C.T.; 5V 2A...	£12·00	£2
220V 45mA. 6·3V 2A	£2·50	£1

GENERAL PURPOSE LOW VOLTAGE
Tapped outputs available

2 amp 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 25 and 30V	£6·00	£2
1 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£6·00	£2
2 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£10·50	£2
3 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£12·50	£2
5 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£16·00	£2

5-8-10-16V ½a	£2·50	80p	12-0-12V 2a	£3·50	£1
6V ½a	£2·00	£1	15-0-15V 2a	£3·75	£1
6-0-6V 1½a	£3·50	£1	20V 1a	£3·00	£1
9V 250ma	£1·50	80p	20V 2a	£3·50	£1
9V 3a	£3·50	£1	20-0-20V 1a	£3·50	£1
9-0-9V 50ma	£1·50	80p	20-40-60V 1a	£4·00	£2
10-0-10V 2a	£3·00	£1	25-0-25V 2a	£4·50	£1
10-30-40V 2a	£3·50	£1	28V 1a Twice	£5·00	£2
12V 100ma	£1·50	80p	30V 1½a	£3·50	£1
12V 750ma	£2·00	80p	30V 5a and 17-0-17V 2a	£4·50	£2
12V 3a	£3·50	£1			
12V 2a	£3·50	£1	35V 2a	£4·00	£1

TORODIAL 30-0-30V 4 Amp + 20-0-20V ½ Amp £10·00 £2

CHARGER TRANSFORMERS-RECTIFIERS

6-12V 3a	£4·00	£2	6-12V 2a	£1·00	80p
6-12V 4a	£6·50	£2	6-12V 4a	£2·00	80p

R.C.S. LOUDSPEAKER BARGAINS

3 ohm. 6 × 4in., 5in., 7 × 4in. £2·50. 8 × 5in. £3·00. 6½in. £3·00. 8in. £3·50. 10in. £4·00. 12in. £6·00.
8 ohm. 2½in. £2·00. 3in., 5 × 3in., 5in. £2·50. 8in. £3·50.
16 ohm. 6 × 4in. £1·50. 5in. £1·50. 8in. £3·50. 10 × 6in. £3·50.
25 ohm. 3½in. 35 ohm. 3in. £2·50. Many others in stock.

R.C.S. LOW VOLTAGE STABILISED POWER PACK KITS 90-100 mA Post 75p **£2.95**
All parts and instructions with Zener diode printed circuit, rectifiers and double wound mains transformer input 200-240 a.c. Output voltages available 6 or 7·5 or 9 or 12V d.c. up to 100mA. State voltage.

PP BATTERY ELIMINATOR. BRITISH MADE **£4.50**
Mains power pack 9 volt 400 ma Post 75p
stabilised, with overload cutout. Plastic case size 5 × 5½ × 2½. Suitable Radio/Cassettes.
DELUXE Switched Model 3-6-7½-9V 400ma. £7·50.

THE "INSTANT" BULK TAPE ERASER
Suitable for cassettes and all sizes of tape reels.
A.C. mains 200/240V. **£9.50** Post 95p
Leaflet S.A.E.

HEAD DEMAGNETISER PROBE £5·00.

A.C. ELECTRIC MOTORS POST 75p.
2 Pole, 240V, 2 Amp. Spindle—1·43 × 0·212in. £1·75. 2 Pole, 240V, 15 Amp Doubl spindle—1·75 × 0·16in. Each £1. 2 Pole, 120V, ·5 Amp Spindle—0·75 × 0·2in. Two in series – 240V. 50p each. Brush Motor. From a Food Mixer 240V, ·3 Amp High Speed and Powerful Spindle—0·5 × 0·25in. £2·95.
B.S.R. Motor £4. Garrard Motor £5.

