EVERYDAY ELECTRONICS and computer PROJECTS

FEBRUARY 1984 90p

EPROM PROGRAMMER FOR THE ZX81

NEGATIVE ION GENERATOR

CAR LIGHT WARNING

LOUDSPEAKER PROTECTION UNIT

SIGNAL TRACER

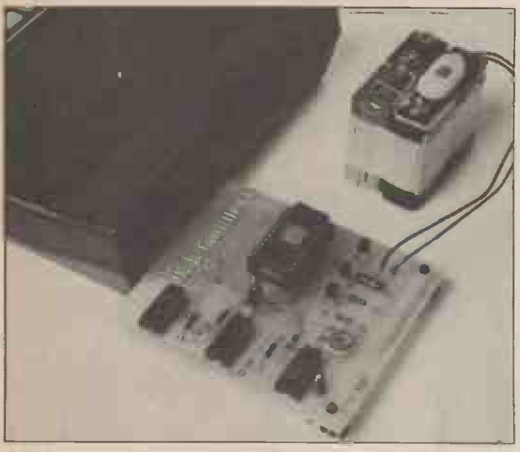
P.C.B. and SOFTWARE SERVICES

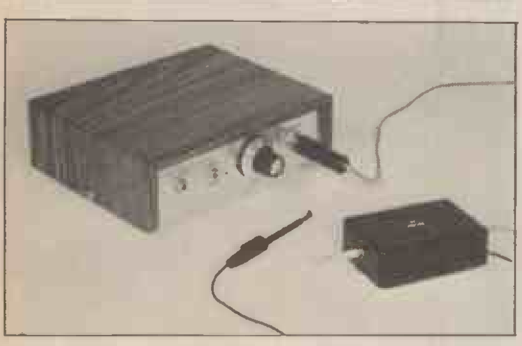
Australia $1.50 New Zealand $1.75 Malaysia $4.95 IR £1.38 (inc V.A.T.)

EVERYDAY ELECTRONICS and computer PROJECTS

VOL. 13 NO. 2 FEBRUARY 1984

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





PROJECTS

SERIES

FEATURES

Our March 1984 issue will be published on Friday, February 17. See page 111 for details.

TEACH-IN 84

Once again GREENWELD will be supplying a complete set of parts for this ever popular series — as we have done for all previous series.
Our experience in this field means your kit can be supplied from stock at the best possible price, so order with confidence. Price for complete kit is only £18.95 inc post and VAT.

MOTORIZED GEARBOX
These units are as used in a computerized tank, and offer the experimenter in robotics the opportunity to buy the electro-mechanical parts required in building remote controlled vehicles. The unit has 2 × 3V motors, linked by a magnetic clutch, thus enabling turning of the vehicle, and a gearbox contained within the black ABS housing, reducing the final drive speed to approx 50rpm. Data is supplied with the unit showing various options on driving the motors etc. £5.95. Suitable wheels also available: 3" Dia plastic with black tyre, drilled to push-fit on spindle. 2 for £1.30 (limited qty). 3" dia aluminium disc 3mm thick, drilled to push-fit on spindle. 2 for 68p.

TREAT YOURSELF TO A NICE NEW DIGITAL MULTIMETER!!
KD55C A DVN for the professional – this 3½ digit multitester has overload protection, low battery and over range indication. Full auto polarity operation.
AC Volts: 0.2-700
DC Volts: 0.2-1000
AC Current: 200uA-10A
DC Current: 200ua-10A
Resistance: 200R-200M
Total 28 ranges for just £44.95

SEAT BELT ALARM
Originally for sale at £8.95, these well made units 70×50×25mm provide both audible and visual alarms. Uses 2 IC's, PB2720 transducer, etc. Available ready built, with circuit and instructions for just £4.95. Also available as a kit, PCB + all components, box, wire, etc, together with instructions. Only £3.95.

RIBBON CABLE
Special purchase of multicoloured 14 way ribbon cable – 40p/metre; 50m £18; 100m £32.00; 250m £65.00.

TTL PANELS
Panels with assorted TTL inc LS types. Big variety. 20 chips £1.00; 100 chips £4.00; 1000 chips £30.00.

"THE SENSIBLE 64"
David Highmores new book on the Commodore 64 now available. £5.95.

THE 1984 GREENWELD CATALOGUE

Now in the course of production, the 1984 GREENWELD catalogue will be published in January. It's Bigger, Brighter, Better, more components than ever before. With each copy there's discount vouchers, Bargain List, Wholesale Discount List, Bulk Buyers List, Order Form and Reply Paid Envelope. All for just £1.00! *Order now for early delivery!*

COMPUTER GAMES
Z901 Can you follow the flashing light/pulsating tone sequence of this famous game? Supplied as a fully working PCB with speaker (no case) plus full instructions. Only £4.95
Z902 Probably the most popular electronic game on the market – based on the old fashioned pencil and paper battleship game, this computerized version has brought it bang up to date! We supply a ready built PCB containing 76477 sound effect chip, TMS1000 micro-processor chip, R's, C's etc. Offered for its component value only (board may be cracked or chipped, it's only £1.95. Instructions and circuit, 30p.

SHOP SALE

Loads of special offers to callers only.
Feb 4th-11th.

PACKS! PACKS! PACKS!

K517	Transistor Pack. 50 assorted full spec marked plastic devices PNP NPN RF AF. Type numbers include BC114, 117, 172, 182, 183, 198, 239, 251, 214, 225, 320, BF198, 255, 394, 2N3904 etc etc. Retail cost £7+. Special low price	275p
K523	Resistor Pack. 1000 – yes, 1000 ¼ and ½ watt 5% hi-stab carbon film resistors with pre-formed leads for PCB mounting. Enormous range of preferred values from a few ohms to a several megohms. Only 250p. 5000 £10; 20,000 £36.	
K520	Switch Pack. 20 different assorted switches – rocker, slide, push, rotary, toggle, micro etc. Amazing value at only	200p
K522	Copper clad board. All pieces too small for our etching kits. Mostly double sided fibreglass. 250g (approx 110 sq ins) for	200p
K541	It's back!! Our most popular pack ever – Vero offcuts. This has been restricted for some time, but we have now built up a reasonable stock and can once again offer 100 sq ins of vero copper clad offcuts, average size 4×3". Offered at around ⅓ the price of new board	320p
K530	100 Assorted polyester caps – all new modern components, radial and axial leads. All values from 0.01 to 1uf at voltages from 63 to 1000!! Super value at	395p
K602	Electrolytics – all long leaded radial type – most values from 10uf to 1000uf, nearly all 10V, few 16V. Bag of 100 assorted	£3.50

GREENWELD

Goods normally despatched by return of post.

443D Millbrook Road Southampton SO1 0HX
Our shop has enormous stocks of components and is open from 9-5.30 Mon-Sat.
Tel (0703) 772501
ALL PRICES INCLUDE VAT; JUST ADD 60p P&P.

TWO FABULOUS OFFERS FROM ALCON

SUPER 20
20kΩ/V a.c. & d.c.

A SUPER PROTECTED UNIVERSAL MULTIMETER

Undestructible, with automatic protection on all ranges but 10A.

ONLY £33·50

inc. VAT, P&P, complete with carrying case, leads and instructions.

This special offers is a wonderful opportunity to acquire an essential piece of test gear with a saving of nearly £20.00.

Accuracy:	d.c. ranges and Ω 2% a.c. 3% (of f.s.d.)
39 ranges:	d.c. V 100mV, 1·0V, 3·0V, 10V, 30V, 100V, 300V, 1000V.
	d.c. I 50μA, 100μA, 300μA, 1.0μmA,3mA, 10mA, 30mA, 100mA, 1A, 10A
	a.c. V 10V, 30V, 100V, 300V, 1000V.
	a.c. I 3mA, 10mA, 30mA, 100mA, 1.0A, 10A.
	Ω 0–5.0kΩ, 0–50kΩ, 0–500kΩ, 5MΩ, 50MΩ.
	dB from –10 to +61 in 5 ranges.
Dimensions:	105 × 130 × 40mm.

SUPER TESTER 50
50kΩ V a.c. and d.c.

A 39 ranges fool-proof multimeter with protective diodes, quick acting 1.25A fuse and resettable cut-out.

PROFESSIONAL SOLUTION TO GENERAL MEASUREMENT PROBLEMS

ONLY £36·30

incl. VAT, P&P, complete with carrying case, leads and instructions. Goods normally by return of post.

The best instrument for the workshop, school, toolbox, TV shop and anywhere accurate measurement is needed quickly and simply.

Accuracy:	d.c. ranges and Ω 2% a.c. 3% (off.s.d)
39 ranges:	d.c. V 150mV, 1V, 3V, 10V, 30V, 100V, 300V, 1000V;
	d.c. I 20μA, 100μA,300μA, 1·0mA, 3mA, 10mA, 30mA, 100mA, 1A, 3A.
	a.c. V 10V, 30V, 100V, 300V, 1000V;
	a.c. I 3mA, 10mA, 30mA, 100mA, 1A, 3A.
	Ohms 5kΩ, 50kΩ, 500kΩ, 5MΩ, 50MΩ.
	dB from –10 to +61 in 5 ranges.
Dimensions:	105 × 130 × 40mm.

For details of these and the many other instruments in the Alcon range, including multimeters, components measuring, automotive and electronic instruments, please write or telephone:

ALCON Instruments Ltd.

19 MULBERRY WALK · LONDON SW3 6DZ · TEL: 01-352 1897 · TELEX: 918867

BI-PAK BARGAINS

MINIATURE TOOLS FOR HOBBYISTS

Miniature round nose side cutters – insulated handles 4½ inch length. Order No: Y043.

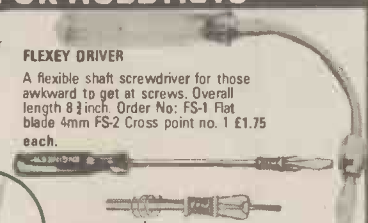
Miniature long nose pliers – insulated handles 5½ inch length. Order No: Y044.

Miniature bend nose pliers – insulated handles 5½ inch length. Order No: Y045.

Miniature end nippers – insulated handles 4½ inch length. Order No: Y046.

Miniature snipe nose pliers with side cutter and serrated jaws – insulated handles 5inch length. Order No: Y042.

ALL AT **1.25** each



FLEXEY DRIVER

A flexible shaft screwdriver for those awkward to get at screws. Overall length 8 ½ inch. Order No: FS-1 Flat blade 4mm FS-2 Cross point no. 1 £1.75 each.

GRIP-DRIVER

8inch long screwdriver with spring loaded grip on end to hold screws in position while reaching into those difficult places. Order No: SD-1 Flat blade 4mm SD-2 Cross point no.0. £95p each.

MULTITESTERS

1,000 opv Including test leads & Battery
AC volts - 0-15-150-500-1,000
DC volts - 0-15-150-500-1,000
DC currents - 0-1ma-150ma
Resistance - 0-2.5 K ohms 100 K ohms
Dims - 90 x 61 x 30mm

O/No.1322.OUR PRICE £6.50 ONLY

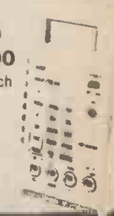
BRAND NEW LCD DISPLAY MULTITESTER

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 *Fast 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	155x88x31mm

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 PRICE

£35.00 each



Leather Case for 188m £2.50 EACH

VALUE PACKS

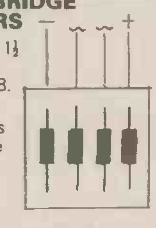
Pak No.	Qty	Description	Price
VP1	300	Assorted Resistors Mixed Types	£1.00
VP2	300	Carbon Resistors ¼-½ Watt Pre-Formed	£1.00
VP3	200		
VP4	150	½ Watt Resistors 100 ohm-1M Mixed	£1.00
VP5	200	Assorted Capacitors All Types	£1.00
VP6	200	Ceramic Caps Miniature – Mixed	£1.00
VP7	100	Mixed Ceramics Disc. 1pf – 56pf	£1.00
VP8	100	Mixed Ceramic Disc. 68pf – .015pf	£1.00
VP9	100	Assorted Polyester/ Polystyrene Caps	£1.00
VP10	60	C280 Type Caps Metal Foil Mixed	£1.00
VP11	100	Electrolytics – All Sorts	£1.00
VP12	60	Bead Type Polystyrene Min Caps	£1.00
VP13	50	Silver Mica Caps Ass. 5.6pf – 150pf	£1.00
VP14	50	Silver Mica Caps Ass. 180pf – 4700pf	£1.00
VP15	50	High Voltage Disc. Ceramic 750v – 8Kv Mixed	£1.00
VP16	50	Wirewound Res. 9W (avg) Ass. 1 ohm – 12K	£1.00
VP17	50	Metres PVC Covered Single Strand Wire Mixed Colours	£1.00
VP18	30	Metres PVC Covered Multi Strand Wire Mixed Colours	£1.00
VP19	40	Metres PVC Single/ Multi Strand Hook-Up Wire Mixed	£1.00
VP20	6	Rocker Switches 5 Amp 240v	£1.00
VP21	20	Pcs. 1 – 2 & 4 mm Plugs & Sockets Matching Sizes	£1.00
VP22	200	Sq. Inches Total, Copper Clad Board Mixed Sizes	£1.00
VP23	20	Assorted Slider Pots. Mixed Values	£1.00
VP24	10	Slider Pots. 40 mm 22K 5 × Log. 5 × Lin	£1.00
VP25	10	Slider Pots. 40 mm 47K 5 × Log. 5 × Lin	£1.00
VP26	20	Small .125" Red LED'S	£1.00
VP27	20	Large .2" Red LED'S	£1.00
VP28	10	Rectangular .2" Green LED'S	£1.00
VP29	30	Ass. Zener Diodes 250mW – 2W Mixed Vlts. Coded	£1.00
VP30	10	Ass. 10W Zener Diodes Mixed Vlts. Coded	£1.00
VP31	10	5 Amp SCR's TO-66 50-400v Coded	£1.00
VP32	20	3 Amp SCR's TO-66 Up To 400v Uncoded	£1.00
VP33	200	Sil. Diodes Switching Like IN4148 DO-35	£1.00
VP34	200	Sil. Diodes Gen. Purpose Like OA200/ BAX13/ 16	£1.00
VP35	50	1 Amp IN4000 Series Sil. Diodes Uncoded All Good	£1.00
VP36	8	Bridge Rects. 4 × 1 Amp 4 × 2 Amp Mixed Vlts. Coded	£1.00
VP37	8	Black Instrument Type Knobs With Pointer ¼" Std	£1.00
VP42	10	Black Heatsinks To Fit TO-3, TO-220 Ready Drilled	£1.00
VP43	4	Power-Fin Heatsinks 2 × TO-3 2 × TO-66 Size	£1.00

SILICON BRIDGE RECTIFIERS

Comprising 4 × 1½ amp rectifiers mounted on PCB.
VRM – 150 vlts
IFM – 1.5 Amps
Size: 1 inch square

10 off **£1.00**
50 off **£4.50**
100 off **£7.50**

Order No. As:4RI BRect.



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 (Philips) 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**

ELECTRONIC SIREN 12v DC

Red plastic case with adjustable fixing bracket. Emits high-pitched wailing note of varying pitch - 100 cycles per minute. Dims - 90mm (dia.) 60mm (depth). Power - 12v DC.

Our Price: £5.50

DIGITAL VOLT METER MODULE

3 x 7 segment displays Basic Circuit 0-2V± instructions provided to extend voltage & current ranges. Operating voltage 9/12v
Typ. Power Consumption 50mA
O/NO:SX99 Once only price
£9.95

REGULATED VARIABLE *Stabilised* POWER SUPPLY

Variable from 2-30 volts and 0-2 Amps. Kit includes – 1 – VPS30 Module, 1 – 25 volt 2 amp transformer, 1 – 0-50v 2" Panel Meter, 1 – 0-2 amp 2" Panel Meter, 1 – 470 ohm wirewound potentiometer, 1 – 4K7 ohm wirewound potentiometer, Wiring Diagram included. Order No. VPS30 KIT **£20**

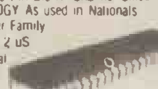
MINIATURE FM TRANSMITTER

Freq: 95-106MHz. Range: ¼ mile
Size: 45 × 20mm. Add: 9v batt.
Not licenced in U.K.
Ideal for: 007-MI5-FBI-CIA-KGB etc.

ONLY £5.50

8 Bit MICROPROCESSOR

National INS8080AN 40 Pin DIL N Channel Silicon GATE MOS TECHNOLOGY As used in Nationals N8080 Micro Computer Family
Instruction Cycle Time 2 uS
Supplied with functional Block Diagram
BRAND NEW —
NOT seconds or reclaims
100% perfect ORDER NO SX8080 **only**



Normal Sell price £4.50 each
Our BI-PAK Special Price **£2.00**
SO HURRY LIMITED STOCKS

40 Pin IC Socket to fit SX8080 Offer price ORDER NO 1609 **30p**

OUR GREAT NEW 1984 CATALOGUE

Presented with a Professional Approach and Appeal to ALL who require Quality Electronic Components, Semiconductors and other Accessories ALL at realistic prices. 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.

We hold vast stocks "in stock" for fast immediate delivery, all items in our Catalogue are available ex stock. The Catalogue is designed for use with our 24 hours "ansaphone" service and the Visa/Access credit cards, which we accept over the telephone.

To receive your NEW 1984 BI-PAK Catalogue, send 75p PLUS 25p p&p to:-

SIREN ALARM MODULE

American Police type screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer breakdown and other security purposes. 5 watt, 12v max.

£3.85
Order No. BP124.

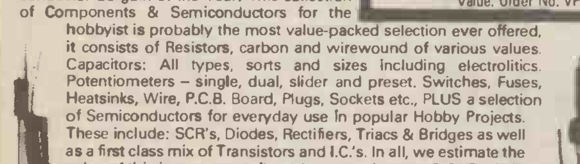
The Third and Fourth Hand . . .

. . . 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 25× 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**

TRANSISTOR CLEARANCE

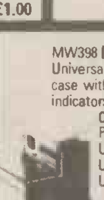
100 All Sorts Transistors. A mixed Bag NPN-PNP Silicon & Germ. Mainly Uncoded You To Sort Pack includes Instructions For Making Simple Transistor Tester. Super Value. Order No. VP60 **£1.00**

TECASBOTY



The Electronic Components and Semiconductor Bargain of the Year! This collection of Components & Semiconductors for the hobbyist is probably the most value-packed selection ever offered, it consists of Resistors, carbon and wirewound of various values. Capacitors: All types, sorts and sizes including electrolitics. Potentiometers – single, dual, slider and preset. Switches, Fuses, Heatsinks, Wire, P.C.B. Board, Plugs, Sockets etc., PLUS a selection of Semiconductors for everyday use in popular Hobby Projects. These include: SCR's, Diodes, Rectifiers, Triacs & Bridges as well as a first class mix of Transistors and I.C.'s. In all, we estimate the value of this in current retail catalogues to be over £25! So, help yourself to a great surprise and order a Box TODAY for **just £6.50** ONLY at BI-PAK. Remember, stocks are limited so hurry! You can call us on 0920-3182/3412 and order with your Barclaycard or Access Card – 24hr Answerphone Service NOW. Order No. V.P. 85.

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 × 100 × 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.

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 – T0202 – TAG 425

1 OFF	10 OFF	50 OFF	100 OFF
60p	£5.75	£27.50	£50.00

VOLTAGE REGULATORS T0220

Positive +	Negative +
7805 – 40p	7905 – 50p
7812 – 40p	7912 – 50p
7815 – 40p	7915 – 50p
7824 – 40p	7924 – 50p

BI-PAK

Send your orders to Dept EE2 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 75p 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 Total order.
Postage add 75p per Total order.

ENFIELD ELECTRONICS

208 Baker Street, Enfield, Middlesex. EN1 3JY Tel: 01-366 1873

TRANSISTORS

				BF198	14p	TIP29C	45p	2N1304	80p
				BF199	14p	TIP30A	40p	2N1305	80p
				BF200	35p	TIP30B	50p	2N1307	70p
AC125	30p	BC183C	12p	BF224B	20p	TIP30C	60p	2N1308	80p
AC126	30p	BC183L	12p	BF244B	35p	TIP31	38p	2N1613	36p
AC127	30p	BC183LB	12p	BF256	35p	TIP31A	40p	2N2222A	30p
AC128	30p	BC184	12p	BF257	35p	TIP31B	40p	2N2369A	28p
AC132	90p	BC184B	12p	BF258	35p	TIP31C	45p	2N2646	68p
AC141	30p	BC184L	12p	BF259	35p	TIP32A	40p	2N2904A/5A	30p
AC142	30p	BC186	30p	BF594	40p	TIP32C	40p	2N2906A	60p
AC176	30p	BC187	30p	BF595	30p	TIP36C	140p	2N2907A	30p
AC187	30p	BC212A	14p	BFR39	20p	TIP41A	50p	2N2926G	12p
AC188	30p	BC212L	12p	BFR79	30p	TIP41B	50p	2N2926R	12p
AD149	80p	BC213	12p	BFR80	30p	TIP42A	60p	2N2926Y	12p
AD161	45p	BC213B	12p	BFX29	30p	TIP42B	65p	2N3053	30p
AD162	45p	BC213L	12p	BFX84	30p	TIP120	80p	2N3054	75p
BC107	12p	BC214	12p	BFX85	30p	TIP121	80p	2N3055E	60p
BC107A	14p	BC214B	14p	BFX87	30p	TIP142	120p	2N3442	150p
BC107B	14p	BC214L	14p	BFX88	30p	TIP2955	70p	2N3615	200p
BC108	12p	BC237	18p	BFY50	28p	TIS43	36p	2N3702	12p
BC108A	14p	BC238B	18p	BFY51	25p	TIS44	40p	2N3703	12p
BC108B	14p	BC307	18p	BFY52	25p	TIS90	30p	2N3704	12p
BC108C	14p	BC308	14p	BFY90	80p	TIS91	30p	2N3705	12p
BC109	12p	BC327	16p	BRY39	40p	VN10KMA	75p	2N3706	12p
BC109B	14p	BC328	16p	BSX20	30p	VN66AF	95p	2N3707	12p
BC109C	14p	BC337	16p	BSX29	35p	VN88AF	110p	2N3708	12p
BC140	35p	BC338	16p	BU105	170p	ZTX107	12p	2N3710	12p
BC141	35p	BC441	36p	BU205	200p	ZTX108	12p	2N3711	12p
BC142	35p	BC461	36p	BU208A	220p	ZTX109	12p	2N3771	200p
BC143	35p	BC477	40p	MJ2955	90p	ZTX300	15p	2N3772	200p
BC147	12p	BC478	40p	MJE340	50p	ZTX301	18p	2N3773	200p
BC148	12p	BC517	45p	MJE371	90p	ZTX302	20p	2N3819	25p
BC157	12p	BC547	15p	MJE2955	110p	ZTX303	20p	2N3820	45p
BC158	12p	BC548	15p	MJE3055T	80p	ZTX304	20p	2N3823	50p
BC159	12p	BC549	16p	MPSA06	25p	ZTX330	35p	2N3866	100p
BC160	50p	BC556	20p	MPSA56	30p	ZTX500	18p	2N3903	15p
BC161	45p	BC557	16p	MPSU05	65p	ZTX501	18p	2N3904	15p
BC167	15p	BC558	16p	MPSU56	60p	ZTX502	18p	2N3905	15p
BC168	12p	BC559	16p	OC22	150p	ZTX503	18p	2N3906	15p
BC169	12p	BCY70	20p	OC23	150p	ZTX504	30p	2N5172	30p
BC170	20p	BCY71	22p	OC26	100p	ZTX531	30p	2N5194	80p
BC171	13p	BCY72	23p	OC28	200p	ZTX550	30p	2N5457	42p
BC172A	12p	BD131	50p	OC36	220p	2N696	35p	2N5458	48p
BC173	13p	BD132	50p	OC41	75p	2N698	45p	3N128	85p
BC177	20p	BD133	60p	OC42	75p	2N699	40p	3N140	85p
BC178	20p	BD135	50p	OC70	60p	2N706A	20p	3N141	85p
BC179	25p	BD136	40p	OC76	60p	2N708	30p	3N163	110p
BC181	23p	BD137	40p	OC81	60p	2N914	36p	3N201	110p
BC182	12p	BD138	40p	OC82	60p	2N918	30p	3N202	125p
BC182B	14p	BD139	45p	OC84	50p	2N930	30p	40406	80p
BC182L	12p	BD140	45p	TIP29	30p	2N1131	30p	40407	80p
BC183	12p	BF194	14p	TIP29A	35p	2N1132	30p		
BC183B	12p	BF195	14p	TIP29B	50p	2N1303	80p		

TTL

		7417	28p	7447	75p	7486	35p	74119	70p	74160	65p	74190	58p
		7420	20p	7448	55p	7489	140p	74121	35p	74161	55p	74191	55p
		7422	28p	7450	21p	7490	37p	74122	41p	74162	46p	74192	55p
7400	18p	7425	28p	7451	20p	7491	45p	74123	41p	74163	46p	74193	55p
7401	18p	7426	28p	4753	21p	7492	40p	74126	70p	74164	46p	74194	52p
7402	18p	7427	30p	7454	21p	7493	41p	74132	65p	74165	60p	74195	52p
7403	18p	7428	30p	7460	21p	7494	41p	74135	50p	74166	60p	74196	55p
7404	18p	7430	26p	7470	25p	7495	41p	74141	51p	74167	185p	74197	55p
7405	18p	7432	26p	7472	25p	7496	41p	74144	250p	74170	195p	74198	95p
7406	32p	7433	35p	7473	30p	7497	60p	74145	575p	74173	120p	74199	95p
7407	32p	7437	30p	7474	35p	74100	95p	74147	125p	74174	65p	74221	60p
7408	25p	7438	30p	7475	40p	74104	58p	74148	65p	74175	65p	74279	60p
7409	25p	7440	23p	7476	35p	74105	58p	74150	70p	74176	46p	74284	95p
7410	18p	7441	51p	7480	30p	74107	30p	74151	46p	74177	55p	74285	95p
7411	25p	7442	40p	7481	110p	74109	30p	74153	46p	74180	50p	74366	64p
7412	26p	7443	71p	7482	70p	74110	41p	74154	81p	74181	121p	74390	325p
7413	26p	7444	95p	7483	58p	74111	70p	74155	46p	74182	70p	74393	100p
7414	37p	7445	71p	7484	81p	74116	70p	74156	46p	74184	105p		
7416	28p	7446	71p	7485	75p	74118	65p	74157	35p	74185	105p		

LS TTL

		74LS27	21p	74LS83	51p	74LS138	40p	74LS169	98p	74LS243	81p	74LS293	46p
		74LS28	21p	74LS85	52p	74LS139	39p	74LS170	86p	74LS244	65p	74LS353	71p
74LS00	17p	74LS30	21p	74LS86	23p	74LS147	121p	74LS173	63p	74LS245	86p	74LS362	110p
74LS01	17p	74LS32	21p	74LS90	39p	74LS148	86p	74LS174	58p	74LS247	65p	74LS365	35p
74LS02	17p	74LS33	21p	74LS93	35p	74LS151	46p	74LS175	52p	74LS248	66p	74LS366	35p
74LS04	17p	74LS37	21p	74LS95	46p	74LS153	52p	74LS181	115p	74LS249	66p	74LS367	35p
74LS05	17p	74LS38	21p	74LS96	109p	74LS154	120p	74LS183	201p	74LS251	40p	74LS368	35p
74LS08	18p	74LS40	21p	74LS107	46p	74LS155	46p	74LS190	58p	74LS253	46p	74LS373	70p
74LS09	20p	74LS42	37p	74LS109	35p	74LS156	46p	74LS191	55p	74LS257	40p	74LS374	70p
74LS10	20p	74LS49	63p	74LS112	32p	74LS157	40p	74LS192	55p	74LS258	43p	74LS375	52p
74LS11	20p	74LS51	21p	74LS113		74LS158	40p	74LS193	55p	74LS259	67p	74LS386	130p
74LS12	23p	74LS54	21p	74LS114	32p	74LS160	40p	74LS194	52p	74LS260	30p	74LS390	55p
74LS13	28p	74LS55	21p	74LS122	46p	74LS161	40p	74LS195	52p	74LS266	32p	74LS393	55p
74LS14	32p	74LS63	138p	74LS123	46p	74LS162	40p	74LS196	52p	74LS273	63p	74LS395	98p
74LS15	21p	74LS73	25p	74LS124	166p	74LS163	43p	74LS197	52p	74LS275	145p	74LS398	310p
74LS20	21p	74LS74	25p	74LS125	37p	74LS164	48p	74LS221	63p	74LS279	40p	74LS541	130p
74LS21	21p	74LS75	28p	74LS126	35p	74LS165	60p	74LS240	81p	74LS280	110p	74LS629	200p
74LS22	21p	74LS76	25p	74LS132	41p	74LS166	85p	74LS241	75p	74LS283	46p	74LS669	160p
74LS26	21p	74LS78	25p	74LS136	28p	74LS168	97p	74LS242	80p	74LS290	60p	74LS670	120p

CMOS

		CD4015	46p	CD4035	55p	CD4054	100p	CD4093	40p	CD4503	46p	CD4569	80p
		CD4016	30p	CD4038	125p	CD4060	80p	CD4099	140p	CD4511	52p	CD4572	80p
		CD4017	40p	CD4040	50p	CD4066	30p	CD4160	75p	CD4512	60p	CD4581	80p
CD4000	15p	CD4018	52p	CD4041	50p	CD4068	20p	CD4161	75p	CD4514	140p	CD4582	80p
CD4001	15p	CD4019	30p	CD4042	45p	CD4069	20p	CD4162	75p	CD4515	200p	CD4583	60p
CD4002	15p	CD4020	52p	CD4043	46p	CD4070	16p	CD4163	75p	CD4516	65p	CD4584	60p
CD4006	60p	CD4021	46p	CD4044	46p	CD4071	18p	CD4175	75p	CD4518	52p	CD4585	110p
CD4007	16p	CD4022	46p	CD4045	120p	CD4072	18p	CD4402	75p	CD4520	60p	CD40100	200p
CD4008	45p	CD4023	20p	CD4046	55p	CD4075	25p	CD4412	75p	CD4528	81p	CD40106	80p
CD4009	30p	CD4024	40p	CD4047	46p	CD4076	60p	CD4419	75p	CD4538	100p	CD40109	100p
CD4010	35p	CD4025	18p	CD4048	45p	CD4077	30p	CD4445	75p	CD4539	78p	CD40114	200p
CD4011	15p	CD4026	100p	CD4049	30p	CD4078	25p	CD4446	75p	CD4541	100p	CD40174	80p
CD4012	20p	CD4027	25p	CD4050	30p	CD4081	25p	CD4449	75p	CD4555	60p		
CD4013	25p	CD4028	45p	CD4052	70p	CD4082	25p	CD4501	35p	CD4561	110p		
CD4014	55p	CD4029	55p	CD4053	60p	CD4085	72p	CD4502	70p	CD4568	80p		

LINEAR

		CA3090	415p	LM339	80p	LM3911	140p	SAA5020		TDA1008	347p	TL074	117p
		CA3130	105p	LM348	90p	LM3914	285p	SN76013N	295p	TDA1022	570p	TL081	40p
CA1310E	185p	CA3140	52p	LM358	62p	LM3915	285p	TAA621A	290p	TDA1024	120p	TL082	65p
CA1350E	90p	CA3240	125p	LM380	85p	LM3916	285p	TAA661B	175p	TDA2002	150p	TL083	92p
CA3020	230p	ICM7555	105p	LM381	170p	MC1458	70p	TBA120B	70p	TDA2003	345p	TL084	65p
CA3028	110p	ICM7556	200p	LM382	130p	MC1488	80p	TBA120S	68p	TDA2020	350p	UA748	40p
CA3035	270p	LF347	200p	LM384	160p	MC1489	90p	TBA120U	98p	TDA2030	340p	ZN414	95p
CA3043	305p	LF351N	55p	LM386	100p	NE555	20p	TBA540Q	161p	TDA2102		ZN424	150p
CA3055	85p	LF353N	100p	ILM387	140p	NE556	55p	TBA651		TDA2522		ZN425	400p
CA3065	150p	LM224	150p	ILM389	110p	NE564	405p	TBA800	95p	TDA9400		ZN426	345p
CA3080	80p	LM301	30p	ILM732	55p	NE566	173p	TBA810S	110p	TL061	50p	ZN427	715p
CA3081	225p	LM308	100p	ILM747	75p	NE567	161p	TBA820	81p	TL062	75p	ZN1034	230p
CA3085	145p	LM311N	81p	ILM1458	45p	NE570	391p	TBA920Q	175p	TL064	150p	ZN1040	750p
CA3086	65p	LM318N		ILM3900	70p	NE571	387p	TCA270S	171p	TL071	50p		
CA3089	230p	LM324	50p	ILM3909	92p	SAA5010		TDA1004	345p	TL072	60p		

RIBBON CABLE

(Priced per ft)

WAYS	COLOUR
10	26p
20	53p
26	76p
34	100p

DIODES

		OA200	9p	1N5060	18p
AA119	15p	OA202	9p	1N5062	20p
AA215	16p	1N823	5p	1N5400	11p
BAX13	10p	1N914	5p	1N5401	12p
BY100	30p	1N916	6p	1N5402	14p
BY127	18p	1N4000	5p	1N5403	15p
BY133	20p	1N4001	5p	1N5404	16p
BY206	30p	1N4002	5p	1N5405	17p
BY207	30p	1N4003	6p	1N5406	18p
BY299	40p	1N4004	6p	1N5407	22p
BYX10	18p	1N4005	7p	1N5408	25p
OA47	10p	1N4006	7p	1S44	5p
OA90	8p	1N4007	8p	1S921	7p
OA91	8p	1N4148	5p	1S922	7p
OA95	8p	1N4448	6p	1S923	7p

D CONNECTORS

	MALE	FEMALE
9 way	75p	100p
15 way	100p	1140
25 way	140p	195p

D-CONNECTOR COVERS

9 way	110
15 way	110
25 way	125

RECHARGEABLE BATTERIES

HP2, 1.2v, 4.0AH	£3.95
HP2, 1.2v, 1.2AH	£2.85
HP11, 1.2v, 1.2AH	£2.70
HP7, 1.25v, 500mAH	£1.00
AAA, 1.2v, 180mAH	30p
PP3, 8.4v, 110mAH	£4.95

I.C. SOCKETS

LOW PROFILE D.I.L Type	Price	TURNED PIN D.I.L. Type	Price
8 pin	10p	8 pin	35p
14 pin	12p	14 pin	50p
16 pin	14p	16 pin	60p
18 pin	18p	18 pin	65p
20 pin	24p	22 pin	75p
22 pin	25p	24 pin	80p
24 pin	30p	28 pin	100p
28 pin	32p	40 pin	150p
40 pin	35p		

ZENER DIODES

BZX61C/1.4 watt: 3V3, 3V6, 3V9, 4V7, 5V6, 6V2, 7V5, 8V2, 10V, 11V, 12V, 13V, 15V, 18V, 20V, 22V, 24V, 27V, 30V, 33V, 36V, 39V, 43V, 47V, 56V, 68V, 75V, 82V, 100V, 180V, 200V 16p each

BZY88C/0.4 watt: 1V3, 2V7, 3V, 3V3, 3V6, 3V9, 4V3, 4V7, 5V1, 5V6, 6V2, 7V5, 8V2, 9V1, 10V, 11V, 12V, 13V, 15V, 16V, 18V, 22V, 24V, 27V, 30V, 33V, 36V 10p each

LEDs

5mm:	Red	10p	113: Red	
	Green	13p	Red	20p
	Yellow	13p	Green	25p
3mm:	Red	10p	Yellow	25p
	Green	13p	323: Tri.	
	Yellow	13p	Red	20p
COX21:	Red		Green	25p
	flashing	65p	Yellow	25p
251: Rect/stack			503: Square	
	Red	20p	Red	20p
	Green	25p	Green	25p
	Yellow	25p	Yellow	25p

REGULATORS

LM304H	180p	UA723C	77p	78H12 (3A/5V)	460p
LM309H	80p	7805A	50p		
LM309K	130p	7812A	50p	78L05	35p
LM317K	350p	7812Kc	121p	78L12	35p
LM317T	130p	7815A	50p	78L15	35p
LM320/5	65p	7818A	50p	78L18	35p
LM320/12	65p	7824A	50p	78L24	35p
LM320/15	65p	7905A	55p	78L62	35p
LM320/24	65p	7912A	55p	79L05	45p
LM337T	180p	7915A	55p	79L12	45p
LM1469	324p	7918A	55p	79L15	45p
UA78P (8A/5V)	450p	7924A	55p	79L18	45p
				79L24	45p

ALUMINIUM BOXES

3 1 7/8" × 1 9 1/2" × 9 7/8"	
80 × 50 × 25	80p
100 × 65 × 50	1.20
100 × 70 × 40	1.20
100 × 100 × 40	1.20
135 × 70 × 40	1.20
135 × 105 × 40	1.40
180 × 125 × 65	1.95
205 × 155 × 75	2.50

VERO PLASTIC BOXES

White 71 × 49 × 25	60p
Blk 71 × 49 × 25	60p
Blk 120 × 80 × 35	1.10
Blk 180 × 110 × 55	1.75

VERO BOARDS

127 × 63	1.10
95 × 63	95p
431 × 63	3.17
127 × 95	1.20
95 × 95	1.15
431 × 95	4.20
454 × 119	5.50
63 × 25	pk of 5 1.30

THYRISTORS

				600mA/200V	45p	5A/400V	60p
				1A/50V	40p	5A/600V	70p
BT101	104p	T05 1A/400V	104p	1A/100V	45p	5A/800V	80p
BT102	104p	2N1599	40p	1A/200V	50p	7A/100V	55p
BT106	104p	2N4441	170p	1A/400V	60p	7A/200V	60p
BT107	132p	2N4444	150p	1A/600V	75p	7A/400V	70p
BT108	143p	2N5060	36p	1A/800V	90p	7A/600V	80p
TIC44	20p	2N5061	33p	3A/50V	46p	7A/800V	90p
TIC106D	40p	2N5062	42p	3A/100V	53p	10A/50V	55p
TIC106M	77p	2N5063	47p	3A/200V	58p	10A/100V	60p
TIC126D	99p	2N5064	47p	3A/400V	71p	10A/200V	65p
TIC206D	80p	600mA/20V	21p	3A/600V	79p	10A/400V	70p
TIC226D	90p	600mA/30V	24p	3A/800V	99p	10A/600V	88p
TIC246D	130p	600mA/100V	30p	5A/50V	43p	10A/800V	115p

TRIACS

2A/200V	50p
2A/400V	60p
2A/600V	60p
4A/400V	60p
6A/100V	80p
6A/200V	80p
6A/400V	90p
8A/400V	80p
10A/100V	80p
10A/200V	100p
10A/400V	110p
10A/400P	100p

BRIDGE RECTIFIERS

1A/50V	30p	6A/50V	75p
1A100V	30p	6A/100V	75p
1A/200V	35p	6A/200V	80p
1A/400V	40p	6A/400V	100p
2A/50V	35p	10A/200V	200p
2A/100V	45p	10A/400V	200p
2A/200V	50p	25A/200V	250p
2A/400V	55p	25A/400V	300p

Dalo Etch resist £1.10

SOLDER

20 swg, 3 core

500g 495p

POTENTIOMETERS

Carbon track, ¼ watt log & linear values:

Range	Price
470R-2.2MR (single track)	40p
4.7K-2.2MR (dual gang)	100p
4.7K-2.2MR (single gang D/P switch)	90p

SLIDER POTS

60mm track, log & linear values:

Range	Price
5K-500K	80p

PRESETS

Pre-set pots ¼ watt

Range	Price
50R-4.7MR (mini vert. & horiz.)	10p

RESISTORS

High stability, ¼ watt, 5%

Range	Price (1-99)	(100+)
1R-10MR	2p	1p

High stability, ½ watt, 5%

Range	Price (1-99)	(100+)
1R-10MR	3p	1.5p

CAPACITORS

CERAMIC 1pF, 2p2, 2p7, 3p3, 3p9, 4p7, 5p6, 6p8, 8p2, 10pF, 12pF, 15pF, 18pF, 22pF, 27pF, 33pF, 39pF, 47pF, 56pF, 68pF, 82pF, 100pF, 120pF, 150pF, 180pF, 220pF, 270pF, 330pF, 470pF, 560pF, 680pF, 820pF, 1000pF, 1n5, 1n8, 2n2, 3n3, 3n9, 4n7, 5n6, 6n8, 8n2, 10nF, 22nF, 47nF, 100nF 6p each

MYLAR: 100V 1nF, 2n2, 3n3, 4n7, 6n8, 10nF 7p each. 15nF, 22nF, 33nF, 47nF 9p each. 68nF, 100nF 11p each. 220nF 15p. 330nF 18p. 470nF, 20p.

POLYSTYRENE 22pF, 47pF, 68pF, 82pF, 100pF, 120pF, 150pF, 220pF, 270pF, 330pF, 390pF, 470pF, 680pF, 820pF, 1000pF, 1200pF, 1500pF, 1800pF, 2000pF, 2200pF, 3300pF, 4700pF, 5600pF, 10nF 8p each

TANTALUM BEAD 3V: 100uF, 150uF, 220uF, 330uF 64p each. 470uF 110p. 680uF 160p. 6V3: 6u8, 12p. 10uF 13p. 33uF 33p. 47uF 25p. 100uF, 220uF 77p each. 470uF 160p. 10V: 15uF, 22uF 20p each. 33uF 33p. 47uF 40p. 68uF 63p. 220uF 110p. 16V: 2u2, 3u3 20p each. 4u7, 6u8 25p each. 10uF 32p. 22uF 35p. 16V: 33uF 40p. 47uF 60p. 100uF 95p. 220uF 105p. 25V: 15uF, 22uF 40p each. 47uF, 68uF 60p. 35V: 0,1uF, 0.22uF, 0.47uF 16p each. 1uF, 1u5 18p each. 2u2 25p. 3u3, 4u7 20p each. 6u8 30p. 10uF 40p. 47uF 60p.

ELECTROLYTIC Axiel or Radial 16V: 10uF, 22uF, 33uF 10p each. 47uF, 68uF, 100uF 12p each. 125uF, 220uF 14p each. 330uF 18p. 470uF 24p. 680uF 36p. 1000uF 30p. 1500uF 40p. 2200uF 50p. 25V: 1uF, 10uF, 22uF, 47uF 10p each. 100uF 12p. 220uF 20p. 470uF 30p. 1000uF 40p. 2200uF 55p. 4700uF 115p. 35V: 120uF, 250uF 20p each. 40V: 6u8 10p. 470uF 30p. 1000uF 45p. 50V: 0.47uF, 1uF 8p each. 1uF (small) 12p. 220uF 35p. 63V: 1uF, 2u2, 4u7 7p each. 10uF, 22uF 10 each. 47uF 12p. 100uF 20p. 220uF 30p. 100V: 4 7F 48p. 160V: 10MF 32p. 250V: 0.01uF, 0.047uF, 0.1uF 10p each. 0.22uF 11p. 0.47uF 12p. 1uF 18p. 2u2 26p. 10uF 23p. 100uF 35p. 400V: 0.47uF 35p. 600V: 0.022uF, 0.047uF 30p each. 0.22uF, 67p. 1000V: 0.0022uF 27p. 0.022uF, 0.1uF 39p each.

POLYESTER C280 250V .01, .022, .033, .068, .1 8p. .15, .22, .33 10p. .47 12p. .68 20p. 1uF 26p. 2.2 50p.

SILVEREO MICA 2p2, 3p3, 5pF, 10pF, 18pF, 20pF, 22pF, 25pF, 27pF 13p each. 30pF, 33pF, 39pF, 47pF, 50pF, 55pF, 68pF, 75pF, 82pF, 100pF, 120pF, 150pF, 180pF, 200pF, 220pF, 250pF, 270pF, 300pF 15p each. 330pF, 390pF, 470pF 19p each. 500pF, 560pF, 680pF 22p each. 820pF 24p. 1000pF 27p. 1500pF 32p. 1800pF 42p. 2200pF 45p. 2700pF 48p. 3600pF 55p. 3900pF 68p. 4700pF 83p. 5000pF 98p. 6800pF 115p. 8200pF 120p. 10000pF 125p.

Prices for TTL Components are changing all the time. Please phone for current prices

NEW ILLUSTRATED CATALOGUE NOW AVAILABLE, £1 including VAT plus P&P

50p P&P ON ALL ORDERS UNDER £10
TELEPHONE ORDERS ACCEPTED WITH ACCESS & BARCLAYCARD. OFFICIAL ORDERS MOST WELCOME FROM SCHOOLS ETC.
WE ARE OPEN MONDAY TO SATURDAY 9-6 PM
All prices include V.A.T. Same day despatch

EVERYDAY ELECTRONICS and computer PROJECTS

VOL. 13 NO. 2 FEBRUARY 1984

CHANGES FOR PASSIVES

PASSIVE components are well named, and in more than just the functional sense. Capacitors and resistors for example are very much taken for granted; they play a subservient though essential part, compared with semiconductor devices, in electronic circuits. It also happens that they have undergone little change in their outward physical form since pre-transistor days. Although smaller in volume as befits the lower power used in modern circuits, resistors and capacitors are still clearly recognisable as descendants of the bulkier counterparts used in valve circuits of forty or fifty years ago.

The only major deviations from traditional form are seen amongst capacitors, where a variety of new styles of cases and encapsulations have been evolved, mainly to suit the requirements of the printed circuit board. For example, double-ended capacitors specially designed for vertical mounting on p.c.b.s. But in general the traditional types of capacitors and resistors with their axial lead-out wires have proved just as amenable to vertical mounting as to horizontal mounting.

Accommodating as they are, it seems the time for radical change of style in these familiar components at last draws near. This is being brought about through new assembly methods likely to be adopted by electronic product manufacturers, as a direct consequence of miniaturisation.

The new assembly technique of the future, known as surface mounted assembly (SMA), will demand a different style of electronic component—different in outward appearance to the conventional resistor, capacitor and d.i.l. semiconductor. As reported in our News pages last month the largest manufacturer of electronic components in the UK has recently announced its commitment to SMA and is planning extensive component ranges of resistors, capacitors and semiconductors designed for this new assembly technique. These SMA devices are smaller than their conventional counterparts and have terminal surfaces instead of lead-out wires. They are intended to be positioned and spot-glued on to a p.c.b. by a special placement machine; the latter no doubt under computer control. When all components have been assembled, the board is then ready for immersion soldering.

Surface mounted assembly will ensure further exciting consumer products in the future, we are told. Miniaturisation will not only make possible complex systems within a very small compass, but will also reduce costs.

Now all of this seems good news, except for the likes of the private constructor and the small-scale manufacturer of equipments who are committed to traditional assembly methods. SMA devices are not suitable for such purposes.

Yet there is no cause for alarm. Mullard assure us that while SMA is being introduced into certain areas of industry, the production of conventional components with lead-out wires will be unaffected, but will continue in parallel with production of the new style devices. No need therefore for panic buying or hoarding. Lead bending and cropping will remain essential operations for the home constructor, for far enough into the future as makes no difference.

Fred Bennett

Editor
F. E. BENNETT

Assistant Editor
B. W. TERRELL B.Sc.

Production and News Editor
D. G. BARRINGTON

Projects Editor
G. P. HODGSON

Technical Sub-Editor
R. A. HOOPER

Art Editor
R. F. PALMER

Assistant Art Editor
P. A. LOATES

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

Secretary
JACQUELINE DOIDGE

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

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
KING'S REACH TOWER
STAMFORD STREET
LONDON SE1 9LS

Readers' Enquiries

We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.

We cannot undertake to engage in discussions on the telephone.

Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

All reasonable precautions are taken to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

Back Issues

Certain back issues of EVERYDAY ELECTRONICS are available worldwide price £1·00 inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. In the event of non-availability remittances will be returned.

Binders

Binders to hold one volume (12 issues) are available from the above address for £4·60 inclusive of postage and packing worldwide.
Please state which Volume.

Subscriptions

Annual subscription for delivery direct to any address in the UK: £12·00. Overseas: £13·00. Cheques should be made payable to IPC Magazines Ltd., and sent to Room 2613, King's Reach Tower, Stamford Street, London SE1 9LS.

NEGATIVE ION GENERATOR

BY A. FLIND

Ionisers are widely used to counteract the negative ion depletion in air, which is commonly experienced in modern buildings with sealed windows and air conditioning. Electric fires and TV screens are also known to promote positive-charged atmospheres.