ALUMINIUM CHASSIS 18 s.w.g. Undrilled, 4 sides, riveted corners; 6 × 4 × 2½in. £1·45; 8 × 6 × 2½in. £1·80; 10 × 7 × 2½in. £2·30; 14 × 9 × 2½in. £3·00; 16 × 6 × 2½in. £2·90; 12 × 3 × 2½in. £1·80; 12 × 8 × 2½in. £2·60; 16 × 10 × 2½in. £3·20.
ALI ANGLE BRACKET 6 × ¾ × ¾in. 25p.
ALUMINIUM PANELS 18 s.w.g. 12 × 12in. £1·50; 14 × 9in. £1·45; 6 × 4in. 43p; 12 × 8in. £1·10; 10 × 7in. 96p; 8 × 6in. 72p. 14 × 3in. 72p; 12 × 5in. 72p; 16 × 10in. £1·68; 16 × 6in. £1·10;
ALUMINIUM BOXES. MANY OTHER SIZES IN STOCK. 4 × 2½ × 2in. £1·00; 3 × 2 × 1in. 80p; 6 × 4 × 2in. £1·60; 8 × 6 × 3in £2·50; 12 × 5 × 3in £2·75; 6 × 4 × 3in £1·80; 10 × 7 × 3in £3.

HIGH VOLTAGE ELECTROLYTICS

8/800V ...£1·20	50/500V ...£1·20	32+32/350V 50p
32/350V 45p	220/450V 95p	32+32/500V ...£1·80
32/500V 75p	8+16/450V ...75p	32+32+32/352V 75p
		16+32+32/500V £2

DE LUXE BSR HI-FI AUTOCHANGER

Stereo Ceramic Cartridge
Plays 12in., 10in., or 7in. records Auto or Manual. A high quality unit 240V AC.
Size 13½ × 11½in.
Above motor board 3½in.
Below motor board 2½in.

£20 Post on All Decks £2.

BSR Single Player P207 cueing device, ADC. QEM 30/3 Magnetic cartridge. **£20** post £2

Garrard Single Player 730 SP metal turntable, cueing device. Snake arm. Magnetic cartridge. **£27.50** post £2

BSR P170 Slim arm. Metal turntable. Ceramic head. Cueing device. Auto stop. **£20** post £2

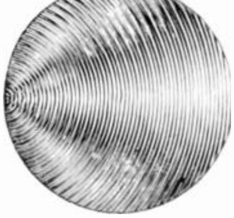
B.S.R. P232. Belt drive, ceramic cartridge, snake arm, cueing device. £24 post £2.

B.S.R. Single Player. 12V D.C. motor, belt drive, magnetic cartridge. £20, post £2.

Radio Component Specialists
337, WHITEHORSE ROAD, CROYDON, SURREY, U.K. TEL: 01-684 1665
Post 65p Minimum. Callers Welcome. Closed Wed. Same day despatch. Access-Barclay-Visa. Lists 28p.

INDEX TO ADVERTISERS

Published approximately the third Friday of each month by IPC Magazines Ltd., Kings Reach Tower, Stamford St., London SE1 9LS. Printed in England by Index Printers, Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Subscriptions: Inland £9.00, Overseas £10.00 per annum payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex. Everyday Electronics is sold subject to the following conditions namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on cover, and that it shall not be lent, resold, or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

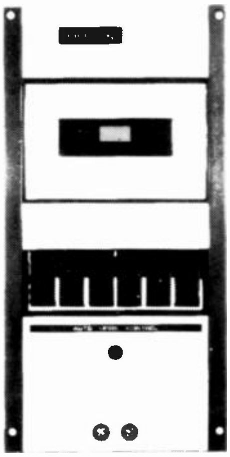


APPROVED thandar STOCKIST

B.K. ELECTRONICS
A SOUND CHOICE

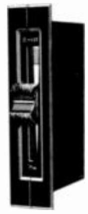
APPROVED thandar STOCKIST

★ PROMPT DELIVERY ★ PRICES INCLUDE V.A.T. ★ AMPLE STOCKS
A PERSONAL SERVICE FROM A SMALL EXPANDING COMPANY



6 piano type keys

STEREO CASSETTE TAPE DECK MODULE. Comprising of a top panel and tape mechanism coupled to a record/play back printed board assembly. Supplied as one complete unit for horizontal installation into cabinet or console of own choice. These units are brand new, ready built and tested.
Features: Three digit tape counter. Auto-stop. Six piano type keys, record, rewind, fast forward, play, stop and eject. Automatic record level control. Main inputs plus secondary inputs for stereo microphones. **Input Sensitivity:** 100mV to 2V **Input Impedance:** 68K. **Output level:** 400mV to both left and right hand channels. **Output Impedance:** 10K. **Signal to noise ratio:** 45dB. **Wow and flutter:** 0.1%. **Power Supply requirements:** 18V DC at 300mA. **Connections:** The left and right hand stereo inputs and outputs are via individual screened leads, all terminated with phono plugs (phono sockets provided). **Dimensions:** Top panel 5½in x 11¼in. Clearance required under top panel 2¼in. Supplied complete with circuit diagram and connecting diagram. Attractive black and silver finish.
Price £26.70 + £2.50 postage and packing.
Supplementary parts for 18V D.C. power supply (transformer, bridge rectifier and smoothing capacitor) £3.



1 K-WATT SLIDE DIMMER
- ★ Controls loads up to 1KW.
- ★ Compact Size 4⅜" × 1$\frac{1}{16}$" × 2½".
- ★ Easy snap in fixing through panel/cabinet cut out.
- ★ Insulated plastic case.
- ★ Full wave control using 8 amp triac.
- ★ Conforms to BS800.
- ★ Suitable for both resistance and inductive loads. Innumerable applications in industry, the home, and disco's/theatres, etc.

Price £11.70 each + 50p P&P. (Any quantity.)

GENERAL PURPOSE 4½" MINI SPEAKER
General purpose full range loudspeaker, ideal for mini systems, etc.
★ Rolled fabric surround ★ Twin cone
★ 8 ohm impedance ★ 15 watt R.M.S.
★ 1" voice coil ★ 13 oz. magnet
★ Frequency range 50/15,000Hz.
Price £6.90 each + 75p P&P.

NEW RANGE QUALITY POWER LOUDSPEAKERS (15", 12" and 8"). These loudspeakers are ideal for both hi-fi and disco applications. Both the 12" and 15" units have heavy duty die-cast chassis and aluminium centre domes. All three units have white speaker cones and are fitted with attractive cast aluminium (ground finish) fixing escutcheons. Specification and Price:–

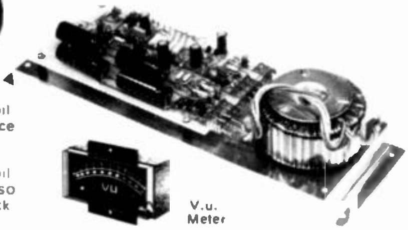
15" 100 watt R.M.S. Impedance 8ohm 59 oz magnet. 2" aluminium voice coil. Resonant Frequency 20Hz. Frequency Response to 2.5KHz. Sensitivity 97dB. **Price £32 each.** £2.50 Packing and Carriage each.

12" 100 watt R.M.S. Impedance 8 ohm, 50 oz magnet. 2" aluminium voice coil. Resonant Frequency 25Hz. Frequency Response to 4KHz. Sensitivity 95dB. **Price £23.70 each.** £2.50 Packing and Carriage each.

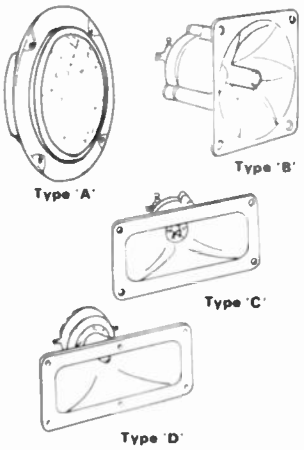
8" 50 watt R.M.S. Impedance 8 ohm, 20 oz magnet. 1" aluminium voice coil. Resonant Frequency 40Hz. Frequency Response to 6KHz. Sensitivity 92dB. Also available with black cone and black protective grill. **Price £8.90 each.** £1.25 Packing and Carriage each.