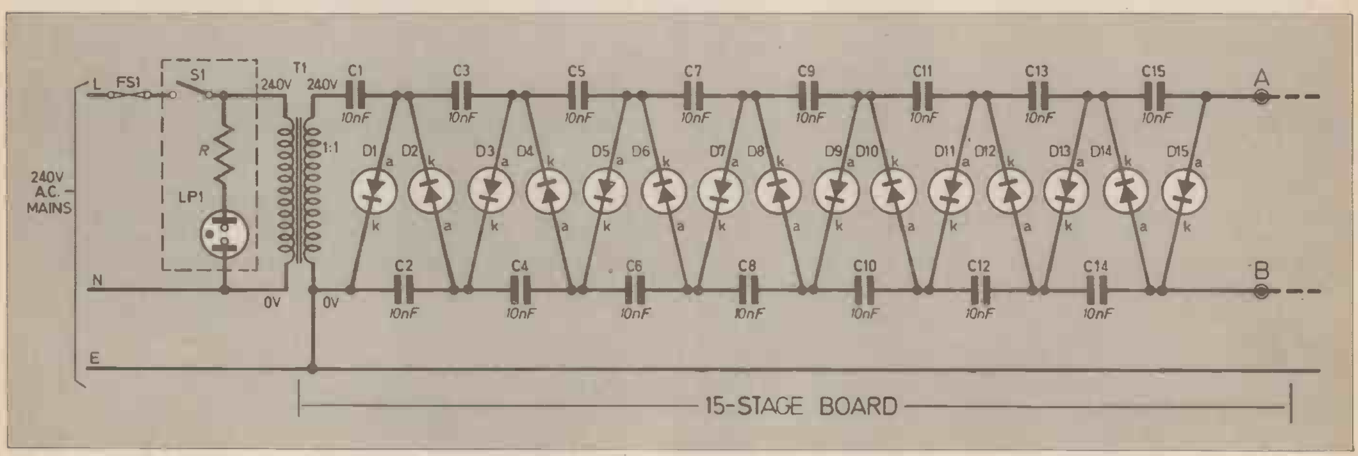


Fig. 1. Circuit diagram of the Negative Ion Generator.

NEGATIVE ION GENERATORS, more familiarly known as *Ionisers*, have been around now for several years. Following a rather shaky start as an offshoot of "crank" medicine, their benefits have become more widely recognised, and today a surprising number of homes are equipped with at least one of these devices.

Ionisers produce large quantities of negatively charged, or ionised, air molecules which are claimed to have beneficial effects upon the health of their users.

Advertising literature from manufacturers usually contain pictures of spring blossoms, alpine scenes and the like, with references to "constant refreshing streams" of ions, claiming such fabulous benefits to health, it's hard to understand how we've survived for so long without them!

However, should you feel inclined to try one, you may find the cost somewhat daunting; typical prices for commercial ionisers range from about £40 to £70 or more. The electronic enthusiast can build his own however, for a much more reasonable outlay.

PRINCIPLE OF OPERATION

The principle behind the ioniser could hardly be simpler. All that's necessary is the generation of a high negative voltage which is then applied to a needle, or several needles. Air coming into contact with the points of these needles will become charged or "ionised" and will then be repelled away by electrostatic force.

This air movement can actually be felt by a damp hand held close to the needles, although it could hardly be described as the "refreshing breeze" claimed by one advertiser!

The actual voltage necessary is subject to some dispute; designs seen by the author have used potentials varying from 3·5kV up to 20kV. The problem here is that together with the ions, the needles produce a small quantity of a gas called ozone which can have injurious effects upon the nasal passages.

Current theory suggests that the ideal voltage to ensure minimum ozone production is somewhere around 8kV. Higher voltages increase production of the gas, but so, apparently, do lower voltages of, say, 3kV to 5kV as have been used in some published designs. The author has heard mention of cheap, low voltage ionisers of this type being banned in the US some time ago, on the grounds that they were a health hazard.

VOLTAGE MULTIPLIER

Having settled on the voltage to be used, the only remaining decision is that of how to raise it. Most designs use a long chain of diodes and capacitors as a voltage multiplier, in what is called the "Cockroft-Walton" arrangement.

Often this multiplier is preceded by a transistor inverter with a ferrite pot-core transformer, running at about 20kHz. This adds interest to the circuit, but unless battery operation is specifically needed it has little else to recommend it. It lowers reliability, and the internal waveforms of the inverter tend to generate large amounts of spurious r.f. interference. Circuits of this type also tend to be rather inefficient.

The diodes in the multiplier chain need to withstand high reverse voltages; in practice the IN4007 miniature plastic encapsulated diode is the usual choice. This has a d.c. rating of 1,000V. At 20kHz, the reverse recovery time of this device is long enough to cause losses.

Hence the inefficiency of multipliers operating at high frequencies.

ISOLATING TRANSFORMER

If mains operation is required, direct generation from the 240V 50Hz mains has much to recommend it; simplicity, no r.f. generation problems, and easy, low-cost construction. Commercial mains-driven ionisers usually employ a small step-up transformer to raise the initial voltage to about 1kV, followed by four or five stages of multiplication using components with 5kV rating.

The home constructor might encounter difficulties in obtaining capacitors rated above 1kV, and a suitable ready-wound transformer would be hard to find, so a practical solution is to start with 240V and have a few more stages in the multiplier. In theory the transformer is then unneccessary, but the use of an isolating transformer improves safety, and allows the positive end of the multiplier chain to be connected directly to the mains earth, greatly improving the ion emission.

COMPONENTS

Resistors

R1–10	3·9MΩ, ±5% 0·5W (10 off)

Capacitors

C1–20	10nF, 1,000V disc ceramic (Ambit 04–10312) (20 off)

Diodes

D1–20	IN4007 miniature 1A, 1,000V (20 off)

Miscellaneous

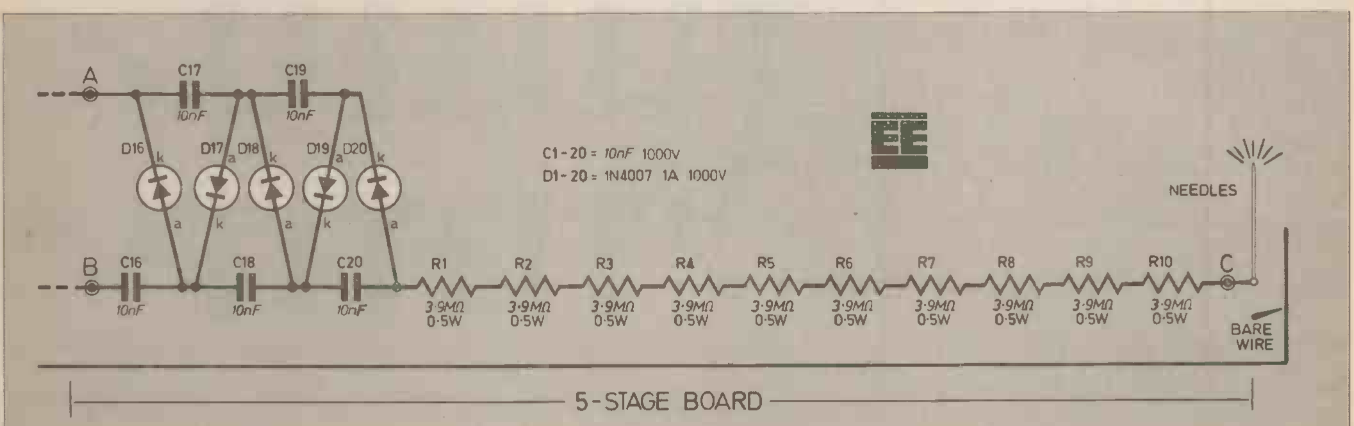
FS1	500mA fuse and panel mounting holder
S1	s.p. switch, 240V d.c., with integral neon indicator
T1	mains isolating transformer 240V 50mA (Maplin LW33L)

Plastics case 190 × 110 × 60mm, grey ABS (Maplin LH62S); printed circuit boards; screws, terminals, soldertag, pins, wire, aluminium sheet, polystyrene tile.

Approx. cost Guidance only £23

See page 87

Because of the high voltage generated, certain precautions are essential during assembly of this project, but once finally secured within its plastic case, the ioniser is perfectly safe in normal use.



Ioniser

Since the subject of safety has now been raised, this would seem an appropriate point to state that IONISER CIRCUITS CAN BE DANGEROUS! Every precaution should be taken to prevent shock whilst constructing or experimenting with this circuit.

Do not touch any part of the circuit whilst it is connected to the mains supply, and if you want to experiment, fit a 1-megohm resistor to the end of a flying lead connected to earth, use this to discharge the multiplier capacitors before touching anything. The resistor will prevent the diodes from being damaged by discharge current surges.

The final output in this design is protected by a string of ten 3·9-megohm resistors which keep current to a safe value if the needles are inadvertently touched; indeed the worst hazard to be encountered from the finished and enclosed project is a pricked finger!

CIRCUIT DESCRIPTION

The full circuit of the ioniser is shown in Fig. 1. The mains input passes through fuse FS1 and switch S1 to the 240V mains isolating transformer T1. The output from the secondary of T1 goes to a twenty-stage voltage multiplier, comprising capacitors C1 to C20 and diodes D1 to D20, which converts the initial supply finally, to approximately 8kV to 9kV of negative d.c., allowing for losses.

The output from the final stage of the multiplier is fed via a chain of ten 3·9-megohm resistors to five needles where the actual ionisation takes place. These resistors ensure safety for the user in the event of the needles being touched.

CONSTRUCTION

PRINTED CIRCUIT BOARDS

Construction is based on three p.c.b.s designed to slot into the plastic case specified, as can be seen in the photograph. Good quality glass-fibre board is recommended for this project to minimise leakage losses. The circuit patterns are very simple and would be an excellent introduction to the use of a "Dalo" type etch resistant pen, as was used to make the prototype.

Full-size p.c.b. patterns are given in Fig. 2a, b and c. These boards are available from the *EE PCB Service*, Order codes 8402-03a, -03b, -03c and 03d.

Layout of components on each board is given in Fig. 3a, b and c.

The only points that need watching during assembly are correct orientation of the diodes and careful positioning of the needles and their holes so that they are central when the needle card is fitted. The needles are actually pins, since needles are usually made from a steel that doesn't solder very well. Cut the heads off them so that they will lie flat on the p.c.b.

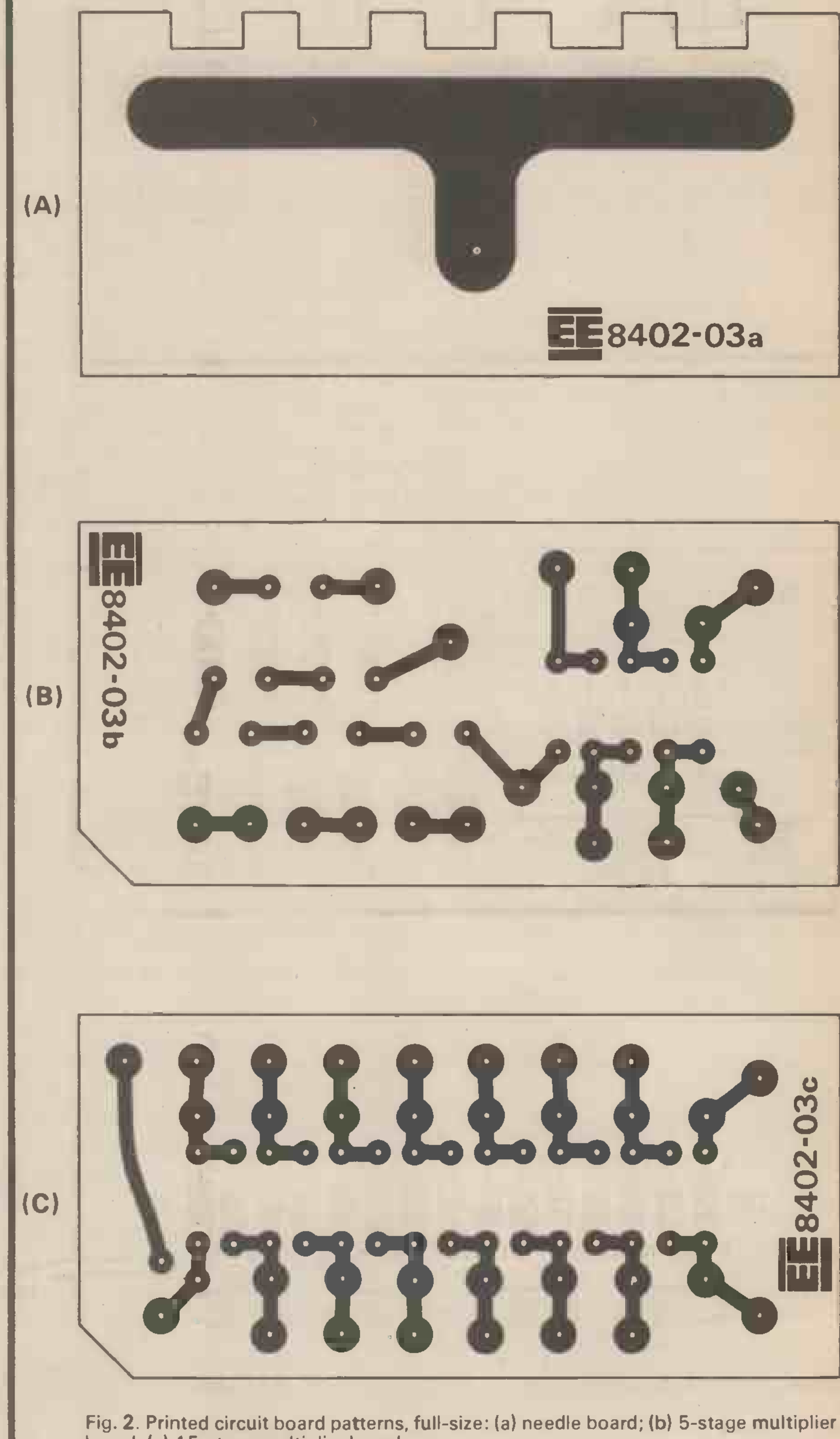
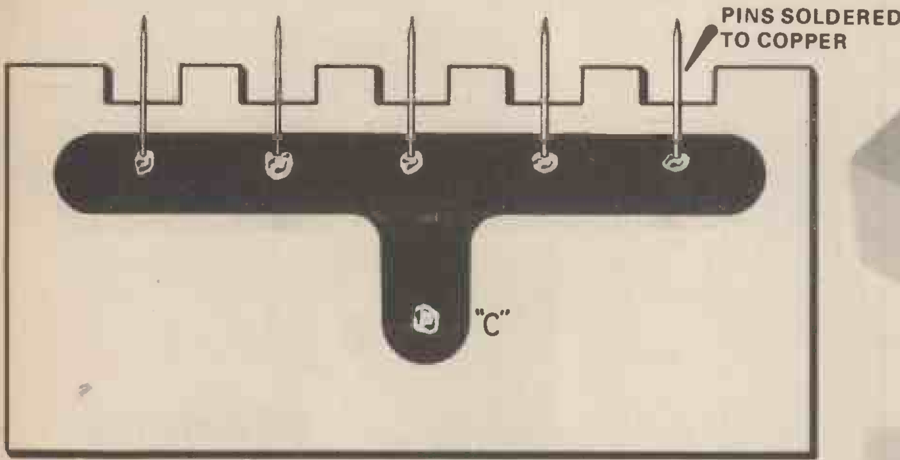
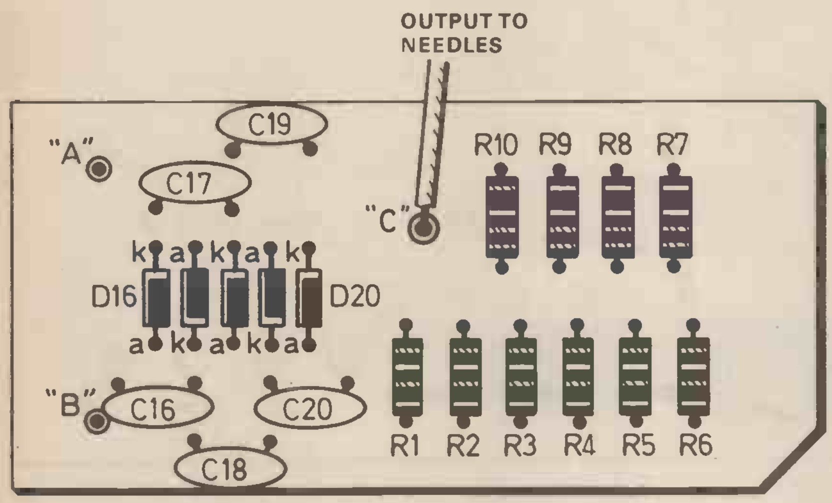
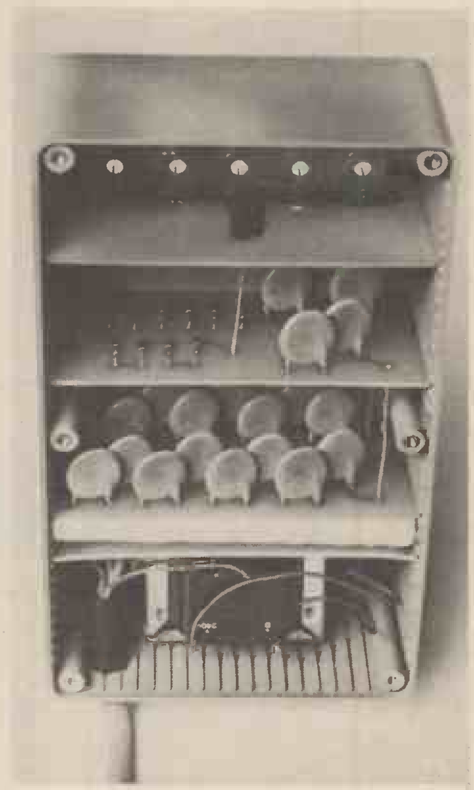


Fig. 2. Printed circuit board patterns, full-size: (a) needle board; (b) 5-stage multiplier board; (c) 15-stage multiplier board.







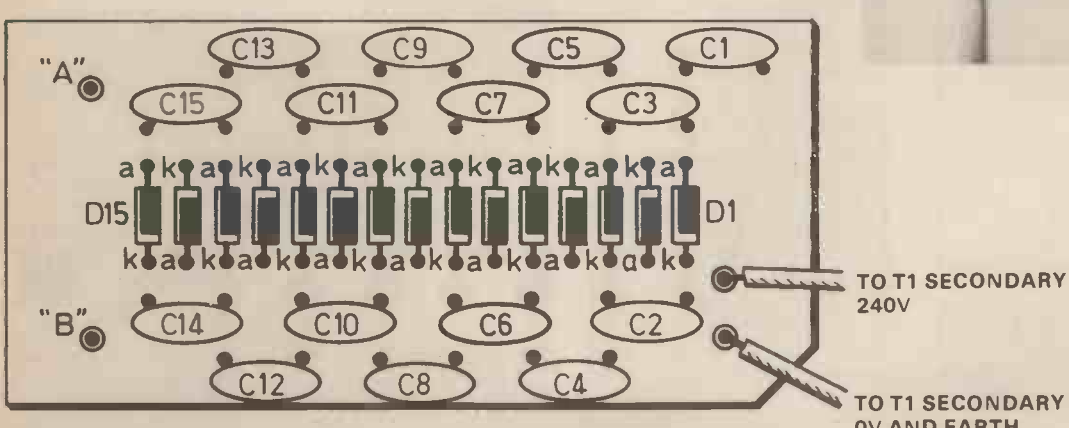


Fig. 3. (a) needle board with pins in position; (b) 5-stage multiplier board, component side; (c) 15-stage multiplier board, component side.

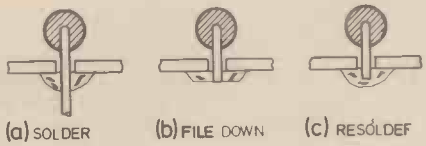


Fig. 4 *left*. Obtaining smooth rounded solder joints.

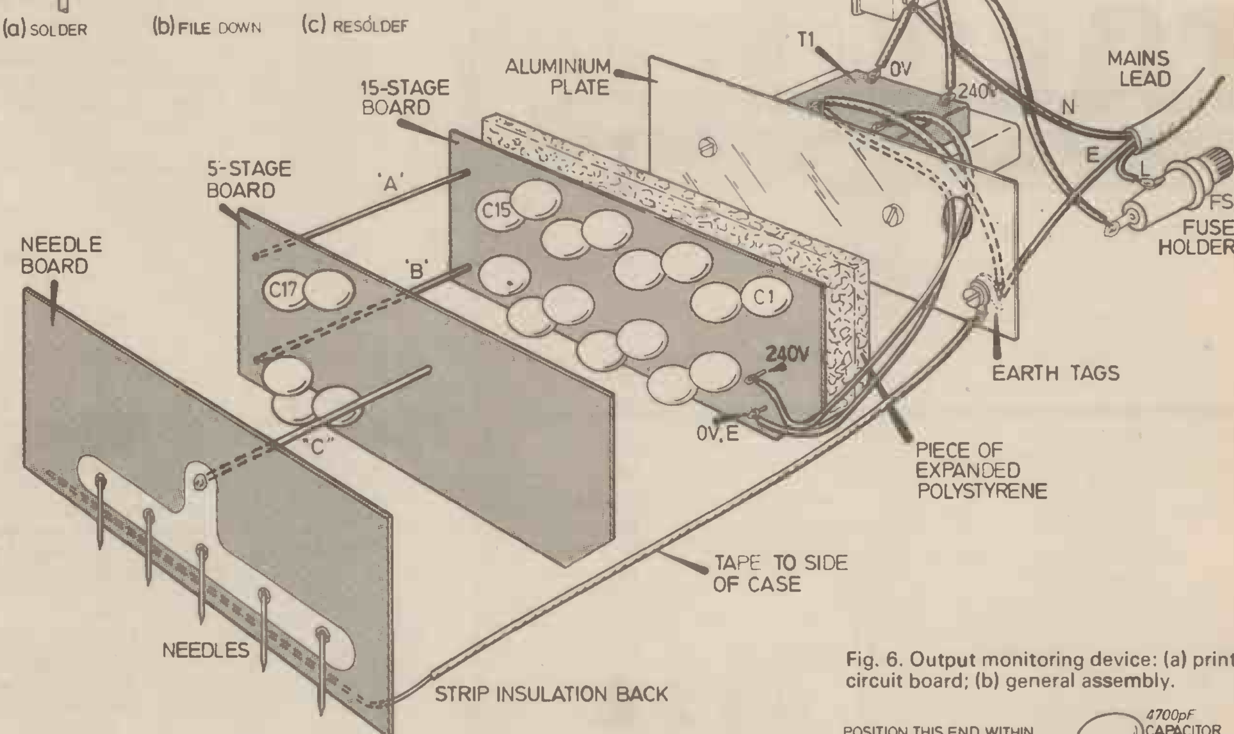


Fig. 5. General assembly and interwiring of the Negative Ion Generator.

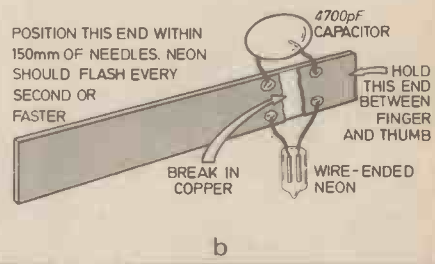


Fig. 6. Output monitoring device: (a) printed circuit board; (b) general assembly.

SOLDER JOINTS

Since ion currents will flow from any sharp point, the solder joints on the p.c.b.s should be smooth and rounded without any sharp protruding ends of component leads. The best way to achieve this is to fit the components and solder as usual, then crop the leads, file them down close to the board, and finally, run over them once more with iron and solder to obtain a smooth, rounded finish. Fig. 4 shows this in detail.

ASSEMBLY IN CASE

After the holes have been cut in the top of the case, for needles, switch, fuse and lead, the unit can be assembled. Fig. 5 shows the arrangement of the boards and other items, together with all interconnections.

Some form of clip should be used to secure the mains cable. The mains switch on the original is of the type with a built-in neon that glows when operated, a worthwhile indication that the unit is running.

The transformer is mounted on a piece of aluminium the same size as the p.c.b.s, which is then earthed. All the connections between the boards should be kept short and direct; the boards are designed so that interconnection points correspond.

EARTHED LEAD

An extra feature in this design is an earthed lead positioned across the box about 5mm away from the needles, held in place by adhesive tape. The chamfered corners on the two multiplier boards provide the space to run this lead from the earthed mounting plate. The purpose of this lead is to increase output; tests during the design showed that the ion emission almost doubled when it was fitted.

Finally, since the first multiplier board is rather close to the earthed aluminium plate, a piece of expanded polystyrene ceiling tile is placed between them to improve insulation.

USING THE IONISER

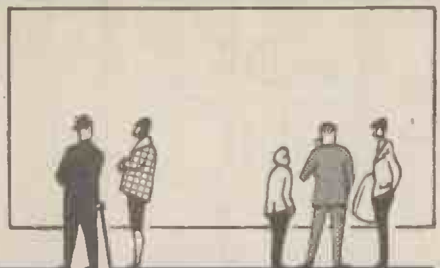
In use, the ioniser may be switched on and left running indefinitely; the power consumed is so low you'll be unable to spot it on your electricity bill. The needles may require replacement from time to time, although after six months use those on the prototype still appear to be in good condition.

A useful extra is some means of checking the output. Fig. 6 shows a simple device made from an off-cut of the p.c.b. with a neon lamp, and a capacitor. The lamp and capacitor form a simple relaxation oscillator that will start to flash quite frequently when held about 100mm away from the needles.

It should also be possible to hear a faint "rushing" sound at very close quarters, and, you may just be able to feel the movement of the repelled, charged air.

One final word of caution. Ionisers are not generally recommended for use by asthma sufferers, as the small quantities of ozone they give off may aggravate this condition. □

SHOP TALK



BY DAVE BARRINGTON

Catalogues Received

It is nice to see that even one of the giants of component stockists, namely **Maplin Electronic Supplies**, are quite happy to learn from the small guy and, unlike previous editions, have followed their lead and printed prices alongside the products on each page of the 1984 Maplin Catalogue.

Having to keep and continually use a large selection of components catalogues in the office, we have always found the practice of having prices alongside each item to be preferred to issuing separate pricing lists. However, with the rapid changes in costs, Maplin are only able to guarantee prices until February 1984 and will be issuing price change leaflets throughout the year as necessary.

A major addition to the new 500-page catalogue, a 20 per cent increase on the 1983 edition, is the recently introduced range of fully documentated kits and educational courses from the world famous electronic kit specialists Heathkit.

The kits range from security alarms, digital clocks, personal weather stations and micro programming courses to (what they claim) the world's most user friendly robot Hero 1. Amongst other kits included in the catalogue is the "Matinee Organ", with a range of "voices" such as flute, cello or clarinet in a variety of tempos including waltz, slow rock or Bossa Nova.

The 37 pages of book listings and 60 pages of computer products, reflects the ever increasing growth in these areas. Also, on "special offer" is a comprehensive range of Atari micro software.

The Maplin 1984 Catalogue costs £1.35 (£1.65 to include postage and packing) and is available direct from **Maplin Electronic Supplies, Dept EE, PO Box 3, Rayleigh, Essex SS6 8LR.** Callers can obtain their copy from their stores in Birmingham, Hammersmith, London, Manchester, Southampton and Southend. It is also stocked by branches of W.H.Smith newsagents.

Although the latest edition of the **BICC-Vero** Hobby Herald carries over one-hundred new products and is printed on a superior quality paper from previous copies, it is a pity that they have considered it unnecessary to include any pricing guide.

The increased range now includes connectors for most applications including micros, telephone connectors, printed circuit board etching kits, cases and cable ties.

For your copy of the BICC-Vero Hobby Herald send 50p to: **BICC-Vero Electronics Ltd., Dept EE, Retail Department, Industrial Estate, Chandler's Ford, Hants SO5 3ZR.** When ordering state if you would like the name and address of your local Vero stockist.

CONSTRUCTIONAL PROJECTS

Negative Ion Generator

The isolating transformer used in the *Negative Ion Generator* was obtained from Maplin Electronic Supplies and has a ratio of 1 to 1 between primary and secondary (240V/240V). This is a 12VA type with a maximum current rating of 50mA and should be ordered as: LW33L (Tr 240V Isotran).

Due to the very high voltages present in this project, it is important to use top quality high voltage capacitors with a working voltage of 1000 volts. The ones used in our model are disc ceramic types obtained from Ambit International and have an Order code: 04-10312.

Disc ceramic capacitors are stocked by most of our advertisers and as a quantity of 20 is required it may be worth investigating a "special price" on a bulk order.

Loudspeaker Protection Unit

The relays used in the prototype *Loudspeaker Protection Unit* are high power types and were obtained from Maplin. These relays have contact ratings of 10A and should be ordered as: YX 97F (10A Mains Relay).

The terminal "posts" for connecting the loudspeaker leads to the unit are the Quick Connection Terminals also available from Maplin. These are spring-loaded push-button types mounted on a Paxolin strip and should be ordered as: BW71N (Quickterm Push).

Signal Tracer

The semiconductor devices, types LM387N and BF244B, used in the *Signal Tracer* are stocked by Enfield, Cricklewood, Magenta Electronics and Maplin.

When ordering the potentiometer with integral switch, for the gain control VR1, be sure to order one with a "Log" or logarithmic law operation.

Car Warning Light

The 12V piezo-electric buzzer used in the *Car Warning Light* project was purchased from a Tandy Store. This should be ordered as catalogue number 273-060.

Microcomputer Interfacing Techniques

The 6522 interface adaptor i.c. used in the *Oric Port Board* is listed by Cricklewood Electronics, price £3.19.

Temperature Measurement and Control System for ZX Computers

The relays used in the *Relay Driver Unit* could prove troublesome to locate. These are double-pole single-throw types with contacts rated at 5A and have a coil resistance of 200 ohms.

A similarly rated relay is stocked by Maplin under their miniature mains relay range. This relay may be used but the printed circuit board will have to be adapted to take the relays or "flying" leads to the board used, i.e. relay mounted upside down with leads from tags to board locations.

The relays should be ordered as: YX98G (5A Mains Relay). Note that one set of contact tags will be left unconnected.

We cannot foresee any component purchasing problems for the **Eprom Programmer/ROM Card for the ZX81.**

Teach-In 84

Readers wishing to purchase kits for the new *Teach-In 84* series may obtain them from the following advertisers. Prices appear in their relevant advertisement in this issue.

SUPPLIERS OF KITS FOR TEACH-IN 84

Please refer to advertisement on page stated.

Greenweld Electronics *(page 76)*
43 Millbrook Road,
Southampton, SO1 0HX.

Magenta Electronics *(page 140)*
135 Hunter Street,
Burton-on-Trent, Staffs
DE14 2ST.

TK Electronics *(page 138)*
11 Boston Road,
London, W7 3SJ.

LOUDSPEAKER PROTECTION UNIT

BY J. DUFFY

WHETHER for hi-fi or PA applications, loudspeakers are often the most crucial elements in a good sound system. They are also the most expensive to repair, so it is therefore worthwhile offering some form of protection to their voice coils and cones.

The Loudspeaker Protection Unit offers active protection on two channels against high d.c. voltages and excessive music power without interfering with the signal path.

CIRCUIT DESCRIPTION

The complete circuit diagram of both channels is shown in Fig. 1. The battery (B1) is common to both channels.

The output from the amplifier is connected to the input terminals of the LS Protection Unit and then fed via relay contacts RLA1 (normally closed) to the output terminals and the loudspeakers. This input signal is monitored by R1 and bridge rectifier D1 to D4.

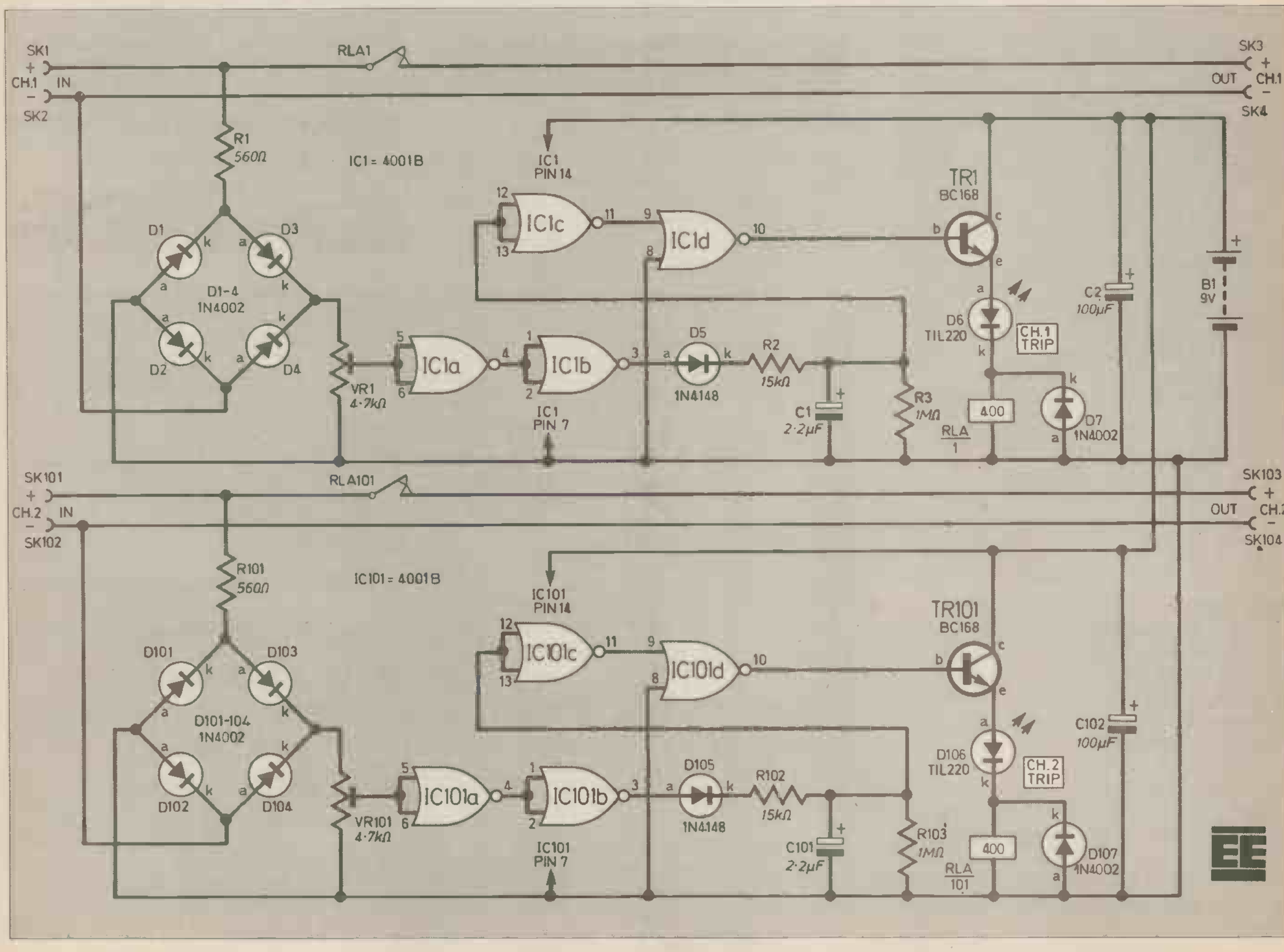
R1 prevents loading of the amplifier, while rectifying the signal enables the unit to trigger on both positive and negative going signals. The rectified signal goes into VR1 which allows the peak signal to trigger IC1a, one of four CMOS 2-input NOR gates in a 4001 package.

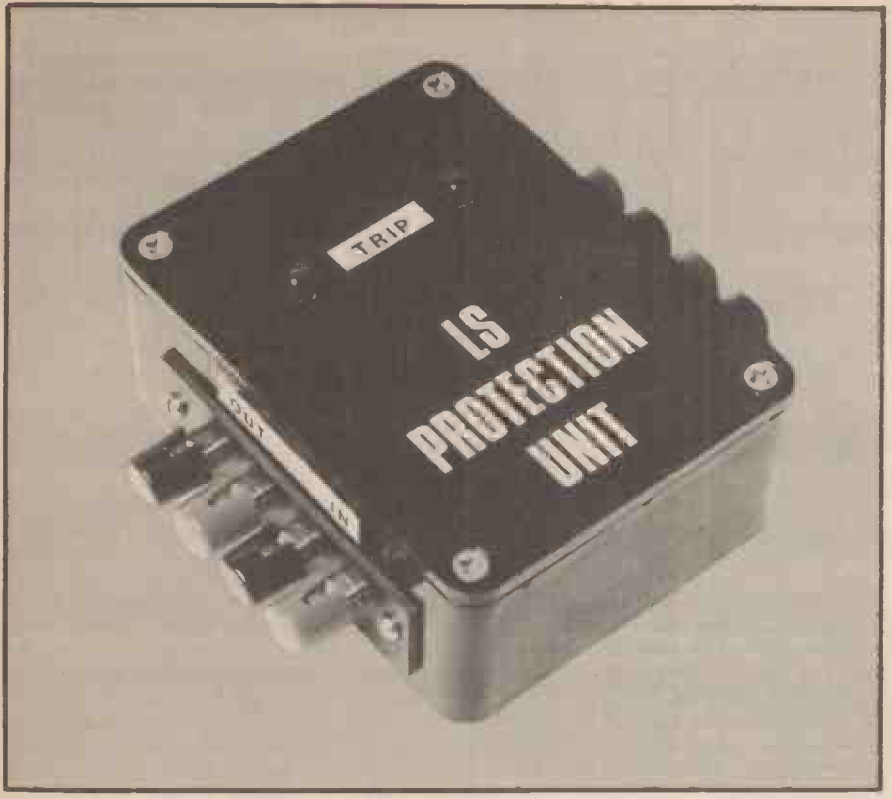
When the input of IC1a rises above half the supply potential ($V_{ss}/2$), the gate switches state. The output goes low and is inverted by IC1b, so that its output is now high. The positive pulse at the output of IC1b charges C1 via D5 and R2 and it takes approximately 20ms for the voltage to rise to a potential high enough to trigger IC1c. It remains at this potential for about 1·5 seconds, as the only path for C1 to discharge is through R3.

The output of IC1c is inverted by IC1d and drives the relay RLA1, and the l.e.d. D6, via TR1. D6 lights up only when the relay is activated and acts as a "trip" indicator.

The relay simply disconnects the amplifier signal from the output terminals thus protecting the speakers.

Fig. 1. The circuit diagram of the Loudspeaker Protection Unit showing both channels.





COMPONENTS

See Shop Talk page 87

Resistors

R1,101 560Ω (2 off)
R2,102 15kΩ (2 off)
R3,103 1MΩ (2 off)
All ¼W carbon ±5%

Capacitors

C1,101	2·2μF 16V elect. (2 off)
C2,102	100μF 16V elect. (2 off)

Semiconductors

D1–4,7, 101–104, 107	1N4002 (10 off)
D5,105	1N4148 (2 off)
D6,106	TIL220 0·2in red l.e.d. (2 off)
TR1,101	BC168 *npn* silicon (2 off)
IC1,101	4001B CMOS quad 2-input NOR gate (2 off)

Miscellaneous

RLA1,101	sub-miniature relay, 12V, 400Ω coil, 10A contacts (2 off)
VR1,101	4·7kΩ miniature horizontal preset (2 off)
SK1–4, 101–104	strip of four push-button terminals (2 off)
B1	9V PP3 battery

Case, 100 × 75 × 41mm with internal guide slots; 0·1in. matrix stripboard, 10 strips × 37 holes (2 off); l.e.d. clip (2 off); 14-pin i.c. holder (2 off); battery clip; 7/0·2mm wire; M2·5 or 6BA screws and nuts.

Approx. cost Guidance only **£8.30**

DELAY TIME

The use of a 20ms delay before triggering was found to be practical when using the unit with normal music signals in which the peaks may often rise above the specified loudspeaker r.m.s. handling power. However, the mean power going to the speaker is still below the r.m.s. power.

The graph in Fig. 2 shows the typical power handling capabilities of a good 6W r.m.s. speaker for different lengths of time. It can be seen that short intermittent peaks of power will not burn out the voice coil, provided that the mean power is within the speaker limits.

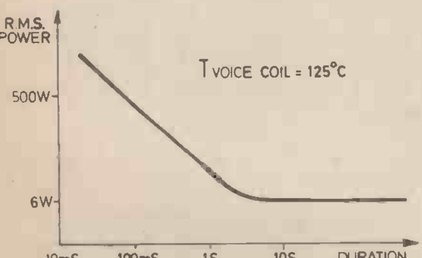
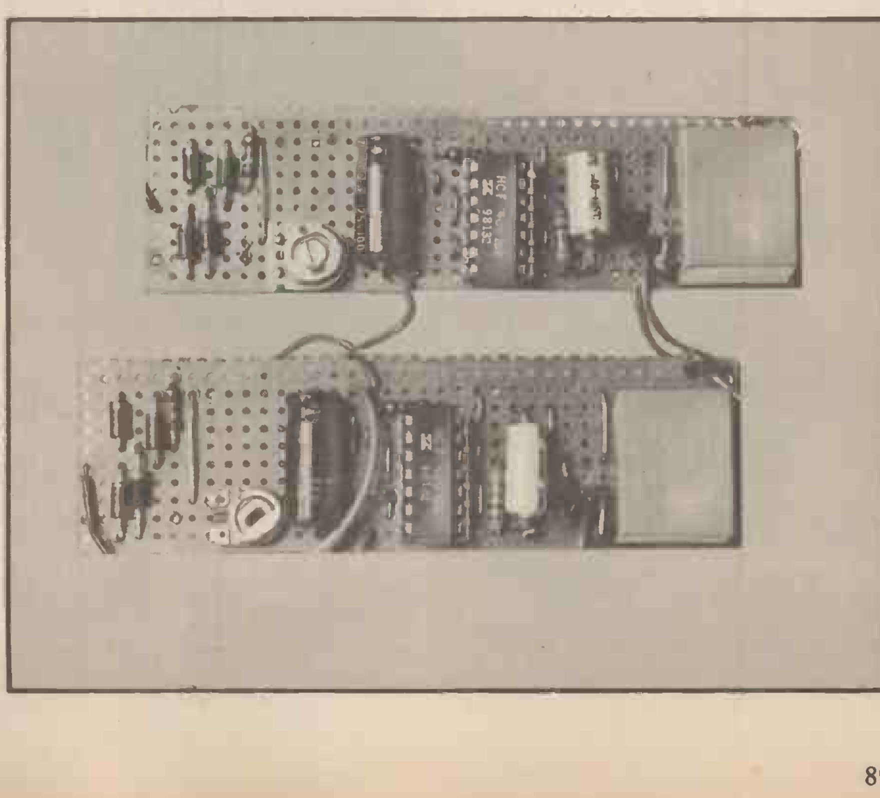


Fig. 2. Power handling of a 6W speaker.

However, "megawatts" of power should not be shoved into speakers, even for very short durations, as the suspension suffers irreparable damage.

The 20ms delay should be adequate protection for both modern and classical music. In modern or pop music, the level is often compressed and limited so that the mean power would almost equal the r.m.s. power with a few peaks. Classical music on the other hand, usually has a high dynamic range and the unit will allow some peaks to pass since a lot of the range is used for peaks.

This allows over-rated amplifiers to be used confidently. If excessive peaks occur frequently, C2 will remain partially charged and the delay will fall below 20ms before cutting out, thus protecting the speaker against short frequent excessive power bursts.



LOUDSPEAKER PROTECTION UNIT

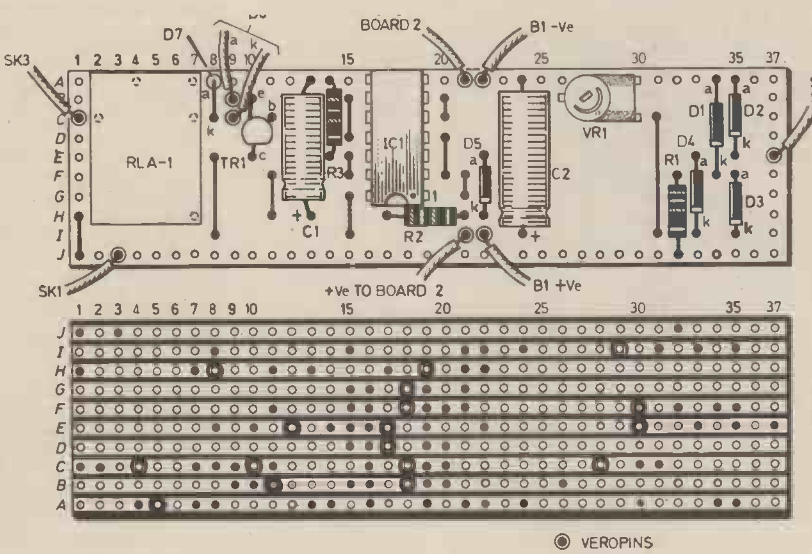


Fig. 3. Component board layout and track-break diagram for one channel of the Loudspeaker Protection Unit. The other channel is identical except for the power connections; the wires marked "to board 2" go to the power tracks (I22 and A22 for positive and negative respectively—see text).

View inside the unit showing the mounting of the two boards and the battery compartment in the case.

CIRCUIT BOARD

The layout for the component board is shown in Fig. 3. Two identical boards are required (one for each channel), the only difference being the battery clip is soldered to one board only and wire links connect the power to the other board as shown.

The board is completed in the usual manner with the breaks on the underside being made first, followed by the i.c. holder, links and components. Lastly, insert the i.c., taking care not to handle the pins as CMOS devices are static sensitive. Before the interwiring is completed, the case must be prepared.

THE CASE

A plastic box measuring 100 × 75 × 41mm with moulded internal p.c.b. guide slots is used to house the Loudspeaker Protection Unit, and the two component boards fit neatly lengthways in this case.

It is advisable to try the boards in the case (prior to any components being inserted) to ensure a good fit. The sides of the case carry the input and output terminals (SK1 to SK4 and SK101 to SK104) and these are push-button quick connection terminals and are available ready mounted on a piece of paxolin in strips of four (Maplin order code BW71N).

Four clearance holes for the tags on the terminals and two mounting holes are required each side and then the strip is assembled as shown in the photographs. The lid houses the two l.e.d.s (D6 and D106) at one end as shown.

The wiring is completed at this stage, and the board slotted into the case observing clearances for the relays (the highest component on the board) and the PP3 battery. The inputs and outputs and trip indicators can now be labelled.

An alternative method of housing the Loudspeaker Protection Unit is in two separate cases, each with its own battery, and positioned within each speaker cabinet.

SETTING-UP

When the unit is complete, it can be inserted into the speaker wires, carefully observing the polarity. At this stage the lid should be off and the boards removed to gain access to the presets VR1 and VR101.

A good quality mono signal (for example f.m. radio) should be sent to both speakers. VR1 (and VR101) is then adjusted to the point where the desired trip level is reached at the maximum volume level acceptable to the speakers. Each channel should trip at the same level (hence the use of a mono signal for setting up).

Since current quiescent consumption is in the order of microamps, the unit should work reliably for a long time—unless activated regularly which is certainly not recommended! □

FOR YOUR ENTERTAINMENT

BY BARRY FOX

Exhibitionist

I seemed to spend weeks on end last autumn doing little else but visit electronics exhibitions. This despite the fact that the annual Harrogate Show was cancelled, for lack of support.

In previous years this once-homely North of England show had grown too big and expensive for its own good. The snag is that Japanese companies see it as lost face to put on a small demonstration. But they don't want to spend £40,000 or £50,000 on what is essentially a local show.

The plan is to re-launch Harrogate this year on a smaller scale. Let's hope it works because Harrogate has always been the most friendly of all exhibitions.

Last year, instead of Harrogate there was a specialist hi fi exhibition out at the Heathrow Penta Hotel. There was not a video game or video recorder in sight, which pleased genuine hi fi enthusiasts who attended. They have grown increasingly bitter over recent years, that exhibitions billed as "hi fi" turn out to be knee-deep in video screens.

However, attendance at Heathrow was below expectations. The perennial problem is that the hotels round Heathrow Airport are awkward to get to and the hotel car parks are always full.

Big Show

If Harrogate is the friendliest, then the Berlin Radio Show, or Funkausstellung, is the largest. It spreads through 25 exhibition halls, two pavilions and a giant summer garden where German radio and TV stations build outdoor studios.

The Berlin show runs (every other year) for 10 days and draws around half a million visitors into the city. You need several days to cover even part of it properly.

The only exhibitions to rival Berlin are the Chicago Consumer Electronics Shows held every year in June and the Japanese electronics exhibitions. But the Chicago CES is for trade only, and Japan is a long way to go for an exhibition!

Britain desperately needs a big consumer electronics exhibition, because it's the only way that the public can get a chance to see a cross section of everything that's available and due soon in the shops. There used to be an annual show at the Olympia Hall in London, but in the mid-70s it failed.

There were industrial relations problems that meant that the stands were often not finished in time for opening day. Union demarcation meant that carpenters couldn't fix wires, and painters couldn't fix wood.

Exhibitors used to carry a pocket of £5 notes to feed the work along. One by one the big names pulled out and the public stopped paying to come in. So more names pulled out and the show went into limbo for several years.

Show Down

The latest attempt at re-establishing the Olympia tradition was the "Great Home Entertainment Spectacular" which ran for nine days last September. Some exhibitors gave sterling support. National Panasonic and Technics, for instance, were reputed to have spent nearly a quarter of a million pounds on their vast display and 200-seater theatre with music and live dancing by American groups.

This is routine for the Japanese and Berlin shows, where every major manufacturer features live music, competitions or broadcasts in front of a seething mob of visitors. But it is the first time that anything like it has been tried in Britain.