OMP **POWER AMPLIFIER MODULES**

100 and 150 WATTS R.M.S.
Power Amplifier Modules with integral toroidal transformer power supply and heat sink. Supplied as one complete built and tested unit. Can be fitted in minutes. Auxilliary stabilised supply and drive circuit incorporated to power an L.E.D. Vu meter available as an optional extra.
SPECIFICATION:
Max. output power 100 watts R.M.S. (OMP 100)
150 watts R.M.S. (OMP 150)
Loads: (Open and short circuit proof) 4–16 ohms
Frequency Response: 20Hz—25KHz ± 3dB
Sensitivity: for 100 watts 500mV at 10K
150 watts 500mV at 10K
T.H.D. 00 1%
Size: 360 × 115 × 80mm
Prices: OMP 100 £29.99 P & P £2.00
OMP 250 £39.99 P & P £2.00
V.u. Meter £6.50



PIEZO ELECTRIC TWEETERS – MOTOROLA
Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series). **FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.**



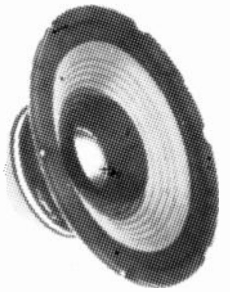
Type 'A' 3in round with removable wire mesh. Ideal for bookshelf hi-fi speakers. **Price (Type 'A') £3.45 each.**
Type 'B' 3½in super horn. For general purpose speakers disco and PA systems, etc. **Price £4.35 each.**
Type 'C' 2in x 5in wide dispersion horn. For hi-fi systems and quality disco etc. **Price £5.45 each.**
Type 'D' 2in x 6in wide dispersion horn. Frequency response extending down to mid-range (2000 c/s) suitable for hi-fi systems and quality disco. **Price £6.90 each.**
Post and Packing, all types, 15p each (or SAE for Piezo leaflets).

Piezo Level Control/Loudspeaker Terminals. Combines two spring loaded loudspeaker terminals wire wound potentiometer and resister network. All mounted on a smart brushed aluminium plate. Fits neatly through a 3" × 3" cut out on rear of speaker cabinet. Price £2.99 + 20p postage and packing.

Matching 3-way loudspeakers and crossover
Build a quality 60 watt R.M.S. system 8 ohm.
- ★ 10" Woofer
- ★ 3" Tweeter
- ★ 5" Mid Range
- ★ 3-way crossover

Fitted with attractive cast aluminium fixing escutcheons and mesh protective grills which are removable enabling a unique choice of cabinet styling. Can be mounted directly on to baffle with or without conventional speaker fabrics. All three units have aluminium centre domes and rolled foam surround. Crossover combines spring loaded loudspeaker terminals and recessed mounting panel.
Price £22.00 per kit + £2.50 P&P.
Available separately, prices on request.

12" 80 watt R.M.S. loudspeaker. A superb general purpose twin cone loudspeaker. 50 oz. magnet. 2" aluminium voice coil. Rolled surround. Resonant frequency 25Hz. Frequency response to 13KHz. Sensitivity 95dB. Impedance 8ohm. **Attractive blue cone with aluminium centre dome.**
Price £17.49 ea + £2.50 P&P.



B.K. ELECTRONICS DEPT E.E.

37 Whitehouse Meadows, Eastwood, Leigh-on-Sea, Essex SS9 5TY

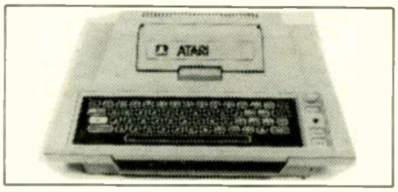
★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Mail order only. ★ All items packed (where applicable) in special energy absorbing PU foam. Callers welcome by prior appointment, please phone 0702-527572.

198

MAPLIN the people for Atari

3 Consoles available:

Atari 400 with 16K RAM (AF36P) £345
Atari 400 with 32K RAM (AF37S) £395
Atari 800 with 16K RAM (AF02C) £645



Lots of other hardware:

Cassette Recorder	(AF28F)	£50 00
Disk Drive	(AF06G)	£345 00
Thermal Printer	(AF04E)	£265 00
Printer Interface for 400	(AF41U)	£49 95
Printer Interface for 800	(AF42V)	£49.95
Interface Module	(AF29G)	£135.00
Versawriter	(AF43W)	£169.00
16K RAM Module	(AF08J)	£64.00
32K RAM Module	(AF44X)	£125.35
32K Upgrade for 400	(AF45Y)	£75.00
Floppy Disk	(YX87U)	£2.75
Le Stick	(AC45Y)	£24.95
Joystick Controllers	(AC37S)	£13.95

For full details ask for our hardware leaflet (XH54J) SAE appreciated

NOW YOU CAN JOIN THE U.K. ATARI COMPUTER OWNER's CLUB. An independent user's group. Four issues of the club magazine for only £1.60! Address your subscription to Graham.