JVC, TDK, Thorn-EMI, GEC, ITT and Agfa all put on worthwhile displays. So did a string of video games' manufacturers who built arcades for their machines. Some firms, notably Sony and Philips, didn't join in.

In the short term they are probably the winners, because attendance at Olympia was very poor. But in the long term everyone is the loser, because it's highly unlikely that National Panasonic and the other exhibitors will spend the same kind of money this year. In fact, it's unlikely that there will be another show.

Why didn't the crowds flock to Olympia? The organisers had been talking about 200,000 paying customers. There's no simple answer, but if the show does happen again there are some important lessons to be learned.

Perhaps readers who went along will have some thoughts of their own. For the trade, nine days is too long. It takes two working weeks out of a firm's business life. Also the show was scheduled for school term time, which inevitably cuts back on family participation during the week.

Admission at £3 for adults and £2 for children under 12 years is steep even in these days of inflation. And it didn't seem clever to effectively close the show for a day, on the Monday after the first weekend, by making it open to press and trade only up to tea-time.

Questionable Service

No fault of the organisers, but the tube train service to Olympia is terrible. I came back from Germany a day early just to attend the opening press conference. But I missed half of it through waiting on Earl's Court Station for the "Special" train to take me the last leg of the journey.

The press conference, too, told a tale. A curiously unrepresentative bunch of journalists were present.

The organisers didn't seem to know the names of the freelance journalists who write most of the articles you read in the hi fi, video and electronics press. As a result there were hardly any searching questions asked, and the answers given by a panel of trade figure heads were largely waffle.

What a sad contrast with the Berlin Radio Show. This starts off with a press conference at which a panel of electronics and broadcast experts give crisp and well informed answers to searching questions put by 200 journalists who really know their field. There is even simultaneous translation into three languages so that everyone knows what's going on.

Oil Burners

Last year (Oct/Nov 1983) the popular press made much of the story that CB enthusiasts, using illegal booster amplifiers or "burners", could upset the electronic guages in petrol pumps. That way, said Fleet Street, drivers got petrol for as little as 40p a gallon.

Not surprisingly the motor trade, the police and the Government, which gets duty and tax from petrol, were all very worried. Within a few days the Department of Trade and Industry had issued a warning. "The use of high powered transmitters adds considerably to the risk of causing an electric spark close to the filling nozzle and an explosion could occur in some circumstances". So was this just the bureaucrats way of deterring CB buffs from getting cheap petrol, or is it a genuine warning?

Any radio transmission will induce a voltage in a metal rod that acts as an aerial. If the transmission power is high, the range short and the rod length tuned to the transmitted wavelength, then a significant current can be generated in the aerial.

There are apocryphal tales of farmers, with fields near medium and long wave radio transmitters, who get free power for their cowsheds by erecting large metal mesh aerials. Nikola Tesla, the man who developed the first a.c. power system while Edison was enthusing over d.c., experimented with the transmission of high power over miles without wires between aerial towers.

Ham radio enthusiasts can legitimately use 100W f.m. amplifiers in their cars. But they have always been warned not to use them in petrol filling stations.

If the transmitter induces power in some part of the pump, then a spark may leap down to earth through the filling nozzle while it is pouring petrol into a car. Obviously the last place you want a spark is at the business end of a petrol nozzle!

CB enthusiasts are not allowed by law to use powerful amplifiers, but many of them do because it helps them blast lower powered stations off the air. This is why CB radio is now virtually unusable in most major cities in Britain.

Superficially the idea of using a CB burner to fool a petrol pump makes sense. Any logic circuit, with clock control, can be upset by high power radiation. This is why military electronic equipment is heavily screened.

But you cannot be sure whether radiation will make a clock run faster or slower. So blitzing a petrol pump with a CB burner could actually cost you more for your petrol. With a bit of bad luck, it could also cost you your life.

EPROM PROGRAMMER/ROM CARD FOR THE ZX81

BY B.W. TERRELL B.Sc. & J.W. TERRELL M.Sc.

THIS project has been specifically designed and developed for use with the ZX81 Personal Computer. It is a dual purpose piece of equipment which is capable of operating in two modes as described below.

It will program the single supply rail 2716 from Intel, and other manufacturers compatible types. The 2716 holds 2048 bytes of data.

In the programming mode, the unit functions as a Programmer for burning data into the 2716 to provide a permanent storage medium for programs/data/routines for use with the ZX81, other computers, or dedicated microprocessor and other projects. It requires only the basic ZX81 with 1K bytes of memory.

In the ROM mode, the unit acts as an extension ROM card for use with the ZX81 and is memory mapped into the system.

THE 2716 EPROM

The pin-out for the 2716 single supply rail EPROM can be seen in Fig. 1. The 2716 requires only a 5V d.c. supply, +5V to pin 24, and 0V to pin 12. The eleven address inputs, AØ–A1Ø allow any of the 2048 locations to be uniquely addressed. Each location holds 8-bits (a byte) of information and these are read or written to (programming mode) via the eight data lines DØ–D7. Whether the 2716 is in the read or programming mode is determined by the voltage levels on the other three inputs: V_{pp}, $\overline{CS}$ and PGM.

To set the 2716 in the *read* mode, the following conditions must exist: V_{pp} at +5V, PGM at logic 1, $\overline{CS}$ at logic 0. *DØ–D7 are outputs*. To set the 2716 in the *programming* mode, the following conditions must be met: V_{pp} at 26V, PGM at logic 0, $\overline{CS}$ at logic 1. *DØ–D7 are inputs*. Pulsing the PGM pin to logic 1 for 50 milliseconds burns the data present on DØ–D7 into the location addressed by AØ–A1Ø.

CIRCUIT DESCRIPTION

The complete circuit diagram for the system is shown in Fig. 2. The EPROM to be programmed (or read) is situated in the previously unused memory space from 8K to 16K in the ZX81. Address decoding is particularly simple using only A14 and A13 together with $\overline{MREQ}$.

Normally in the ZX81, any memory read requested in the 8K to 16K range will produce a read from the ZX81 ROM situated from 0K to 8K. However, with the unit in circuit, for all locations addressed within the 8K to 16K block (A14=Ø, A13=1) a logic 1 is produced at IC1b output, pin 12, which over-rides the command to the ZX81 ROM chip select ($\overline{ROM\ CS}$) causing it not to be selected. Instead, the EPROM on board the unit is selected. This over-riding action is achieved using diode D1.

The EPROM can be considered to reside between 2ØØØH and 27FFH, but since address lines A12 and A11 play no part in the decoding, decoding is not unique. Identical results would be obtained if the EPROM was considered to reside in either (a) 28ØØH to 2FFFH or (b) 3ØØØH to 37FFH or (c) 38ØØH to 37FFH. This ambiguity however has no effect whatsoever on performance.

The CPU memory read signal $\overline{RD}$ is used by the circuitry to differentiate between a read and a write to the second 8K block of memory. $\overline{RD}$ goes to logic 0 during a read cycle. This is indicated by the "bar". During a memory read or write cycle, $\overline{MREQ}$ also goes to logic 0. If it is accompanied by $\overline{RD}$ going low, the circuitry determines that a memory read has been requested. If $\overline{MREQ}$ goes low, but $\overline{RD}$ remains high, then the logic knows that a write is being requested. (A write to an EPROM may only be carried out in the programming mode when data is burned into the appropriate location.)

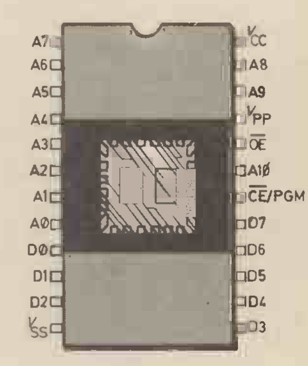


Fig. 1. Pin-out details for the 2716 +5V supply rail EPROM.

The output of IC1b produces a logic 1 when 8K to 16K is being addressed, and a logic 0 at all other times. This signal reaches both IC2a and IC2b. Now IC1c acts as an inverter, so $\overline{RD}$ reaches IC2a, and the inverse of $\overline{RD}$ reaches IC2b. Consider a memory read to 2ØØØH for example: IC2b output at pin 6 goes low with IC2a output remaining high. It can be seen that IC2b output feeds the $\overline{CS}$ (chip select) pin on the EPROM. A low on this pin enables the data in location 2ØØØH (the first EPROM location) onto the ZX81 data bus.

If $\overline{RD}$ remains high during a memory cycle addressing the 8K to 16K block, IC2a output, pin 3, goes low with IC2b output remaining high. This falling level reaches the trigger input of IC3. IC3 is a TTL monostable multivibrator which produces a presettable duration logic high at its Q output when triggered. The time for which Q stays high is set by the values of C1 and VR1. These components should be set to produce a high-on time of 50 milliseconds as required for successful EPROM programming.

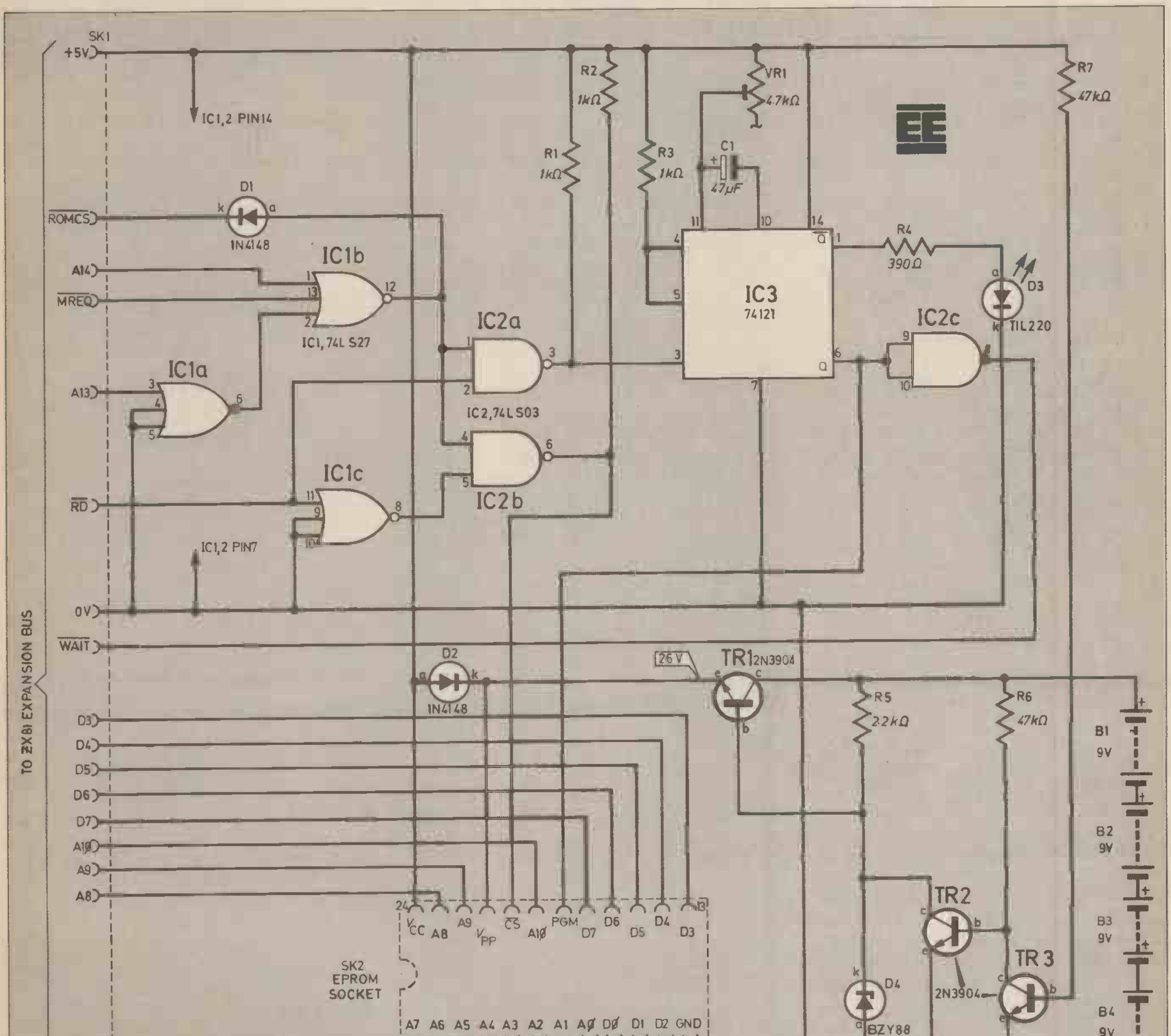


Fig. 2. Complete circuit diagram of the Eprom Programmer/ROM Card for the ZX81.

The Q output directly feeds the PGM pin on the EPROM, pin 18. Providing that V_{pp} is at 26V, the information on the data bus at the time will be burned into the EPROM by this pulse. If the 26V is not present, the EPROM contents will remain unchanged.

The Q output is also inverted by IC2c to produce a 50ms low pulse. This gate has an open collector output which is suitable for feeding the ZX81 WAIT line. A low level on $\overline{\text{WAIT}}$ will freeze CPU action and hold the data and address bus information for the duration of the $\overline{\text{WAIT}}$ low time. Thus during a memory write to the 8K to 16K block, the information on the data bus is burned into the EPROM location pointed to by the address bus when the 50ms pulse reaches the PGM pin.

After 50ms, $\overline{\text{WAIT}}$ is returned to logic high and the CPU resumes operation.

The l.e.d., D3, acts both as a power on indicator and a programming pulse indicator, turning off during a burn.

POWER SUPPLY LINES

The unit requires two d.c. supply lines: +5V to power the on-board devices, and a 30V to 36V supply for use in the programming mode. The +5V supply is derived from the ZX81 internal supply via the edge connector. The 30V to 36V supply is to be supplied by the user and may be either a battery supply (such as 4 × PP3s connected in series) or may be mains derived.

The external supply is connected to the unit via a PP3 battery clip if this type of battery is chosen.

When the external power supply is connected, it reaches TR1 collector; TR1 forms part of a voltage regulator circuit which provides a stable 26·3V to V_{pp}. D4 is a Zener diode, and voltages greater than 27V placed across R5 and D4 cause the Zener to "switch on". This action clamps the base of TR1 at 27V and produces a 26·3V at the emitter (27V minus the voltage dropped across TR1 base/emitter junction).

When disconnecting the power supply lines from a 2716, it is important that the V_{pp} supply be removed before or at the same time as the 5V supply. If not, permanent damage to the EPROM will result. To prevent such an occurrence, protection circuitry has been included in the design. This is composed of TR2, TR3, R6 and R7.

Consider both supplies reaching the circuitry. Resistor R7 connected to +5V causes TR3 to be turned on fully; its collector is at 0V. Consequently, TR2 is not conducting, it is turned fully off. Its collector voltage is at 27V, the level produced by the action of the Zener diode, D4, and 26V approximately reaches V_{pp}.

If the 5V is now removed, TR3 immediately turns off. TR2 is now biased fully on by R6, and TR2 collector falls to 0V, effectively short circuiting D4 and grounding TR1 base. This turns off TR1 and no voltage reaches V_{pp}.

CONSTRUCTION

PRINTED CIRCUIT BOARD

The circuitry is assembled on a double-sided printed circuit board. The actual-size master p.c.b. pattern is given in Fig. 4. This board (calibrated, see below) is available from the *EE PCB Service*, Order code 8402-01. The board will be supplied ready calibrated because the programming timing pulse needs to be set precisely. It must be 50 milliseconds ±10%. If these limits are exceeded, the EPROM may become damaged if it is too high, and only partially programmed if the timing pulse is less than 45ms. The board therefore contains VR1, C1 and IC3 in its socket. VR1 position is sealed and should not be altered.

The layout of the components on the board topside (side containing the reference number) is shown in Fig. 3.

Although the order of component assembly is not critical, you will find it much simplified if you follow the procedure set out below.

EDGE CONNECTOR

The edge connector should be fitted with a polarising key in the correct position to align the board contacts with the ZX81 bus. It is necessary to remove (clip off) pins lower 4 and 6. Double-sided tape should be laid on the board topside where the edge connector pins come in contact with the bare board. Position the edge connector pins to align and be in contact with the copper tracks they are to be connected to.

Push the pins onto the adhesive tape. This will hold the 22 top pins in place while they are being soldered. Solder these 22 pins to the board.

The other set of edge connector pins will not at this stage be in contact with the tracks they are to be connected to on the board underside. Liberally tin all the pin ends. Next, using the blade of a small screwdriver, push the pin from above so that it makes contact with the appropriate track, and then solder. Continue to hold the pin in contact with the track until the solder has set. Repeat for the remaining pins.

ASSEMBLY DETAILS

Nine track pins are specified. These are used to interconnect the tracks on the two sides of the board. Insert these in the nine positions as indicated in Fig. 3 and solder them on both sides.

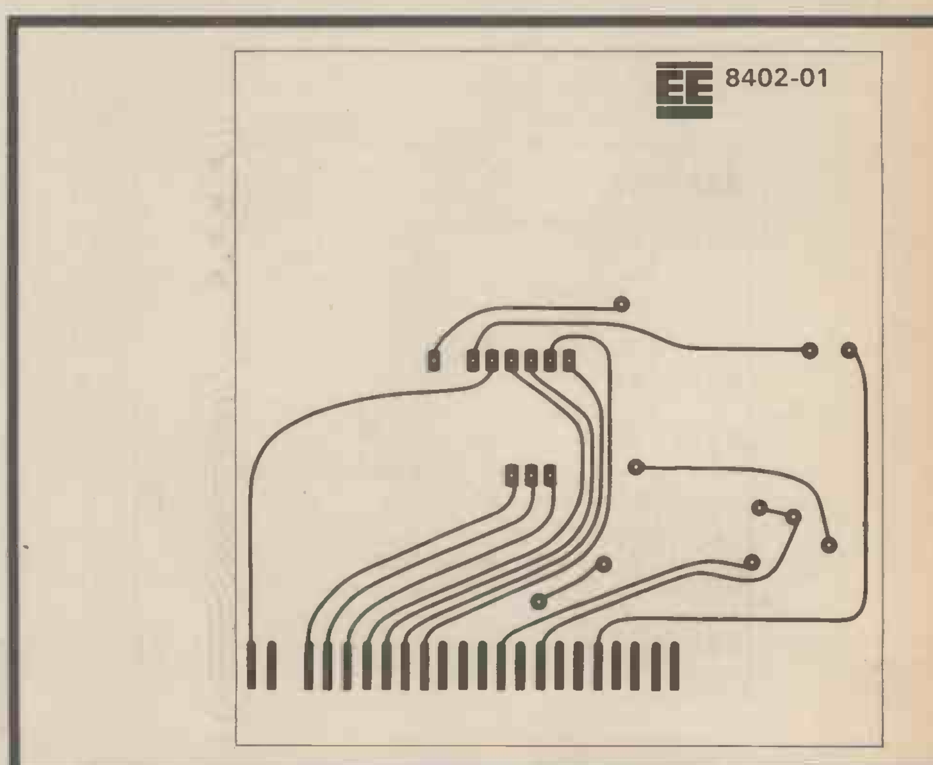
Position and solder the seven resistors to the board. Trim off the excess component lead using wire cutters. Note that resistor R2 also needs to be soldered on the topside track at one end.

Identify the Zener diode, D4. This will be marked with its type number which includes "27V". Solder this to the board paying attention to its polarity. The cathode (k) is indicated by a black band or tip at one end.

Solder the two remaining signal diodes, D1, D2 to the board paying attention to polarity. The cathode (k) will be marked with a band at one end of the body.

Solder the two 14-pin d.i.l. sockets to the board.

Insert the l.e.d., D3, in the board paying attention to polarity. The cathode (k)



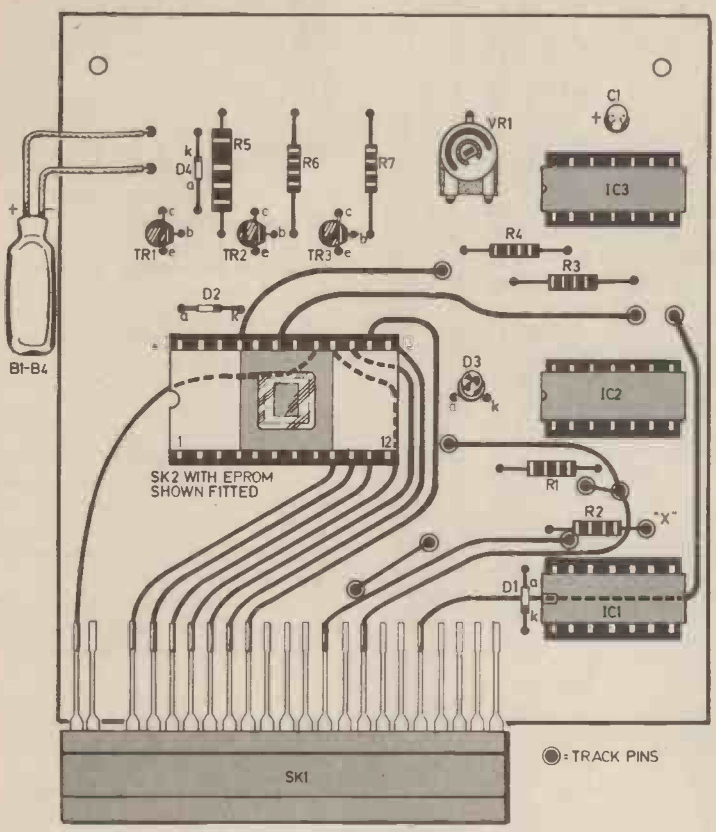


Fig. 3. The layout of the components on the board topside.

Fig. 5. Suggested method of interconnecting the four PP3 batteries to provide a 36V supply. A single battery clip only is required.

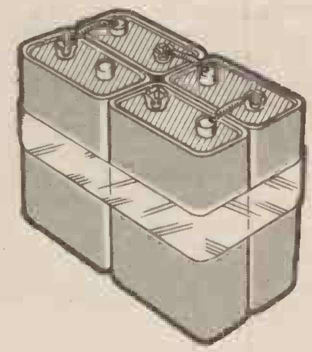
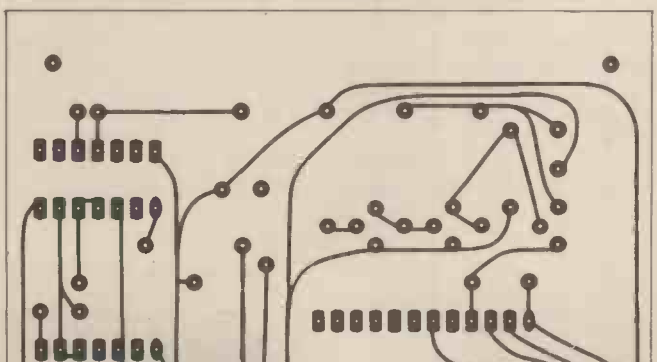


Fig. 4. The master patterns for the double-sided p.c.b. Left shows topside (component mounting side) below shows underside. Both are reproduced actual size. This board is available ready calibrated from the *EE PCB Service*, Order code 8402-01.



COMPONENTS

Resistors

R1,2,3	1 kilohm (3 off)
R4	390 ohm
R5	2·2 kilohm $\frac{1}{2}$W
R6,7	47 kilohm (2 off)

All $\frac{1}{4}$W carbon unless specified otherwise, ±5% tolerance

Capacitor

C1	4·7µF 10V elect. radial leads

Semiconductors

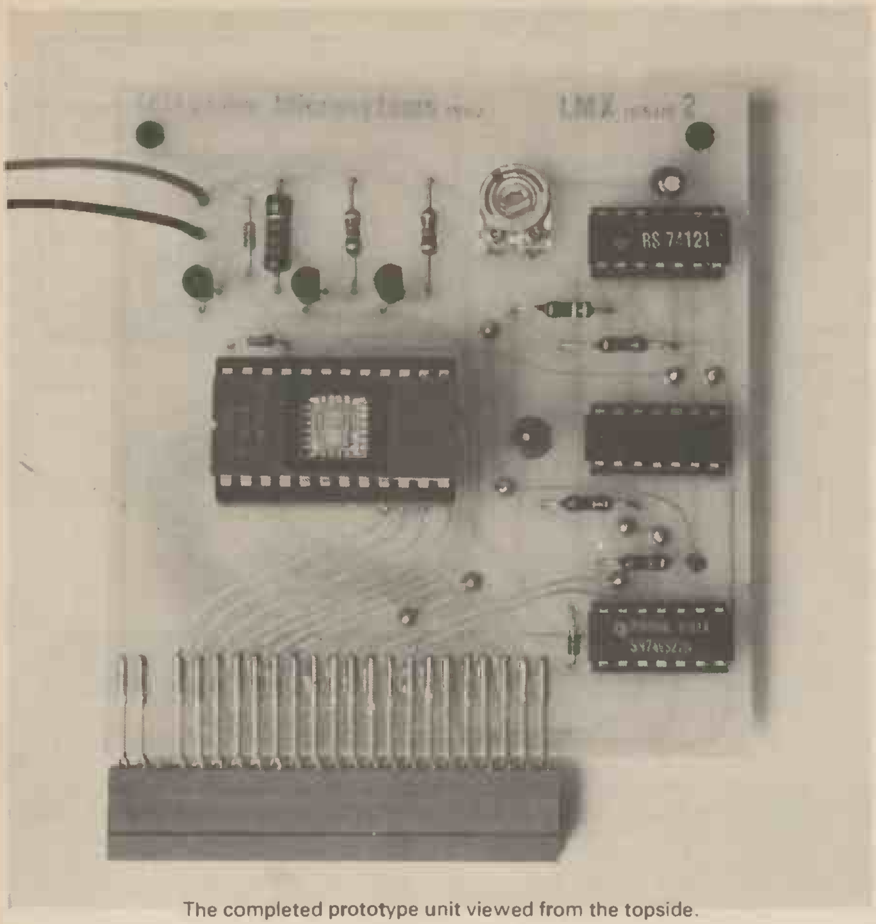
D1,2	1N4148 (2 off)
D3	TIL220 red l.e.d.
D4	BZY88C27V 27V 400mW Zener
IC1	74LS27 TTL triple 3-input NOR
IC2	74LS03 TTL quad 2-input NAND o.c.
IC3	74121 TTL monostable
TR1,2,3	2N3904 silicon *npn* switching (3 off)

Miscellaneous

SK1	23 + 23-way edge connector wire-wrap pins
VR1	47 kilohm horizontal cermet preset

Printed circuit board: double-sided size 90 x 90mm, *EE PCB Service*, Order code 8402-01; PP3 battery clip; d.i.l. sockets; 14-pin (3 off), 24-pin wire-wrap pins (1 off); snap fixing stand-off pillars (2 off); track pins (9 off); insulated wire for battery links.
Software: T007 Eprom Programmer, ZX81.

Approx. cost Guidance only **£16**



The completed prototype unit viewed from the topside.

is the lead nearest to a small "flat" on the body of the l.e.d.

Do not cut the leads on the EPROM socket. Position the 24-pin wire-wrap d.i.l. socket on the board with pin 1 nearest to the edge connector; the pin numbers on the prototype socket were embossed on the socket, and these should correspond with the EPROM pin numbers. About 2mm of the leads should project through the other side of the board. Carefully solder this in place. Pins 9, 10, 11, 13, 14, 15, 16, 17, 18 and 20 need to be soldered on the topside of the board also.

Solder the three transistors to the board as shown in Fig. 4 ensuring correct orientation and then solder the battery clip leads to the board. Make sure the leads are the right way round.

Push the two snap fixing stand-off pillars into their holes in the board. These will support the board at the correct height above the work-base when in use.

Insert the i.c.s in their sockets ensuring they are correctly orientated. All i.c.s, including the EPROM, face the same way. There is a notch between pins 1 and 14 (IC1 to IC3) and pins 1 and 24 (EPROM). Sometimes a circular indentation will also be found alongside pin 1.

BATTERY PACK

Details for wiring up four PP3 batteries in series to provide a 36V supply using only one battery clip is shown in Fig. 5. The four batteries should be taped together before soldering. We have checked with a major battery manufacturer regarding the soldering to the battery terminals directly. This is in order providing the soldering iron bit is not excessively hot and the iron is not applied for too long. A cardboard box could be made in which to house the batteries, and a slot cut in the top to allow access to the two contacts.

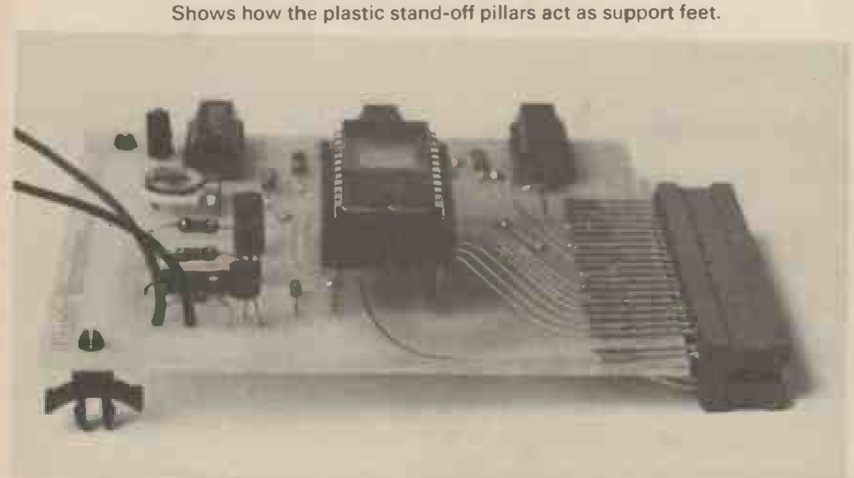
Thoroughly inspect all soldered joints and check for possible solder bridges between tracks befor proceeding.

DISPLAY AND KEYBOARD OVERLAY

The display is made up of three separate boxes as shown in Fig. 6. The first box, DISPA, holds the EPROM address which is currently being pointed to and also the contents of that location. The second, DISPB, holds the byte which is to be burned into the EPROM at the address pointed to by DISPA.

The third box, DISPC, is used to display one of two error codes. "P" stands for programming error and "V" for verification error. These are explained later. DISPC is also used to signify that a key has been pressed. For example, in Fig. 6, location 2429 is being pointed to and the location contains the byte 21. DISPB holds the byte 2Ø which could be programmed into location 2429.

Shows how the plastic stand-off pillars act as support feet.



The battery pack showing soldered connectors.

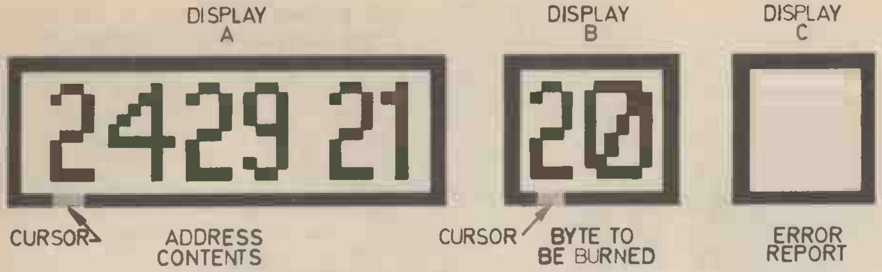


Fig. 6. Typical screen display during use. Note the cursor positions.

For reasons of key grouping and ease of use, many of the ZX81 keys have been re-defined and a keyboard overlay produced to identify these functions. The unused ZX81 keys have been disabled. This overlay can be taped over the keyboard using double-sided Sellotape. The keyboard overlay reduced in size is shown in Fig. 7. A full-size printed overlay is supplied with the software cassette available from the *EE Software Service*, see page 131.

The keyboard overlay is shown in Fig. 7. To change the address in DISPA, press and hold down the ADDRess key and enter the appropriate hexadecimal character. The character pointed to by the cursor will be over-written and the cursor advanced. The contents part of DISPA is updated everytime the address in DISPA is changed.

To change the byte in DISPB, press the appropriate hexadecimal character without the ADDRess key pressed.

INC increments the address in DISPA.

DEC decrements the address in DISPA.

The addresses of DISPA form a circular sequence of 2K bytes. Thus if DISPA reads ØØØØ and the DEC key is pressed, DISPA will change to Ø7FF. Similarly, if DISPA reads AFFF and the INC key is pressed, DISPA will change to A8ØØ. This facilitates easy keyboard input from a hex listing in which the EPROM is to be used in some other system where it could reside in any 2K block within 64K.

TEST tests consecutive locations, from the address in DISPA, for FF and either displays the address of the first non-FF byte or the last EPROM address or the circular sequence described above.

For example, if DISPA points to ØØØØ and TEST is pressed, and DISPA changes Ø7FF FF, then the entire EPROM is empty or erased. On the other hand, if DISPA points to Ø213 while TEST is pressed and DISPA changes to Ø24B 21, then the section from Ø213 to Ø24A is clear, that is, Ø24B contains the first non-FF byte.

Thus the TEST key is to be used for searching for clear sections of the EPROM.

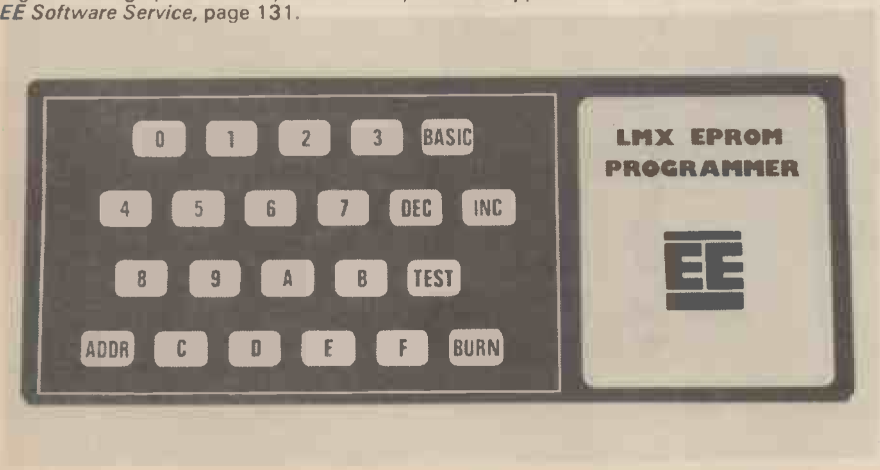
BURN burns the byte displayed in DISPB into the EPROM address of DISPA providing that a programming error does not exist. The bits of an EPROM can only be programmed from a "1" to a "0". A programming error will occur if an attempt is made to burn a "1" bit into a "0" bit.

For example, if DISPB contains 22 and the contents part of DISPA contains 21 and the BURN key is pressed, a "P" will be displayed in DISPC. Bit 1 causes the programming error.

If there is a discrepancy between DISPB and the contents part of DISPA after the BURN key is pressed (assuming that a programming error does not exist), a verification error has occurred and a "V" will be displayed in DISPC.

This should not occur under normal circumstances, but if it does, it either means that the programming supply voltage is not connected, or that a hardware fault has developed, or the EPROM is faulty.

Fig. 7. Photograph of the keyboard overlay. This is supplied with the software cassette, see *EE Software Service*, page 131.



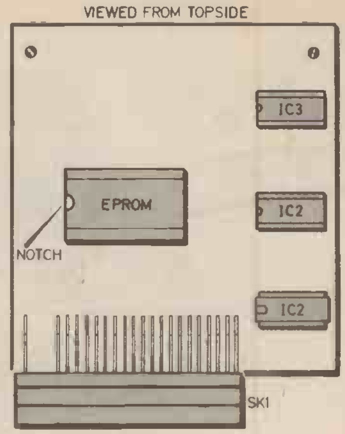


Fig. 8. The EPROM must be inserted in its socket as shown above, otherwise it will be permanently damaged.

TESTING

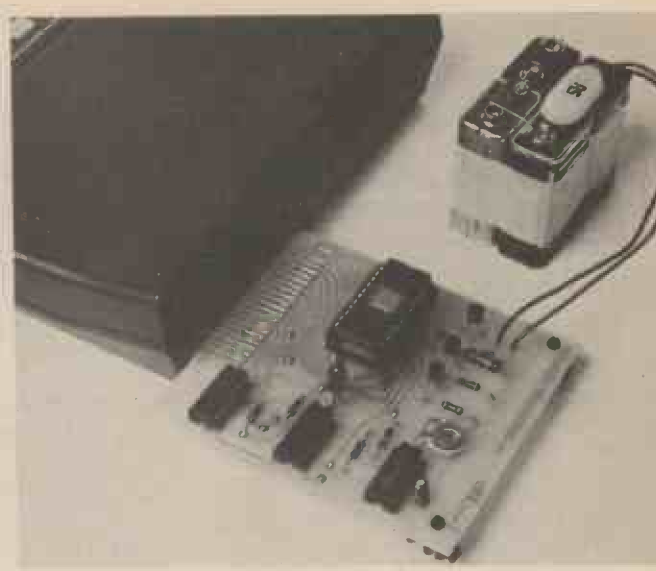
The unit should not be inserted at this stage.

1. Turn all power off.
2. Make sure that the EPROM socket is empty.
3. With the EPROM socket empty, plug the unit into the expansion slot at the back of the ZX81, taking care to align the slot in the printed circuit board with the polarising key on SK1 before applying pressure.
4. Turn on power to the ZX81. The l.e.d. (D3) should light up.
5. Enter the SLOW mode by pressing the SLOW key followed by NEWLINE.
6. Type PRINT PEEK 8192. You should get 255.
7. Now type POKE 8192,Ø. Even though the ZX81 is in SLOW mode the screen and D3 should blink for a short time.

If steps 4, 6 and 7 are successful proceed to step 8. If any of these three steps fail, do not proceed to step 8. Instead, re-check your construction for errors.

8. Turn off *all* power.
9. Remove the unit from the ZX81.
10. Refer to Fig. 8. Insert a 2716 EPROM into the 24-pin socket. Take care not to bend the legs of the EPROM (the legs can bend in on themselves as well as splaying out) and be especially careful to put the EPROM in the right way round.
11. With the EPROM in its socket and all power still off, plug the unit back into the ZX81.
12. Fit the battery clip onto the programming power supply. The l.e.d. should not light up.
13. Turn on power to the ZX81 and the l.e.d. should light up.

The keyboard overlay is held secure using double-sided tape at the top corners.



The Eprom Programmer/ROM Card plugged into the ZX81 Expansion bus.

14. Load the software under the filename "LMX".
15. The program is self-running and within 25 seconds you should see the display shown in Fig. 9.

Fix double-sided tape to the back of the keyboard overlay and carefully position the overlay on the ZX81 keyboard. The Eprom Programmer is now ready for use.

BURNING

There are 2048 locations in a 2716 EPROM so do not be concerned in the early stages of testing if you use up some of the locations to store short test routines.

After completing step 17 of the TESTING section and with ØØØØ in the address field of DISPA, press the TEST key. If the EPROM is a new one DISPA should change to Ø7FF FF. If this is the case, the entire EPROM is empty and any byte can be burnt into any location of the EPROM. No programming errors should occur.

Press the INC key to return DISPA to ØØØØ.

The EPROM is memory mapped to addresses 2ØØØ–27FF. If the unit is to be used in its ROM card mode at a later stage, machine code routines will be origined somewhere in this range.

Change the address in DISPA to 2ØØØ by pressing the ADDRess key and "2" key simultaneously.

The following test routine displays the string "ZX81" on the screen.

With the address 2ØØØ in DISPA, type the first byte 21 into DISPB. Press the BURN key. The screen should blink and the contents part of DISPA should change to 21. This indicates a successful burn.

Fig. 9. The screen display obtained at start up. Note the "tinted" cursors.

Address	*Machine Code*	*Label*	*Assembly Code*	*Comments*
2ØØØ	21		ld HL,ZX81	; point to ZX81 string
2ØØ1	ØB			
2ØØ2	2Ø			
2ØØ3	Ø6		ld B,4	; four characters to print
2ØØ4	Ø4			
2ØØ5	7E	loop:	ld A,(HL)	; get character
2ØØ6	D7		rst 10H	; display it
2ØØ7	23		inc HL	; point to next
2ØØ8	1Ø		djnz loop	; loop until complete
2ØØ9	FB			
2ØØA	C9		ret	; return to Basic
2ØØB	3F	ZX81:	Defm"Z"	
2ØØC	3D		Defm"X"	
2ØØD	24		Defm"8"	
2ØØE	1D		Defm"1"	

Press the INC key and DISPA should change to 2ØØ1 FF. Type the second byte ØB into DISPB and repeat the burn procedure.

Repeat this procedure for all 15 bytes remembering that the address in DISPA has to be manually incremented.

Use the DEC key to decrement the address in DISPA fourteen times, each time checking that the contents part of DISPA is correct.

Return to BASIC by pressing the "BASIC" key and remove the keyboard overlay.

Type RAND USR 8192. The "ZX81" string should be displayed on the screen.

Remove all power from the ZX81 and the programming power supply from the unit.

Turn on power to the ZX81. The unit is now in its ROM card mode.

Type RAND USR 8192 again. The string "ZX81" will again be displayed indicating that the routine is permanent and independent of the state of the power supply. All other routines are burned in, in exactly the same way. □

BOOK REVIEWS

THE COMPUTER USERS' YEAR BOOK 1983

Editor B. Hypher
Price £52.95 Hard back
Size 280 × 203mm. 1,552 pages
Publisher Computing Publications Ltd.
ISBN 0-902-90817-0

In its fifteenth edition, the Computer Users' Year Book is still the computer industry's major reference source. The information contained within is very comprehensive, which no doubt accounts for the 1,552 pages and the price tag of £52.95 + £2.10 p&p.

Salaries of staff involved in the computer industry are listed in over 90 tables along with job title, salary range, size of firm and location. The annual survey included in the book is very impressive and covers over 19,000 data processor staff.

There are some new additions to the contents of the book this year, the first is local area networks. This section deals with new companies and products that are available in the data processing market. The second new section is independent computer maintenance and provides information on 48 suppliers of computer hardware services.

R.A.H.

TEACH YOURSELF ELECTRONICS (New Edition)

Author Professor W. P. Jolly
Price £2.95
Size 200 × 130mm. 208 pages
Publisher Hodder and Stoughton 1983
ISBN 0-340-32976-9

Teach yourself books are aimed at readers with "a will to understand" and a real interest in their chosen subject. This title aims to introduce the vast subject of electronics simply and clearly, from the basics of electron theory through to the futuristic sounding Quantum and Cryoelectronics.

There are 13 chapters covering the basics, the nature and properties of devices, circuits and systems. The final chapter investigates i.c.s, microprocessor applications, including CAD (Computer Aided Design) and EFT (Electronic Fund Transfer). Fourteen pages contain a useful Glossary of Terms and many circuit symbols.

Although some of the drawings look a little unprofessional they do not distract too much and in general the study sequence is very readable. The careful study of electronic history with the important developments and new applications help to avoid the problem of assuming a level of knowledge in the student. This book aids understanding of a vast and complex subject by gently introducing the reader through an historical approach. Professor Jolly's good efforts provide a realistic training and reference book.

D.J.G.

Books in Brief

Computer Jargon by C. Stockley and L. Watts (Usborne Publishing Ltd.) Limp £1.99. For the first time there is a book which provides an illustrated guide to the bewildering computer language, which is now a part of everyday speech. The computer jargon is easily defined with diagrams to support the text, although the illustrations are rather disappointing.

Information Revolution by L. Myring and I. Graham (Usborne Publishing Ltd.) Hard back £3.95. A comprehensive guide to the effect computers and new technology are having on communications. The book contains 48 pages covering cable and satellite television, databases, teletext and other communication technology. There are a lot of diagrams to support the text but again they are rather poorly done.

Adventure Programs by J. Tyler and L. Howarth (Usborne Publishing Ltd.) Limp £1.99. Adventure programs are the new craze for computer enthusiasts. An adventure game is like a story in which the player is the hero, the difference being, the sequence of events and movements that are controlled by the player. There is an adventure game program contained within the book, called Haunted House and this program will work on any computer which uses Microsoft style BASIC.

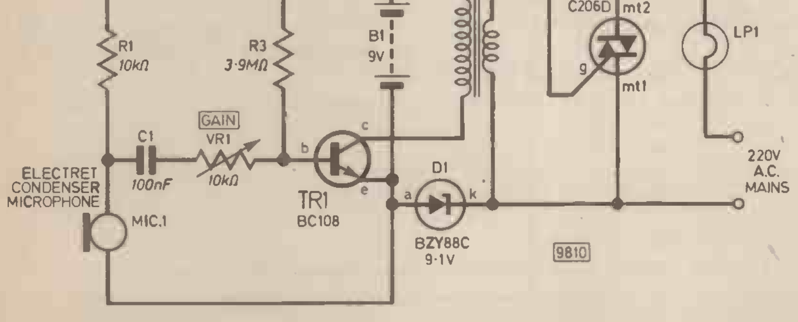
20 Programs for the ZX Spectrum and 16K ZX81 by S. Daly (Bernard Babani). Limp £1.95. Another programming book for the ZX81 and Spectrum user, but with a difference. Unlike most of the books published in this field there are plenty of practical programs contained within the seven chapters. Starting with a basic biorythms program and then progressing to the more sophisticated filing programs.

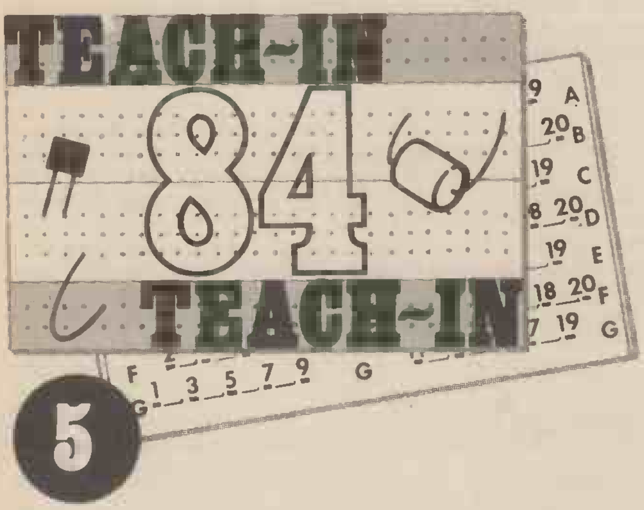
SIMPLE SOUND OPERATED LIGHT

This circuit was designed as a simple circuit that can control a light with speech, music or other noise sources. The triac and light can be changed as desired.

The transistor could be a BC107, BC177, BC108 or a BC109. The power supply section of the circuit is a PP3 9V battery.

Hamid Reza Taizadeh, Tehran, Iran.





A TWELVE-PART HOME STUDY COURSE IN THE PRINCIPLES AND PRACTICE OF ELECTRONIC CIRCUITS. ESSENTIALLY PRACTICAL, EACH PART INCLUDES EXPERIMENTS TO DEMONSTRATE AND PROVE THE THEORY.
USE OF A PROPRIETARY BREADBOARD ELIMINATES NEED FOR SOLDERING AND MAKES ASSEMBLY OF CIRCUITS SIMPLE.
THE IDEAL INTRODUCTION TO THE SUBJECT FOR NEWCOMERS. ALSO A USEFUL REFRESHER COURSE FOR OTHERS.

AUDIO AMPLIFIERS

Now that we've built a simple audio voltage amplifier, let's stick with audio circuits for the time being.

NOISE

Last month we turned an amplifier into an oscillator. To do so, we connected the amplifier output back to its input so that signals kept getting amplified again and again. In this way, any input signal, however small, gets repeatedly boosted until it becomes large.

All amplifiers contain built-in "signals". Not man-made ones, but natural ones. Thermal energy (which all matter contains, even when cold) causes random movements of electrons. These show themselves in circuits as random currents and voltages—very small ones.

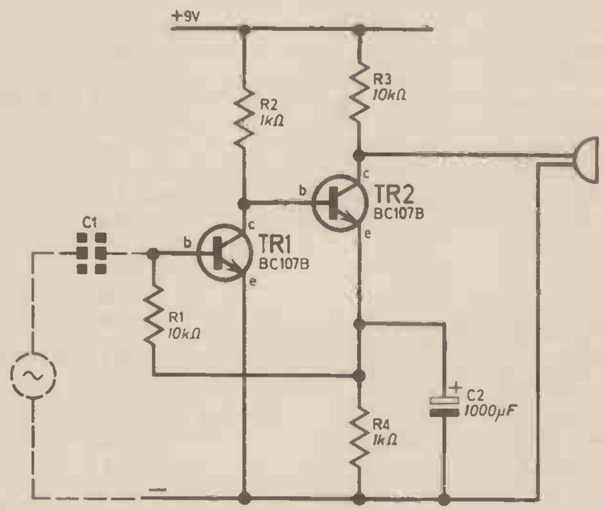


Fig. 5.1. Circuit for noise experiment.

EXPERIMENT 5.1

SIGNALS AND NOISE

To make random noise audible, build the circuit of Fig. 5.1. You may recognise this (from last time) as a two-stage audio amplifier with direct coupling between stages. But, unlike last month's low-noise circuit, this one is designed to be comparatively noisy. The noise produces a gentle hiss in the earphone.

When we are playing a gramophone or tape deck, or listening to the radio, we don't want to hear any of this noise. This means that the audio signals must be so much stronger than the noise, that when the volume control is set to give the right level of sound the "noise" is inaudible.

The signals we want to hear must be at least 1,000 times greater than the noise, and preferably 10,000 times greater. If the noise voltage at the input of an audio amplifier is one millionth of a volt (one microvolt, 1μV), the audio input signal should be at least one thousandth of a volt (one millivolt, 1mV: 1mV = 1,000μV).

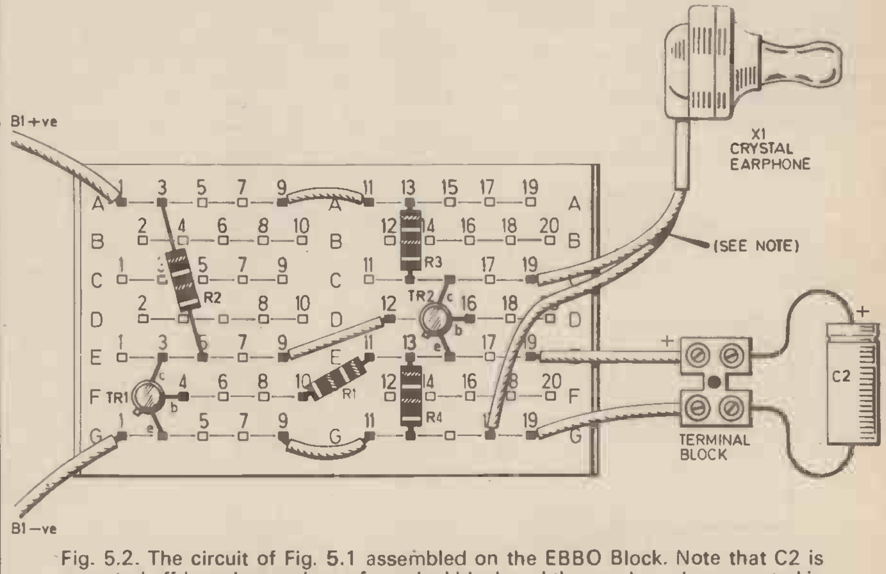


Fig. 5.2. The circuit of Fig. 5.1 assembled on the EBBO Block. Note that C2 is mounted off-board on a piece of terminal block and the earphone is connected in the manner described in Part 4.

This puts a limit on the amount of amplification which can be used. If the loudspeakers in a "hi-fi" need 10V of audio, and the audio input signal is 1mV, the overall "gain" needed is 10,000. It would be quite easy to produce a gain of a million. But quite useless, because a noise input of $1\mu V$ would now arrive at the loudspeaker as a very audible 1V.

The average pocket AM radio illustrates the point. Being small, it can only contain a small aerial, which can collect only a small signal. The designer attempts to compensate for this by providing a very high gain. But what comes out of the loudspeaker is hiss, except when a station strong enough to suppress the noise is tuned in. (In radio receivers the gain is automatically reduced by strong signals so you don't have to turn down the volume to get rid of the hiss when a strong station is present.)

The lesson is clear: the amount of amplification which can be used is limited by noise. So, although it is easy enough, in principle, to produce enormous amounts of amplification, this is of no practical value unless the noise can also be reduced.

COMBATING NOISE

Noise reduction may seem impossible in view of the fact that the transistors in the amplifier are themselves a source of noise. But various ways of reducing the effect of transistor noise exist. One which is easy to apply is to restrict the range of frequencies handled by an amplifier. The lowest audible frequency is around 20Hz. The highest depends largely on your age. A child can hear up to about 20kHz, but as you grow older your upper frequency limit falls.

For real hi-fi, then, your audio system should handle every frequency from 20Hz to 20kHz. But it will then accept every noise frequency in the same range.

Noise, being random, exists at all frequencies. If we restrict the frequency range (reduce the bandwidth) noise is reduced. So are signals, but it so happens that in speech and music there is not much energy in the upper part of the 20Hz to 20kHz range, while noise energy is spread evenly through the upper reaches of the audio band. So, with only a small sacrifice of fidelity, you might remove everything above, say, 10kHz.

HARMONICS

If you are prepared to make a larger sacrifice the bandwidth can be further reduced. The highest note on the piano has a frequency (pitch) of about 3·5kHz. It might seem that 3·5kHz would do as an upper limit for reproducing music. Unfortunately, most musical instruments generate "harmonics". Harmonics are multiples of the actual pitch. If the "3·5kHz" key (top A) on a piano is struck the instrument also emits sound on 7kHz (second harmonic), 10·5kHz (third), 14kHz (fourth) and so on. Harmonics give instruments their individual quality or timbre. The more harmonics you cut out, the less "personality" of instruments remains, even though all the notes are still there.

There's even less scope for trimming the bandwidth at the low end. The bottom note on a piano is 27Hz. You might cut out this *fundamental frequency* and rely on the harmonics (at 54Hz, 81Hz, 108Hz, etc.) to produce the impression of the note.

But, in general, the higher the harmonic the weaker its intensity, so you soon run into problems. Speech is still intelligible if everything below 300Hz is cut out, but if you do this to music it sounds "thin" and unnatural.

FREQUENCY RESPONSE

In audio amplifiers, the limits of the bandwidth handled (also called the frequency response) are usually determined by the capacitances in the circuit. We'll deal first with low frequencies.

In Fig. 5.3a, the circle with the squiggle inside is the symbol for any sort of generator of a.c. The squiggle is one *cycle* of a *sine wave*. If an instrument were playing a sustained pure note, free of harmonics, a microphone responding to the sound would produce a voltage wave of this shape. It would repeat itself (Fig. 5.3b) for as long as the sound lasted. Softer or louder sounds would change the size ("amplitude") of this signal (as shown dotted) but the general smooth curving shape would remain.

Suppose the generator in Fig. 5.3a is set to produce a constant voltage, say 1V a.c. Current then flows through C1 and R1, which are in series. They form a sort of voltage divider, but one whose upper resistance has been replaced by C1. With an input (V_{in}) of 1V a.c., what is the output voltage, V_{out}?

The answer obviously depends on the "resistance" of C1. If this is small, most of the input voltage gets to R1. If large, most is lost in C1. But what is it? Past experience gives a clue.

You know that if C1 is a large capacitance and you apply, not a.c., but a d.c. voltage to the circuit, it takes a long time for C1 to charge up appreciably.

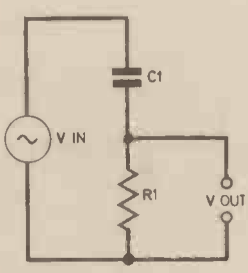
During the first moments of charging, the voltage on C1 is very small, and as the charging current flows round the circuit the voltage set up across R1 is large, almost the full battery voltage. (If you want to check this, use the circuit of Fig. 5.4, which is like last month's Fig. 4.3 but with C and the meter resistance R in reverse order.)

If C became fully charged, current would cease.

In our a.c. circuit, Fig. 5.3a, current flows *into* C1 during the times when the a.c. signal V_{in} happens to be positive and *out* when V_{in} is negative. If we want most of the voltage to appear across R1 we must not allow C1 to become anywhere near fully charged. That is, C1 must be large enough to make the time constant of the circuit so long that in the time available very little voltage builds up in C1.

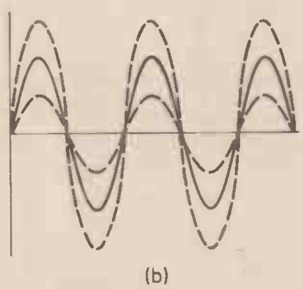
This voltage, as we saw last time, restricts the flow of current. But to develop plenty of voltage across R1 we want current to flow freely.

Now, C1 charges during each positive part of the voltage wave, or *positive half-cycle*. (During the negative half-cycles, C1 discharges.) For our purposes, the time constant CR or RC must be *long* compared with the duration of a half-cycle. What is this duration? It depends on how rapidly the a.c. voltage is reversing polarity. That is, it depends on the *frequency* of the input signal V_{in}.

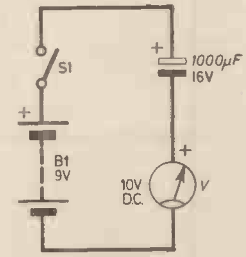


(a)

Fig. 5.3 (a). Coupling circuit


(b)

(b). Sine waves; three different amplitudes.



5.4. D.C. experiment to illustrate Fig. 5.3(a).

If the signal goes through 1,000 up-down-and-back-again cycles per second it takes 1/1,000th of a second for a complete cycle and half this time for each half-cycle. If the frequency (f) is only 100 cycles per second (100 hertz, 100Hz) these periods are ten times as long.

REACTANCE

You can see from this that as the frequency is reduced, C1 must be made larger to allow the same amount of current to flow. So the "resistance" of C1 is not a fixed quantity. At low frequencies it is high. At high frequencies it is low.

This behaviour is so different from that of ordinary resistance (which is the same at all frequencies) that it is given a different name: *reactance*. The reactance of a capacitance falls as the frequency rises. It also falls as the capacitance increases.

CIRCUIT DESIGN

Looking at Fig. 5.3a as a voltage divider, it's clear that to maximise V_{out} the reactance of C1 must be small compared with the resistance R1. Small, that is, at the *lowest* frequency we're interested in. If the effect of C1 is negligible at the lowest frequency it will be even more negligible at higher frequencies, since the reactance decreases as the frequency increases.

There's a useful "rule of thumb" for selecting a suitable value for C1 when R1 is fixed. It involves our old friend the time constant C times R. If the time constant is the same duration as one complete cycle of the signal, the amount of voltage lost in C is for most purposes negligible.

Let's try it. If the lowest frequency of interest is 20Hz, then the period of one whole cycle is 1/20th of a second and CR must be at least as long as that.

Suppose R1 is 1kΩ. From last month you know that when R is in kΩ, C has to be in millifarads for the answer to be in seconds. If C were 1mF (1,000μF), with R = 1kΩ the time constant would be 1 second. So 1mF would be more than adequate. If you can tolerate a voltage loss of about 30 per cent, you can reduce the capacitance by a factor of 20, to give a time constant of 1/20 second.

The 30 per cent loss occurs when the reactance of C is equal to the resistance of R. Charts for finding reactance exist, but you can save work by using this month's alignment chart (Fig. 5.5) which shows the CR time constant corresponding to each "30 per cent loss" frequency. This frequency is often called the cut-off frequency or corner frequency, or "3dB down" frequency ("dB" is an abbreviation for "decibels" which are a way of comparing signal strengths).

PRACTICAL CIRCUITS

There is a real-life case which corresponds almost exactly with Fig. 5.3a. This is when the signal-source itself is a capacitance. Crystal pickups, crystal microphones, capacitor microphones and electret microphones are like this. They behave like C1 and the generator combined.

The maker usually specifies the value of load resistance (R1) which is needed to get an adequate low-frequency response. In fact, he often specifies the required load *impedance*. Impedance is just a general name for the "resistance" of a circuit to a.c.

In practice, R1 is often not a real, physical resistance in the form of a resistor, but the input resistance of an amplifier.

Looking at Fig. 5.1, if the input were applied as shown dotted, it looks as if the input resistance must depend mainly on R1 (10kΩ). But the real input resistance is much less than R1. There is a hidden element: the impedance or resistance between base and emitter of TR1. That is, the input impedance of TR1 itself.

In this particular circuit the transistor input impedance is only around 1kΩ. Most of the input signal current flows through this, little through R1.

TRANSISTOR INPUT IMPEDANCE

The input impedance of a bipolar (*npn* or *pnp*) transistor is not a fixed quantity. It increases as the collector current is reduced. At audio frequencies, the BC107 will work at very small collector currents, down to about 10μA. If the current amplification factor is 100 at this current the input impedance at audio frequencies is around 200kΩ.

A capacitive signal-source which "looks like", say, 100pF requires an enormous load impedance if it is to deliver frequencies down to 20Hz without much loss. Bipolar transistors are not really suitable for use with such signal-sources (which include high-quality capacitor microphones). The alternative is to use a *field-effect transistor* (f.e.t.).

F.e.t.s have an inherently high input impedance because they work without "base current". Low-noise audio f.e.t.s with input impedances of 1,000MΩ enable the required values of around 100MΩ to be obtained easily.

HIGH-FREQUENCY RESPONSE

You can see that in the general case where the capacitance is under the designer's control the low-frequency response can be extended as far down as needed by using large coupling capacitors. What about the high-frequency response?

In theoretical circuits like Fig. 5.3a the h.f. response extends to infinity, since C1 reactance goes on decreasing as the frequency is raised. In practical amplifiers this doesn't happen because the gain of transistors falls off at really high frequencies. Even so, with modern transistors it is more than adequate for the audio range and unless something is done to restrict it the amplifier will work at frequencies above the limit of human hearing.

The set-up for Experiment 5.2. As only two leads from potentiometer VR1 are used, the lead attached to one of the outer tags should be folded back so that its bared end does not make accidental contact with any other component.

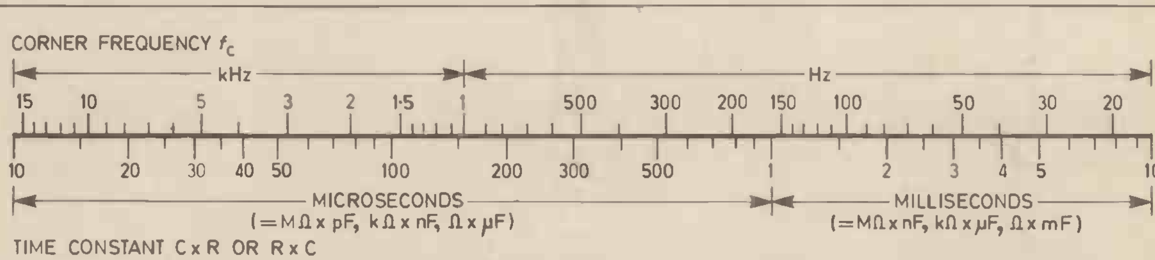


Fig. 5.5. Alignment Chart relating the time constant CR or RC to the corner frequency of a network like Fig. 5.3(a) or Fig. 5.6(b).

CHECK YOUR PROGRESS

Questions on *Teach-In 84 Part 5*
Answers next month

Q5.1 An amplifier has an input impedance of 10kΩ. If it is required to handle frequencies down to 20Hz what is the minimum acceptable size of input-coupling capacitor?

Q5.2 In Fig. 5a, what d.c. voltage is applied by the circuit to: (a) C1; (b) C2; (c) the earphone?

Q5.3 If a microphone generates 10mV audio signal, what is the greatest noise voltage which can be tolerated in its associated amplifier, if the signal-voltage to noise-voltage ratio must be 1,000 minimum?

ANSWERS TO PART 4

Q4.1 a. 10V
b. 10mA. (There is 10V across RC. The base current can be neglected in comparison with IC.)
c. 0·1mA (100µA). $I_B = I_C/h_{FE}$.

Q4.2 5 seconds (8V is 2/3 of V_{CC} so the time is roughly one "time constant". C = 0·5mF so RC in kΩ x mF is 10 x 0·5 = 5).

Q4.3 2mA. There is about 0·7V across R4; this gives a little over 2mA for the emitter current. The collector current is slightly less than this.

Q4.4 200. If R3 is 10kΩ the voltage is divided by 200. Note that this figure is for the voltage gain. The current gain might be quite different. Also, it is unlikely that a 10kΩ log pot will have a track resistance of exactly 10kΩ. The tolerance of these pots is usually 30 per cent.

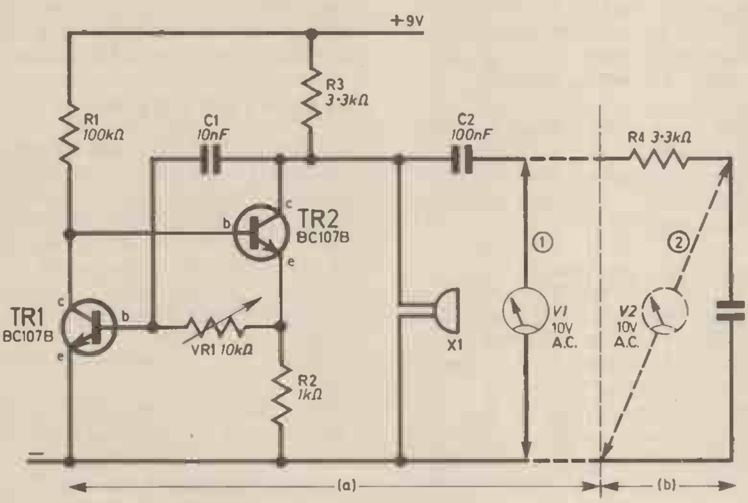
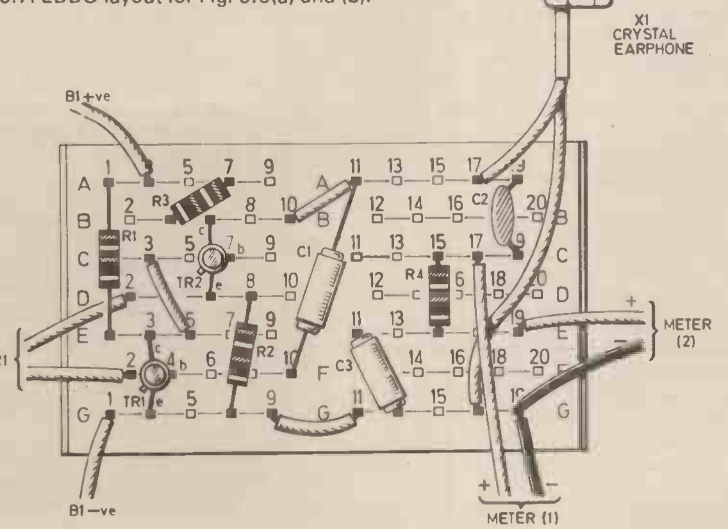


Fig. 5.6(a). Oscillator covering 3kHz to 30kHz approx. (b) High frequency roll-off circuit.

Fig. 5.7. EBBO layout for Fig. 5.6(a) and (b).



EXPERIMENT 5.2

To illustrate this, build the oscillator of Fig. 5.6a.

With C1 = 1nF (1,000pF) the frequency is a high audio frequency when VR1 is at its full 10kΩ and rises as VR1 is reduced, until the sound becomes inaudible (ultrasonic). Connecting a low-voltage a.c. voltmeter (for example, the KEW7S on its 10V a.c. range) to monitor the output shows that the circuit goes on oscillating even when inaudibly high in frequency (C2 is to block d.c. Many cheap meters still register d.c. voltages when turned to their a.c. ranges. More expensive ones incorporate their own internal d.c. blocking capacitor which is switched in circuit when the meter is set to a.c.).

H.F. ROLL-OFF

It is undesirable that an audio amplifier should pass frequencies above the audio range, because these can produce unwanted audible effects. For example, in FM stereo reception a frequency of 38kHz is mixed up with the audio. This can interact with other high frequencies to produce audible whistles.

For this reason, ultrasonic frequencies are attenuated (weakened) by an "h.f. roll-off" circuit, such as Fig. 5.6b. Here the capacitance forms the "output arm" of a voltage divider. Since its reactance falls as the frequency rises, while the impedance of the resistance (R4) is constant, signals at higher frequencies are progressively reduced.

The "corner frequency" for an h.f. roll-off circuit like this is given by the same rule as before, but the frequencies *above* the corner frequency are now the ones which are attenuated.

Try experimenting with various values for C1 and C3. You'll find that for any value of C1 there is always a value of C3 which just begins to attenuate within the tuning range provided by VR1.

Next month: Operational Amplifiers

ELECTRICAL HAZARDS

HOW TO AVOID DANGER AND HOW TO ADMINISTER TREATMENT FOR SHOCK

AS AN electronic hobbyist, and probably something of a d.i.y. electrician as well, the possibility of suddenly becoming a component yourself (and we are quite good conductors!) is one of the hazards you face.

It is well worth considering the danger before it happens. Of course the trivial little incident is nothing, although even a mild and unexpected shock can give you a fair amount of discomfort. But remember voltages far lower than the mains supply can kill.

PRECAUTIONS

The best approach of course is to avoid it happening, whilst still knowing how to deal with the worst. Unfortunately you are the most likely victim and you can't give yourself first aid!

Apart from the contempt bred of familiarity, haste, carelessness and absentmindedness lead to accidents. It is easy to forget that faults do occur, a chassis, spindle, or even headphones can become live; to forget that capacitors can, and do, store considerable charge.

These things happen even if we don't use matches to plug wires into the mains, or twist old bits and pieces together for the Christmas tree lights.

Many more examples will come to mind, and it's worth taking the obvious precautions. Perhaps, for example, using batteries to replace the mains, arranging a master switch near the door for anyone to use in emergency, and not standing on a wet floor with nails in your boots.

IF IT HAPPENS

Let us assume the worst and consider what to do when you are with someone who is electrocuted. In the unlikely event of very high voltages you must stay well away until you are sure the supply has been switched off and that it won't be restored without warning.

You are more likely, however, to be dealing with domestic power supplies. Even here you must avoid becoming a casualty yourself. The usual advice is to try to quickly break the contact between victim and supply by pushing him away with any insulator such as a stick, rolled newspaper, or by wearing a pair of rubber gloves. Bear in mind that you must never pull the victim away by his armpits which may be moist and therefore conducting.

Unfortunately most of us don't carry rubber gloves, and rolled newspapers aren't very good for pushing inert bodies with, so when possible, it's probably quicker, easier and safer to pull out the plug or disconnect in some other way.

It is always wise to call the ambulance by a 999 call if the accident seems at all serious.

EFFECTS OF SHOCK

It is usual to say that amperes kill, although this is not strictly true, and isn't very helpful anyway. The effects depend on the current, the duration of the contact, the path it takes, and the state of the victim. Apart from the physical effect of the shock, the victim may also fall and injure himself.

A trivial shock could well precipitate a heart attack in a predisposed person, and there is some evidence that an unexpected shock has more effect than an expected or intentional one.

If the current path is through the head, consciousness may be lost, and the breathing or heart may stop. As the brain controls these functions this isn't really surprising. After all, if you put the mains current through a computer memory it wouldn't do it much good either, would it?

A path through the heart may stop it especially if there has been previous disease.

Burns are likely, and are often much deeper and more severe than at first appears on the surface. They can involve muscle and tendon especially in the hand which is far the most common site of entry. A further hazard here is that the victim may grip the conductor because of local muscle spasm in the hand. So it does not take much imagination to see that permanent disability often results especially in the fingers.

Problems with the heart or breathing may occur later on for which it is wise to seek medical treatment, possibly in a casualty department.

First aid measures depend upon the victim's condition, the priorities being to maintain breathing and the heart beat. Excellent instructions with diagrams are given in most first aid books, especially St. John Ambulance manual on the subjects of artificial respiration and heart compression.

QUALIFIED HELP

If the victim is conscious and breathing it's really a matter of making him comfortable and not meddling. In most parts of the country the wait for a doctor or ambulance will be quite short and unless there's good reason it's far better and kinder not to attempt to splint fractures or dress burns. The ambulance attendants have the proper equipment and are better qualified to do it.

If the victim is unconscious turn him onto his side, the top leg bent at hip and knee to support him, and to help his breathing, tip his head backwards by pulling his chin up. If he stops breathing you will need to use mouth to mouth resuscitation (the "kiss of life"). Commonsense should tell you to remove an unconscious person's dentures or any other obstruction.

If you are sure the heart has stopped he will need heart compression.

If you do these things you may well save a life, so it is worth reading it up, and being aware of the methods and techniques we have discussed.

PERSEVERE

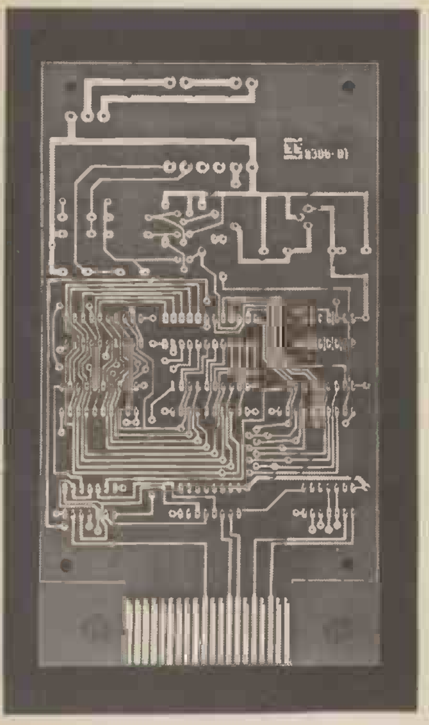
Finally, electrocution is one of the conditions where recovery is possible after apparent death, so that attempts to resuscitate should continue even when they don't seem to be helping.

Bearing in mind the difficulty which eminent doctors sometimes have in deciding whether a patient is dead you should feel encouraged to persevere with your efforts, all is by no means lost.

However, since *you* may be the victim, the best approach is prevention, which brings us back to where we came in.

General Practitioner.

EVERYDAY ELECTRONICS PRINTED CIRCUIT BOARD SERVICE



Printed circuit boards for certain EE constructional projects are now available from the EE PCB Service, see list. These are fabricated in glass-fibre, and are fully drilled and roller tinned. All prices include VAT and postage and packing. Remittances should be sent to: EE PCB Service, Everyday Electronics Editorial Offices, King's Reach Tower, Stamford Street, London SE1 9LS. Cheques should be crossed and made payable to IPC Magazines Ltd.

We regret that the ordering codes for the August projects have been incorrectly quoted in the Sept-Oct issues. Correct codes are given here.

Please note that when ordering it is important to give project title as well as order code.

Readers are advised to check with prices appearing in current issue before ordering.

PROJECT TITLE	Order Code	Cost
Eprom Programmer, TRS-80 (June 83)	8306-01	£9.31
Eprom Programmer, Genie (June 83)	8306-02	£9.31
Eprom Programmer, TRS-80 & Genie (June 83)	8306-03	£1.98
User Port Input/Output *M.I.T. Part 1* (July 83)	8307-01	£4.82
User Port Control *M.I.T. Part 1* (July 83)	8307-02	£5.17
Storage 'Scope Interface, BBC Micro (Aug 83)	8308-01	£3.20
Car Intruder Alarm (Aug 83)	8308-02	£5.15
High Power Interface *M.I.T. Part 2* (Aug 83)	8308-03	£5.08
Pedestrian Crossing Simulation *M.I.T. Part 2* (Aug 83)	8308-04	£3.56
Electronic Die (Aug 83)	8308-05	£4.56
High Speed A-to-D Converter *M.I.T. Part 3* (Sept 83)	8309-01	£4.53
Signal Conditioning Amplifier *M.I.T. Part 3* (Sept 83)	8309-02	£4.48
Stylus Organ (Sept 83)	8309-03	£6.84
Distress Beacon (Sept 83)	*8309-04	£5.36
Distress Beacon Pocket Version (Sept 83)	8309-05	£3.98
D-to-A Converter *M.I.T. Part 4* (Oct 83)	8310-01	£5.77
High Power DAC Driver *M.I.T. Part 4* (Oct 83)	8310-02	£5.13
Electronic Pendulum (Oct 83)	8310-03	£5.43
TTL/Power Interface for Stepper Motor *M.I.T. Part 5* (Nov 83)	8311-01	£5.46
Stepper Motor Manual Controller *M.I.T. Part 5* (Nov 83)	8311-02	£5.70
Digital Gauss Meter (Nov 83)	8311-03	£4.45
Speech Synthesiser for BBC Micro (Nov 83)	8311-04	£3.93
Car On/Off Touch Switch (Nov 83)	8311-05	£3.11
4-Channel High Speed ADC (Analogue) *M.I.T. Part 6* (Dec 83)	8312-01	£5.72
4-Channel High Speed ADC (Digital) *M.I.T. Part 6* (Dec 83)	8312-02	£5.29
TRS-80 Twin Cassette Interface (Dec 83)	8312-03/09	£7.43
Environmental Data Recorder (Dec 83)	8312-04	£7.24
Touch Operated Die (Dot matrix) (Dec 83)	8312-05/06	£4.34
Touch Operated Die (7-segment) (Dec 83)	8312-05/07	£4.34
Continuity Tester (Dec 83)	8312-08	£3.41
Central Heating Pump Delay (Jan 84)	8401-01	£3.33
Biological Amplifier *M.I.T. Part 7* (Jan 84)	8401-02	£6.27
Temp. Measurement and Control System for ZX Computers (Jan 84)		
Analogue Thermometer Unit	8401-03	£2.35
Analogue-to-Digital Unit	8401-04	£2.56
Games Scoreboard (Jan 84)	8401-06/07	£9.60
Eprom Programmer/ROM Card for ZX81 (Feb 84)	**8402-01	£7.84
Oric Port Board *M.I.T. Part 8* (Feb 84)	8402-02	£9.56
Negative Ion Generator (Feb 84)	*8402-03	£8.95
Temp. Measurement and Control System for ZX Computers (Feb 84)		
Relay Driver Unit	8402-04	£3.52

*Set of four boards.
**Calibrated with C1, VR1 and IC4 fitted.
M.I.T.—Microcomputer Interfacing Techniques, 12-Part Series.

TEMPERATURE MEASUREMENT AND CONTROL SYSTEM FOR ZX COMPUTERS

PART 2: RELAY DRIVER UNIT AND SOFTWARE

BY M. PLANT

IN Part 1 of this article, the theoretical and constructional details were given for the Analogue Thermometer and ADC Units of this measurement and control system. This second and final part describes the Relay Driver Unit; calibration of the ADC with full interwiring details and software examples for both the ZX81 and the ZX Spectrum.

RELAY DRIVER CIRCUIT

In the circuit shown in Fig. 9, four of the seven Darlington pair drivers available in IC1 are used to drive four relays, each of which has a 5A switching capacity. The Darlington pairs present a high impedance load to the 5V logic signals from the read port of the PIA, and IC1 thus providing a low-cost and simple buffer for a control interface.

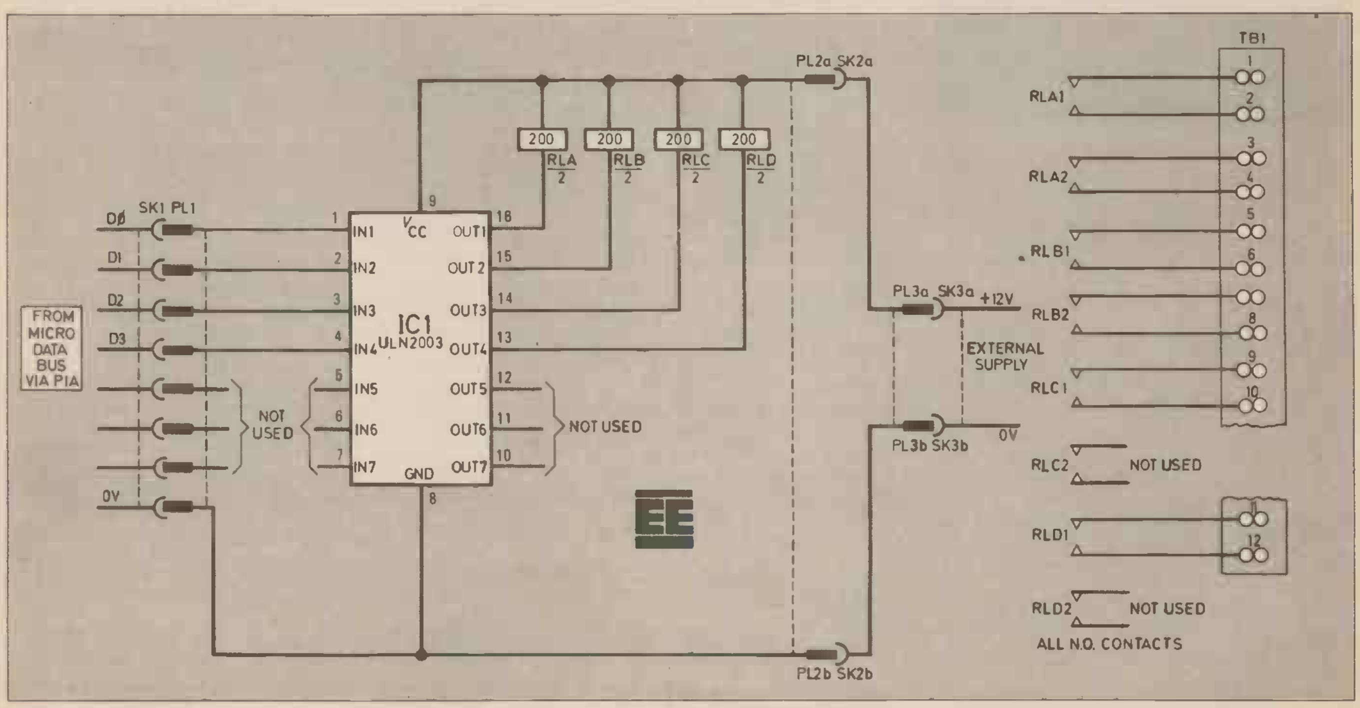
The relays are energised by a POKE command to the PIA. The unit can be used for general control applications or in association with the Thermometer and ADC Units for thermostat applications as indicated by the sample programs.

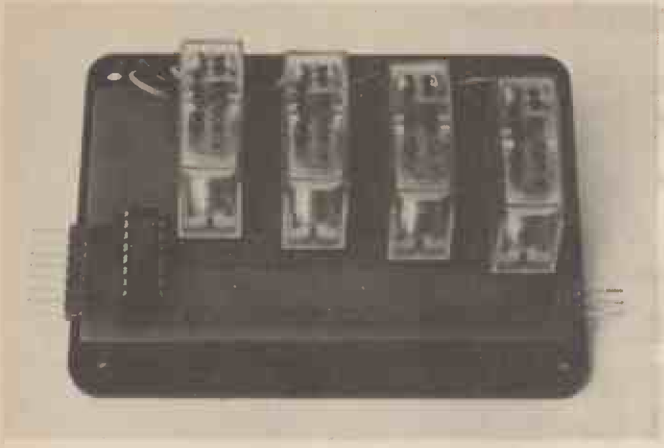
ASSEMBLY

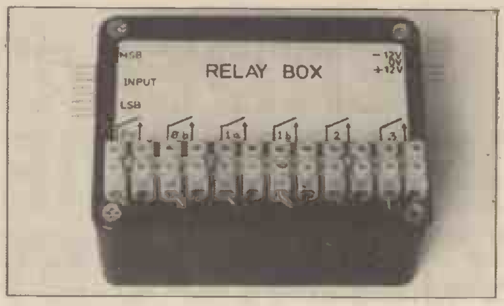
Figs. 10 and 11 show the p.c.b. pattern and component layout for the driver unit, respectively. Four ways of an 8-way inter-p.c.b. plug are used for bringing the four least (or four most) significant bits from the PIA, each bit controlling its own relay. Note that the unit operates direct from a +12V d.c. supply. The PIA 0V line is connected to the driver 0V at SK1h/PL1h. The printed circuit board is available from the *EE PCB Service*, Order code 8402-04.

Note that each relay in the unit is a double-pole single-throw type. Wires are brought out from both pairs of contacts on two relays (RLA and RLB) and from only a single pair of contacts on the remaining two relays. This selection makes use of all twelve connectors on a 12-way terminal block (TB1) which is bolted to the boxed Relay Driver Unit as shown in the photographs.

Fig. 9. Circuit diagram for the Relay Driver Unit.







The completed prototype Relay Driver Unit showing labelling of screw terminal block, input and supply to plugs.

Left shows the assembled Relay Driver Unit removed from its case.

COMPONENTS

IC1	ULN2003 7-stage Darlington driver
RLA, RLB, RLC, RLD	miniature relay type Feme MHP A200 45 05 Coil resistance 200 ohms d.p.s.t. 5A contacts (4 off)
SK1	8-way inter-p.c.b. socket
SK2,3	2-way inter-p.c.b. socket (2 off)
PL1	8-way inter-p.c.b. straight plug
PL2,3	2-way inter-p.c.b. straight plug (2 off)
TB1	12-way screw 2A terminal block

Printed circuit board: single-sided, size 94 x 53mm, *EE PCB Service*, Order code 8402-04; 16-pin d.i.l. socket; plastics case, size 95 x 71 x 35mm, type MB2; 8-way ribbon cable; pvc-covered interconnecting cable; 6BA fixings (2 sets).

Approx. cost Guidance only **£15**

See SHOPTALK page 87

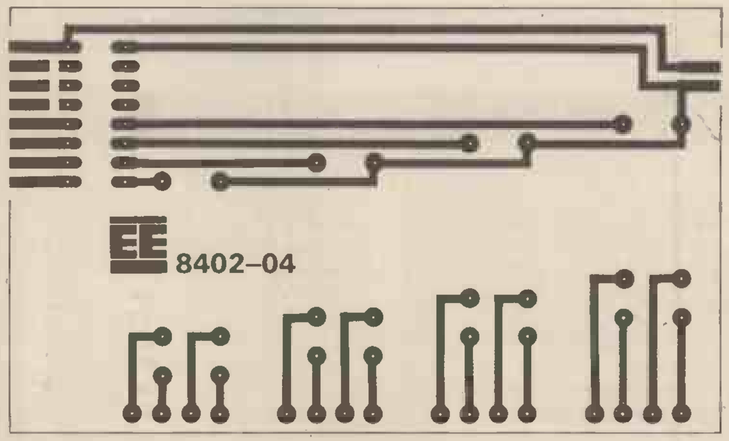


Fig. 10. The master p.c.b. pattern (actual size) for the Relay Driver Unit. This board Is available from the *EE PCB Service*, Order code 8402–04.

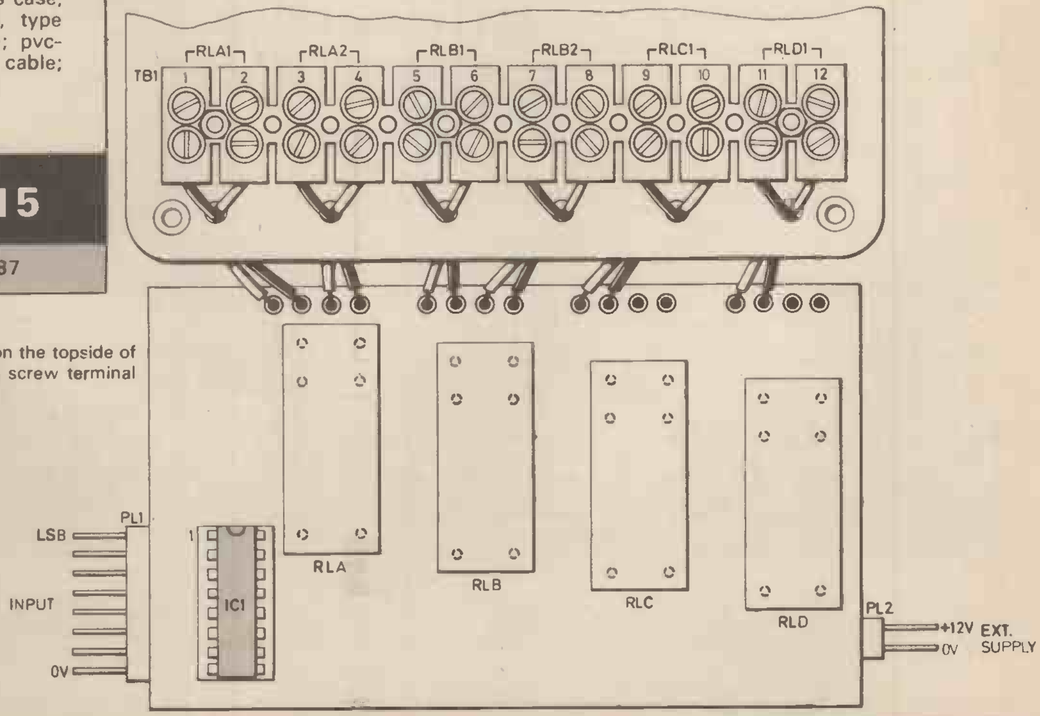


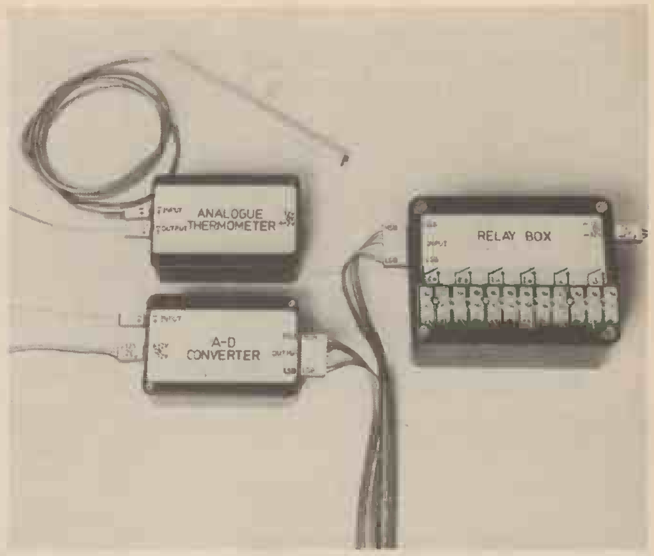
Fig. 11. Layout of the components on the topside of the p.c.b. and wiring details to the screw terminal block mounted on the case lid.

INTERWIRING

The complete interwiring of the three units described, to the ZX81 and ZX Spectrum Input/Output Port boards from Redditch Electronics is shown in Fig. 12.

Each of the Port boards has a single-sided fingerset. Rather than solder directly to these contacts, it is recommended that a wire-wrap single-sided card edge connector be used. These are also supplied by Redditch. This type of connector lead allows the inter-p.c.b. sockets used in the other interconnections in the system to be used to connect to the I/O board.

The inter-p.c.b. sockets come in two parts: a cable shell and terminals. It is intended with these connectors that the terminals be crimped onto the wire before pushing it into the shell, but if you do not



The three prototype units plus temperature sensor.

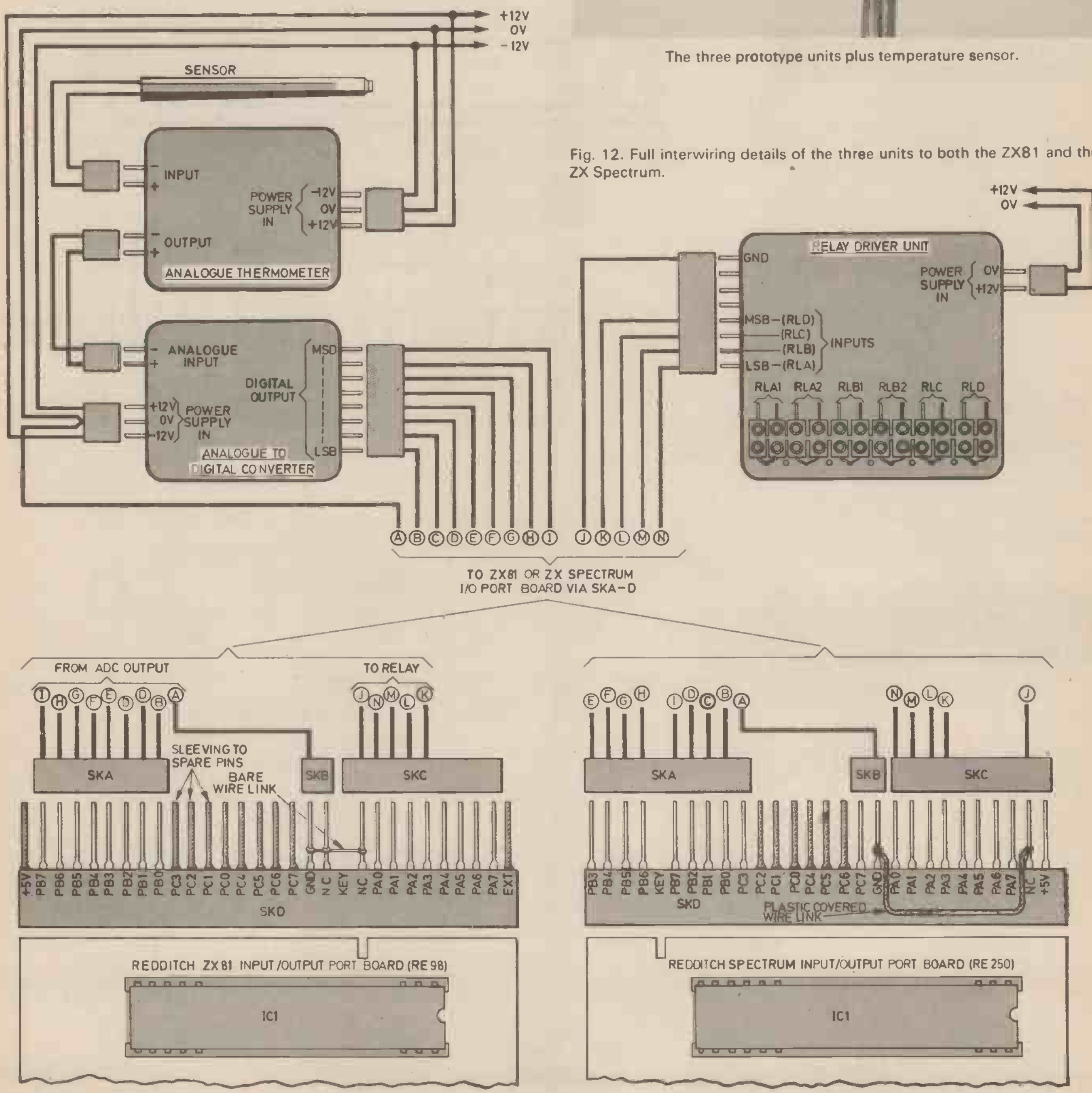


Fig. 12. Full interwiring details of the three units to both the ZX81 and the ZX Spectrum.

have the special crimping tool, soldering of the wire to the terminal has been found to be a satisfactory inexpensive alternative. Stranded lightweight wiring is preferred.

ADC CALIBRATION

Connect the ADC Unit to the appropriate I/O Port board and its power supplies. Turn on the ZX81 or Spectrum followed by the ±12V supplies. Enter the appropriate test routine, Program A, and RUN the program. A constant number should be seen scrolling on the screen.

Connect a shorting link across the analogue inputs to the ADC Unit (the analogue input is then 0V) and adjust VR1 so that the display on the screen reads Ø.

Now connect the analogue output from the calibrated Thermometer Unit to the ADC, making sure that the leads make the correct polarity connections. Immerse the sensor in water at 100 degrees C. Wait a few moments for the sensor to reach this temperature and adjust VR2 so that 100 is displayed on the screen. Check that the display still reads zero when the sensor is immersed in melting ice and adjust VR1 if necessary.

Thus calibrated, the screen directly displays the temperature of the sensor in degrees Centigrade. Theoretically a maximum temperature of 255 degrees C could be displayed, although the sensor should not be used above 150 degrees C.

PROGRAM A

Test Routine: ADC

Line No.	ZX81	ZX Spectrum
1Ø	POKE 4Ø963,13Ø	OUT 2271,13Ø
2Ø	LET X=PEEK 4Ø96Ø	LET X=PEEK 2143
3Ø	PRINT X	PRINT X
4Ø	GOTO 2Ø	GOTO 2Ø

RELAY DRIVER TEST

Turn off all power to the computer and units. Connect the Relay Driver Unit to the I/O Port board. Turn on power to the computer followed by the power supplies to the unit. Enter the Test Routine given in Program B.

Run the program and in response to the input prompt enter a number between Ø and 15. Check with an ohmmeter or some other means, the state of the six relay sets of relay contacts. They should be according to Table 3.

PROGRAM B

Test Routine: Relay Driver Unit

Line No.	ZX81	ZX Spectrum
1Ø	POKE 4Ø963,13Ø	OUT 2271,13Ø
2Ø	POKE 4Ø961,Ø	OUT 2Ø79,Ø
3Ø	INPUT X	INPUT X
4Ø	POKE 4Ø961,X	POKE 2Ø79,X
5Ø	GOTO 2Ø	GOTO 2Ø

Table 1. Relay Truth Table

X	RLA1 RLA2	RLB1 RLB2	RLC	RLD
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

0 = open 1 = closed

SOFTWARE

Constructors will undoubtedly have their own ideas for using the units described in this article and will write their own software to suit. Three software examples are listed below for each of the two computers, the ZX81 and ZX Spectrum, to illustrate a few applications of the system with printouts of the display where appropriate.