THE CHOICEST GEMS OF ATARI SOFTWARE FROM MAPLIN

Adventure Games

Star Warrior	C - 32K - (BQ24B)	£28 95
Rescue At Rigel	C - 32K - (BQ21X)	£22 45
Invasion Orion	C - 32K - (BQ23A)	£18 95
Datestones of Ryn	C - 32K - (BQ22Y)	£14 95
Galactic Empire	C - 24K - (BQ14Q)	£14 95
Hi-Res Adventure // 2	D - 48K - (BQ25C)	£24 95
Analog Adventure	D - 32K - (BQ33L)	£24 95
Adventure Land	C - 24K - (BQ00A)	£14 95
Pirates Adventure	C - 24K - (BQ01B)	£14 95
Mission Impossible	C - 24K - (BQ02C)	£14 95
Voodoo Castle	C - 24K - (BQ03D)	£14 95
The Count	C - 24K - (BQ04E)	£14 95
Strange Odyssey	C - 24K - (BQ05F)	£14 95
Mystery Fun House	C - 24K - (BQ06G)	£14 95
Pyramid of Doom	C - 24K - (BQ07H)	£14 95
Ghost Town	C - 24K - (BQ08J)	£14 95
Savage Island I	C - 24K - (BQ09K)	£14 95
Savage Island II	C - 24K - (BQ10L)	£14 95
Golden Voyage	C - 24K - (BQ11M)	£14 95
Energy Czar	C - 16K - (YG53H)	£8 95
Kingdom	C - 8K - (YG55K)	£8 95

Teach-Yourself Programs

Conversational French	5C - 16K - (YG44X)	£32 50
Conversational German	5C - 16K - (YG45Y)	£32 50
Conversational Spanish	5C - 16K - (YG46A)	£32 50
Conversational Italian	5C 16K (YG47B)	£32 50
Touch Typing	2C - 16K - (YG49D)	£14 95
States & Capitals	C 24K - (YG56L)	£8 95
European Countries & Capitals	C - 16K - (YG57M)	£8 95

Learn Programming

Invitation to Programming	C - 8K (YG43W)	£11 95
Basics of Animation	C 32K - (BQ57M)	£9 95
Basics of Animation	D - 32K - (BQ58N)	£10 95
Player Missile Graphics	C - 16K - (BQ59P)	£18 95
Player Missile Graphics	D - 24K - (BQ60Q)	£19 95
Display Lists	C - 16K - (BQ51F)	£9 95
Display Lists	D - 24K - (BQ52G)	£10 95
Horiz/Vertical Scroll	C - 16K - (BQ53H)	£9 95
Horiz/Vertical Scroll	D - 24K - (BQ54J)	£10 95
Page Flipping	C 16K - (BQ55K)	£9 95
Page Flipping	D - 24K - (BQ56L)	£10 95
Master Memory Map	Wallchart - (XH57M)	£4 00

Business Programs

Visicalc	D - 32K - (YL39N)	£119 95
Word Processor	D - 32K - (YG42V)	£85 00
Calculator	D 24K - (YG50E)	£16 95
Graph—It	C - 16K - (YG51F)	£11 95
Statistics	C - 16K - (YG52G)	£11 95

Arcade Games

Star Raiders	E - 8K - (YG66W)	£29 95
Asteroids	E - 8K - (YG60Q)	£29 95
Space Invaders	E - 8K - (YG70M)	£24 50
Missile Command	E 8K - (YG64U)	£29 95
Super Breakout	E - 8K - (YG67X)	£29 95
Tari Trek	C - 24K (YL36P)	£8 95
Tari Trek	D - 32K - (YL37S)	£11 95
Star Trek 3 5	C - 32K - (BQ15R)	£14 95
Race In Space	C - 16K - (BQ35Q)	£14 95
Shooting Gallery	C - 16K - (BQ36P)	£14 95
Mountain Shoot	C - 16K - (BQ12N)	£10 95
Jawbreaker	D - 48K - (BQ26D)	£22 95
Basketball	E - 8K - (YG61R)	£29 95
Tank Trap	C - 16K - (YL34M)	£8 95
Tank Trap	D 32K - (YL35Q)	£11 95