ZX81

Program 1: THERMOMETER

Reads the input port and displays the temperature of the sensor.

```
  1 REM THERMOMETER
  5 POKE 4Ø963,13Ø
 1Ø LET C=PEEK 4Ø961
 2Ø PRINT AT 1Ø,12;C;TAB 14; "C"
 3Ø PAUSE 5Ø
 35 IF C<1Ø THEN PRINT AT 1Ø,13," "
 4Ø IF C=PEEK 4Ø961 THEN GOTO 4Ø
 5Ø GOTO 1Ø
```

Typical display: **13 C**

Program 2: THERMOSTAT

Reads the input port and displays the temperature of the sensor. The relays are activated at a preset temperature.

```
  1 REM THERMOSTAT
 1Ø POKE 4Ø963,13Ø
 2Ø PRINT AT Ø,Ø; "INPUT SET
    TEMPERATURE AND PRESS
    NEWLINE
 3Ø INPUT H
 35 CLS
 4Ø POKE 4Ø96Ø,Ø
 5Ø LET C=PEEK 4Ø961
 6Ø IF C<H THEN POKE 4Ø96Ø,1
 65 IF C<H THEN POKE 4Ø96Ø,Ø
 7Ø PRINT AT 1Ø,12; "SET TEMP=";
    TAB 25; "C"
 8Ø PRINT AT 1Ø,22; H
 9Ø PRINT AT 12,12; "TEMP
    NOW="; TAB 25; "C"
1ØØ PRINT AT 12,22; C
11Ø PAUSE 2Ø
13Ø GOTO 5Ø
```

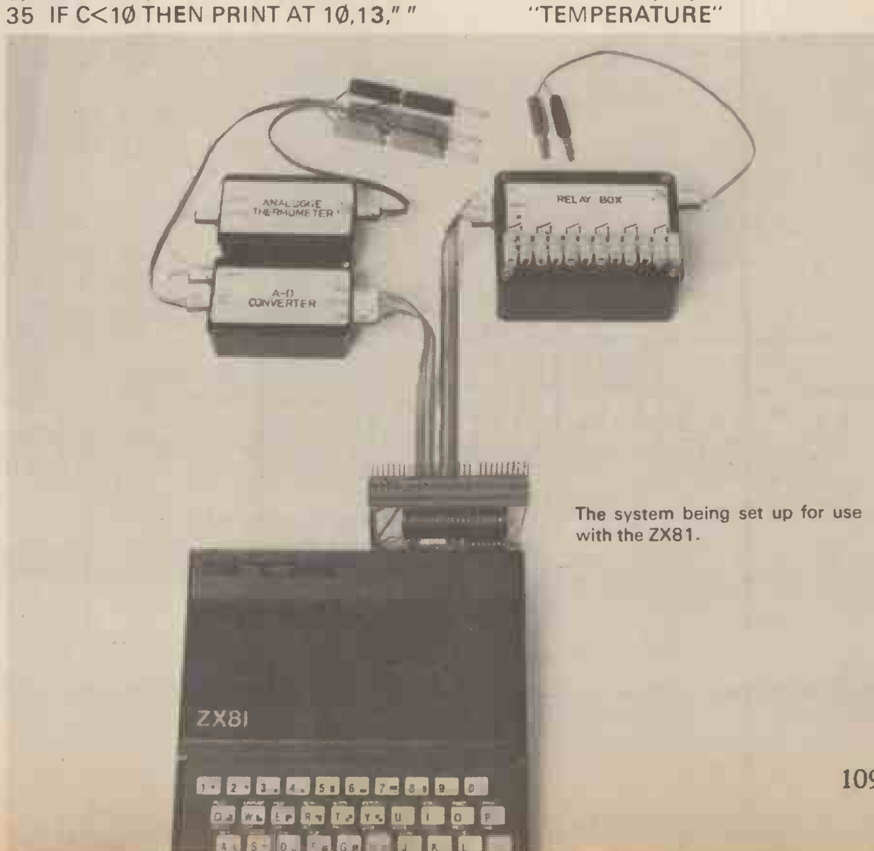
Typical display:

SET TEMP = 23 C
TEMP NOW 19 C

Program 3: THERMOMETER

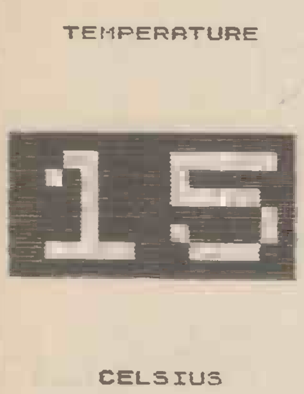
Reads the input port and displays the temperature of the sensor in large characters.

```
  1 REM "LARGE TEMPERATURE
    DISPLAY"
  2 POKE 4Ø963,13Ø
  3 POKE 165Ø7,PEEK 4Ø961
  4 FAST
  5 PRINT AT 1,11;
    "TEMPERATURE"
```

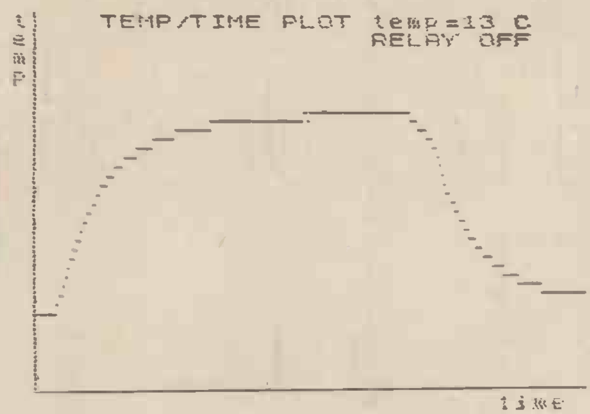


The system being set up for use with the ZX81.

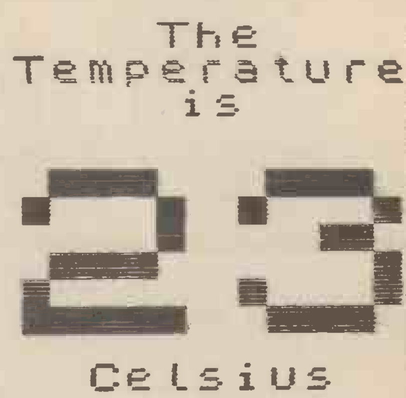
ZX81 PROGRAM 3



ZX SPECTRUM PROGRAM 2



ZX SPECTRUM PROGRAM 3




```
  6 PRINT AT 2/00,13; "CELSIUS"
 1Ø DIM A$(1,2)
 2Ø FOR I = 1 TO 2
 25 FOR K = 1 TO 2
 3Ø LET B$ = STR$ PEEK 4Ø961
 35 IF I = 2 THEN GOTO 3ØØ
 4Ø LET AS(I) = BS
 85 LET M = 14
 9Ø LET C = CODE A$(I,K)
1ØØ IF C<128 THEN GOTO 13Ø
13Ø FOR L = Ø TO 7
14Ø LET P = PEEK (768Ø + C*8 + L)
15Ø LET V = 128
16Ø FOR J = Ø TO 7
17Ø IF P<V THEN GOTO 198
18Ø PRINT AT 21 – (M – L), 8 + 8*
    (K–1) + J
19Ø LET P = P–V
195 GOTO 2ØØ
198 PRINT AT 21 – (M – L), 8 + 8*
    (K–1) + J
2ØØ LET V = V/2
21Ø NEXT J
22Ø NEXT L
23Ø NEXT K
24Ø NEXT I
3ØØ SLOW
31Ø POKE 16436,2ØØ
32Ø POKE 16437,255
33Ø IF PEEK 16437 = 255 THEN
    GOTO 33Ø
335 IF PEEK 165Ø7 = PEEK 4Ø961
    THEN GOTO 31/00
34Ø CLS
35Ø GOTO 3
```

ZX SPECTRUM

Program 1: THERMOMETER

Reads the input port and displays the temperature of the sensor. Updated at 0·6 second intervals.

```
 1 REM Temperature
 5 OUT 2271,13Ø
1Ø LET P = IN 2143; PRINT AT
   12,15; P; AT 12,17; "C" :
   PAUSE 3Ø: GOTO 1Ø
```

Typical display: **15 C**

Program 2: TEMP/TIME PLOT

Plots a graph of the sensor temperature over a time period and activates a relay at a preset temperature.

```
 1 REM Temp/Time Plot
 5 OUT 2271,13Ø
1Ø PRINT AT Ø,Ø; "t"; AT 1,Ø; "e"; AT
   2,Ø; "m"; AT 3,Ø; "p"
15 PRINT AT 21,27; "t"; AT 21,28;
   "i"; AT 21,29; "m"; AT 21,3Ø; "e"
2Ø PRINT AT Ø,5; "TEMP/TIME
   PLOT"
3Ø PLOT 1Ø,1Ø: DRAW 245,Ø: PLOT
   1Ø,1Ø: DRAW Ø,165
4Ø FOR X = 1Ø TO 255
5Ø LET p = IN 2143: PLOT x,4*p
55 PAPER 7: FLASH 1: INK Ø: PRINT
   AT Ø,2Ø; "temp = C": PRINT AT
   Ø,25; p: FLASH Ø
6Ø IF IN 2143<25 THEN OUT
   2Ø78,1; PRINT AT 1,2Ø; "RELAY
   ON"
64 IF IN 2143<25 THEN OUT
   2Ø78,Ø: PRINT AT 1,2Ø; "RELAY
   OFF"
7Ø PAUSE 1Ø: FLASH Ø
8Ø NEXT x
```

Program Notes

Line 5 sets the PIA Port B to input, and Port A to output.

Lines 1Ø to 3Ø draws and labels axes of graph.

Line 5Ø recovers temperature from input port and plots graph. Scaling of plot can be done here.

Line 55 prints value of temperature.

Lines 6Ø and 64 operate relay at selected temperature.

Line 7Ø sets delay between points plotted before next value.

Program 3; THERMOMETER

Reads the input port and displays the temperature of the sensor in large characters.

```
  1 REM Large Temp Display
  5 OUT 2271,13Ø
 1Ø BORDER 1: PAPER 7: INK 1
 2Ø LET yy = 5: LET ys = 2: LET xs =
    2: LET p$ = "The": GOSUB 1ØØ:
    LET yy = 2Ø: LET ys = 2: LET xs =
    2: LET p$ = "Temperature":
    GOSUB 1ØØ: LET yy = 35: LET ys
    = 2: Let xs = 2: LET p$ = "is":
    GOSUB 1ØØ
 3Ø LET bS = STR$ IN 2143: INK 2:
    LET yy = 6Ø: LET ys = 12: LET xs
    = 12: LET pS = bS: GOSUB 1ØØ
 4Ø LET yy = 155: LET xs = 2: LET ys
    = 2: LET p$ = "Celsius": GOSUB
    1ØØ
 5Ø LET p = IN 2143: IF p$ = b$
    THEN GOTO 5Ø
 6Ø GOTO 3Ø
1ØØ LET xx = (256 – 8* xs* LEN p$)/2
11Ø LET i = 233Ø6: POKE i,xx: POKE
    i + 1,yy: POKE i + 2,xs: POKE i +
    3,ys: POKE i + 4,8: LET i = i + 4:
    LET m = LEN p$: FOR n = 1 TO
    m: POKE i + n, CODE p$(n):
    NEXT n: POKE i + m + 1,255:
    LET m = USR 32256: RETURN
```

Program Notes

This program uses the machine code routine for printing large-scale characters on the screen held on the Spectrum "Horizons" introductory tape. To use this routine, load "Wall", press "New" and "Enter" and the machine code routine is not destroyed. Type in and run the Basic program shown above.

Line 5 sets the Redditch PIA Port B to input and Port A to output.

Line 2Ø prints "The Temperature is" in large letters the size of which are determined by the values of yy (position of letters down screen from the top), ys (the vertical size of the letters), xs the horizontal size of the letters).

Lines 1ØØ and 11Ø use the machine code routine for printing on the screen.

Line 3Ø recovers the temperature at the input port of the PIA and prints it in extra large letters on the screen.

Line 5Ø changes the temperature displayed only when it changes at the input port. □

MARCH FEATURES

BLACK BOX PROJECTS

DIN LEAD TESTER

The first in an occasional series of short projects, all utilising the same size black plastic case and piece of stripboard. The DIN Lead Tester checks the wiring of audio leads. Catering for 5-pin DIN, 2·5mm, 3·5mm and 0·25in jack plugs and phono leads, this unit will detect open circuits, shorted pins or normal working—displaying the results on a row of l.e.d.s.

MULTIMETER ADD-ON FOR BBC MICRO

THIS UNIT CONNECTS TO THE USER AND ANALOGUE PORTS, TO PRODUCE AN ACCURATE DIGITAL MULTIMETER WITH SCREEN READOUT. FOR VOLTAGE, RESISTANCE AND CAPACITANCE MEASUREMENTS, IN RANGES UP TO 100V, 10MΩ AND 10µF, RESPECTIVELY. MAY BE USED WITH OTHER COMPUTERS EQUIPPED WITH I/O AND ANALOGUE PORTS.

REVERSING BLEEPER

Loud bleeping sound warns pedestrians when driver moves gear lever into "reverse". Bleeper is automatically rendered inoperative when side lights are on—the reversing lights giving adequate warning to passers-by at night time.

NI-CAD BATTERY CHARGER

For use with a car battery charger. This unit enables ni-cad cells to be recharged from a standard 12V car battery charger. Caters for PP3, HD7, HP11 and HP2 in banks of up to 12 cells (of the same type). Charge current shown on panel meter.

LOW POWER STEREO AMPLIFIER

A modest budget project, ideal for the beginner. 2·5 watts per channel. Used with efficient loudspeaker units will provide adequate output for a small room. Three inputs: for ceramic cartridge pick-up, tape recorder and auxiliary. Bass and treble tone controls.

EVERYDAY ELECTRONICS and computer PROJECTS

MARCH 1984 ISSUE ON SALE FRIDAY, FEBRUARY 17

Projected TV Developments

A MULTIFUNCTIONAL digital television, and the world's first 6·5in screen portable rear-projection colour sets announced by Matsushita would seem to point the way that future advances in television design may take.

The plans are to market the multifunctional digital TV in Japan, under the Panasonic brand in the early part of 1984. The 6·5in portable projection colour set is expected to be available within the year. At present, there are no plans to introduce either set into the UK.

It is claimed that the digital TV set marks a new generation that will serve as the focal point for the home information centre of the future. It can easily incorporate a viewdata and teletext adaptor and can be linked up directly with home computers, hi fi systems, VCRs and other ancillary equipment.

Viewers can watch more than one video source at the same time by a digitally processed 6in colour picture which can be inserted in the 20in main picture.

Digital TV

An infra-red remote control unit controls operations of both the TV and many other pieces of equipment which can be linked up to it. Because the remote control signal is generated by an 11-bit digital signal system, it is theoretically capable of controlling up to 2048 functions.

The remote control unit controls 61 functions, including colour saturation and brightness of the TV as well as various functions of a VTR, video disc player, personal computer or video camera hooked up to the TV.

The digital TV uses two i.c.s and four l.s.i.s (Large Scale Integration), including a newly developed microcomputer CPU (Central Processing Unit). It has 30 per cent less components than conventional analogue sets which reduces cost and increases reliability.

The incorporation of digital circuitry is claimed to give far crisper, cleaner images due to the reduction of spots, screen flickering and colour saturation which exists in analogue sets.

Projection Portable TV

The portable 6·5in colour TV is collapsible and folds down into an attaché case of 25 × 8·5 × 31cm and weighs only 3kg. By comparison, conventional TV sets which have a 7in screen, weigh almost twice as much as the new portable display system and are nearly twice as big.

Based upon the technology in their large-screen projection TV system, the new portable projection TV contains three 5cm projection tubes for red, green and blue, which replaces the bulky cathode ray tubes (CRT) found in conventional TVs.

The new portable has reduced power consumption quite considerably—on a conventional 7in colour TV the power consumption is 36W on a.c. and 27W on d.c. while Matsushita's portable set uses only 12W. In addition to receiving regular broadcast programmes, it can be used as a portable display terminal for teletext and viewdata, and other video information services.

BBC CONTRACT

Setting their sights on the lucrative BBC Micro contract are several UK home computer companies. At the moment this franchise is held by Acorn but the contract is due for renewal in August, and UK manufacturers are already lining-up their armies for the expected battle.

Sinclair, Dragon Data, Oric and Camputers are preparing presentations to the BBC with either new machines or modified existing, "tried and tested" models. All the companies are reputed to have new computers due out early this year.

Sinclair Research has launched six new spelling and punctuation programs developed by Blackboard Software to entertain children and at the same time teach basic writing skills.

RADIO TELESWITCHING

The Electricity Supply industry in close collaboration with the British Broadcasting Corporation has developed a Radio Teleswitching system that offers economies in the use of electricity, especially for space heating and water heating. There are energy saving advantages for homes, offices and factories with this system, which uses the BBC Radio 4 (UK) low frequency (200Hz) transmitters to send coded signals to a small receiver fitted beside the electricity meter.

The radio signals activate switches and these, in turn, control the tariff metering of the electricity supply. The method designed by the BBC's Engineering Department adds information to radio broadcasts in a similar way that teletext is added to television.

The radio teleswitching receiver would take the place of the time clock used to control a two-rate meter.

Sales Counter

Ambit International have opened another sales counter for electronics, computing products and components, at Park Lane, Broxbourne, Hertfordshire.

Manager of the new sales facility is David Scott, who will be constantly available to offer advice to customers.

Exhibitionist

The 1984 "Scottish Computer Show" is to be staged in Glasgow, Holiday Inn & Albany Hotels, from 13 to 15 March 1984.

A major conference, alongside the exhibition, will provide the Scottish business community with information, expert advice and an opportunity for discussion across a wide spectrum of computer-related topics.

Four weeks after the announcement of the first Acorn Education Exhibition, the organisers, Computer Marketplace (Exhibitions) Ltd. have announced that the show is a complete sell out with a reserve list of 10 would-be exhibitors.

The exhibition is to be held at the Central Hall, Westminster, London, SW1, from 25–27 January 1984, and is specifically aimed at people directly involved with Acorn computers in education.

More than 1,200 companies will be represented at ELECTREX '84, the 22nd International Electrotechnical Exhibition, being held in the National Exhibition Centre, Birmingham, from 27 February to 2 March.

Devon County Council have placed an order with Plessey Radar for a *Watchman* surveillance radar system for Exeter Airport.

Digital Labels

Looking ahead to the increasing use of digital audio recording, the BBC, in close co-operation with Willi Studer A.G., has proposed a format for the inclusion of digital "labels" in such recordings.

The labels could carry a wealth of operational information such as: programme duration, serial number, time and date of origin and editing cues; together with technical information such as: audio word length, mono/stereo, signal compression characteristics and level and balance settings.

Also possible would be commercial data such as copyright details and perhaps keys for protection against unauthorised copying.

Does the general public have sufficient scientific and technological knowledge for the continued well-being of the UK? If not, how can people's understanding of science be increased?

These questions are being considered by an *ad hoc* group set up by the Council of the Royal Society, the leading scientific learned society in the UK.

Ladies' Day

The Japanese audio/television and domestic appliance giant Hitachi, has just announced that it is to sponsor the "1984 Ladies' British Open Golf Championship" at Woburn Golf and Country Club, Woburn Abbey, Beds.

The 72-hole event will commence on 3 October to 6 October, and will carry a prize fund of $200,000, with the winner receiving $30,000. It is hoped that all the top American tour women will be competing.

Announcing the sponsorship deal, Mr. K. Sugiyama, managing director Hitachi Sales (UK) said:

"Ladies' Golf represents an ideal opportunity for us at Hitachi to reach an increasingly important sector of our market—the woman. Women play a vital role in the purchase decision of many of our company's leading products, particularly televisions, portable audio products and obviously microwave ovens."

The Hitachi Ladies' British Open will be covered by BBC television.

AWARDS

Two engineers, Roy Harris and John Martin, who masterminded for British Telecom the early stages of the design and development of System X *have been awarded the coveted Martlesham Medal.*

The Martlesham Medal gives recognition to members of British Telecom, past or present, who have made an outstanding personal contribution to science and technology with a particular revelance to telecommunications.

An engineering paper "C-MAC—A high quality television service for DBS"—by IBA engineer, W. G. Stallard, has been selected for the "First Place Best Paper Award" of the 1983 International Conference on Consumer Electronics held in Chicago last June.

AUDIO VISUAL MARRIAGE

DESCRIBED as a "dramatic marriage between audio and video," Akai have introduced a new multifunction amplifier.

Known as the AV-U8, this compact slimline amplifier will fit into practically any normal stereo system rack. From there it will not only act as a conventional 22 + 22W stereo amplifier but will also bring the benefits of stereo sound to two video recorders, a video disc player and TV receiver or monitor.

While Akai video recorders use the popular VHS system, the dual-purpose amplifier will work equally well with Betamax or V2000, or any combination of units. A home computer can also be linked to the system provided it has a video output.

In announcing the new development, Andrew Low of Akai (UK) said:

"Tapes for VHS, Betamax or V2000 systems are not compatible and the AV-U8's ability to switch from one system to another will benefit many families who, separated by distance, are increasingly using video tapes to exchange greetings.

"It does not matter if a complete mixture of manufacturers' products are used. An Akai cassette deck, someone else's speakers, a different tuner or turntable, video recorder or compact disc—they are all the same to AV-U8."

In addition to controlling both audio and video systems, the new unit also incorporates its own 4in TV monitor. This enables the operator who may be watching another channel, or listening to stereo, to check that the programme being recorded is the one selected.

The AV-U8 audio/video amplifier is expected to retail at between £240 and £250, including VAT.

RADIO WORLD

BY PAT HAWKER G3VA

Radio Limitations

The objective of radio broadcasting is a simple one: to reproduce from the loudspeaker the sounds reaching the microphone(s) with as little change as possible. In practice, of course, the sounds emerging from the loudspeaker differ in many ways from those in the studio.

The very large number of amplifiers; the links between studio and transmitter; the transmitter itself; the radio path, and above all the typical radio receiver, reduce the signal-to-noise ratio, limit the dynamic range, restrict the audio-frequency and introduce many forms of non-linear distortion. The acoustics of the rooms in which we listen also introduce coloration, and then finally the listeners themselves differ greatly in their hearing.

Practical radio engineering often involves introducing changes in the audio signal both to limit interference between adjacent channel transmissions and to make the restrictions imposed by the system less noticeable. The dynamic range of most radio broadcasts is deliberately compressed, even on v.h.f./f.m., and processed in a variety of ways to increase the average modulation.

In Europe on medium- and long-waves all audio frequencies above about 5000Hz are filtered out. When this is done it is also desirable to reduce the very low bass frequencies.

This may seem severe but it should be remembered that for very many years the vast majority of medium-wave radio receivers have had an i.f. bandwidth that is about 6dB down at 5kHz or 6kHz, and a slope of about 5dB/kHz. With a normal double sideband a.m. signal this means that audio frequencies above about 3000Hz are increasingly attenuated, to a degree where even speech may sound muffled.

Tricks Of The Trade

One method of providing higher audio frequencies is deliberately to distort or "process" the broadcast audio signal so that the higher frequencies are emphasised. This is to counter the subsequent attenuation in the receiver. A number of clever ways of doing this have been developed such as "Optimod" and "Vocal Stresser" and such systems are now used in the UK on some BBC and ILR m.f. transmitters.

But audio processing can be carried too far. Some American broadcasters use systems that make their transmissions sound rather like the old-fashioned juke boxes. Lots of top and lots of bass but far from pleasing to the more critical listeners!

Even in the UK, the BBC keeps audio processing and compression on Radio 3 to a minimum. You can usually detect this by noting that the volume control often needs turning up a bit when you tune in.

Compatible Transmission

Another way in which the effect of the narrow i.f. response of receivers could be countered would be to use "compatible single sideband" (c.s.s.b.). That is to say, an s.s.b. transmission with almost full carrier and capable of being demodulated on a conventional envelope detector.

With such a transmission, by tuning to the side of carrier, virtually the full audio up to 5kHz can be received on a set having an i.f. bandwidth of only about 5kHz. Also, of course, since one sideband is largely suppressed, the mutual adjacent-channel interference between stations could be reduced.

In the early 1960s the American Leonard Kahn and also a Dutch Philips engineer, van Kessel, developed practical systems of c.s.s.b. In fact one of the American-owned transmitters in Germany, broadcasting to East Europe, used the Kahn system for some years.

However, as so often happens with new ideas, various committees considered c.s.s.b. for many months, finally suggesting that the small degree of quadrature distortion, that arises from not using synchronous detection to demodulate a single-sideband signal, made the system unacceptable for general use. Kahn now uses some of his c.s.s.b. techniques as the basis of his system of a.m.-stereo used by some American stations.

The idea of using c.s.s.b. on medium- and long-waves seems to have disappeared—more is the pity! Although s.s.b. with a slightly reduced carrier is still being considered for h.f. broadcasting, as a preliminary step towards pilot-carrier s.s.b. with a 12dB reduction of the carrier.

Both Kahn and van Kessel claimed that linear, non-linear and intermodulation distortion with c.s.s.b. need not differ significantly from what is currently experienced by most listeners to double-sideband a.m. broadcasts.

In-Flight Calls

A number of countries are now actively working toward cellular systems that put a telephone into a car with the vehicle connected to the public switched telephone network via short-distance 900MHz radio links under computer control. Multicom Airborne Telephone Service Inc of New York want to go one better and use cellular-radio technology to put telephones into aircraft flying over the United States for use by passengers.

They believe this could be done with 4MHz of radio spectrum and 30 ground stations. They have applied to FCC for an experimental service on the busy New York to Chicago route using two ground stations about 340 miles apart. Calls would be automatically handed on from one ground station to the next, with signals much less subject to multipath problems than for land-based mobile cellular systems.

The old problem of intelligibility of aeronautical radio became apparent once again in the tragic loss of Korean Airways flight 007. A transcript issued shortly after the plane had been shot down was later drastically amended.

People concerned with aeronautical radio admit that many of the messages are understood largely because they are in standard form and that problems can arise when non-routine or emergency messages are transmitted by or to traffic controllers who may not speak English very clearly. They also point out that the "live" communications are of better quality than might appear from the very slow-speed tape recordings made in the aircraft or on the ground.

Viva Valves!

The other day the technology correspondent of one of our national newspapers expressed great surprise when I told him that most listeners and viewers still receive their programmes courtesy of the thermionic devices in the output stages of high-power transmitters.

Like many others, he had assumed that we had long entered the era of all-solid-state and consigned thermionic valves to museums. In practice, the multicavity klystron, the travelling-wave-tube and even high-power tetrodes and triodes still play a vital role in space communications, broadcasting, radar and the like, although solid-state transmitters are now available for use up to v.h.f. at ratings up to about 10kW.

Well over 90 per cent of UK TV viewers depend on klystrons which, when all is said and done, are just another form of the traditional thermionic valve. Initially developed in the 1930s by the Varian brothers as a low-power microwave oscillator, this device was given a new lease of life with the coming of multicavity klystron amplifiers for radar in the 1960s.

Platforms in Space

To most of us the large *Intelsat* satellites that can carry 12,000 simultaneous telephone conversations across the oceans seem the last word in space technology. But not to Dr. Delbert Smith, an American lawyer and space communications expert.

In a London lecture to the Royal Television Society he forecast the early coming of enormous multi-purpose space platforms the size of two football pitches. These will, he believes, be built in low-space orbit using materials and equipment brought up in the cargo bays of re-usable manned launchers developed from the Space Shuttle.

When built, they would be shot into the geo-stationary orbit 22,300 miles above the equator as large unmanned telecommunications, television and radio complexes. Equipment would be repaired by sending up from space laboratories unmanned repair vehicles, utilising systems based on the developing robotics technology.

He believes that by AD2001 just six multi-purpose platforms could handle all continental and intercontinental telephone and data traffic and each beam down some 40 channels of television. But, as a lawyer, he forecast that many legal problems will arise. Many of the current regulations aimed at regulating TV across frontiers will, in his opinion, totally fail.

COMPUTER PROJECTS

PUBLISHED IN PREVIOUS ISSUES

APRIL 1982
2K RAM PACK FOR SINCLAIR ZX81
Also: Capacitance/Frequency Meter; Magnetic Lock; V.C.O. Sound Effects Unit; In-Car P.S.U.; Light Activated Switch.

JUNE 1982
KEYBOARD SOUNDER FOR SINCLAIR ZX81
Also: C.B. Power Supply; Nightlight; Seat Belt Reminder; Public Address System (pt 2); Egg Timer.

AUG/SEPT 1982
TEMPERATURE INTERFACE FOR TANDY TRS-80
Also: (Aug) C.B. Roger Bleeper; Two-Tone Doorbell; Quiz Master; Instrument Pre-Amp; Public Address System (pt 4). (Sept) Sound Splitter; C.B. Battery Charger; Screen Washer Delay; Monthly Planner; Continuity Tester.

OCTOBER 1982
EXPANSION SYSTEM FOR SINCLAIR ZX81
Also: Sine Wave Generator; General Purpose Pre-Amp; Optical Tachometer; Lights On Alert; Simple S.W. Radio.

NOVEMBER 1982
TAPE CONTROLLER FOR SINCLAIR ZX81 AND SPECTRUM
Also: Combination Lock; Digital Metronome; Oscilloscope Companion; Photo Finish; Beat The Relay.

DECEMBER 1982
EXTRA RAM FOR SINCLAIR ZX81
Also: Security Vari-Light; Car Indicator Alarm; Velocity Measurer; Electric V/I Meter; 5V Regulated Supply.

JANUARY 1983
A TO D CONVERTER FOR PET
Also: Personal LS Amplifier; Coulomb Meter; Opto Repeater; Double Dice.

FEBRUARY 1983
SPEED COMPUTING SYSTEM FOR SINCLAIR ZX81
Also: Pushbike/Motorbike Alarm; Beehive Temperature Meter; Short Interval Timer; Speech Processor.

FEB/MARCH 1983
EPROM PROGRAMMER FOR ACORN ATOM
Also: (March) Multi-Station Intercom; Car Thermometer; Buzz Off!; Dual Power Supply.

MARCH/APRIL 1983
EXPANDED ADD-ON KEYBOARD FOR SINCLAIR ZX81

APRIL 1983
AMPLIFIER FOR SINCLAIR SPECTRUM
Also: (April) Function Generator; Novelty Egg Timer; Flanger Sound Effect; Neon Nightlight; Car Radio Booster.

MAY 1983
REAL-TIME CLOCK FOR APPLE II and BBC MICRO
TEMPERATURE SENSOR FOR PET and VIC 20
Also: Guitar Headphone Amplifier; MW Personal Radio; Laboratory Amplifier; Model Train Controller; Moisture Detector.

JUNE 1983
EPROM PROGRAMMER FOR TRS-80 and GENIE
Also: Push Button Combination Lock; Caravan Power Supply; Caravan Fridge Alarm; Transistor Tester; Envelope Shaper for Bass Guitar.

JULY 1983
USER PORT INPUT/OUTPUT BOARD
USER PORT CONTROL BOARD
Also: Automatic Greenhouse Watering System; Digi Alarm Wristwatch Amplifier; Tri Boost Guitar Tone Controller; Binary Bandit Game; Pulse Generator.

AUGUST 1983
STORAGE 'SCOPE INTERFACE FOR BBC MICRO—HIGH POWER INTERFACE BOARD—PEDESTRIAN CROSSING SIMULATION BOARD
Also: Electronic Die; Home Systems Monitor; Car Intruder Alarm; 1kW Mains Power Controller.

SEPTEMBER 1983
A-TO-D CONVERTER FOR RM380Z COMPUTER—COMPUTER AIDED EXPERIMENTS—HIGH SPEED ANALOGUE-TO-DIGITAL CONVERTER—SIGNAL CONDITIONING AMPLIFIER
Also: Stylus Organ; Distress Beacon; Traffic Light Simulator; Voltage Dualiser.

OCTOBER 1983
DIGITAL-TO-ANALOGUE BOARD—HIGH POWER DAC DRIVER BOARD—COMPUTER AIDED EXPERIMENTS—TEMPERATURE TRANSDUCER AMPLIFIER—ELECTRONIC PENDULUM
Also: Home Intercom; Immersion Heater Tell-Tale; Model Car "Petrol Tank"; Short Wave Radio.

NOVEMBER 1983
SPEECH SYNTHESISER FOR THE BBC MICRO—TTL/POWER INTERFACE FOR STEPPER MOTOR—STEPPER MOTOR MANUAL CONTROLLER—COMPUTER AIDED EXPERIMENTS
Also: Multimod; Long Range Camera/Flash Gun Trigger; Digital Gauss Meter; Car On/Off Touch Switch.

DECEMBER 1983
TRS-80 TWIN CASSETTE INTERFACE—ENVIRONMENTAL DATA RECORDER—4-CHANNEL HIGH SPEED ADC
Also: Children's Disco Lights; Magic Candle; Novel Egg-Timer; Continuity Tester; Touch Operated Die.

JANUARY 1984
BIOLOGICAL AMPLIFIER—TEMPERATURE MEASUREMENT AND CONTROL SYSTEM FOR ZX COMPUTERS—COMPUTER AIDED EXPERIMENTS
Also: 4-Channel Gas and Smoke Sentinel; Games Scoreboard; Central Heating Pump Delay; Guitar Tuner.

All the above are fully illustrated, detailed constructional articles. Back numbers £1.00 (inclusive of p&p) per copy currently available from: Post Sales, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.

Stocks of back issues are limited. In the event of non-availability a photocopy of the relevant article will be supplied. Please enclose appropriate remittance and specify month of issue and title of article required.

EVERYDAY ELECTRONICS and computer PROJECTS

Published approximately the third Friday of each month by IPC Magazines Ltd., Kings Reach Tower, Stamford St., London SE1 9LS. Printed in England by Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Subscriptions: Inland £12.00, Overseas £13.00 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.

MICROCOMPUTER INTERFACING TECHNIQUES

INCLUDING MANY USEFUL CONSTRUCTIONAL PROJECTS

PART EIGHT: DIRECT BUS INTERFACING

BY J. ADAMS B.Sc., M.Sc. & G. M. FEATHER B.Sc.

THE User Port, derived from an internal VIA, has been used exclusively throughout this series as a means of communicating with the outside world.

In this article the expansion port, provided on various microcomputers, will be explored as another method of external communication. The next part of this series will include detailed descriptions of how the expansion port provided on the VIC-20, Commodore 64, PET and BBC machines may be used to control and read data from external devices. The constructional project this month however, is designed specifically to provide an external VIA to another 6502 based microcomputer—the Oric 1—which does not already possess one.

Readers will be aware that the techniques discussed can also provide such a facility for those machines already in possession of a VIA: this allows the addition of extra bi-directional ports to their microcomputer system.

The function of a microprocessor is to receive data from an input device, process this data and output new data to an output device. This is achieved by communication with other components in the microcomputer system using a network of communication paths called buses.

THE DATA BUS

The eight parallel electrical conductors, or lines, which together constitute the bi-directional data bus (D7–D0), allow an 8-bit binary number to be sent to, or retrieved from, a specified location.

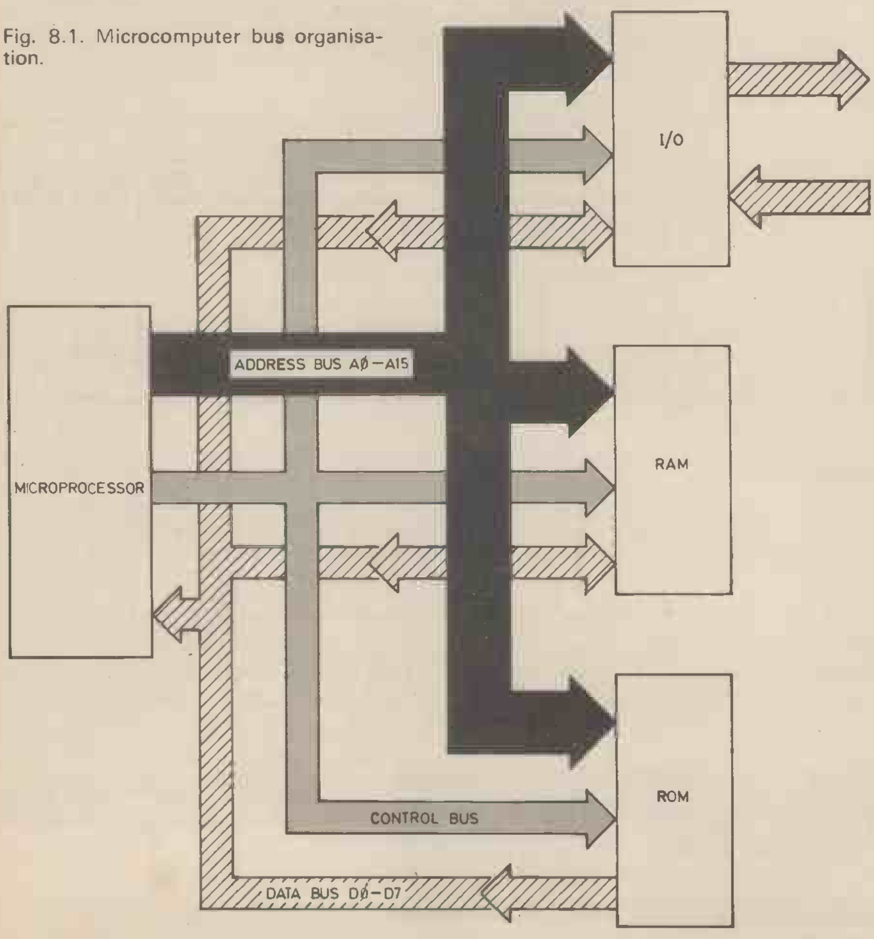


Fig. 8.1. Microcomputer bus organisation.

THE ADDRESS BUS

The sixteen parallel lines of the address bus (A15–A0) carry an output binary pattern, or address, which is unique insofar as it allows the selection of a single device which, in most cases, is a specific memory location corresponding to that device. The address can specify the source or destination of the data on the data bus.

THE CONTROL BUS

It is essential that the microprocessor should be able to control the direction of data transfer on the bi-directional data bus. This is achieved by using an output line on the control bus called the $R/\overline{W}$ (READ/WRITE) line. All data transfers will be into the microprocessor (READ) when this line is high, whereas data transfer from the microprocessor (WRITE) occurs when this line is low.

Other control lines on the control bus include clock signals and interrupt lines.

These buses and their links with the microprocessor and other devices, which constitute the address space of the microcomputer system, are illustrated diagrammatically in Fig. 8.1.

DEVICE SELECTION

As each of the sixteen lines on the address bus is limited to one of two levels (logic high or logic low) it is possible to access any one, up to a total of 2^{16} (65536) separate devices.

It is, of course, essential that a device occupying a location in the address space of the microprocessor should be able to recognise the fact that it has been addressed. This is achieved by enabling the device when the microprocessor places the appropriate address on the bus.

ADDRESS DECODING

The process of activating a particular device when its address appears on the bus is called decoding. This process is in many ways analogous to making a telephone call to a particular subscriber.

The dialled number will activate one and only one telephone receiver. In the same way a particular address placed on the address bus by the microprocessor will activate one and only one device connected to the bus.

A decoding circuit is simply a set of simple logic gates added to the bus capable of recognising a unique code when it appears and producing a corresponding output signal.

A simple 2-line decoder can be made using a 2-input AND gate (for example, a 7408). The truth table, Fig. 8.2, illustrates how the output signal becomes logic high only when each input line is logic high.

In practice, decoding circuits produce an output signal which is deemed "active low". This means that the device becomes activated by a logic low if the correct code appears at the inputs of the decoder.

A simple 2-line decoder which accomplishes this can be made using a 2-input NAND gate (for example, a 7400) as shown in Fig. 8.3. Note how the output signal now becomes logic low only when the input line is logic high.

THE 3-TO-8 DECODER

Fig. 8.4 illustrates how a single integrated circuit may be used to select 2^3 separate devices by connecting the three address lines A2 to AØ to a 74S138 decoder. It should be noted that the transient nature of the signals placed by the microprocessor on the address bus and appearing at the inputs of the decoder will result in a short duration negative-going device select pulse as shown.

LATCHING

If data is to be outputted to an external port to control external devices, then some arrangement must be made for holding the information presented briefly on the data bus. Such a technique is called latching and various integrated circuits can provide this facility.

Most are derivatives of the standard S-R (set/reset) flip-flop. On receipt of new data from the data bus, the outputs of the flip-flops are reset and then set to the new values representing the data.

Useful devices include the 74LS100 octal bistable latch and the 74LS273 octal D-type flip-flop.

DATA BUS INPUTS

If the microcomputer is to be used to read digital data via its expansion port, then the device supplying the data must be effectively disconnected from the data bus at all times other than those at which a read operation is in process.

Input buffers use tri-state technology to achieve this. A typical device is the 74LS244, which is shown in Fig. 8.5.

Eight non-inverting buffers are included, the tri-state action being controlled by gate pins 1 and 19. When these latter pins are at logic 0, the buffer outputs (which would be connected to the data bus) assume the same logic levels as their inputs, thus the data is transferred to the data bus. When the gate pins assume a logic 1 level, the buffer outputs assume a high impedance state and are thus effectively disconnected from the bus.

The tri-state gating signal can be derived from the address decoding circuitry.

A USER PORT FOR THE ORIC-1 MICROCOMPUTER

The 16K and 48K Oric-1 machines are deservedly quite popular. However, although the Oric 1 does possess an internal VIA it is tied up with keyboard and printer port operations and hence cannot be used for the interfacing experiments and projects described in this series. In order to allow the provision of a user port it is necessary to add an external VIA to the machine.

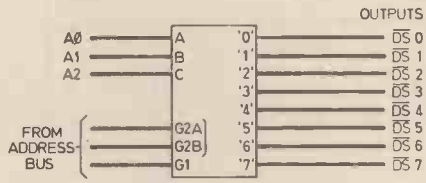


Fig. 8.4. Low device select (DS) line controlled by AØ, A1, A32 address. Device select signals G1 and G2 are also derived from address bus.

INPUTS					OUTPUTS							
G1	$\overline{G2}$	A	B	C	$\overline{DSØ}$	$\overline{DS1}$	$\overline{DS2}$	$\overline{DS3}$	$\overline{DS4}$	$\overline{DS5}$	$\overline{DS6}$	$\overline{DS7}$
1	0	0	0	0	0	1	1	1	1	1	1	1
1	0	0	0	1	1	0	1	1	1	1	1	1
1	0	0	1	0	1	1	0	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1	1	1
1	0	1	0	0	1	1	1	1	0	1	1	1
1	0	1	0	1	1	1	1	1	1	0	1	1
1	0	1	1	0	1	1	1	1	1	1	0	1
1	0	1	1	1	1	1	1	1	1	1	1	0

NB: G2 = G2A + G2B

INPUTS		OUTPUT
AØ	A1	DS
0	0	0
0	1	0
1	0	0
1	1	1

Fig. 8.2. 2-input NAND gate symbol and truth table. Device select high when 2-bit address 11 appears.

INPUTS		OUTPUT
A_0	A_1	DS
0	0	1
0	1	1
1	0	1
1	1	0

Fig. 8.3. 2-input NAND gate symbol and truth table. Device select low when 2-bit address 11 appears.

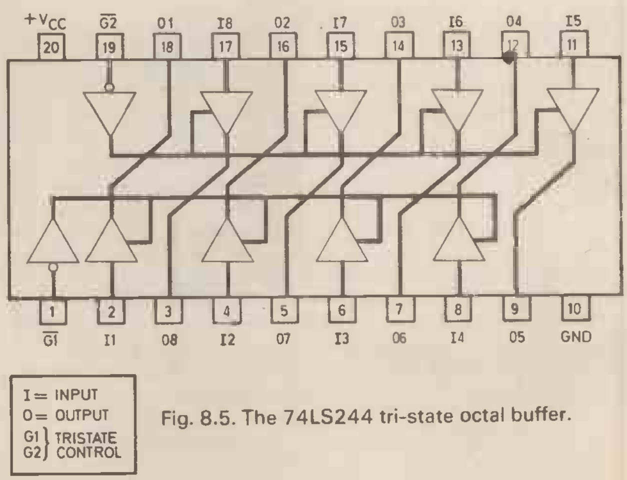
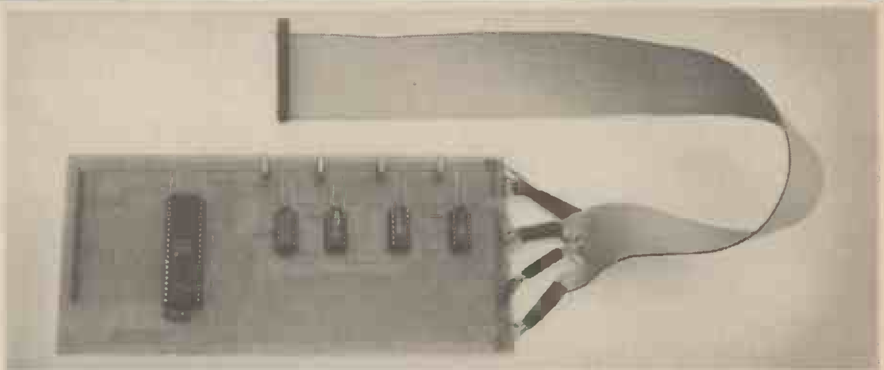


Fig. 8.5. The 74LS244 tri-state octal buffer.

ORIC PORT BOARD



CIRCUIT DESCRIPTION

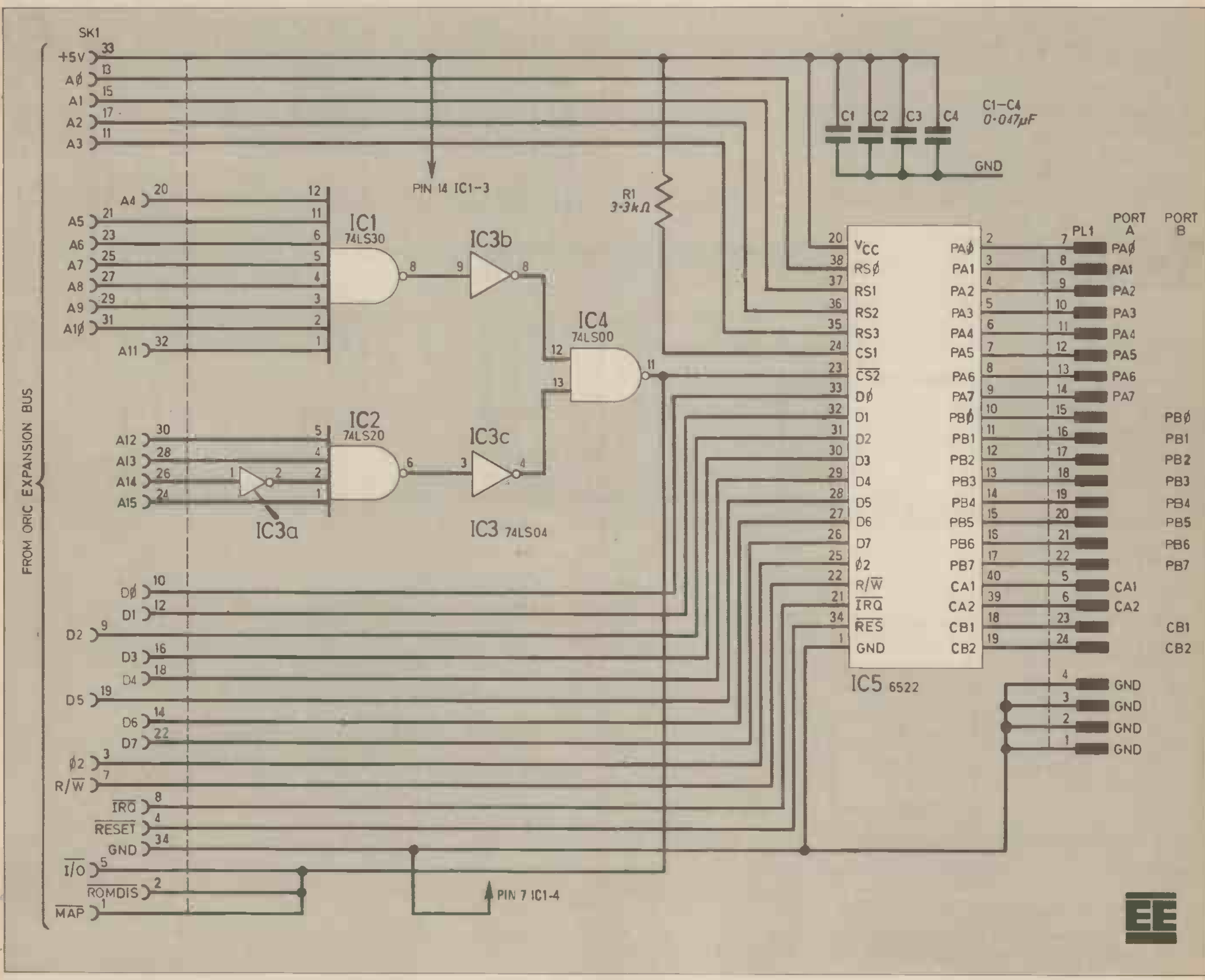
Fig. 8.6 shows the circuit diagram of an arrangement in which a 6522 VIA is interfaced to the Oric by the expansion bus.

The owner manual indicates that there are unused memory locations provided for I/O from 49120 to 49151, inclusive. It is thus possible to locate the VIA somewhere in this available address space. The decoding circuit utilises the techniques so far discussed and places the VIA in the contiguous memory locations 49136 to 49151.

A device enable pulse is generated by the decoding circuitry, IC1, IC2 and one of the inverters of IC3, when the binary pattern 1011 1111 1111 appears on the address bus lines A15 to A4, inclusive.

IC1, a 74LS30 8-input NAND gate, gives an active low output when address

Fig. 8.6. Circuit diagram for the Oric Expansion Port Interface.



lines A11 to A4 are high. Lines A15 to A12 are applied to the inputs of IC2, a 74LS20 NAND gate, line A14 being routed via an inverter to give a logic 1 input to the NAND gate when the line is, in fact, low.

The active low outputs of the two gates are inverted and applied to the inputs of the NAND gate, IC4 (which is one quarter 74LS00 quad NAND). This NANDs the two active high signals present at its inputs when the address is "true" and provides the active low chip enable pulse for the 6522.

The 6522 has, in fact, two device select pins CS1 and $\overline{CS2}$, at pins 24 and 23, respectively. $\overline{CS2}$ accepts the enable pulse from the decoding circuitry whilst, in this application, CS1 is tied to logic 1 by R1.

Lines A3 to A∅ are decoded internally by the 6522 to select one of the appropriate internal registers of the VIA.

CONTROL BUS SIGNALS

The necessary control bus signals R/$\overline{W}$, Reset (which is used to initiate the microprocessor on power up), and $\overline{IRQ}$ (the interrupt request line) are taken directly to the appropriate pins on the 6522. Data is clocked into and out of the VIA by another control signal, the phase 2 clock (θ2), from the 6502.

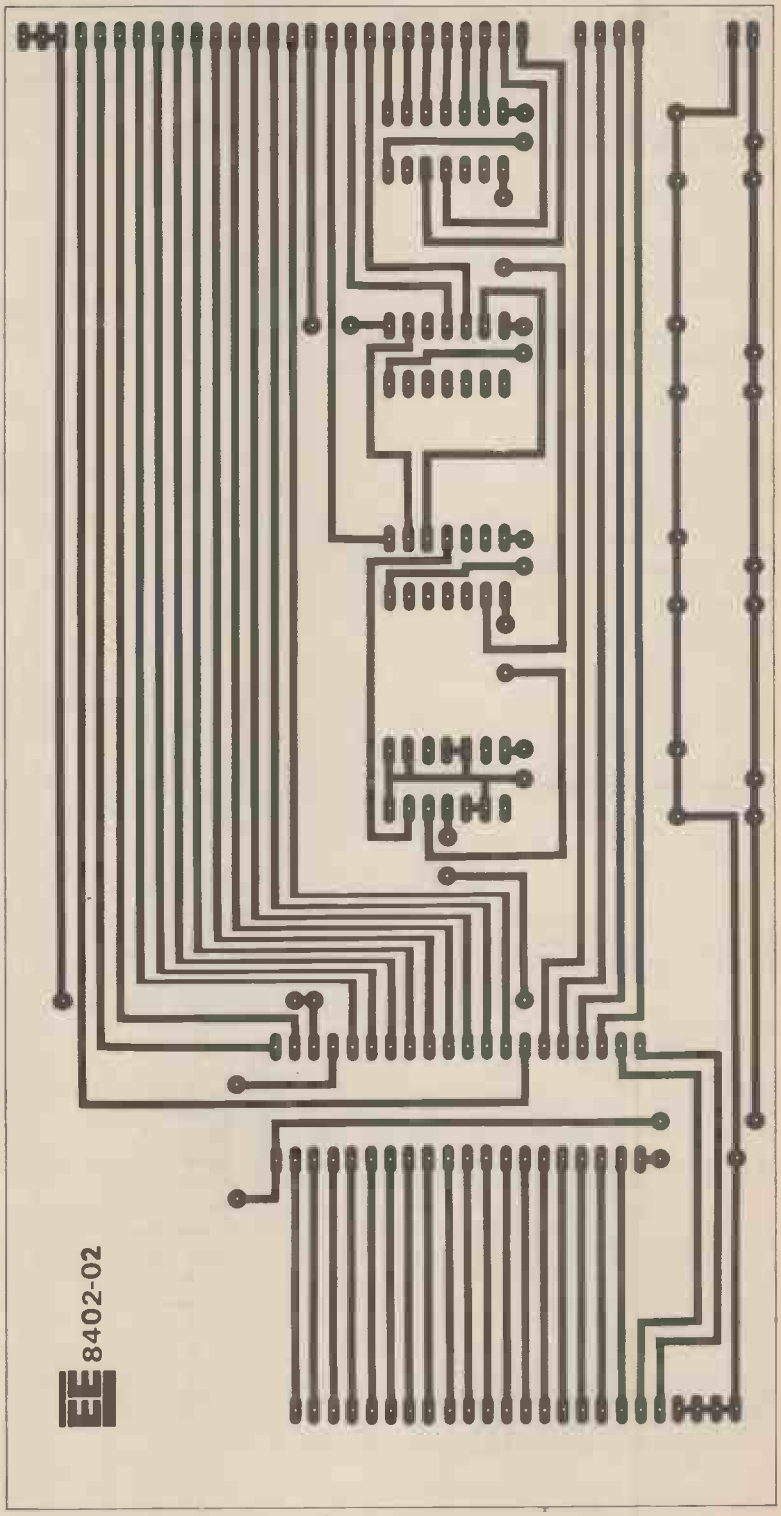
The eight data bus lines, D7 to D∅, are routed directly from the 6522 to the appropriate data bus pins on the expansion bus socket.

A slight difficulty arises when the microprocessor is reading data from the 6522 if RAM happens to be present at these address locations as is the case with the Oric 1 (48K). Fortunately, this situation can be prevented since the internal RAM can be effectively disconnected from the data bus by taking the pins labelled MAP, ROMDIS and I/O control low during a read operation. The 6522 $\overline{CS2}$ signal obtained from the A15 to A4 address decoder is used for this purpose.

All input/output lines of the 6522 are available to the user, including the edge-sensitive inputs CA1 and CB1.

The +5V supply for the circuit is derived from the Oric expansion port.

Fig. 8.7. Master p.c.b. pattern for the Oric Port Board shown actual size. This board is available from the *EE PCB Service*, Order code 8402-02.



COMPONENTS

See Shop Talk page 87

Resistor
- R1 3·3kΩ ¼W carbon ±5%

Capacitors
- C1–4 0·047μF polyester type C280 (4 off)

Semiconductors
- IC1 74LS30 low power Schottky TTL 8-input NAND gate
- IC2 74LS20 low power Schottky TTL dual 4-input NAND gate
- IC3 74LS04 low power Schottky TTL hex inverting buffers
- IC4 74LS00 low power Schottky TTL quad 2-input NAND gate
- IC5 6522 versatile interface adaptor

Miscellaneous
- PL1 24-way inter-p.c.b. straight plug (see text)
- SK1 34-way i.d.c. cable mounting socket

Printed circuit board: size 203 x 95mm, *EE PCB Service*, Order code 8402-02; 14-pin d.i.l. i.c. socket (4 off); 40-pin d.i.l. i.c. socket; 22 s.w.g. tinned copper wire; 34-way i.d.c. ribbon cable.

Approx. cost Guidance only **£18**

Fig. 8.8. Pin numbering of the Oric Expansion socket.

Fig. 8.9. Layout of the components on the topside of the p.c.b.

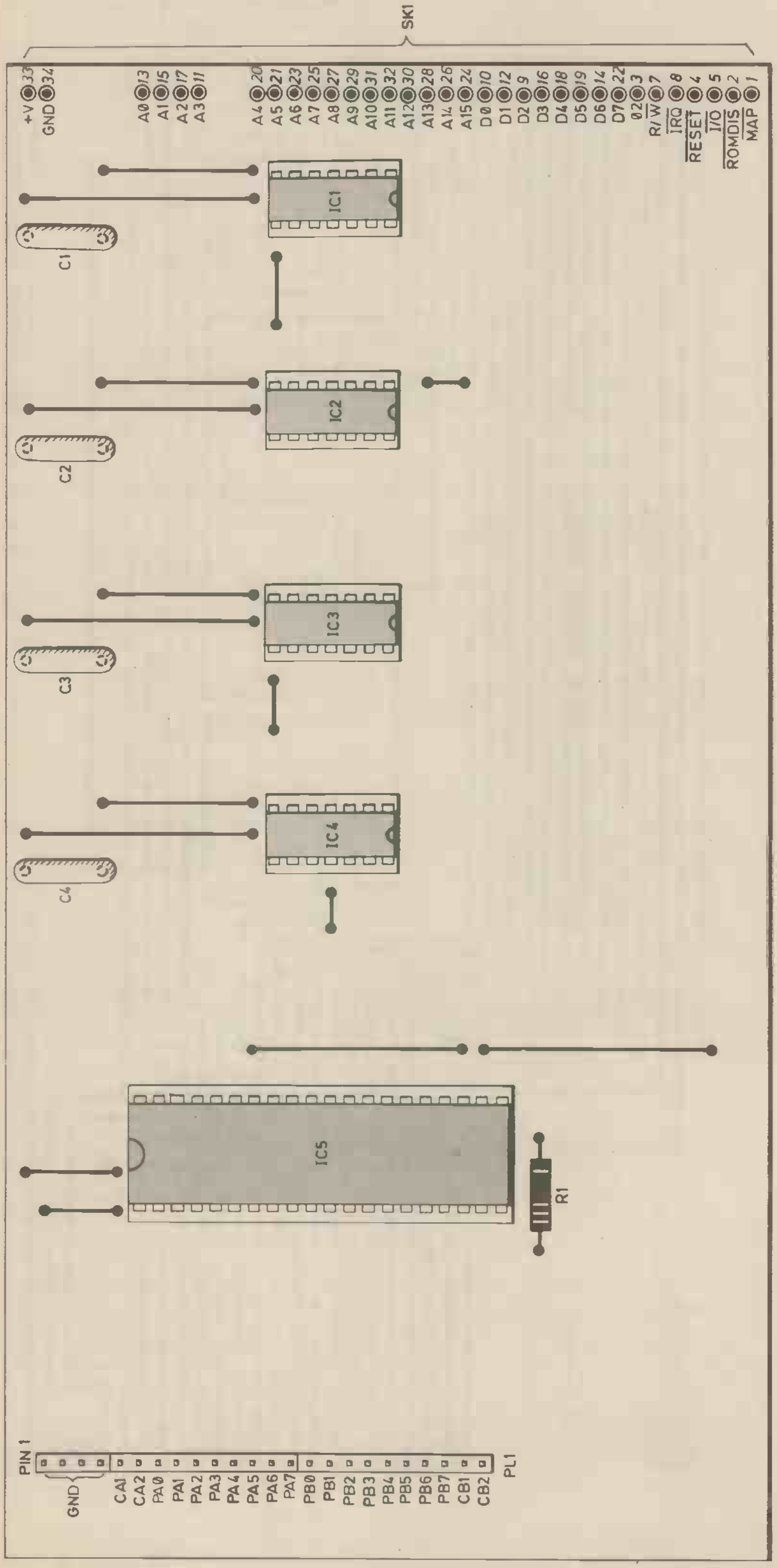


Table 8.1. Identification of the Oric Expansion Port Connector

Pin No.	Signal	Pin No.	Signal
1	MAP	18	D4
2	ROMDIS	19	D5
3	Ø2	20	A4
4	RESET	21	A5
5	I/O	22	D7
6	I/O CONTROL	23	A6
7	R/W	24	A15
8	IRQ	25	A7
9	D2	26	A14
10	DØ	27	A8
11	A3	28	A13
12	D1	29	A9
13	AØ	30	A12
14	D6	31	A1Ø
15	A1	32	A11
16	D3	33	+5V
17	A2	34	GND

It is essential that low power Schottky TTL devices (LS types) are used for IC1 to IC4.

Fig. 8.7 shows a rear view of the Oric and in particular the Expansion Port. Table 8.1 identifies the 34 signal lines.

ASSEMBLY

All the components are assembled on a printed circuit board. The actual-size master pattern for this p.c.b. is shown in Fig. 8.8. This board is available from the *EE PCB Service*, Order code 8402-02 The components are mounted on the topside of the board as shown in Fig. 8.9.

Begin by soldering in the preformed link wires (16 in all) followed by the five i.c. sockets.

PL1 is a 24-way p.c.b. mounted plug. This has been made up from standard sizes—two 10-way types and one 4-way. Fit and solder these plugs to the p.c.b.

The expansion bus on the Oric is accessible via a 34-way plug fitted to the rear of the computer as shown in Fig. 8.8. Fit the mating i.d.c. socket to a length of 34-way i.d.c. ribbon cable. Strip and tin all the free ends of this cable and solder to the p.c.b. as shown in Fig. 8.9.

Finally, solder in place the four capacitors. Fit four or six self-adhesive rubber feet to the p.c.b. underside to complete the unit.

SOFTWARE

Software detailing how the 6522 VIA may be used with external I/O devices has been covered in earlier articles in this series. The sixteen internal registers in the external VIA for the Oric 1 are situated between 49136 and 49151 (decimal).

Some appropriate registers, together with their memory locations, are:

Parallel Port B	49136
Parallel Port A	49137
Data Direction Register for Port B	49138
Data Direction Register for Port A	49139
Peripheral Control Register	49148
Interrupt Flag Register	49149

To be continued: Direct Bus Interfacing for BBC and Commodore computers.

CIRCUIT EXCHANGE

NOVEL SOUND-TO-LIGHT

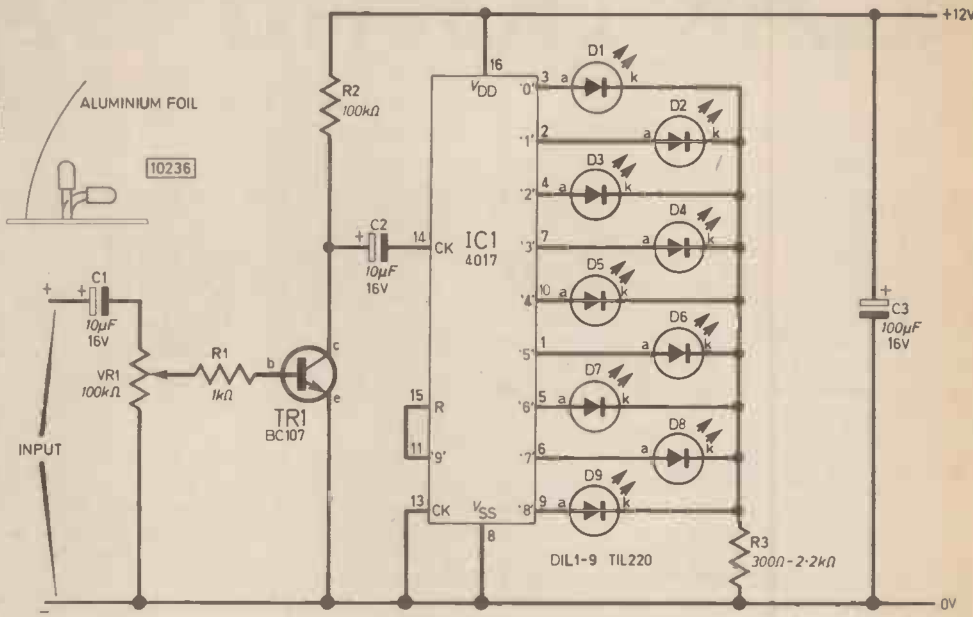
I HAVE designed this circuit to fill the gap between a simple one-transistor sound-to-light and a unit using filters and mains lamps.

The effect of the sound reaching the input is to trigger IC1 to count on one. This means that when the music gets louder the l.e.d.s move faster.

If you wish to use fewer l.e.d.s, a wire link should be taken from where the next l.e.d. would have gone to the reset, pin 15.

If two l.e.d.s are put in parallel, the second one can be pointed towards the viewer for added effect as shown in the diagram.

Jeremy Kendall,
Chelmsford,
Essex.



COUNTER INTELLIGENCE

BY PAUL YOUNG

Out of Order

There is one problem that, in all my years of retailing, I have never successfully solved. If you run a Mail Order Service, and a customer orders a certain semiconductor device or similar component, should you send him the exact equivalent if you haven't got the original?

The difficulty is this, if you send the equivalent some customers will be delighted, others will be furious, and you cannot send it without a word of explanation. I can take the easy way out, and write on the order, "Out of Stock", or I can write saying that I have an exact equivalent and will be pleased to send it if required.

One customer will reply and say, why on earth didn't you send it, and the next will write to say he doesn't want it. I remember an instance a few years ago, when the late and much missed Frank Rayer, designed at my suggestion a Soldering Iron Heat Control. Unfortunately on the list of components required, two digits on the thyristor type number were transposed, it may have been my fault, and consequently a spate of letters from disgruntled customers followed, saying that they had been sent the wrong component. This necessitated a letter of explanation to each one, and I know some of my colleagues will agree with me when I say none of us enjoy letter writing.

All Charged Up

I wonder how many of our readers were caught out with flat car batteries during the recent sudden snap of cold weather? With a manual gear box it is always possible to push your car, but if you have an automatic you are in real trouble.

Most of us carry a pair of heavy duty leads to enable us to jump start from someone else's battery. All the same it occurred to me it would be much safer to always have a spare battery to hand.

The question is, how do you make sure that your spare battery is always on the top line? If it is left either fully charged, or uncharged, it will deteriorate fairly rapidly.

I called on a gentleman who has been making car batteries for over thirty years, and here are his words of wisdom. First of all fully charge the battery. He suggests charging at 3 to 4 amps for at least 24 hours. After 28 days fully discharge the battery at about 2 to 3 amps. This could be done with a heavy duty resistor about 6 ohms at 25W should suffice. If this is difficult to locate, a 36W car bulb will serve the same purpose.

Having a poor memory, my next requirement is a time switch. After 28 days it must switch off the charger and connect the lamp or resistor, and then after the battery is discharged it must reverse the process. If a lamp was used the reversal process could be initiated from the light source.

Can any of our readers make suggestions how to accomplish this. The 28-day time switch is the stumbling block.

Vital Statistics

The other night I was relaxing in my armchair, trying to forget all about components and computers when suddenly on the box, up came the "Miss World Competition". Deciding it might improve my knowledge, and perhaps I should find out what these mysterious figures called: "Vital Statistics" really are, I forced myself to continue watching.

Imagine my dismay, when, just before they paraded in their swimsuits, Peter Marshall said: "To help the judges decide, all the figures (digital of course) are going to be fed into a computer and as each girl appears, her score will be shown at the bottom of the screen".

The numerical results seemed to me to be quite meaningless varying from one to twenty-six. After all, I've always maintained there is very little to choose between any of these lovely young ladies, an inch here or an inch there.

Walter Mitty Young was of course busy imagining how much better job he could make of it with a tape measure, but I suppose after being fed with an endless succession of 36–24–36's the computer was about red hot, and didn't care what results it put out. I mention all this, because I know most of our readers are far too serious minded to waste their time on such frivolous things as watching Miss World.

However, I must conclude with a warning note. In case you are not familiar with the strange reasoning processes of the fair sex, don't under any circumstances say to the girl of your dreams: "I am not sure if you are really beautiful, I will have to feed the essential figures into my computer first". You will not only, not get the bird, you will be given the bird and your Acorn wrapped round your neck for good measure.

Under these circumstances, you can only say, as Sir Phillip Sydney said to Good Queen Bess, after incurring her wrath,

> *"Thy most kissworthy face,*
> *Anger invests with such a lovely grace."*

and hope for the best.

CAR LIGHTS WARNING

BY A. BURDETT

Most drivers have experienced the frustration some time or another of parking their car for the day and coming back in the evening to find that they have accidentally left their lights on. The result, with modern small batteries, is often that they have discharged too much to start the engine. At the end of a long day, the last thing one wants to cope with is a flat battery!

It is very easy to forget to switch off the side and tail lights and on a bright day, equally easy to walk away from the car without noticing either that the dashboard warning light, or the car lights, are on. This danger is increased on those cars that have lights controlled by a joystick switch on the steering column which only needs a very light touch with the knee to switch the lights on unintentionally.

Such accidents, occurring several times last year, prompted the writer to design and construct the simple device described here. It has the advantage of being very easy to build, robust to stand the vibration it will get, and it requires no alteration to the wiring of the car, bodywork drilling, or attachment of sensors. It is designed for the normal 12-volt system. (Subsequent checks have shown that it will operate on 6 volts with only a small reduction in sound level.)

THE CIRCUIT

Fig. 1 shows the circuit, which utilises two *npn* transistors connected in the grounded emitter mode to control a piezo-electric buzzer. Two BC 107s were used in the prototype because they were handy on the bench and from another job, the resistor values necessary to make them switch as logic NOR gates, which is what they are in effect doing in this application, had already been derived.

There are three internal connections:

The lead marked "Lights" is connected to the output side of the switch which controls the side and tail lights.

The lead marked "Ignition" is connected to the output side of the ignition switch.

The lead marked "0V" is connected to the negative side of the car system. This is usually also earth but in some cars with a positive earth system, this is not so. This should be checked for the car to which it is intended to fit the device.

OPERATION

When the car lights are switched off, nothing happens as the whole circuit is de-energised. If the ignition is on and also the lights, the base of TR1 is held at about 4 volts positive through the potential divider R1, R2 and this is sufficient to cause it to conduct. The collector voltage comes down to practically zero, and this is applied to the base of TR2 which stops it conducting and the buzzer will not sound.

In this condition, the device will put a negligible load on the car battery of about 4 milliamps.

If the ignition is switched off and the lights are left on, the signal on TR1 falls to about zero and TR1 will cease to conduct. The base voltage of TR2 is now set by the potential divider chain R3, R4, R5 at about 3·8 volts which allows TR2 to conduct sufficient current for buzzer WD1 to sound. Switching the car lights off, of course, stops it.

COMPONENTS

CAR LIGHTS WARNING DEVICE

See Shop Talk page 87

Resistors

R1	82kΩ
R2	39kΩ
R3	3·3kΩ
R4	82kΩ
R5	39kΩ

All ¼W carbon film ±5%

Semiconductors

TR1,2	BC107 *npn* silicon (2 off)
WD1	12V piezo-electric buzzer

Stripboard 0·1in matrix, 16 strips by 22 holes.

ADDITIONAL COMPONENTS FOR FIG. 3 VERSION

Resistors

R6	82kΩ
R7	82kΩ
R8	39kΩ
R9	3·3kΩ
R10	82kΩ
R11	39kΩ
R12	3·3kΩ
R13	82kΩ
S1	panel mounted push-button switch, one pair normally open contacts

Stripboard of suitable size.

Approx. cost Guidance only £3

Fig. 1. Circuit of Car Lights Warning Device.

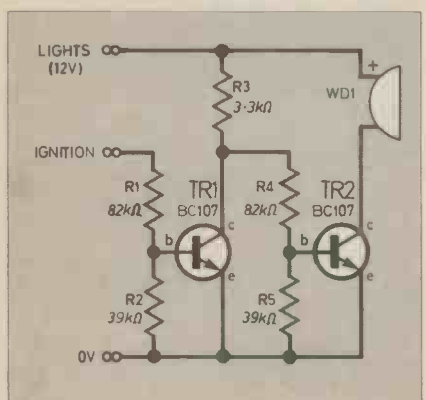
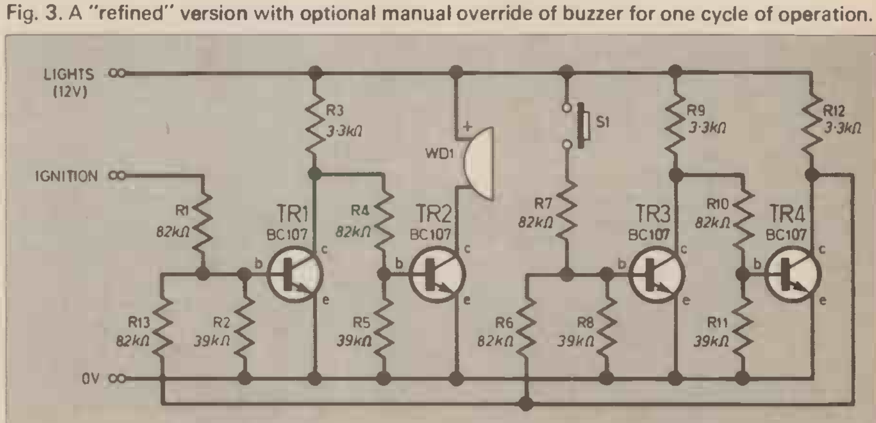


Fig. 3. A "refined" version with optional manual override of buzzer for one cycle of operation.



CIRCUIT BOARD

The device is built upon a piece of 0·1in pitch Veroboard fitted with the necessary links, which can be made with bare 22 s.w.g. tinned copper wire or similar, as shown in Fig. 2. The places where the track needs cutting on the opposite side of the board are indicated in Fig. 2, also the three flying leads to connect into the car wiring.

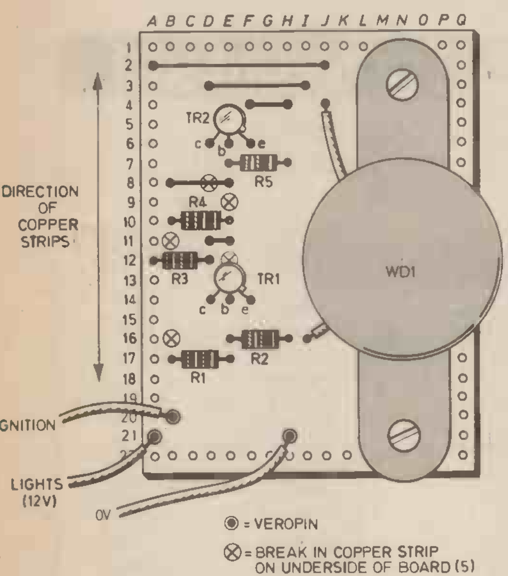


Fig. 2. Component layout. Note breaks in copper strips on underside, and link wires to be fitted to top of board.

INSTALLATION

The positioning of the device in the car is largely a matter for the constructor's inclination and the layout of his or her car. In the car in which the prototype was to be fitted, all the wiring for the ignition and lights comes up the steering column. The simplest way to install it in this case was to wrap it in insulating tape, make the necessary connections and allow it to lay in the wiring harness, held securely in place by the wiring cover.

A POSSIBLE REFINEMENT

A refinement which has not been added to the prototype yet but which has been successfully bench tested allows the buzzer to be switched off when parking in places where it is necessary to leave the lights on. The circuit is shown in Fig. 3 and requires the addition of two more transistors, eight extra resistors and a push-button with one normally open contact.

Operating the push-button inhibits the buzzer but when the lights are switched off, the whole circuit resets. The alternative of simply inserting a switch in the buzzer supply has the big disadvantage that the switch would tend to be left in the off position and defeat the whole idea of the device.

On switching on the ignition and lights, TR3 is biased to cut off and the base of TR4 is held at about 3·8 volts via R9, R10, R11. In this state TR4 conducts and its collector is at about zero volts. Thus there is no feedback signal to TR1 and TR1 and TR2 operate exactly as in Fig. 1.

If the ignition is switched off, leaving the lights switched on, the buzzer will sound as before. If push-button S1 is then pressed momentarily, it will send the base of TR3 high. TR3 then conducts and pulls the base of TR4 down to near zero. TR4 cuts off and as its collector voltage rises, it applies a signal to TR1 via R13, and to TR3 via R6.

The signal to TR1 serves to replace that previously supplied from the ignition switch, causes TR1 and TR2 to change state again, and the buzzer stops.

The voltage simultaneously applied to TR3 acts as a latching signal to retain TR3 and TR4 in the same state when PB is released. Thus the signal is maintained on TR1 and the buzzer stays silent.

When the lights are switched off, the circuit resets.

With this "improved" version, the drain on the car battery is about double that of the simpler circuit as two transistors are conducting at any one time, but it then only amounts to about 8 milliamps which is still low enough to have no practical effect for the relatively short periods when it will occur. □

CIRCUIT EXCHANGE

SOIL MOISTURE MONITOR

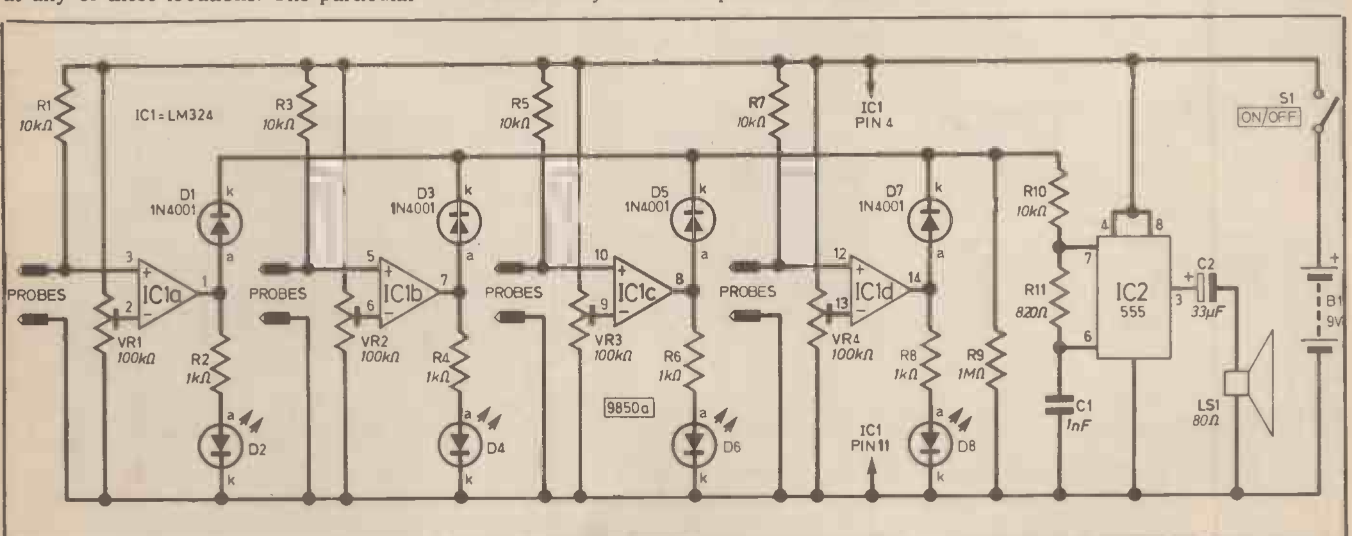
The circuit to be described can be used to monitor soil moisture level at four different locations simultaneously. An alarm is sounded when watering is needed at any of these locations. The particular location will be indicated by an illuminated l.e.d.

Only two i.c.s are used. IC1 is a quad op-amp. Each op-amp is used as a sensing circuit and the l.e.d. at the output of each would be lit up if their probes are in a comparatively dry soil. The moisture levels for each probe can be controlled individually by setting the presets VR1 to VR4.

Each probe is made from a pair of thick wires or rods about 12cm long. Their mutual separation should be about 1·5cm. They must be parallel to each other, with their upper ends fixed to some non-conducting board of suitable size. The probes should be tinned (if possible) to prevent corroding. Screened cable should be used for connecting each probe to the unit.

When any of the probes "feel" that the soil is becoming drier than the preset level, the corresponding l.e.d., is lit up. This activates the 555 timer (IC2) which produces the alarm via LS1.

J. Sreekumar,
Kaloor, Cochin,
India.



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.

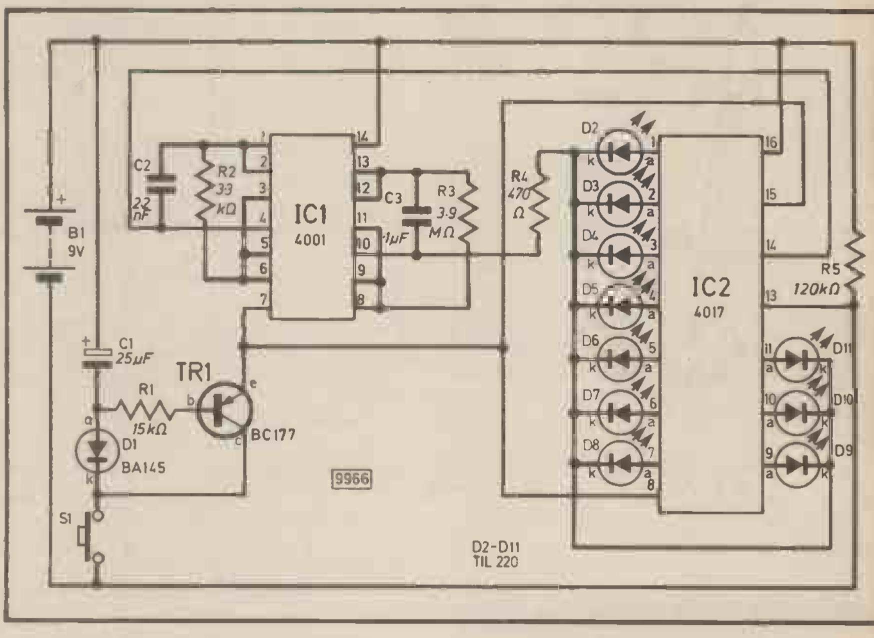
MINI-ROULETTE

When S1, a push-to-make switch is pressed a negative charge on C1 turns on TR1 and also enables pin 13 of IC2 a CMOS 4017 decade counter to start sequencing. The 10 l.e.d.s will all flash. When S1 is released the winning l.e.d. will remain flashing for approximately 20 seconds, then will automatically switch off.

IC1 a CMOS quad 2-input NOR gate, gates "A" and "B" connected as an astable, provides pulses for pin 14 of IC2.

Gates "C" and "D" also connected as an astable provides the negative supply line for the cathodes of the 10 l.e.d.s via R4, pin 10 of IC1, pin 7 of IC1 and emitter of TR1. D1 ensures IC2 stops sequencing with l.e.d.s 1, 3, 5, 7, 9 red and 2, 4, 6, 8, 10 green. This can also be used as a "yes or no" game.

Joseph Wood,
Fauldhouse,
West Lothian.



BURGLAR ALARM SYSTEM WITH EXIT DELAY

The monostable timer based around IC1 is provided so that the operator may arm the unit, by turning on at S1, and leave the premises after pressing S2 without triggering the alarm. When S2 is pushed, the output (pin 3) of IC1 goes high for a period controlled by the values of R3 and C3 and activates RLA. The normally closed contacts RLA1 open and switch off power to the alarm circuitry.

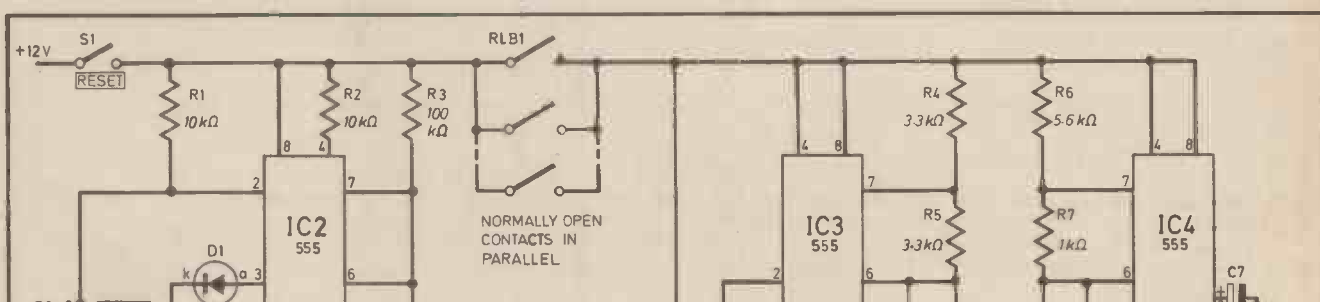
After the set period, 30 seconds with component values shown, the relay drops out and contacts RLA1 close and reconnect power to the alarm circuitry. Increase the values of C3 and/or R3 to increase the exit delay time.

When one of the normally open security switches closes, RLB is energised and RLB1 contacts close. This latches on RLB so even if the security switch is opened quickly after being closed, power will still be applied to the alarm circuitry and the alarm will sound.

IC2 and IC3 are two astable multivibrators, the first modulating, the second to produce a siren-like sound.

The maximum current that may be supplied by a 555 timer i.c. is 200mA. This sets the minimum speaker impedance at about 64 ohm. If a louder sound is required then a higher powered speaker rated at 8 ohms may be used, provided a current amplifier is interposed between the output of IC3 and the speaker.

Brian McNeill,
Boghall,
Scotland.



SIGNAL TRACER

BY R. A. PENFOLD

SERVICE YOUR ELECTRONIC EQUIPMENT WITH THIS DUAL PURPOSE INSTRUMENT

THE unit described here can be used as either a Signal Injector or a Tracer, but it cannot provide the two functions simultaneously due to breakthrough from the injector circuitry to the tracer circuitry. The output of the tracer is intended for use with a crystal earphone, and the fairly high sensitivity of an earphone of this type combined with the fairly high gain of the unit enables signals of less than a millivolt peak-to-peak to be detected.

The circuit is based on a dual low noise audio amplifier i.c. which gives the signal tracer section an excellent signal-to-noise ratio. Power is provided by a small internal 9V (PP3 size) battery, and the unit is therefore self-contained and easily portable.

SIGNAL PATH

Signal injectors and tracers enable faulty audio, radio, and similar items of electronic equipment to be rapidly serviced if there is a fault that causes a break in the signal path. A signal injector simply produces an audio signal that is rich in harmonics and therefore provides a wide range of output frequencies that extend well into the radio frequency spectrum, in addition to the fundamental audio signal.

This enables the unit to be used for checks on the mixer and i.f. stages of a.m. radios, as well as on the audio stages and on radio equipment. A signal tracer is merely a high gain audio amplifier that feeds a loudspeaker or earphone, and can therefore be used to detect even very low-level audio signals. With the addition of an r.f. probe it is also possible to detect amplitude modulated radio signals of moderate strength (or even very low-level r.f. signals if an active probe is employed).

DUAL OP-AMP

The integrated circuit used in the unit is the National Semiconductor's LM387, and this is housed in a standard 8-pin d.i.l. plastic package. Fig. 1 shows the general arrangement and pin-out details of this device, and as will be apparent from this, the device is basically two operational amplifiers.

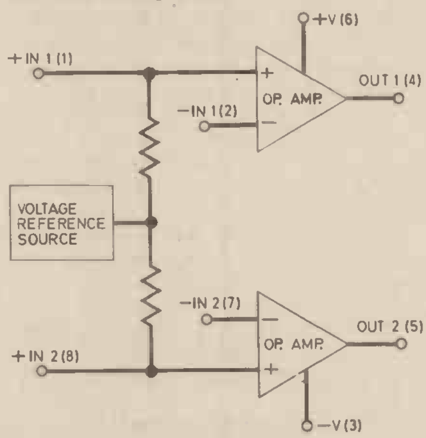
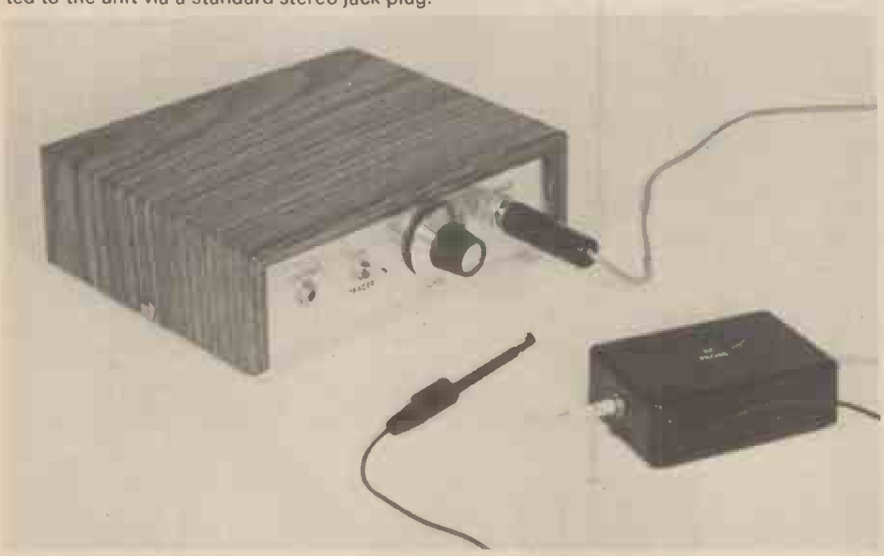


Fig. 1. The general arrangement and pin-out details of the LM387 integrated circuit, and also shown are the two operational amplifiers that make up the circuit.

However, these two amplifiers are designed to have low levels of noise and distortion, and there is an internal bias circuit which feeds a low voltage (about 1·4V) to the non-inverting input of each amplifier. The two amplifiers are internally compensated and require no external components to prevent instability in normal use.

The signal injector tracer unit showing the front panel controls with the r.f. probe connected to the unit via a standard stereo jack plug.



COMPONENTS

See Shop Talk page 89

Resistors

R1,6	39kΩ (2 off)
R2,5	120kΩ (2 off)
R3	220Ω
R4	12kΩ
R7	6·8MΩ
R8,9	1kΩ (2 off)

All $\frac{1}{3}$W carbon ±5%

Capacitors

C1,3	100nF (2 off) type C280
C2	390pF ceramic plate
C4,5	100µF 10V elect. (2 off)
C6	10nF type C280
C7	4·7nF polystyrene
C8	2·2µF 25V elect.
C9	150pF ceramic plate
C10	22nF ceramic plate
C11	2·7nF ceramic plate

Semiconductors

D1	OA91 germanium
TR1	BF244B j.u.g.f.e.t. *n-channel*
IC1	LM387N low-noise dual pre-amplifier

Miscellaneous

VR1	100kΩ log. with switch S2
S1	s.p.s.t. miniature toggle
S2	d.p.d.t.
SK1	standard jack socket
SK2	3·5mm jack socket
PL1	standard stereo jack plug
B1	PP3 9V

0·1 inch matrix stripboard, 13 strips by 26 holes (signal injector/tracer circuit); 0·1 inch matrix stripboard, 7 strips by 6 holes (r.f. probe circuit); plastics case, 152 x 114 x 44mm (Maplin type TP2), for main circuit; plastics case, 71·5 x 49 x 24·5mm (for r.f. probe circuit); earthing clip; long M3 or 6BA bolt, matching nut and soldertag; p.v.c. sleeving.

Approx. cost Guidance only £13

They have the usual high voltage gain associated with operational amplifiers (their typical voltage gain is 160,000 times at 100Hz), and a high unity gain frequency of typically 15MHz.

The device will operate over a supply voltage range of 9V to 30V and has a current consumption of typically 10mA. It is short circuit protected.

CIRCUIT DESCRIPTION

Refer to Fig. 2 for the complete circuit diagram of the signal injector tracer unit. IC1a is used as the basis of the tracer section while IC1b is used in the injector section.

Taking the tracer circuitry first; IC1a is used as a non-inverting amplifier. Normally with this type of circuit 100% negative feedback over the amplifier is provided at d.c. and a bias potential of half the supply voltage is applied to the non-inverting input. As the feedback gives unity voltage gain at d.c., this results in the output of the amplifier being biased to half the supply potential, and permits the optimum peak-to-peak voltage swing before clipping of the output signal and severe distortion are produced.

This method cannot be used here as the input bias voltage is too low and it is necessary to have a d.c. negative feedback loop that gives a small amount of voltage gain at d.c., and therefore gives a quiescent output voltage that is suitably high. R1 and R2 form the d.c. feedback circuit, and give a voltage gain of roughly four times.

This level of gain is inadequate at audio frequencies where a much higher voltage gain is needed in order to give the unit good sensitivity. R3 is therefore used to shunt R1 at these frequencies and give a voltage gain of about 545 times. C5 provides d.c. blocking and prevents the d.c. voltage gain being similarly boosted by R3.

D.C. BLOCKING CAPACITOR

The capacitor C1 is the input d.c. blocking capacitor and VR1 is the sensitivity control. The input impedance of the circuit is quite high at about 50 kilohms. With a crystal earpiece connected to the output there is a danger of stray feedback from the earphone lead to the input circuitry being sufficiently strong at high frequencies to cause instability. This possibility is avoided by including a low-pass filter (R4 and C6) at the output and using a filter capacitor (C2) at the input.

OSCILLATION

The integrated circuit, IC1b, is biased in the same way as IC1a, but there are no additional components to boost the gain at audio frequencies. This is simply because a voltage gain of four times is quite sufficient to cause strong oscillation, and no advantage was found in using a higher gain. In order to produce oscillation it is merely necessary to provide an a.c. feedback path of reasonably low impedance from the output of the amplifier to the non-inverting input. This positive feedback is provided by C7, and the value of this component has been chosen to produce oscillation at a frequency of roughly 800Hz.

Breakthrough from the injector circuit makes it impossible to use the tracer circuit and it is therefore necessary to mute the injector while the tracer is in use. This is achieved by short circuiting C7 using S1b so that d.c. positive feedback is applied over IC1b and its output latches in the fully high or fully low state. S1a connects the output of the tracer through to the output socket when the injector circuit is muted, or the output of the injector circuit to this socket when the injector is operating.

C8 provides d.c. blocking at the output of the injector circuit, but no d.c. blocking is necessary at the output of the tracer circuit (provided this is used with an earphone of the correct type). C3 and C4 are supply decoupling capacitors and S2 is the on/off switch. The latter is ganged with the sensitivity control, VR1, which is effectively an ordinary volume and on/off control.

CONSTRUCTION

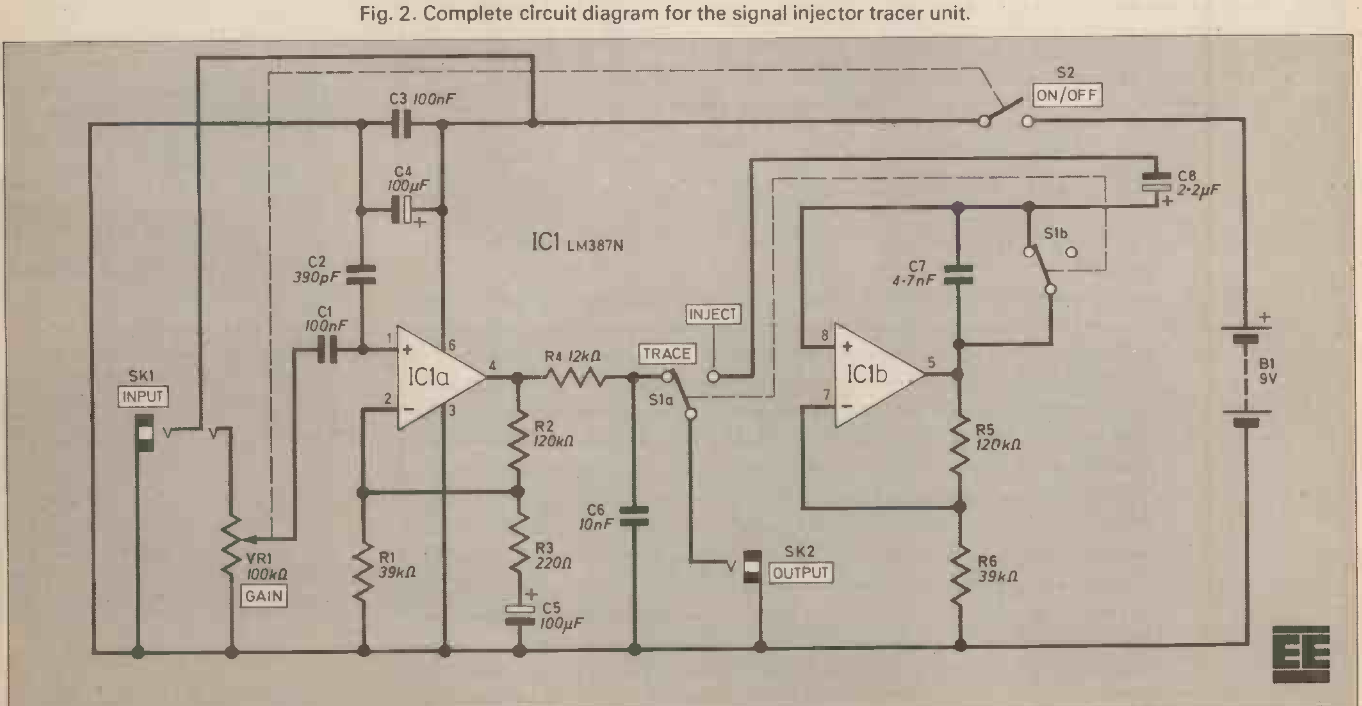
CASE

The prototype unit is housed in a metal instrument case which has approximate outside dimensions of 152 × 114 × 44mm, but a smaller case would be sufficient to accommodate the unit if maximum portability is required. A metal case is preferable to a plastic or other non-metallic type as it screens the signal tracer circuitry from any sources of mains hum, radio signals, or other sources of interference.

COMPONENT PANEL

The small components are assembled on a 0·1in matrix stripboard which has 13 copper strips by 26 holes, and as this is not a standard size in which the board is available it is necessary to cut out a piece this size from a larger board using a hacksaw.

Fig. 2. Complete circuit diagram for the signal injector tracer unit.



The two mounting holes and the four breaks in the copper strips are made prior to fitting the components and two link wires in place. The LM387 is not one of the cheapest of integrated circuits, and it is worthwhile using a socket for this.

Before bolting the completed component panel in place it is necessary to wire it to the sockets, battery clip, and controls. A few other wires are then required to complete the unit. Fig. 3 gives full details of the component panel and all the wiring of the unit.

TESTING AND USE

As for any project, a couple of thorough checks of all the wiring for errors is a good idea before connecting the battery and switching on. With the unit switched to the inject mode, a crystal earpiece connected to the output socket, and the unit switched on by advancing VR1, a loud audio tone should be heard from the earphone.