Home Game Programs

Scram	C 16/24K - (YG58N)	£12 95
Cypher Bowl	C 32K - (BQ20W)	£22 45
Thunder Island	C - 16K - (BQ37S)	£10 95
Rotating Tilt	C - 16K - (BQ48C)	£14 95
Lunar Lander	C - 16K - (BQ16S)	£10 95
Jumbo Jet Lander	C - 16K - (BQ46A)	£29 95
Submarine Commander	C 16K - (BQ47B)	£24 50
Sunday Golf	C - 16K - (BQ13P)	£10 95
Darts	C - 16K - (BQ42V)	£19 95
Tournament Pool	C - 16K - (BQ45Y)	£19 95
Snooker & Billiards	C - 16K - (BQ44X)	£19 95
Chess	E - 8K - (YG63T)	£29 95
Microchess	C - 16K - (YL40T)	£15 95
Checker King	C - 16K (YL41U)	£15 95
Cribbage & Dominoes	C - 16K (BQ43W)	£14 95
Poker Solitaire	C - 16K - (BQ17T)	£10 95
Blackjack	C - 8K - (YG62S)	£8 95
Fast Gammon	C - 8K - (YL33L)	£9 95
Reversi (Othello-type)	C - 16K - (BQ19V)	£14 95
Gomoko	C - 16K - (BQ18U)	£14 95
Hangman	C - 8K - (YG54J)	£8 95
Humpty Dumpty & Jack & Jill	C - 16K - (BQ38R)	£19 95
Hickory Dickory Dock	C - 16K - (BQ39N)	£19 95
British Heritage Jig-Saw Puzzles	C - 16K - (BQ40T)	£19 95
European Scene Jig-Saw Puzzles	C - 16K - (BQ41U)	£19 95
Atari Safari (25 Programs)	C - 16K - (BQ49D)	£18 95
Atari Safari (25 Programs)	D - 16K - (BQ50E)	£24 95
Mind Bogglers (3 Programs)	C - 16K - (YL38R)	£8 95

Music Programs

Music Composer	E - 8K - (YG48C)	£32 50
Movie Themes (use with Music Composer)	C - 16K - (BQ34M)	£9 95

Computer Languages

Basic A +	D - 48K - (BQ31J)	£52 50
Operating System A +	D - 48K - (BQ30H)	£52 50
Basic A + & Operating System A +	D - 48K - (BQ32K)	£99 50
QS Forth	D - 24K - (YL29G)	£44 90
Pilot	E&2C - 8K (YG69A)	£49 50

Utilities

3D-Super Graphics	D - 48K (BQ28F)	£29 95
3D-Super Graphics	C - 48K - (BQ29G)	£29 95
Atari World (Graphics)	D - 48K - (BQ27E)	£43 95
Assembler Editor	E - 8K - (YG68Y)	£34 50
Assembler	C - 16K (YL32K)	£14 95
6502 Disassembler	C - 8K - (YL30H)	£8 95
6502 Disassembler	D - 8K - (YL31J)	£11 95
Character Generator	C 16K - (YL27E)	£9 97
Character Generator	D 16K - (YL28F)	£12 50
Telelink	E - 8K - (YG59P)	£14 95

Key C = Cassette, D = Disk E = Cartridge
2C = 2 Cassettes etc 8K, 16K etc shows minimum memory requirement

Send sae now for our new software leaflet with details of all the above programs. Order As XH52G — Issue 2.
Lots of exciting new software titles available soon. Keep in touch with Maplin!
Subscribe now to America's leading Atari-only magazine — Analog — 6 issues per year for just £9.00. Order as GG24B.

MAPLIN

Maplin Electronic Supplies Ltd
P.O. Box 3, Rayleigh, Essex.
Tel: Southend (0702) 552911/554155.

Demonstrations at our shops NOW
See the amazing Atari's in action at 159-161 King St., Hammersmith W6
Tel: 01-748 0926
or at 284 London Road, Westcliff-on-Sea, Essex.
Tel: (0702) 554000

Note: Order codes shown in brackets. Prices firm until 15th May, 1982 and include VAT and Postage and Packing (Errors excluded)