If no tone is obtained the unit should be switched off at once and rechecked. If a tone is obtained, switching to the trace mode should silence the tone, and a slight background hiss should be heard instead. Coupling an audio signal to the input should produce the appropriate audio output from the earphone, with VR1 controlling the volume. Again, if the unit does not operate as it should, switch off immediately and recheck the wiring.

When used as a signal injector the output is first coupled to the final stages of the equipment under test and then at other strategic points in the circuit working backwards towards the input. At some point there will be an absence of the audio tone at the output, and the fault then lies in the circuitry around this last test point, or in the circuitry that immediately follows it.

SIGNAL TRACER

A similar technique is used when fault finding using a signal tracer, but the initial tests are made at the input of the unit being tested, with subsequent tests being made at points which progress towards

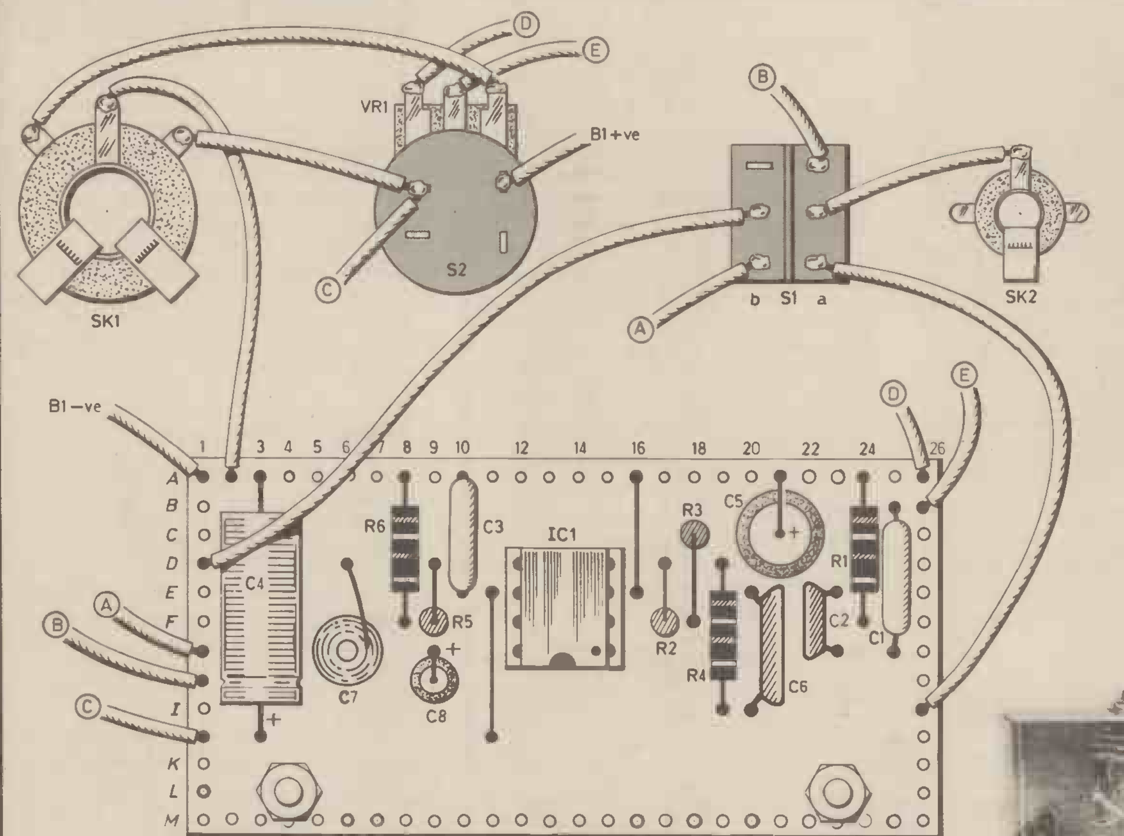
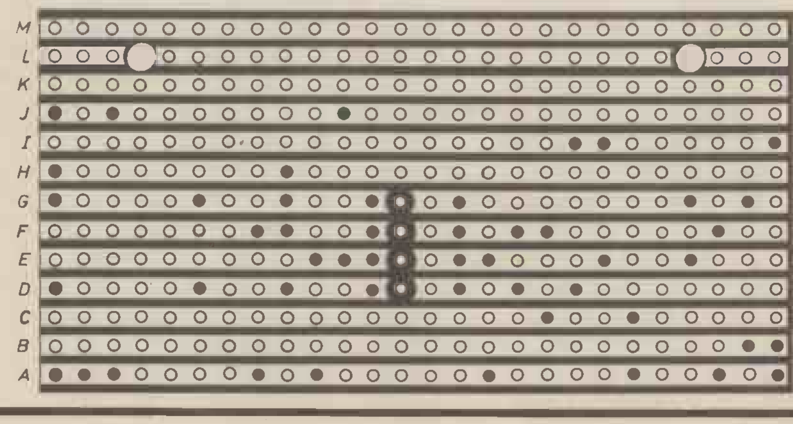
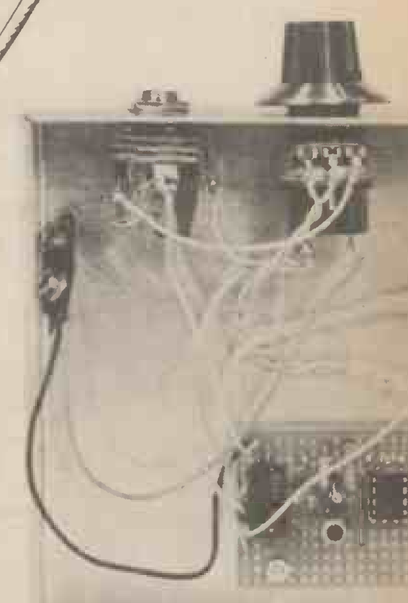


Fig. 3. Layout of components on the topside of the stripboard and interwiring to the components mounted on the front panel and the supply switch S1.





the output. Of course, there must be an input signal for the unit to trace, and this can be provided by an ordinary programme signal source for the equipment being checked, or by a signal generator of the appropriate type if a suitable instrument is available.

When this signal can no longer be detected by the tracer the approximate position of the fault has been located. It either lies in the circuitry where the fault was made, or in the circuitry immediately prior to this. Once again, the precise position of the fault will not be revealed and voltage and component test must be made in order to find out exactly what is wrong.

PROBE

The radio frequency probe is only necessary if the unit is to be used for signal tracing in a.m. radios, and audio signals are coupled to the input of the tracer via the usual set of screened test leads. The tip and main barrel connections of the input plug carry the "hot" and earth input connections respectively, and the third terminal of the plug is only employed with the r.f. probe.

It then carries the positive supply to the probe so that the probe is powered from the main unit and does not require its own battery supply.

The probe just consists of a wideband amplifier to give a high input impedance, low input capacitance, and increased sensitivity, plus a simple a.m. demodulator. The unit is not suitable for use with f.m. equipment since the demodulator will not function properly with an f.m. signal, and would probably fail to produce any audio output at all. The probe has an operating frequency range of about 100kHz to over 50MHz.

CIRCUIT DESCRIPTION

Fig. 4 shows the simple circuit of the r.f. probe, and the input amplifier is a straightforward common source amplifier using a duration field effect transistor. This gives the required high input impedance and low capacitance, together with a typical voltage gain of a little under 20dB (10 times).

The output from the drain terminal of TR1 is coupled direct to diode detector D1. C3 is the r.f. filter capacitor and the load resistor is the track resistance of VR1 at the input of the injector/tracer unit.

As the current consumption of the probe is only about 2mA or 3mA, it will not significantly reduce the life of the battery in the injector/tracer unit.

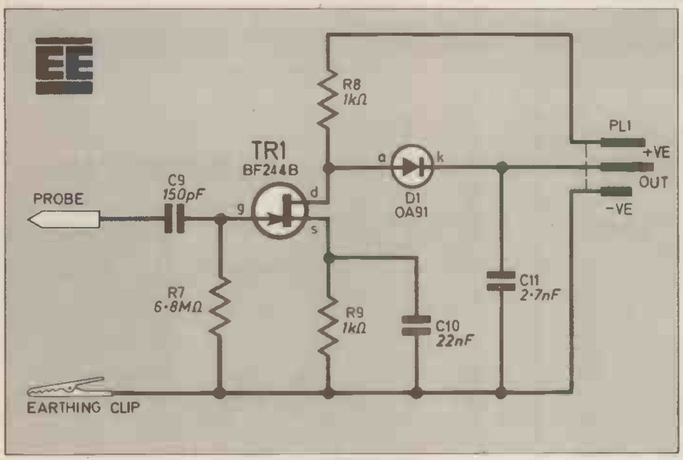
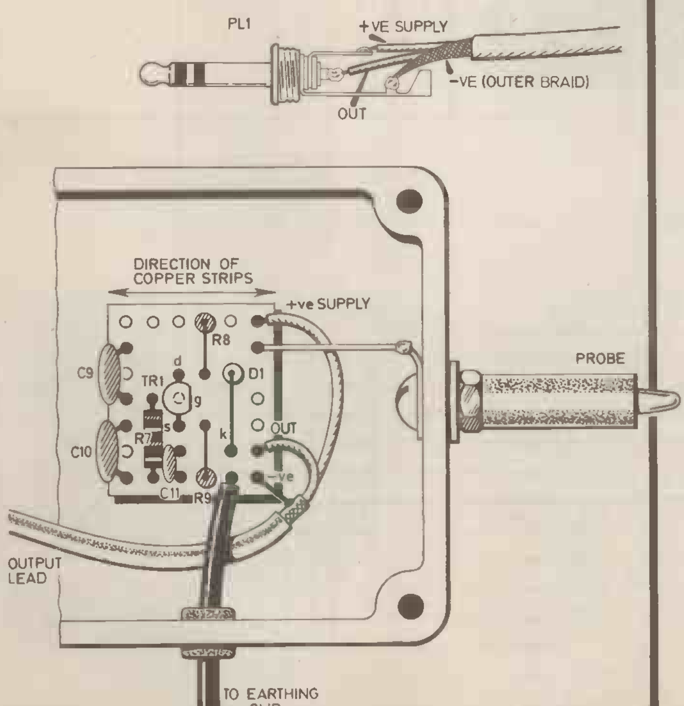


Fig. 4. The complete circuit for the radio frequency probe.

Fig. 5 (below). Details of the component layout of the r.f. probe and details for the wiring of the standard stereo jack plug.



COMPONENT BOARD

A 0·1in matrix stripboard having 7 strips by 6 holes is used to accommodate the components, and this board is illustrated in Fig. 5. The layout is very compact and it is essential to use modern miniature components, but the small size of the board enables it to be fitted into virtually any small plastic case.

The prototype is housed in a miniature Verobox, and it is advisable to use a very small case as the unit would otherwise be rather cumbersome to use.

A 6BA or M3 bolt 25mm or more in length is fitted at the front end of the case to act as the probe tip and a soldertag is fitted on this bolt, on the inside of the case, to enable a connection to be made easily to the bolt.

A file can be used to smooth and round off the end of the bolt to give a neater finish, and a piece of p.v.c. sleeving can be placed over the bolt, leaving only the tip exposed, to further improve the appearance of the unit.

WIRING

A small hole for the output lead is drilled in the rear of the case, and an entrance hole for the lead to the earthing clip is drilled in the underside of the case. These leads must be threaded through the case before they are connected to the component panel.

Twin overall screened lead is suitable for the output cable. The component panel is connected to the probe tip via a short piece of thick tinned copper wire (about 20 s.w.g.), and this also serves as the mounting for the component panel.

The r.f. probe is switched on and off in sympathy with the signal injector/tracer unit, and the probe can therefore be left connected to the injector/tracer unit without running down the battery. □

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

MAIN PROTECTOR

A NEW Filterplug from **Galatrek International** is designed to protect microcomputers, word processors and all voltage sensitive equipment from mains borne interference. They claim that for the first time a filterplug has been developed with transverse mode and common mode attenuation capability.

The "plug" will protect equipment from transients and spikes which can wipe out memory and corrupt data. It will also protect from some momentary surges, mains r.f. interference and lighting disturbance.

The unit is current rated at 2A, sufficient for most micros and accessories. Frequency is 50/60Hz.

The Galatrek Filterplug costs £29.95 including VAT and p&p. It is also available direct from the manufacturers:

Galatrek International Ltd., Dept EE, Scotland Street, Llanrwst, Gwynedd, North Wales.

IN THE SWIM

PLAYING both hunter and hunted, the central figure in Casio's CG50 pocket electronic game is a spearfisherman: out to catch as much as he can, while avoiding the perils of the giant shark.

This is a game you can play as much and as often as you like, with no fear of batteries giving up on you. Power comes from built-in solar cells, operating under any commonly available light.

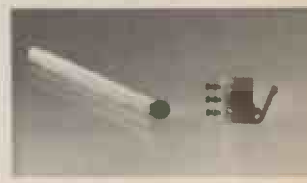
The Casio CG50 Marine Hunter keeps score for you, provides accompanying sound-effects, and makes things more difficult as your skill improves. All for a recommended retail price of £11.95.

For details of nearest stockist write to:

Casio Electronics Co. Ltd., Dept EE, Unit 6, 1000 North Circular Road, London, NW2 7JD.

MICROSWITCH

AN ultra miniature microswitch with actuator arm is now being marketed by **Semiconductor Supplies International Ltd.**



The switch is rated at 50V 300mA single pole changeover and measures only 10mm (inclusive of connecting pins and actuator arm compressed) high, 8mm wide and 3mm thick. The actuating lever is shaped for cam follower applications. Other uses include security switching and scale models.

The price per pack of 10 switches is £4, including post and packing. For more details write to:

Semiconductor Supplies International Ltd., Dept EE, Dawson House, 128/130 Carshalton Road, Sutton, Surrey SM1 4RS.

WORDS 'N MUSIC

A HAND-HELD cassette recorder called Words 'n Music has just been marketed by **Dictaphone.** It is a fully-featured dictation machine which also plays pre-recorded stereo tapes on the same compact unit. Stereo earphones for private listening are standard, and a small pair of high fidelity speakers are available as extras.

Most dictation machine users take their portable units with them on business trips and Words 'n Music is an ideal travelling companion for the executive. Thoughts, correspondence and conferences are recorded with one hand operation, audible cues for the secretary of item ends and special instructions.

When work is done, Words 'n Music may be used as a stereo playback to shorten long boring journeys or unwind after a hectic day. The featherweight stereo headphones are provided for personal listening and compact speakers plug in for music in the office or to play tapes at home.

It uses standard C-60 cassettes, to give one hour's dictation capacity. Claimed frequency response for the machine is 50kHz to 12kHz, ±3dB.

The Words 'n Music unit comes complete with a stereo demonstration cassette, soft case, ni-cad battery pack a.c. adaptor/battery charger, instruction manual, two AA batteries for immediate use and lightweight stereo headset for £147 plus VAT.

The optional stereo speakers are £30 plus VAT per pair. An optional stereo steel-fold headset is available at £15 plus VAT.

For addresses of local stockists contact:

Dictaphone Co. Ltd., Dept EE, Regent Square House, The Parade, Leamington Spa, Warks CV32 4NL.

CIRCUIT EXCHANGE

V.C.O. AND SOUND EFFECTS

THIS circuit should provide an insight into the interesting world of electronic music. TR1 acts as an amplifier for LS1 and gives a voltage drop to 0V across C2 when LS1 is touched. When this happens, TR2 conducts, charging C4. R6 and VR1 provide a d.c. short across C4 and allows it to discharge.

This means that an envelope with a fast attack and a variable decay is produced across C4 every time LS1 is touched. As LS1 is to be touched often, some sort of protection should be fitted to LS1.

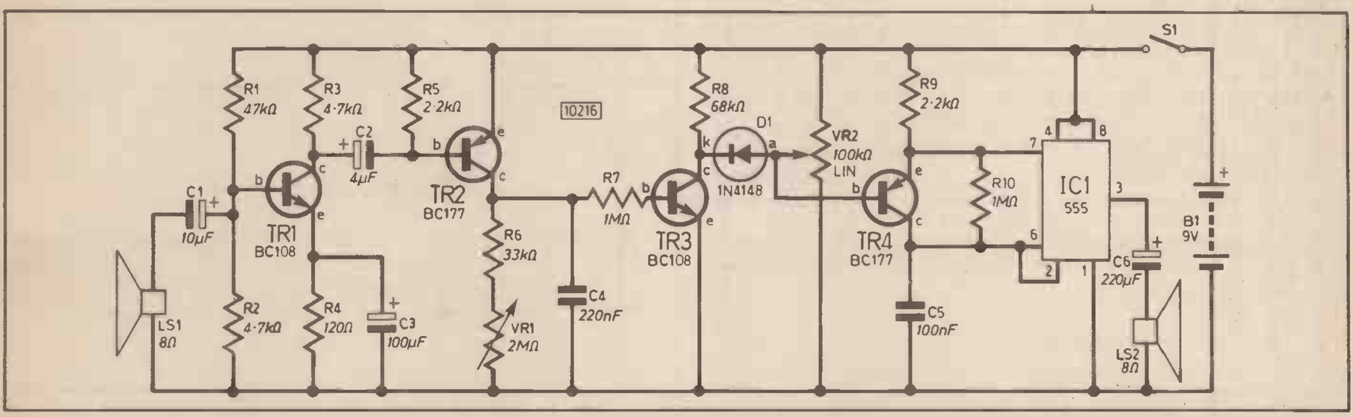
TR3 senses the envelope voltage via R7. Without R7, the capacitor discharges too quickly and distorts the envelope. When the envelope is present, the voltage at the collector of TR3 varies with respect to the envelope, which means that TR3 acts as a buffer. D1 only allows the negative portion of the voltage to pass to TR4.

IC1 is a 555 in the astable mode. The frequency of this is determined by C5, R10 and R9. When TR4 conducts, R10 is shorted out. When this happens the frequency of the wave at pin 3 increases. This means that the frequency is proportional to the voltage at the base of TR4. Hence the 555 acts as a simple v.c.o.

The frequency of the v.c.o. is set by VR2 which acts as a potential divider. When LS1 is touched, the voltage across D1 causes the frequency of the v.c.o. to vary with respect to the envelope.

"Phaser" sounds and others can be obtained by varying the setting of VR1. The whole circuit can be powered from one 9V battery. The simple alternative!

Mark Oxland,
Waterthorpe,
Sheffield.



EVERYDAY ELECTRONICS SOFTWARE SERVICE

The EE Software Service provides an easy and reliable means of program entry for our computer-based projects. All programs have been tested by us and consist of two good quality copies of the working program on cassette tape. Certain program listings are also available.

All prices include VAT, postage and packing. Remittances should be sent to Everyday Electronics Software Service, Editorial Offices, King's Reach Tower, Stamford Street, London SE1 9LS. Cheques should be crossed and made payable to IPC Magazines Ltd.

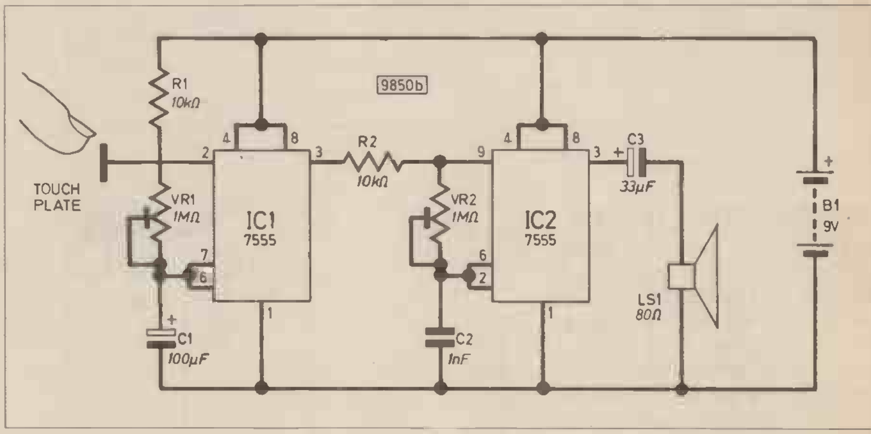
PROJECT TITLE	CASSETTE CODE	CASSETTE COST	LISTING CODE	LISTING COST
ZX81 SPEED COMPUTING SYSTEM (Feb 83)	T001	£2.95	L001	£2.95
REAL-TIME CLOCK (*Apple II*) (May 83)	T002	£2.95	L002	£2.95
REAL-TIME CLOCK (*BBC Micro*) (May 83)	T003	£2.95	L003	£2.95
EPROM PROGRAMMER (*TRS-80 & GENIE*) (June 83)*	T004	£3.95	N/A	—
STORAGE 'SCOPE INTERFACE (*BBC Micro*) (Aug 83)	T005	£2.95	—	—
ELECTRO-CARDIOGRAPH (*BBC Micro*) (Jan 84)	T006	£2·95	—	—
EPROM PROGRAMMER/ROM CARD (*ZX81*)** (Feb 84)	T007	£3.95	—	—

*Includes Command List with examples.
**Includes Keyboard Overlay.

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.

TOUCH BLEEPER



THIS circuit uses two 7555 CMOS timer i.c.s. The current consumption of these devices is negligible when the unit is kept idle, hence no on/off switch is required. A pair of the more common 555 i.c.s can also be used in place of the 7555s, but in that case there will be a sizeable idle current so that an on/off switch will become indispensable.

When once touched, the unit will oscillate for a fixed time, which can be set anywhere between 1 second and 100 seconds by setting VR1. The tone of the output is determined by VR2.

The touch plate can be any metallic object about the size of a coin, for example, the head of a drawing pin. Other possible uses of the unit would be as a bicycle alarm or door bell.

J. Sreekumar,
Kaloor, Cochin, India.

CAR BATTERY MONITOR

THIS circuit will help the motorist to see if his car battery is in need of being recharged by simply looking at a row of ten l.e.d.s, on the dashboard.

The circuit can be put in a box 100 × 50 × 35mm. To set up the circuit adjust VR2 until the voltage at its wiper is 1·9V and then adjust VR1 until the end green l.e.d. lights up (with a fully-charged battery).

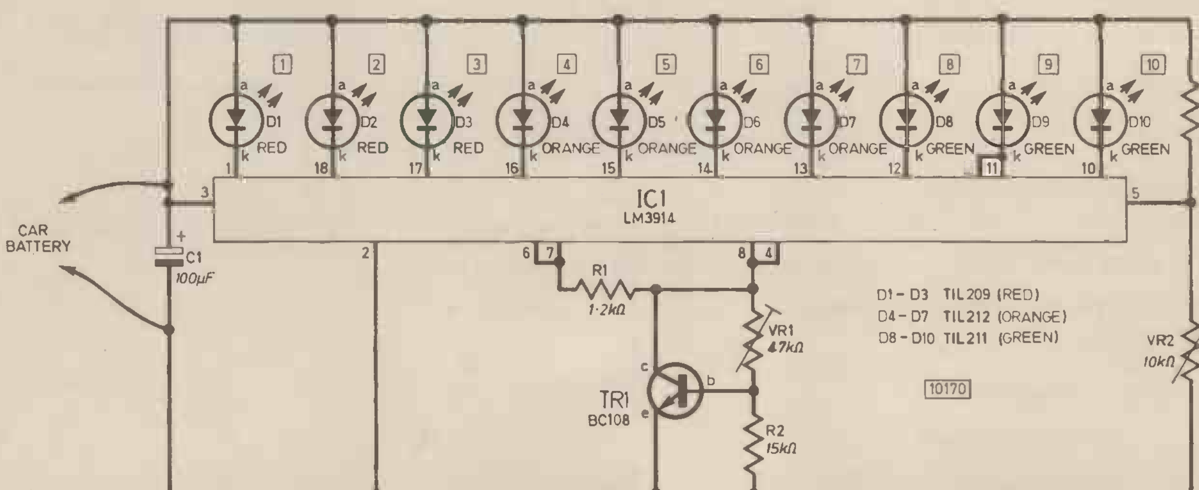
The i.c. contains an input buffer, a potential divider chain, comparators and an accurate 1·2V reference source. Logic is also included which gives the choice of bar or dot-mode operation—the latter is used in this application. The comparators cause the l.e.d.s to light at 0·12V intervals of the input voltage.

TR1 acts as an amplified diode and raises the lower end of the divider chain and the negative terminal of the reference source (pins 4 and 8 of IC1) to 1·9V. The upper end of the chain (pin 6) is connected to the reference source output (pin 7) and therefore is at about 3·1V.

The potential divider formed by R3 and VR2 attenuates the supply voltage and uses it as the signal input to the comparators such that a supply range of 9V to 14V covers the span of the divider chain and is indicated over the whole of the ten l.e.d. display.

The l.e.d. brightness is held constant by an internal constant current source. This unit has many other uses such as a Bench Voltmeter.

Jason Short,
Westcliff,
Essex.



SQUARE one FOR BEGINNERS

An important part of any electronic project is the wiring of the components and in particular the type of connecting wires that are used.

CONNECTING WIRES

The type of wire that is used for the wiring of electronic chassis, front panels and circuit boards, can be divided into four categories: single-strand bare; single-strand insulated; multi-strand insulated; and plastics covered screened containing one or more insulated strands.

When describing equipment wire, two figures are normally quoted, the first being the number of conductors in the wire and the second being the diameter in millimetres of each conductor in that wire. So for example, a 1/0·6 wire has one conductor 0·6mm in diameter whereas a 7/0·2 wire has seven smaller conductors, each of 0·2mm diameter.

SCREENED CABLE

This type of cable is used where it is necessary to shield one or more insulated strands from possible radiation or interference sources. The protective shield takes the form of a woven wire mesh which surrounds the insulated strands to be screened.

LINK WIRES

Link wires are used on circuit boards where it is easy to connect one component to another or to connect one section of copper strip to another located some distance away. Link wires are also used extensively to interwire the pins of integrated circuits.

For link wires used on circuit boards use a fairly stiff tinned copper wire. This is bare, single-stranded copper wire with, in most cases, a special fluxed coating for easy soldering which does not oxidise easily. The bending of link wires is best accomplished with a pair of long-nosed pliers. Single-stranded equipment wire must never be used in applications where the wire is likely to be continually flexed back and forth as this will eventually fracture the copper and the wire will break.

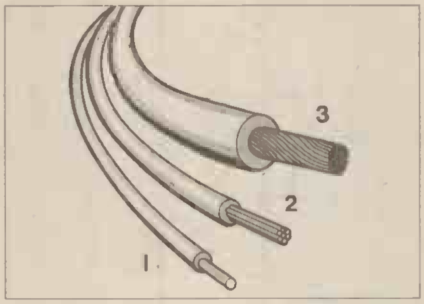


Fig. 1. Examples of equipment wire: (1) 1/0·6; (2) 7/0·2; (3) 55/0·1.

MULTI-STRANDED WIRE

In the cases where the wires in a piece of equipment do get subjected to a lot of flexing, as in a cableform or in front panel to circuit board wiring, a multi-stranded wire of the correct voltage and current rating must be used. In instances where the wire will frequently be moved about, as for example, with a test probe, a wire with a large number of very small diameter strands and an extremely pliable p.v.c. sheath is used, for example 55/0·1 wire.

SLEEVING

If there is any possibility of link wires contacting with other wires or components and forming a direct short circuit then insulating plastics sleeving should be used. This is a thin tube of plastics material which can be cut to the required length and slipped over the wire to provide an electrical isolation from other components and wires.

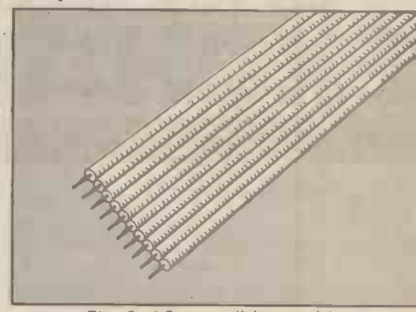


Fig. 2. 10-way ribbon cable.

RIBBON CABLE

A wire which is coming more and more into use for the projects enthusiast is the ribbon cable. This is formed by a number of different coloured plastic insulated wires bonded together to give a flat ribbon or tape appearance. Available in single-strand or multi-strand, this wire is ideal for micro-processor based projects and where a light emitting diode display matrix is used.

The cable usually comes in 10 or 20-way lengths to suit or can be split to any combinations of wires.

MAINS LEAD

Mains cable from equipment is always of the insulated multi-strand type and colour coded: brown for live (L) or positive; blue for neutral (N); green and yellow striped for earth (E). The live lead to the equipment, usually to a mains transformer, should always be fused via a panel mounted or chassis mounted fuse holder.

Never pass a mains lead through a bare lead-in hole in the side of the case, the results can be disastrous. **Never, absolutely never, tie a knot in mains cable to act as strain relief against the inside of the lead-in hole.**

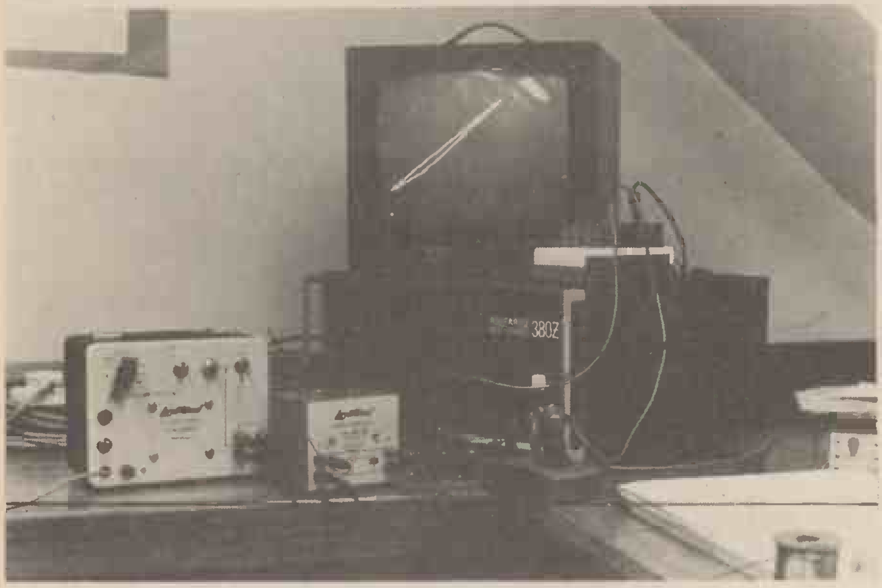
The only correct way is to always fit a rubber grommet where the cable enters the case and use a cable/strain relief clamp.

TABLE 1. EQUIPMENT WIRE DATA

SIZE	MAX. RATING	DESCRIPTION	TYPICAL APPLICATIONS
1/0·25mm (0·05mm²)	150V r.m.s., 0·4A @ 25°C	silver-plated copper, Kynar insulated, 0·5mm dia.	suitable for wire wrapping only
1/0·6mm (0·28mm²)	1kV r.m.s., 1·8A @ 70°C	tinned copper, p.v.c. insulated, 1·2mm dia.	rigid wiring of electronic equipment (chassis, p.c.b.s)
10/0·1mm (0·08mm²)	750V r.m.s., 0·5A @ 70°C	tinned copper, stranded, p.v.c. insulated, 1·05mm dia.	
7/0·2mm (0·22mm²)	1kV r.m.s., 1·4A @ 70°C	tinned copper, stranded, p.v.c. insulated, 1·2mm dia.	
16/0·2mm (0·5mm²)	1kV r.m.s., 3·0A @ 70°C	tinned copper, stranded, p.v.c. insulated, 1·6mm dia.	wiring of electronic equipment where a degree of flexing of the wires is expected (front panels, external components)
24/0·2mm (0·75mm²)	1kV r.m.s., 4·5A @ 70°C	tinned copper, stranded, p.v.c. insulated, 2·0mm dia.	
32/0·2mm (1·0mm²)	1kV r.m.s., 6·0A @ 70°C	tinned copper, stranded, p.v.c. insulated, 2·5mm dia.	
55/0·1mm (0·43mm²)	650V d.c. (500V a.c.), 2·5A @ 70°C	plain copper, stranded, pliable p.v.c. insulated, 2·8mm dia.	very flexible for test leads and probes

Effective cross sectional areas of the conductors are given in parentheses in the first column.

COMPUTER AIDED EXPERIMENTS



BY A. A. CHANERLEY B.Sc. M.Sc.

5. *V-I* CHARACTERISTIC OF A *P-N* JUNCTION DIODE

THIS is a standard experiment for obtaining the characteristic of a *p-n* junction, except that instead of using moving coil milliammeters and voltmeters, noting the readings and plotting the results on graph paper, the outputs are fed directly into the *Analogue-to-Digital Converter* (ADC) described in the September '83 issue of EE.

This converts the analogue data into an 8-bit digital word, which is read by the RML380Z microcomputer user port, and immediately plotted on the VDU, so that the plot is obtained as the experiment is being performed.

THE *P-N* JUNCTION DIODE

Basically, a *p-n* junction diode comprises a piece of silicon (or germanium) which is "doped" with impurities. For example, arsenic or phosphorus are two such impurities which can be used. These have five electrons orbiting in their outer shells, and when such an atom takes the place of one of the silicon atoms in the piece of silicon, it brings in an extra electron, because the silicon atom which it replaces has only four electrons in its outer shell.

Hence the portion of silicon doped in such a manner has free negative charge carriers (the extra electron) and hence the conductivity of such silicon increases. Silicon doped in such a manner is called *n*-type.

P-TYPE

Alternatively, if a material such as boron is used as dopant, which has only three orbiting outer electrons, it creates a "hole" because a gap occurs where an electron was before the silicon atom was replaced by the boron atom. This attracts an electron, which in turn leaves a "hole" in another part of the silicon structure, where it originally resided. Silicon doped in such a manner has an excess of holes and is called *p*-type, and as such has an increased conductivity due to the presence of holes.

It can be arranged that one piece of silicon can be doped such that part of it is *p*-type and part of it is *n*-type, and wherever the two regions meet is the "*p-n* junction" which forms the basis of electronic circuits.

The diagram in Fig. 5.1(a) illustrates this situation. On formation of the *p-n* junction, there is on each side of the junction a number of free electrons and a number of free holes, in the *n*-type and *p*-type respectively. Since the crystal structure is preserved across the junction, electrons from the *n*-type diffuse across and are trapped in the holes of the *p*-type silicon. Hence a layer of negative charge builds up on the *p*-side, and a layer of holes is left on the *n*-side where the electrons have left their sites.

These two layers of positive and negative charge eventually create a region of very high electric field and prevent any more electrons from diffusing across. The action is similar to the build up of positive and negative charge on either side of a capacitor. This region of strong electric field is called the depletion region, and as such acts as an insulator.

FORWARD AND REVERSE BIASING

When a potential difference (p.d.) is applied with the positive terminal connected to the *n*-type and the negative terminal connected to the *p*-type, the depletion layer becomes thicker, because the electrons in the *n*-type are attracted towards the positive terminal and leave holes behind, that is, more positive charge at the junction. Similarly, in the *p*-type, holes are attracted to the negative terminal and leave an excess of negative charge on that side of the junction.

The net effect is to create an even more powerful electric field and make thicker the depletion region and hence make it a better insulator. This is crucial to the rectifying action of the *p-n* junction, since

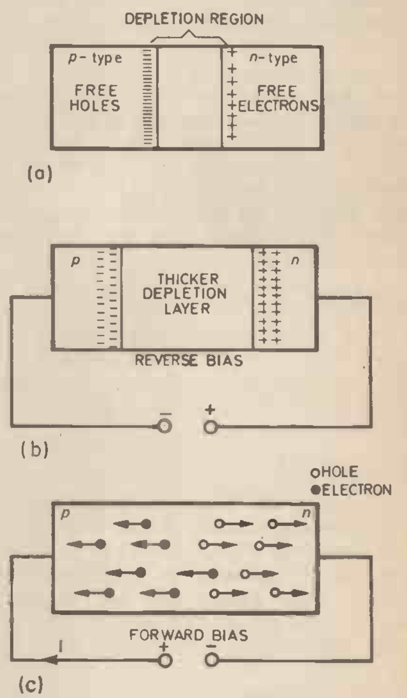


Fig. 5.1. (a) The formation of the depletion region at the junction of *p*-type and *n*-type doped silicon. (b) The widening of the depletion region when reverse biased. (c) Forward biased junction showing current flow.

with the polarity described, the junction will not conduct. This is illustrated in Fig. 5.1(b) and is called reverse bias.

When, however, the positive terminal is connected to the *p*-type material, the depletion layer becomes narrower as the voltage is increased from 0 to about 600mV. The current is therefore slow to rise as the applied voltage is increased up to this value because the depletion layer still exists. Once the voltage exceeds 600mV, it is noticed that the current increases considerably. This is because the negative terminal of the voltage source, now being connected to the *n*-side, repels the electrons with sufficient force to enable them to penetrate the depletion layer; similarly an attractive force urges holes from the positive layer of charge to move to the negative terminal.

The charges are therefore dispersed and very little resistance exists once the depletion has vanished. Current now flows freely through the silicon. With this polarity across the *p-n* junction, the junction is said to be forward biased, as shown in Fig. 5.1(c).

If then a plot is obtained of the diode current against the applied voltage, the *V–I* characteristic is obtained, both in the forward bias and the reverse bias modes, as shown in Fig. 5.2.

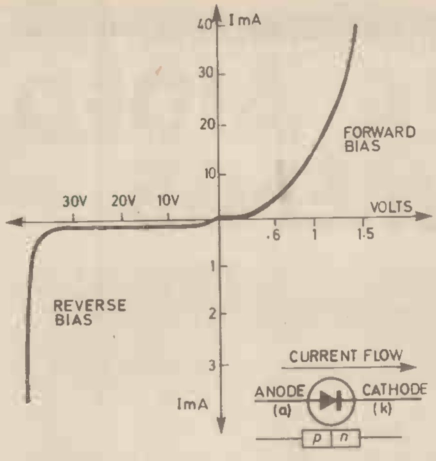


Fig. 5.2. The typical *V-I* characteristic of a silicon *p-n* junction diode. Note the small leakage current in the reverse biased quadrant until the reverse breakdown voltage is reached.

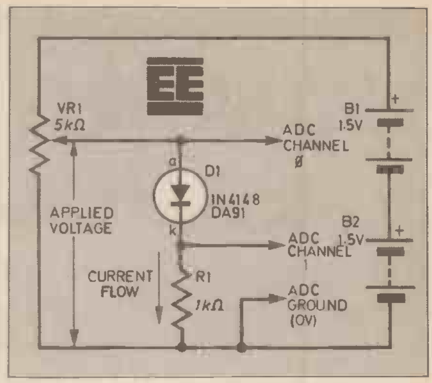


Fig. 5.3. The circuit diagram of the experimental set-up for obtaining the *V-I* characteristic of diode D1. The computer monitors the voltage and current via the ADC.

EXPERIMENT

The circuit diagram of the experiment is shown in Fig. 5.3. A 5-kilohm linear potentiometer (VR1) is used to vary the voltage across the *p-n* junction, and a 1-kilohm resistor is used to measure the current. Assuming the variation in resistance is negligible during operation, the current is then proportional to the p.d. across the resistor. Both the input p.d. and that across the 1kΩ resistor are monitored by two channels of the ADC, channel Ø and channel 1, their analogue values are converted into digital data bytes in rapid succession and read by the user port on the RML380Z microcomputer, and subsequently the software plots the *V–I* characteristic on the VDU.

Again, as for previous experiments in this series, multiple plots of characteristics can be obtained for the different types of *p-n* junction diodes available on the market. The complete experimental set up is shown in Fig. 5.4.

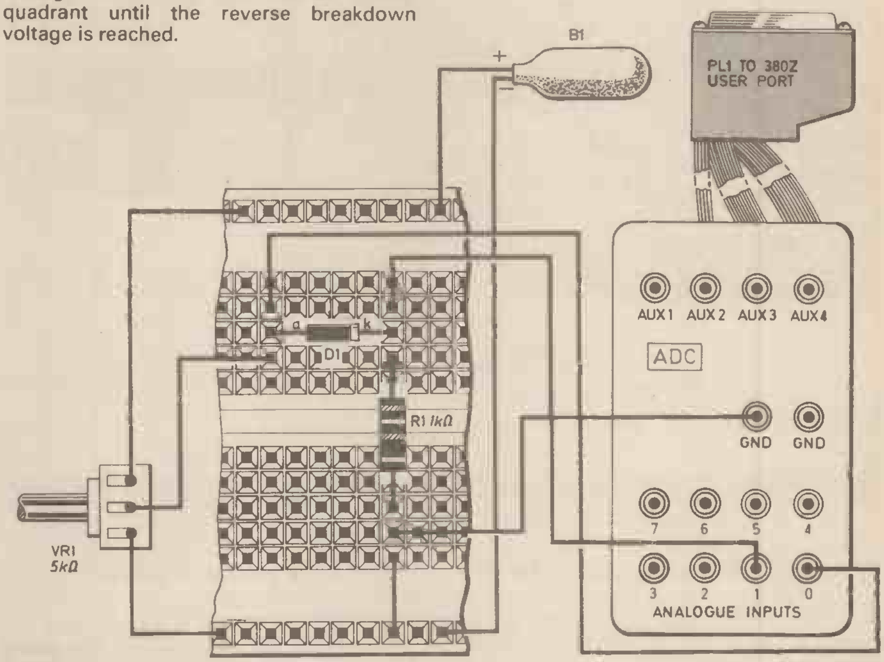


Fig. 5.4. The suggested solderless breadboard layout of the diode *V-I* characteristic experiment.

SOFTWARE

The program "Diode" initialises two of the channels, channel Ø and channel 1. The statement POKE 64511,Ø initialises channel Ø, followed by PEEK(64511) which then reads the bit pattern, corresponding to a data byte, at the user port. This is then immediately followed by:

```
POKE 64511,1
Y=PEEK(64511)
```

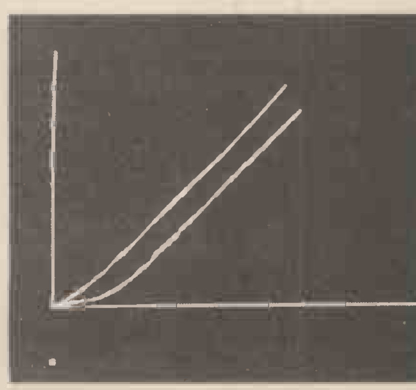
statements which initialise and read channel 1. Bearing in mind that in this experiment, two varying quantities are necessary for a plot, one of the input voltage and one of the output current through the *p-n* junction.

It should be pointed out that the POKE statements actually activate the pin numbers 5, 18 and 6 on the user port, which are connected to A_0, A_1 and A_2. These address the locations in the 8 × 8 RAM inside the 7581 chip, which contains the latest converted data bytes from each of the analogue inputs.

The statements:

```
POKE(&6ØØØ+A):REM
relocating milliamps
POKE(&64ØØ+A):REM
relocating volts
```

relocate the raw data to other memory locations prior to storage as a disk file. &6ØØØ is hexidecimal for location 24576, and A is the total number of readings taken by the computer during the course of the experiment, which is



A photograph of the plot obtained for a 1N4148 silicon diode. Note that only the forward biased quadrant is displayed as the ADC is unipolar (will only work with one polarity).

COMPUTER AIDED EXPERIMENTS SOFTWARE: EXP. 5

DIODE

```
10 REM:this programme plots the I-V
20 REM:characteristic of a P-N junction
30 A=0
40 POKE 64511,8
50 GRAPH 1
60 CALL"RESOLUTION",0,2
70 GOSUB 230
80 CALL"PLOT",0,0,3
90 POKE 64511,0
100 X=PEEK(64511):REM VOLTAGE
110 POKE 64511,1
120 Y=PEEK(64511):REM mAMPS
130 CALL "LINE",X*5,Y*5,3
140 PLOT 70,50,STR$(X)+" "
150 PLOT 60,50,STR$(Y)+" "
160 POKE (&6000+A),Y:REM STORING mAMPS
170 POKE(&6400+A),X:REM STORING VOLTS
180 A=A+1:REM NO.OF READINGS TAKEN
190 PRINT A:REM FINAL READING PRINTED
200 FOR N=1 TO 1000:NEXT:REM TIME DELAY
210 GOTO 90
220 REM FOLLOWING PLOT & LABEL X-Y AXIS
230 FOR Y=0 TO 191:CALL"LINE",0,Y,3:NEXT
240 FOR X=0 TO 319:CALL"LINE",X,0,3:NEXT
250 PLOT 1,1,"0":PLOT 1,10,"2mA"
260 PLOT 1,20,"4mA":PLOT 1,30,"6mA"
270 PLOT 1,40,"8mA":PLOT 1,50,"10mA"
280 PLOT 20,58,"PLOT OF I-V CURVE"
290 PLOT 20,55,"FOR P-N JUNCTION IN4148"
300 PLOT 20,1,"0.5V":PLOT 40,1,"1.0V"
310 PLOT 60,1,"1.5V":RETURN
```

STORE

```
10 CREATE£10,"DIODE.DAT"
20 FOR I=24576 TO (24576+35)
30 BYTE=PEEK(I)
40 PRINT£10,I;",";BYTE
50 NEXTI
52 FOR V=25600 TO (25600+35)
54 BYTE=PEEK(V)
56 PRINT £10,V;",";BYTE
58 NEXT V
60 CLOSE£10
70 REM:this programme stores the data
80 REM:to disk-file
```

POKER

```
10 OPEN£10,"DIODE.DAT"
20 FOR I=24576 TO (24576+39)
30 INPUT£10,ADDR,BYTE
40 POKE ADDR,BYTE
50 NEXT I
52 FOR V=25600 TO (25600+39)
54 INPUT£10,ADDR,BYTE
56 POKE ADDR,BYTE
58 NEXT V
60 CLOSE£10
70 REM:this programme repokes the data
80 REM:into memory from disk-file
```

GRAPH

```
10 REM:this programme replots the repoked
20 REM:results from previous programme
30 REM:X-READS VOLTS,Y-READS mA
40 REM:mA IS CHANNEL 1
50 REM:VOLTS IS CHANNEL 0
60 GRAPH 1
70 CALL"RESOLUTION",0,2
80 CALL"PLOT",0,0,3
90 GOSUB 180
100 FOR N=1 TO 18
110 X=PEEK(&6400+N)
120 Y=PEEK(&6000+N)
130 CALL "LINE",X*2,Y*2,3
140 NEXT N
150 CALL"LINE",PEEK(&6400+(N)),PEEK(&6000+(N)),0
160 CALL"LINE",0,0
170 END
180 FOR Y=0 TO 191:CALL"LINE",0,Y,3
190 NEXT Y
200 FOR X=0 TO 319:CALL"LINE",X,0,3
210 NEXT X
220 PLOT 1,1,"0":PLOT 1,10,"2mA"
230 PLOT 1,20,"4mA":PLOT 1,30,"6mA"
240 PLOT 1,40,"8mA":PLOT 1,50,"10mA"
250 PLOT 20,58,"Plot of I-V curve"
260 PLOT20,55,"for p-n junction,IN4148"
270 PLOT 20,1,"0.5V":PLOT 40,1,"1.0V"
280 PLOT 60,1,"1.5V":RETURN
```


printed on the VDU as the experiment is performed.

Locations beginning at &6000 hex (24576) relocate the milliamps, locations beginning &6400 hex (25600) relocate the volts. This is necessary in order to retrieve these data bytes when opening a data file on disk, when using the "Store" program.

The "Store" program opens a data file in the first program line by using the CREATE#10, command, followed by a FOR . . . NEXT loop from the beginning of the aforementioned memory locations from 24576 to (24576+35), where 35 is the number of readings originally taken in this example experiment.

The PRINT#10,I;",";BYTE statement now reads the memory locations specified by the variables in the FOR . . . NEXT loop, that is, from 24576 to (24576+35), and prints the location and the data byte contained therein to disk file.

The same format is used for locations 25600 to (25600+35). When using this program, a file name must be created in line 10, each time a new set of data is to be stored to disk, and the variable A, for number of readings must be changed in the FOR . . . NEXT loops to accommodate the number of readings taken.

Having followed these procedures, the computer can be turned off in the knowledge that all experimental data is stored as a disk file.

The next program called "Poker" reopens the created data file, using the OPEN#10, command. It then reads the data file in the same format as it was printed, that is, address (ADDR), data (BYTE), using the INPUT#10, command and POKE ADDR, BYTE re—POKE's the same data back into the same memory addresses. Hence all data is retrieved.

Finally the remaining program "Graph" simply reads these same memory locations and replots the same data on the VDU. This procedure, with slight modifications, is repeated for all experiments, so that a comprehensive set of data files is created with all results of experiments.

Theory shows that the relation between the junction voltage and current is as follows:

$$I = I_0(e^{11600V/T} - 1)$$

where I = forward current
I_0 = reverse saturation current
V = junction voltage
T = absolute temperature

Since the ADC is unipolar, only the forward biased portion shows on the VDU. This is obtained by twirling the 5kΩ potentiometer and as this is being done so the V–I curve is plotted by the RML380Z. The software comprises a suite of four programs, Diode, Store, Poker and Graph. Virtually the same programs are used throughout the remainder of the experiments.

To be continued

E.E. PROJECT KITS

Full Kits inc. PCBs, or veroboard, hardware, electronics, cases (unless stated). Less batteries.
If you do not have the issue of E.E. which includes the project – you will need to order the instruction reprint as an extra – 50p each. Reprints available separately 50p each + p&p 50p.

CONTINUITY TESTER DECK 83	£9.99
CHILDREN'S DISCO LIGHTS DECK 83	£8.42
NOVEL EGG TIMER DECK 83 inc. case	£10.24
SPEECH SYNTHESIZER FOR THE BBC MICRO Nov. 83 less cable + sockets	£21.98
MULTIMOD Nov. 83	£16.98
LONG RANGE CAMERA/FLASHGUN TRIGGER Nov. 83	£13.50
HOME INTERCOM less link wire Oct. 83	£14.38
IMMERSION HEATER TELL-TALE Oct. 83	£9.98
TEMPERATURE TRANSDUCER AMP Oct. 83	£14.87
SHORT WAVE RADIO less 'phones, Oct. 83	£25.63
Mono headphones extra	£3.36
ELECTRONIC PENDULUM Oct. 83 less wire & hardware for electromagnet	£17.98
DIGITAL TO ANALOGUE BOARD Oct. 83 less cable, case & connector	£19.98
HIGH POWER DAC DRIVER BOARD Oct. 83 less case	£12.52
A TO D CONVERTER FOR RM380Z Sept. 83 inc plug	£35.98
HIGH SPEED A TO D CONVERTER Sept 83 less cable & connector	£27.98
SIGNAL CONDITIONING AMP Sept 83 no case	£8.98
STORAGE 'SCOPE INTERFACE FOR BBC MICRO Aug 83 less software	£15.38
PEDESTRIAN CROSSING SIMULATION BOARD Aug 83 no case	£10.29
HIGH POWER INTERFACE BOARD Aug 83 no case	£10.38
CAR INTRUDER ALARM Aug 83	£16.98
TRI BOOST GUITAR TONE CONTROLLER July 83	£8.35
USER PORT I/O BOARD less cable + plug	£10.49
USER PORT CONTROL BOARD July 83 less cable + plug	£25.14
BINARY BANDIT GAME July 83 less case	£9.88
EPROM PROGRAMMER Jun. 83 less software, TRS80 £44.99 Genie	£45.73
ENVELOPE SHAPER Jun. 83 less case	£12.33
REAL TIME CLOCK May 83 less software and cases. Apple II £33.98 BBC £39.59 less power plug	
MODEL TRAIN CONTROLLER May 83	£27.17
GUITAR HEADPHONE AMPLIFIER May 83	£7.92
MW PERSONAL RADIO less case, May 83	£7.62
MOISTURE DETECTOR May 83	£5.46
CAR RADIO POWER BOOSTER April 83	£11.99
FUNCTION GENERATOR April 83	£45.98
FLANGER SOUND EFFECTS April 83	£24.17
NOVELTY EGG TIMER April 83 less case	£5.48
ZX SPECTRUM AMPLIFIER April 83	£9.87
DUAL POWER SUPPLY March 83	£59.38
BUZZ OFF March 83	£4.51
SPEECH PROCESSOR Feb. 83	£11.66
PUSH BIKE ALARM Feb. 83	£11.73
DOUBLE DICE Jan. 83	£11.90
ELECTRONIC V/I METER Dec. 82	£12.52
ZX TAPE CONTROL Nov. 82	£7.13
SINE WAVE GEN Oct. 82	£16.11
G. P. PRE-AMP Oct. 82	£6.09
LIGHTS ON ALERT Oct. 82	£4.68
CONTINUITY CHECKER Sept. 82	£5.47
SOUND SPLITTER Sept. 82	£17.35
SOUND RECOMBINER Sept. 82	£4.07
SCREEN WASH DELAY Sept. 82	£4.93
CB ROGER BLEEPER Aug. 82	£9.32
2-WAY INTERCOM July 82 no case	£4.52
ELECTRONIC PITCH PIPE July 82	£5.40
REFLEX TESTER July 82	£7.77
SEAT BELT REMINDER Jun 82	£4.10
EGG TIMER June 82	£5.44
CAR LED VOLTMETER less case. May 82	£3.18
V.C.O. SOUND EFFECTS UNIT Apr. 82	£12.71
CAMERA OR FLASH GUN TRIGGER Mar. 82 £13.65 less tripod bushes	
POCKET TIMER Mar. 82	£4.10
GUITAR TUNER Mar. 82	£17.19
SIMPLE STABILISED POWER SUPPLY Jan. 82	£26.98
MINI EGG TIMER. Jan. 82.	£4.40
SIREN MODULE Jan. 82 less speaker	£6.10
MODEL TRAIN CHUFFER Jan. 82	£8.98
SIMPLE INFRA RED REMOTE CONTROL Nov. 81	£18.70
EXPERIMENTER CRYSTAL SET Nov. 81 less aerial	£6.60
Headphones	£3.36 extra
CAPACITANCE METER Oct. 81	£25.81
SUSTAIN UNIT Oct. 81	£13.99
'POPULAR DESIGNS' Oct. 81	£00.00
TAPE NOISE LIMITER	£4.98
HEADS AND TAILS GAME	£2.75
CONTINUITY TESTER	£4.48
PHOTO FLASH SLAVE	£3.80
FUZZ BOX	£7.98
SOIL MOISTURE UNIT	£6.39
ICE ALARM	£8.70
0-12V POWER SUPPLY Sept. 81	£19.48
CMOS CAR SECURITY ALARM Sept. 81	£9.95
CMOS DIE Sept. 81	£8.80
CMOS METRONOME Aug. 81	£8.99
COMBINATION LOCK July 81 less case	£21.58
LIGHTS REMINDER AND IGNITION LOCATOR E.E. May 81	£6.26
SOIL MOISTURE INDICATOR E.E. May 81	£4.49
GUITAR HEADPHONE AMP E.E. May 81	£4.66
PHONE BELL REPEATER/BABY ALARM May 81	£6.15
INTERCOM April 81	£24.43
SIMPLE TRANSISTOR & DIODE TESTERS Mar. 81 Ohmeter version	£2.22
Led version	£2.98
LED DICE Mar. 81	£9.35
MODULATED TONE DOORBELL Mar. 81	£7.35
2 NOTE DOOR CHIME Dec. 80	£11.35
LIVE WIRE GAME Dec. 80	£12.87
GUITAR PRACTICE AMPLIFIER Nov. 80 £14.10 less case. Standard case extra	£3.88
SOUND TO LIGHT Nov. 80 3 channel	£23.40
TRANSISTOR TESTER Nov. 80	£12.80
AUDIO EFFECTS UNIT FOR WEIRD SOUNDS Oct. 80	£14.40
IRON HEAT CONTROL Oct. 80	£6.30
TTL LOGIC PROBE Sept. 80	£5.68
ZENER DIODE TESTER Jun. 80	£7.30
LIGHTS WARNING SYSTEM May 80	£5.20
BATTERY VOLTAGE MONITOR May 80	£5.66
CABLE & PIPE LOCATOR less coil former Mar. 80	£4.61
KITCHEN TIMER Mar. 80	£16.20
MICRO MUSIC BOX Feb. 80	£17.86
Case extra	£3.60
SLIDE/TAPE SYNCHRONISER Feb 80	£13.50
MORSE PRACTICE OSCILLATOR Feb. 80	£4.98
SPRING LINE REVERB UNIT Jan. 80	£27.20
UNIBOARD BURGLAR ALARM Dec. 79	£6.70
DARKROOM TIMER July 79	£3.20
ELECTRONIC CANARY Jun. 79	£6.40
TRANSISTOR TESTER Apr. 79	£5.38
MICROCHIME DOORBELL Feb. 79	£17.48
FUSE CHECKER Sept. 78	£2.54
SOUND TO LIGHT Sept. 78	£9.20
CAR BATTERY STATE INDICATOR less case Sept. 78	£2.29
R.F. SIGNAL GENERATOR Sept. 78	£31.20
IN SITU TRANSISTOR TESTER Jun. 78	£7.50
FLASHMETER less calc & diffuser May 78	£16.50
WEIRD SOUND EFFECTS GENERATOR Mar. 78	£6.20
AUDIO VISUAL METRONOME Jan. 78	£6.58
ELECTRONIC TOUCH SWITCH Jan. 78	£2.99
RAPID DIODE CHECK Jan. 78	£3.15
PHONE/DOORBELL REPEATER July 77	£8.20
ELECTRONIC DICE Mar. 77	£6.24

FUN WITH ELECTRONICS

Enjoyable introduction to electronics. Full of very clear full colour pictures and easy to follow text. Ideal for all beginners — children and adults. Only basic tools needed. 64 full colour pages cover all aspects — soldering — fault finding — components (identification and how they work).
Also full details of how to build 6 projects — burglar alarm, radio, games, etc. Requires soldering — 4 pages clearly show you how.
COMPONENTS SUPPLIED ALLOW ALL PROJECTS TO BE BUILT AND KEPT.
Supplied less batteries & cases.
FUN WITH ELECTRONICS,
COMPONENT PACK £16.48
BOOK EXTRA £1.25.
Book available separately.

MORE KITS AND COMPONENTS IN OUR LISTS

FREE PRICE LIST
Price list included with orders or send sae (9 x 4)
CONTAINS LOTS MORE KITS, PCBs & COMPONENTS

ELECTRONICS CATALOGUE

Illustrations, product descriptions, circuits all included. Up-to-date price list enclosed. All products are stock lines for fast delivery.

Send 80p in stamps or add 80p to order.
Free to Schools/Colleges requested on official letterhead.

MAGENTA ELECTRONICS LTD.

**EE13, 135 HUNTER ST.,
BURTON-ON-TRENT
STAFFS, DE14 2ST.
MAIL ORDER ONLY.**
0283 65435, Mon-Fri 9-5.
Access/Barclaycard (Visa) by phone or post.

Add 50p p&p to all orders.
Prices include VAT.
Sae all enquiries.
Official orders welcome.
OVERSEAS: Payment must be sterling.
IRISH REPUBLIC and BFPO: UK PRICES.
EUROPE: UK PRICES plus 10%.
ELSEWHERE: write for quote.

TEACH IN 84

NEW SERIES – ALL COMPONENTS IN STOCK NOW FOR FAST DELIVERY. All top quality components as specified by Everyday Electronics. Our kit comes complete with **FREE COMPONENT IDENTIFICATION SHEET.** Follow this educational series and learn about electronics – Start today.

MAGENTA'S TEACH IN KIT INCLUDES ALL OF THESE TOP QUALITY ITEMS: resistors, pot, capacitors, semiconductors, varicap diode, leds, ferrite rod, sockets, crystal earpiece, terminal blocks, wire and of course 2 breadboards. **PLUS A FREE COPY OF OUR CATALOGUE & PRICE LIST. AVAILABLE NOW – TEACH IN 84 KIT. £18.98 inc VAT. P + P 50p.** Send now for fast delivery. Reprints of previously published parts 50p each. Official school/college orders welcome.

BOOKS: ELECTRONICS & COMPUTING

First Book of Hi-Fi Loudspeaker Enclosures	95p
28 Tested Transistor Projects	£1.25
50 Projects Using IC CA3130	£1.25
A Practical Introduction to Digital IC's	£1.25
How to Build Advanced Wave Receivers	£1.95
Essential Theory for the Electronics Hobbyist	£1.95
50 (FET) Field Effect Transistor Projects	£1.75
How to Design and Make Your Own PCBs	£1.95
Fun with Electronics	£1.25
50 Simple L.E.D. Circuits	£1.50
How to Make Walkie-Talkies	£1.95
Projects in Opto-Electronics	£1.95
Mobile Discotheque Handbook	£1.35
Electronic Projects for Beginners	£1.95
Popular Electronic Projects	£1.95
Electronic Security Devices	£1.95
50 Circuits Using 7400 Series IC's	£1.75
Second Book of CMOS IC Projects	£1.50
Beginners Guide to Digital Techniques	95p
Transistor Radio Fault-Finding Chart	50p
Electronic Household Projects	£1.75
Electronic Test Equipment Construction	£1.75
Practical Computer Experiments	£1.75
Radio Control for Beginners	£1.75
Popular Electronic Circuits – Book 1	£1.95
Electronic Synthesiser Projects	£1.75
Electronic Projects Using Solar Cells	£1.95
International Transistor Equivalents Guide	£2.95
Simple L.E.D. Circuits – Book 2	£1.35
Easy Electronics – Crystal Set Construction	£1.75
Electronic Projects for Cars and Boats	£1.95
Popular Electronic Circuits – Book 2	£2.25
How to Identify Unmarked IC's	65p
Multi-Circuit Board Projects	£1.95
International Diode Equivalents Guide	£2.25
The Art of Programming the 1K ZX81	£1.95
The Art of Programming the 16K ZX81	£2.50
The Art of Prog the ZX Spectrum	£2.50
Semiconductor Data Book Newnes	£6.95
Basic Electronics. Theory and practice	£7.98
Microprocessors for Hobbyists	£4.75
Burglar Alarm Systems	£5.55
Electronics, Build and Learn	£3.90
Electronic Projects in Music	£3.90
Electronic Projects in Photography	£3.90
Electronic Projects for Home Security	£3.90
Questions and Answers Electronics	£2.70
Electronic Projects in the Car	£3.90
20 Solid State Projects Car and Garage	£4.80
110 Electronic Alarm Projects	£5.98
Computing is Easy	£4.25
ZX81 Users Handbook	£5.75
ZX81 Basic Book	£5.75
50 Cmos JC Projects	£1.35
52 Projects using IC741	£1.25
IC555 Projects	£1.95
IC LM3900 Projects	£1.35
Single IC Projects	£1.50
Electronic Games	£1.75
A Microprocessor Primer	£1.75
Remote Control Projects	£1.95
Electronic Music Projects	£1.75
Power Supply Projects	£1.75
VMOS Projects	£1.95
Digital IC Projects	£1.95
How to use Op-Amps	£2.25
Audio Projects	£1.95
Electronic Timer Projects	£1.95
Model Railway Projects	£1.95
IC Projects for Beginners	£1.95
Mini Matrix Board Projects	£1.95
Aerial Projects	£1.95
Modern Op-Amp Projects	£1.95
The Pre-Computer Book	£1.95
Electronic Science Projects	£2.25
More books in our price list	
Handbook of Integrated Circuits (IC's) Equiv. & Substitutes	£1.95
Solid State Short Wave Receivers for Beginners	£1.25
Beginners Guide to Building Electronic Projects	£1.95
First Book of Transistor Equivalents and Substitutes	£1.50
Second Book of Transistor Equivalents and Substitutes	£1.75
Chart of Radio, Electronic, Semi-conductor and Logic Symbols	50p
How to Build Your Own Metal and Treasure Locators	£1.95
50 Circuits Using Germanium, Silicon and Zener Diodes	£1.50
50 Projects Using Relays, SCR's and TRIACS	£1.95
Electronic Music and Creative Tape Recordings	£1.95
Practical Electronics Calculations and Formulae	£2.95
How to Build Your Own Solid State Oscilloscope	£1.95
Practical Construction of Pre-amps, Tone Controls, Filters & Attn.	£1.45
Beginners Guide to Microprocessors and Computing	£1.75
Counter, Driver and Numeral Display Projects	£1.75
An Introduction To BASIC Programming Techniques	£1.95
30 Solderless Breadboard Projects – Book 2	£2.25
How to Get Your Electronic Projects Working	£1.95
Practical Electronic Building Blocks – Book 1	£2.25
Practical Electronic Building Blocks – Book 2	£1.95
Elementary Electronics. Sladdin. Excellent theory and 35 constructional projects. Uses S-Dec. First steps to CSE level.	£3.98
Interfacing to Microprocessors and Microcomputers	£5.75

ZX81 edge connector **£2.25**
ZX81 edge plug **£1.50**
ZX Spectrum edge connector **£2.55**
SPO256 speech I.C. **£11.83**
47μH choke **£1.27**
AY3–8912 i.c. **£5.98**

INTRODUCING ELECTRONICS

INTRODUCING ELECTRONICS
6 part series E.E. Oct. 82–Mar. 83.
No soldering. Connections via screw terminal blocks. Very clear drawings showing how to connect components. Covers the basis of electronics.
Components (less batteries) parts 1–6 £6.98. Reprints 50p each extra.

30 SOLDERLESS BREADBOARD PROJECTS
Book 1 by R. A. Penfold

Clear verobloc layouts and circuit diagrams. Includes fuzz box, radio, metronomes, timers, transistor checker, switches, etc. Introduction gives basic information on components including resistors, capacitors, I.C.s, transistors, photocells etc. Ideal for beginners as well as those with some experience.
Complete kit includes verobloc, book and components (less batteries) £27.55. Less book £25.30. Book only £2.25.

ADVENTURES WITH DIGITAL ELECTRONICS

Entertaining and instructive. Includes details of some digital IC's and 8 projects: shooting gallery, 2 way traffic lights, electronic adder, computer space invaders game etc. No soldering.

Adventures with Digital Electronics Book £3.25

Component pack including Breadboards £45.50 less batteries

ADVENTURES WITH MICROELECTRONICS

Similar to 'Electronics' below. Uses I.C.s. Includes dice, electronic organ, doorbell, reaction timer, radio etc. Based on Bimboard 1 bread board.
Adventures with Microelectronics **£3.20**
Component pack £34.64 less battery.

ADVENTURES WITH ELECTRONICS by Tom Duncan

An easy to follow book suitable for all ages. Ideal for beginners. No soldering, uses an S-Dec Breadboard. Gives clear instructions with lots of pictures. 16 projects — including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-Dec breadboard and all the components for the projects.
Adventures with Electronics £2.85. Component pack £20.98 less battery.

Security

BURGLAR ALARM EQUIPMENT. Free catalogue. C.W.A.S. Ltd., 0274-308920, showrooms open 9-5, Mon-Sat.

SECURITY Alarm Systems

FREE COMPREHENSIVE CATALOGUE!

- *LOWEST DISCOUNT PRICES*
- *HIGHEST QUALITY EQUIPMENT*
- *FREE DIY DESIGN GUIDE*
- *FULLY ILLUSTRATED*
- *MICROCHIP CIRCUITRY*
- *QUICK DESPATCH SERVICE*
- *FULL INSTRUCTIONS*

SEND SAE OR PHONE

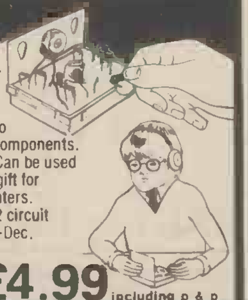
C-TEC SECURITY, Dept EE,
60 Market St, Wigan WN1 1HX
Telephone (0942) 42444

Trade Enquires Welcome

Miscellaneous

OSSCILLASCOPE TELEQUIPMENT D55A dual beam delayed timebase £165, Tektronix 575 transistor curve tracer £155, Lambda dual regulated power supply LPD-423A-FM £85. Crowthorne 773774.

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.

£4.99 including p & p

EVERYDAY ELECTRONICS and computer PROJECTS

Reach effectively and economically to-days enthusiasts anxious to know of your products and services through our semi-display and classified pages. Semi-display spaces may be booked at £7·80 per single column centimetre (minimum 2·5cm). The prepaid rate for classified advertisements is 33 pence per word (minimum 12 words), box number 60p extra. All cheques, postal orders, etc., to be made payable to

Receivers & Components

COMPONENTS & EQUIPMENT – 1984 Catalogue 70p + 20p P&P. Callers: 18 Victoria Road, TAMWORTH. 369 Alumrock Road, BIRMINGHAM. 103 Coventry Street, KIDDERMINSTER. Express Mail Order Service. LIGHTNING ELECTRONICS, PO Box 8, Tamworth, Staffs.

RESISTOR PACKS FOR ALL PROJECTS

¼ watt carbon film resistors 5% 1 ohm to 10M E24 series. Packs of 10 each value (1690 resistors) £12.50. Your choice of quantities/values 100 for £1.00. VAT and Post Free.

GORDON HALLETT
20 Bull Lane, Maiden Newton,
Dorchester, Dorset DT2 0BQ.

TURN YOUR SURPLUS capacitors, transistors etc., into cash. Contact Coles Harding & Co., 103 South Brink Wisbech. Cambs. 0945-584188. Immediate settlement.

AERIAL BOOSTERS

Next to the set fitting

B45H/G-UHF TV, gain about 20dbs, Tunable over the complete UHF TV band. PRICE £8.70.

BII-VHF/FM RADIO, gain about 14dbs, when on the off position connects the aerial direct to the radio. £7.70.

All Boosters we make work off a PP3/006p/6F22 type battery or 8v to 18v DC. P&P 30p PER ORDER

ELECTRONIC MAILORDER LTD, 62 Bridge St, Ramsbottom, Lancs BL0 9AG. Tel (070682) 3036

Access/Visa Cards Welcome — SAE Leaflets

ELECTRONIC COMPONENTS MERSEYSIDE, Myca Electronics, 2 Victoria Place, Seacombe Ferry, Wallasey, L44 6NR. 051-638 8647.

500 SMALL COMPONENTS including TTL transistors £2.50, 7lbs or 10lbs assorted components £5.00/£6.50. Fifty 74 series I.Cs on panel £2.20. Post Paid. J. W. BLANSHARD, 2 Barnfield Crescent, Sale, Cheshire, M33 1NL.

BUMPER BOX OF BITS

WOW!!! We've got so many components in stock, we can't possibly list them all!!! – So buy a box, in it you'll find resistors, capacitors, displays, switches, panels with transistors, diodes, IC's etc, coils, pots . . . and so on. All modern parts – guaranteed at least 1000 items, minimum weight 10lbs. ONLY £8.50.

PSU PANEL

Stabilized 5v, variable ±0.5V. Regulation 1% Max. current 2A. Will take AC I/P up to 15V, or DC I/P up to 24V. Panel 140 ×35mm containing all components except series reg. transistor which is supplied separately. PCB stand-offs, included. ONLY £3.95. Heatsink 75p; transformer £5.00

RESISTOR PACK

All sorts – everything from ⅛th to 10W. Carbon, Film, W/W, Oxide, PCB, etc. 2000 resistors – yes, 2000!!! For only £4.95.

SWITCH PACK

Slide (up to 9 way), push button banks, push types – a total of 50 switches for only £3.95.

All prices include VAT and Post/Packing.
Send SAE for latest lists.
ELECTRONICS WORLD
1d Dews Road, Salisbury, Wilts, SP2 7SN

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 . . . .
. . . .
. . . .

EVERYDAY ELECTRONICS
Classified Advertisement Dept., Room 2612, King's Reach Tower, Stamford Street, London SE1 9LS
Telephone 01-261 5942
Rate:
33p 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. 2/84

AT YOUR SERVICE

Everyday Electronics and Computer Projects and crossed "Lloyds Bank Ltd." Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Department, Everyday Electronics and Computer Projects, Room 2612, IPC Magazines Limited, King's Reach Tower, Stamford St., London SE1 9LS. (Telephone 01-261 5942).

INDEX TO ADVERTISERS

T.V. SOUND TUNER

SERIES II

BUILT AND TESTED

In the cut-throat world of consumer electronics, one of the questions designers apparently ponder over is "Will anyone notice if we save money by chopping this out?" In the domestic TV set, one of the first casualties seems to be the sound quality. Small speakers and no tone controls are common and all this is really quite sad, as the TV companies do their best to transmit the highest quality sound. Given this background a compact and independent TV tuner that connects direct to your Hi-Fi is a must for quality reproduction. The unit is mains-operated.

COMPLETE WITH CASE

£26.50 + £2.00 p&p.

This TV SOUND TUNER offers full UHF coverage with 5 pre-selected tuning controls. It can also be used in conjunction with your video recorder. Dimensions: 10½"x 7½"x 2½".

PRACTICAL ELECTRONICS STEREO CASSETTE RECORDER KIT

COMPLETE WITH CASE

ONLY £31.00 plus £2.75 p&p.

• NOISE REDUCTION SYSTEM. • AUTO STOP. • TAPE COUNTER. • SWITCHABLE E.Q. • INDEPENDENT LEVEL CONTROLS. • TWIN V.U. METER. • WOW & FLUTTER 0.1%. • RECORD/PLAYBACK I.C. WITH ELECTRONIC SWITCHING. • FULLY VARIABLE RECORDING BIAS FOR ACCURATE MATCHING OF ALL TYPES.

Kit includes tape transport mechanism, ready punched and back printed quality circuit board and all electronic parts, i.e. semiconductors, resistors, capacitors, hardware, top cover, printed scale and mains transformer. You only supply solder & hook-up wire. Featured in April P.E. reprint 50p. Free with kit.

STEREO TUNER KIT

SPECIAL OFFER! £13.95 + £2.50 p&p.

This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with P.E. (July '81). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF System.

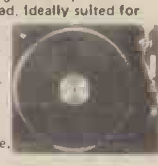
FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM-ferrite rod, FM-75 or 300 ohms. Stabilised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification. Front scale size 10½"x 2½" approx. Complete with diagram and instructions.

BSR RECORD DECKS

3 speed, manual, auto, setdown; with auto return.

Fitted with viscous damped cue, tubular aluminium counter-weighted arm, fitted with stereo ceramic head. Ideally suited for home or disco use:

£17.50 +£1.75 p&p.



Auto Changer model — takes up to six records with manual override. Also supplied with stereo ceramic cartridge.

£12.95 +£1.75 p&p.

PLINTH to suit BSR Record Player Deck (with cover). Size 16½"x 14¾"x 2¾". Cover size: £14½"x 13½"x 3½". Due to fragile nature, Buyer collect only. Price: £8.95.

125W HIGH POWER AMP MODULES

The power amp kit is a module for high power applications - disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, result, a high powered rugged unit. The PC board is back printed, etched and ready to drill for ease of construction and the aluminium chassis is preformed and ready to use. Supplied with all parts, circuit diagrams and instructions.

SPECIFICATIONS: Max. output power (RMS): 125 W. Operating voltage (DC): 50 - 80 max. Loads: 4 - 16 ohm. Frequency response measured @ 100 watts: 25Hz - 20KHz. Sensitivity for 100w: 400mV @ 47K. Typical T.H.D. @ 50 watts, 4 ohms: 0.1%. Dimensions: 205x90 and 190x36mm.

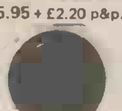
ACCESSORIES: Stereo/mono mains power supply kit with transformer: £10.50 plus £2.00 p&p.

KIT **£10.50** +£1.15 p&p.

BUILT **£14.25** +£1.15 p&p.

HI-FI SPEAKER BARGAINS

AUDAX 8" SPEAKER £5.95 + £2.20 p&p.



High quality 40 watts RMS bass/mid. Ideal for either HiFi or Disco use this speaker features an aluminium voice coil and a heavy 70mm dia. magnet. Freq. Res.: 20Hz to 7kHz. Imp.: 8 ohms.

AUDAX 40W FERRO-FLUID HI-FI TWEETER Freq. res.: 5KHz - 22KHz. Imp.: 8 ohms. 60mm sq. £5.50 +60p p&p.

GOODMANS TWEETERS 8 ohm soft dome radiator tweeter (3¾"sq) for use in systems up to 40W. £3.95 ea + £1 p&p. £6.95 pr +£1.50.

MONO MIXER AMP

Ideal for halls and clubs.

£45.00 +£2 p&p.

50 Watt, six individually mixed inputs for 2 pickups (Cer. or mag), 2 moving coil microphones and 2 auxiliary for tape tuner, organs etc. Eight slider controls — 6 for level and 2 for master bass and treble, 4 extra treble controls for mic. and aux. inputs. Size: 13¼"x 6½"x 3¾" app. Power output 50 W RMS (cont.) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.

All mail to: 21B HIGH ST, ACTON W3 6NG. Callers welcome from 9.30 – 5.30. Half day Wednesday.

Note: Goods despatched to U.K. postal addresses only. All items subject to availability. Prices correct at 30/11/83 and subject to change without notice. Please allow 14 working days from receipt of order for despatch. RTVC Limited reserve the right to update their products without notice. All enquiries send S.A.E. Telephone or mail orders by ACCESS welcome

CALLERS TO: 323 EDGWARE ROAD, LONDON W2. Telephone: 01-723 8432. (5 minutes walk from Edgware Road Tube Station) Now open 6 days a week 9 – 5.30. Prices include VAT.

RTVC

COMPUTER LINK

DIL PLUGS (Headers) IDC

Pins	
14	.90
16	£1.00
24	£1.40
40	£2.15

IDC P.C.B. PLUGS

10-way	.85
16-way	£1.20
20-way	£1.35
26-way	£1.60
34-way	£1.95
40-way	£2.00
50-way	£2.25
60-way	£2.60

IDC SOCKET CONNECTORS

2 Row	
10-way	.80
14-way	.90
16-way	£1.00
20-way	£1.20
26-way	£1.45
34-way	£1.60
40-way	£1.85
50-way	£2.00
60-way	£2.25

CARD EDGE CONNECTORS IDC

Female	
10-way	£1.20
16-way	£1.60
20-way	£1.90
26-way	£2.40
34-way	£3.10
40-way	£3.40
50-way	£3.85
60-way	£4.80

IDC D CONNECTORS

	Male	Female
9-way	£2.70	£3.20
15-way	£3.20	£3.70
25-way	£3.80	£4.45
37-way	£5.90	£6.80

IDC SHROUDED HEADERS WITH EJECTING LOCKING ARMS

	Straight	Right Angle
10-way	.85	.90
14-way	£1.00	£1.20
16-way	£1.25	£1.45
20-way	£1.40	£1.60
26-way	£1.70	£1.95
34-way	£2.00	£2.30
40-way	£2.15	£2.45
50-way	£2.30	£2.65
60-way	£2.45	£2.85

IDC AMPHENOL PLUGS

24-way	£5.00
36-way	£5.20

EDGE CONNECTORS

23-way (ZX81)	£1.85
28-way (Spectrum)	£2.10

RIBBON CABLE (Price per foot)

	Grey	Rainbow
9-way	.13	.24
10-way	.15	.28
14-way	.18	.32
15-way	.20	.36
16-way	.22	.40
20-way	.30	.50
24-way	.36	.60
25-way	.40	.65
26-way	.45	.70
34-way	.60	.80
37-way	.65	.85
40-way	.70	.90
50-way	.95	£1.25
60-way	£1.10	£1.40
64-way	£1.15	£1.50

D CONNECTORS (Solder Bucket)

	Male	Female
9-way	.75	£1.00
15-way	.95	£1.50
25-way	£1.50	£1.90
37-way	£2.40	£3.25

HOODS .95

IDC 25-WAY D CONN

Jumper Lead Ribbon Cable Assembly

18" long Single End Mle	£4.65
18" long Single End Fmle	£5.10
36" long Dbl Ended M/M	£9.75
36" long Dbl Ended F/F	£10.00
36" long Dbl Ended M/F	£9.85

DIL PLUG HEADERS

Jumper Leads Ribbon Cable Assembly

Single ended lead:

Length	14 Pin	16 Pin	24 Pin	40 Pin
24"	£1.35	£1.55	£2.30	£3.20
Double ended leads:				
6"	£1.80	£2.00	£2.90	£3.25
12"	£1.90	£2.10	£3.10	£4.85
24"	£2.00	£2.25	£3.40	£5.30
36"	£2.25	£2.45	£3.65	£5.85

Z80A CPU	£2.95
Z80A CTC	£2.55
Z80A DART	£5.45
Z80A PIO	£2.70
ZN424E	£1.25
ZN425E	£3.40
ZN426E	£2.95
ZN427E	£5.95

ANY COMBINATION OF LEAD MADE TO ORDER

IDC JUMPERS 36" SINGLE ENDED

Ways	2 Row Socket	Card Edge	PCB
10	£1.35	£1.95	£1.45
14	£1.70	—	—
16	£1.90	£2.45	£1.75
20	£2.20	£2.95	£1.95
26	£2.95	£3.85	£2.95
34	£3.40	£4.35	£3.35
40	£4.50	£5.65	£4.20
50	£5.25	£6.85	£5.20
60	£6.25	£8.25	£6.20

ASSORTMENTS

C12 – C14 – C15 Cassettes	.52 ea.
(ZX81) 23-way Plug Board	£1.25
(SPECTRUM) 28-way Plug Board	£1.50

COMPUTER LEADS

BBC Computer to Printer 2 metre lead	£12.75
BBC or ORIC 7-pin DIN plug to 2 x3.5mm Jack to 1 x2.5mm Jack 1 metre lead	£2.25
5-Pin Domino Plug	.50
6-Pin DIN Plug	.50
7-Pin DIN Plug	.50

LIGHT PEN

Light Pen for ZX80/81 SPECTRUM enables you to produce high resolution drawings on your own T.V. screen.

ONLY £14.75

NO HIDDEN EXTRAS – PRICES INCLUSIVE – FREE P&P – C.W.O.

COMPUTER LINK 8 Ranworth Avenue, Hoddesdon, Herts.

Tel. 0992-466832/462371.

ELECTROVALUE

Your SPECIALIST SUPPLIERS for SOLDER TOOLS

From a simple 15 watt model to a precision temperature controlled iron, we stock solder irons to suit all manual requirements together with supporting stocks of bits, desolder tools, materials, etc.

ANTEX

C.240 – 15W/240V:
CSCN – 15W/240V
CS – 17W/240V
CSBP – 17W/240V + 13A plug
XS – 25W/240V
XSBP – 25W/240V + 13A plug

Replacement bits from 3/32" to ¼"

De-solder heads, stands, elements and handles.

ERSA

'Sprint' high speed iron: 80/150W, 240V. Heats in 10 seconds!

ORYX

Temperature controlled solder iron TC82 45W/240V with scale.

Oryx 50 – 50 watt version of above.

Standard types

Oryx 30 – 30W/240V
Viking – 27W/240V
Oryx M3 – 17 watts, 12 volts.

A wide range of replacement tips available for all models, also tips from 0.8 to 6.4mm dia. and flat tips.

Oryx safety stand.
Oryx de-solder tool.

MINIATURE SOLDER STATION

SOLDER and DE-SOLDER BRAID SOLDER in many grades.

Please mention E.E. when sending for latest free A-Z list.

BRITAIN'S LEADING QUALITY COMPONENT SUPPLIERS - SEND FOR FREE 32 PAGE A-Z LIST

ATTRACTIVE DISCOUNTS · FREE POSTAGE · GOOD SERVICE & DELIVERY

ELECTROVALUE LTD 28 St. Judes Rd., Englefield Green, Egham, Surrey TW20 0HB.

(0784) 33603; Telex 264475. North – 680 Burnage Lane, Manchester. 061-432 4945.

EV Computing Shop –
700 Burnage Lane, Manchester. 061-431 4866.

ACCESS AND BARCLAYCARD Phoned Orders Welcome

5

MULLARD SPEAKER KITS

Purposefully designed 40 watt R.M.S. and 30 watt R.M.S. 8 ohm speaker systems recently developed by MULLARD'S specialist team in Belgium. Kits comprise Mullard woofer (8" or 5") with foam surround and aluminium voice coil. Mullard 3" high power domed tweeter. B.K.E. built and tested crossover based on Mullard circuit, combining low loss components, glass fibre board and recessed loudspeaker terminals. SUPERB SOUNDS AT LOW COST. Kits supplied in polystyrene packs complete with instructions.

8" 40W system — recommended cabinet size 240 × 216 × 445mm
Price £14.90 each + £2.00 P & P.

5" 30W system — recommended cabinet size 160 × 175 × 295mm
Price £13.90 each + £1.50 P 8 P.

Designer approved flat pack cabinet' kits, including grill fabric. Can be finished with iron on veneer or self adhesive vinyl etc.
8" system cabinet kit £8.00 each + £2.50 P & P.
5" system cabinet kit £7.00 each + £2.00 P & P.

OMP 80 LOUDSPEAKER

The very best in quality and value.

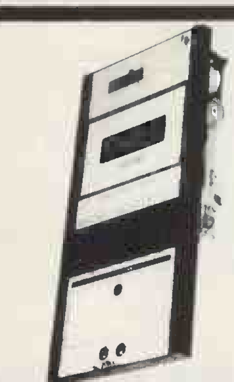
Ported tuned cabinet in hard-wearing black vynide with protective corners and carry handle. Built and tested, employing 10in British driver and Piezo tweeter. Spec: 80 watts RMS; 8 ohms; 45Hz-20KHz; Size: 20in x 15in x 12in; Weight: 30 pounds.

Price: **£49.00 each**
£90 per pair
Carriage: **£5 each £7 per pair**

BK ELECTRONICS

Prompt Deliveries
VAT inclusive prices
Audio Equipment
Test Equipment
by
Thandar
and
Leader

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. Autostop. **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 × 11½in. Clearance required under top panel 2½in. 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) £3.50.

PANTEC

HOBBY KITS. Proven designs including glass fibre printed circuit board and high quality components complete with instructions.

FM MICROTRANSMITTER (BUG) 90/105MHz with very sensitive microphone. Range 100/300 metres. 57 x 46 x 14mm (9 volt) **Price: £7.99p**

DIGITAL THERMOMETER -9.9°C to +99.9°C. LED display. Complete with sensor. 70 x 70 mm (9 volt) **Price: £27.60p**

3 WATT FM TRANSMITTER 3 WATT 85/115MHz varicap controlled. professional performance. Range up to 3 miles 35 x 84 x 12 mm (12 volt) **Price: £12.49p**

SINGLE CHANNEL RADIO CONTROLLED TRANSMITTER/RECEIVER 27MHZ Range up to 500 metres. Double coded modulation. Receiver output operates relay with 2amp/240 volt contacts. Ideal for many applications. Receiver 90 x 70 x 22 mm 9/12 volt) **Price: £16.49** Transmitter 80 x 50 x 15 mm (9/12 volt) **Price £10.29** P&P All Kits +50p. S.A.E. for complete list.

3 watt FM Transmitter

BSR P256 TURNTABLE

P256 turntable chassis ● S shaped tone arm ● Belt driven ● Aluminium platter ● Precision calibrated counter balance ● Anti-skate (bias device) ● Damped cueing lever ● 240 volt AC operation IHz) ● Cut-out template supplied ● Completely manual arm. This deck has a completely manual arm and is designed primarily for disco and studio use where all the advantages of a manual arm are required.

Price £31.35 each. £2.50 P&P

LOUDSPEAKERS POWER RANGE

THREE QUALITY POWER LOUDSPEAKERS (15", 12" and 8" See 'Photo). **Ideal for both Hi-Fi and Disco applications.** All units have attractive cast aluminium (ground finish) fixing escutcheons. **Specification and Prices.**

15" 100 watt R.M.S. Impedance 8 ohms. 50 oz. magnet. 2" aluminium voice coil. Res. Freq. 20 Hz. Freq. Resp. to 2.5KHz. Sens. 97dB. Price: £34.00 each + £3.00 P&P

12" 100 watt R.M.S. Impedance 8 ohms. 50 oz. magnet. 2" aluminium voice coil. Res. Freq. 25Hz. Freq Resp. to 4 KHz. Sens. 95dB. Price: £24.50 each + £3.00 P&P

8" 50 watt R.M.S. Impedance 8 ohms. 20 oz. magnet. 1½" aluminium voice coil. Res. Freq. 40Hz. Freq. Resp to 6 KHz. Sens. 92dB. Black Cone. Price: £9.50 each. Also available with black protective grille Price: £9.99 each. P&P £1.50.

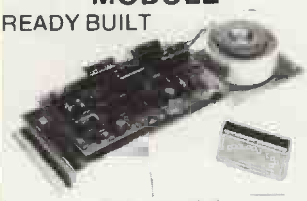
12" 85 watt R.M.S. McKENZIE C1285GP (LEAD GUITAR, KEYBOARD, DISCO) 2" aluminium voice coil, aluminium centre dome, 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 6.5KHz., Sens, 98dB. **Price: £23.00** + £3 carriage.

12" 85 watt R.M.S. McKENZIE C1285TC (P.A., DISCO) 2" aluminium voice coil. Twin cone. 8 ohm. imp., Res. Freq. 45HZ., Freq. Resp. to 14KHz. **Price £23 + £3** carriage.

15" 150 watt R.M.S. McKENZIE C15 (BASS GUITAR, P.A.) 3" aluminium voice coil. Die.cast chassis. 8 ohm imp., Res. Freq. 40Hz., Freq. Resp. to 4KHz. **Price: £47 + £4** carriage.

OMP POWER AMPLIFIER MODULE

READY BUILT



New model.
Improved specification

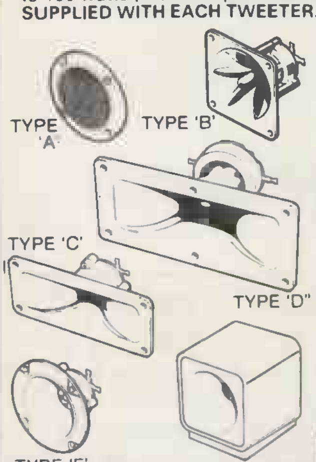
NEW OMP100 Mk.II POWER AMPLIFIER MODULE Power Amplifier Module **complete** with integral heat sink, toroidal transformer power supply and glass fibre p.c.b. assembly. Incorporates drive circuit to power a compatible LED Vu meter. New *improved specification makes this amplifier ideal for P.A., Instrumental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

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

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

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' (KSN2036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-fi speakers. **Price £4.29 each.**

TYPE 'B' (KSN1005A) 3½" super horn. For general purpose speakers, disco and P.A. systems etc. **Price £4.99 each.**

TYPE 'C' (KSN6016A) 2" × 5" wide dispersion horn. For quality Hi-fi systems and quality discos etc. **Price £5.99 each.**

TYPE 'D' (KSN1025A) 2" × 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-fi systems and quality discos. **Price £7.99 each.**

TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-fi monitor systems etc. **Price £4.99 each.**

TYPE 'F' (KSN1057A) Cased version of type 'E'. Free standing satellite tweeter. Perfect add on tweeter for conventional loudspeaker systems. **Price £10.75 each**

P&P 20p ea. (or SAE for Piezo leaflets).

HOME PROTECTION SYSTEM

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

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

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

Outdoor Alarm — Electronic swept freq. siren. 98dB output. Housed in a tamper-proof heavy duty metal case.

Both the control unit and outdoor alarm contain rechargeable batteries which provide full protection during mains failure. Power requirement 200/260 Volt AC 50/60Hz. Expandable with door sensors, panic buttons etc. Complete with instructions

SAVE £128 Usual price £228.85

BKE's PRICE £99.p&p£4

SAE for colour brochure

STEREO DISCO MIXER

STEREO DISCO MIXER with 7 band graphic equaliser and 10 segment L.E.D. Vu Meters. Many outstanding features.
5 Inputs with individual fader controls:—
2 Mag. turntable, 2 Aux. plus Mic. with talk-over switch. Headphone monitor. Master output control with Hi-Low outputs. Compatible with our OMP Power Amplifiers.
Size: 360 x 200 x 120 mm. Supply 240V/50Hz AC.

Price £99.99 + £3.00 P&P.

B.K. ELECTRONICS

UNIT 5, COMET WAY, SOUTHEND-ON-SEA, ESSEX, SS2 6TR

★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Sales Counter. ★
★ All items packed where applicable in special energy absorbing PU foam. ★ Please phone 0702 527572 ★

Full-travel, full size

KEYBOARD

Simply plugs into expansion port on your

SPECTRUM

KIT ONLY £39.95
READY-BUILT £44.95
Case Included in both prices

- ★ *Single-key selection of all major multi-key functions.*
- ★ *Plugs directly into Spectrum expansion port and extends port for other peripherals.*
- ★ *Can accept Atari-type joysticks (optional extra).*
- ★ *Absolutely no soldering or dismantling of Spectrum.*
- ★ *Available in kit-form or ready-built.*

The kit is sold in three parts — the Keyboard Main Kit which allows you to make your own arrangements for connection to the Spectrum — the Adaptor Kit which contains the extension board and socket for the expansion port and the cable between the extension board and the keyboard — and the Case Kit which includes all the necessary mounting hardware.

Order As	**LK29G (Keyboard Main Kit)**	**Price £28.50**
	LK30H (Adaptor Kit)	**Price £6.50**
	XG35Q (Case)	**Price £4.95**

Full construction details in Projects Book 9.

Also available ready-built for direct connection and including case.
Order As XG36P (Spectrum Keyboard) Price £44.95

Maplin's Fantastic Projects

Full details in our project books. Price 70p each.

In Book 1 (XA01B) 120W rms MOSFET Combo-Amplifier • Universal Timer with 18 program times and 4 outputs • Temperature Gauge • Six Vero Projects.

In Book 2 (XA02C) Home Security System • Train Controller for 14 trains on one circuit • Stopwatch with multiple modes • Miles-per-Gallon Meter.

In Book 3 (XA03D) ZX81 Keyboard with electronics • Stereo 25W MOSFET Amplifier • Doppler Radar Intruder Detector • Remote Control for Train Controller.

In Book 4 (XA04E) Telephone Exchange for 16 extensions • Frequency Counter 10Hz to 600 MHz • Ultrasonic Intruder Detector • I/O Port for ZX81 • Car Burglar Alarm • Remote Contol for 25W Stereo Amp.

In Book 5 (XA05F) Modem to European standard • 100W 240V AC Inverter • Sounds Generator for ZX81 • Central Heating Controller • Panic Button for Home Security System • Model Train Projects • Timer for External Sounder.

In Book 6 (XA06G) Speech Synthesiser for ZX81 & VIC20 • Module to Bridge two of our MOSFET amps to make a 350W Amp • ZX81 Sound on your TV • Scratch Filter • Damp Meter • Four Simple Projects

In Book 7 (XA07H) Modem (RS232) Interface for ZX81/VIC20 • Digital Enlarger Timer/Controller • DXers Audio Processor • Sweep Oscillator • CMOS Crystal Calibrator.

In Book 8 (XA08J) Modem (RS232) Interface for Dragon and Spectrum • Synchime • I/O Ports for Dragon • Electronic Lock • Minilab Power Supply • Logic Probe • Doorbell for the Deaf.

In Book 9 (XA09K) Keyboard with electronics for ZX Spectrum • Infra-Red Intruder Detector • Multimeter to Frequency Meter Converter • FM Radio with no alignment • Hi-Res Graphics for ZX81 • Speech Synthesiser for Oric • VIC Extendiboard •ZX81 ExtendiRAM • Dynamic Noise Limiter for Personal Cassette Players • TTL Levels to Modem/RS232 Converter • Logic Pulser • Psuedo-Stereo AM Radio • Ni-Cad Charger Timer • Adder-Subtractor • Syndrums' Interface • Microphone Pre-Amp Limiter.

1984 CATALOGUE

A massive 480 big pages of description, pictures and data and now with prices on the page. The new Maplin catalogue is the one book no constructor should be without. Now includes new Heathkit section. On sale in all branches of W.H. Smith. Price £1.35 — It's incredible value for money. Or send £1.65 (including p & p) to our mail-order address.

Great Projects From E&MM

Our book "Best of E&MM Projects Vol. 1" brings together 21 fascinating and novel projects from E&MM's first Year.

Projects include Harmony Generator, Guitar Tuner, Hexadrum, Syntom, Auto Swell, Partylite, Car Aerial Booster, MOS-FET Amp and other musical, hi-fi and car projects.

Order As XH61R. Price £1.

THE MAPLIN MODEM KIT

Exchange programs with friends, leave or read messages from the various Billboard services, talk to computer bureaux, or place orders and check stock levels on Maplin's Cashtel service. A Maplin Modem will bring a whole new world to your computer and vastly increase its potential.

Now you can exchange data with any other computer using a 300 baud European standard (CCITT) modem and because the Maplin Modem uses this standard, you could talk to any one of tens of thousands of existing users.

Some computers need an interface and we have kits for the ZX81, VIC20/Commodore 64, Dragon and Spectrum and shortly Atari, whilst the BBC needs only a short program which is listed in Projects Book 8.

A Maplin Modem will add a new dimension to your hobby.

Order As LW99H (Modem Kit) excluding case. Price £39.95.
YK62S (Modem Case) Price £9.95.

Full construction details in Projects Book 5.

Post this coupon now for your copy of the 1984 catalogue. Price £1.35 + 30p post and packaging. If you live outside the U.K. send £2.20 or 11 International Reply Coupons. I enclose £1.65

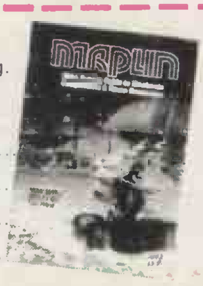
Name: ....

Address: ....

....

....

EE284



MAPLIN ELECTRONIC SUPPLIES LTD

Mail Order: P.O. Box 3, Rayleigh, Essex SS6 8LR. Tel: Southend (0702) 552911 • Shops at: 159-161 King Street, Hammersmith, London W6. Tel: 01-748-0926. • 8 Oxford Road, Manchester. Tel: 061-236-0281. • Lynton Square, Perry Barr, Birmingham. Tel: 021-356-7292. • 282-284 London Road, Westcliff-on-Sea, Essex. Tel: 0702 554000. • 46-48 Bevois Valley Road, Southampton. Tel: 0703 25831.
All shops closed all day Monday.
All prices include VAT and carriage. Please add 50p handling charge to orders under £5 total value (except catalogue).

Despatch by return of post where goods available.