198 MOTT

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Everyday ELECTRONICS

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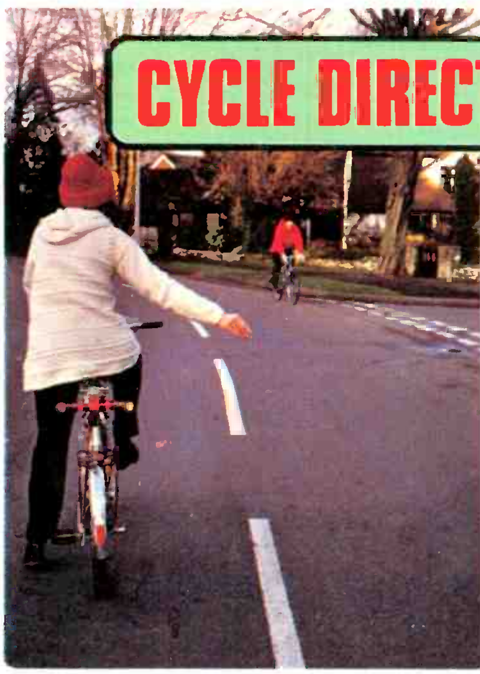
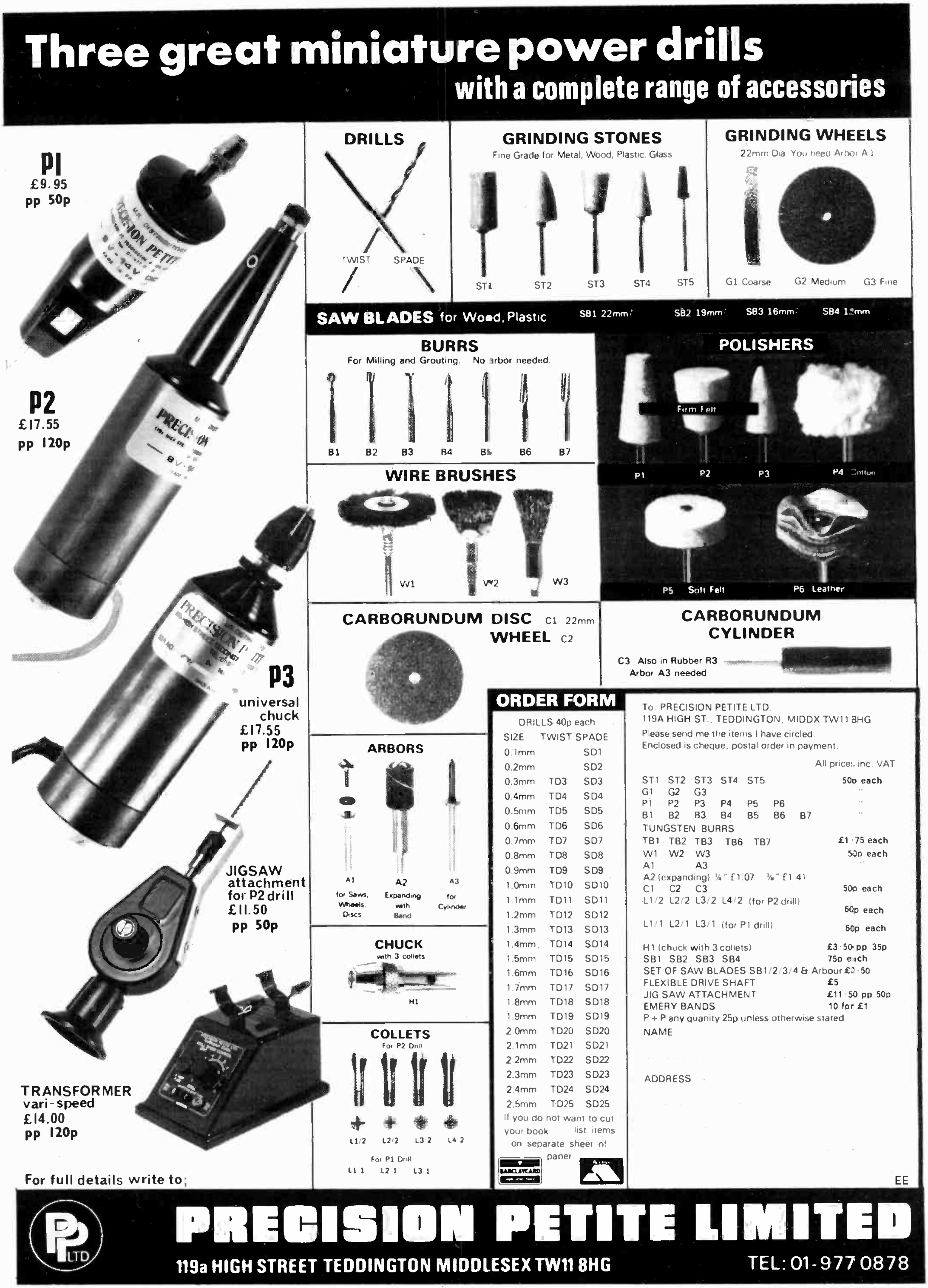


FOR SAFETY'S SAKE

Australia 85c South Africa 85c New Zealand 95c Malaysia $3·50



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pp 120p
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universal chuck
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DRILLS
TWIST
SPADE
GRINDING STONES
Fine Grade for Metal, Wood, Plastic, Glass
ST1
ST2
ST3
ST4
ST5
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22mm Dia You need Arbor A1
G1 Coarse
G2 Medium
G3 Fine
SAW BLADES for Wood, Plastic
SB1 22mm
SB2 19mm
SB3 16mm
SB4 13mm
BURRS
For Milling and Grouting. No arbor needed.
B1
B2
B3
B4
B5
B6
B7
POLISHERS
Firm Felt
P1
P2
P3
P4 Cotton
P5 Soft Felt
P6 Leather
WIRE BRUSHES
W1
W2
W3
CARBORUNDUM DISC C1 22mm
WHEEL C2
CARBORUNDUM CYLINDER
C3 Also in Rubber R3
Arbor A3 needed
ARBORS
A1 for Saws, Wheels, Discs
A2 Expanding with Band
A3 for Cylinder
CHUCK
with 3 collets
H1
COLLETS
For P2 Drill
L1/2
L2/2
L3/2
L4/2
For P1 Drill
L1/1
L2/1
L3/1
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1.3mm TD13 SD13
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1.5mm TD15 SD15
1.6mm TD16 SD16
1.7mm TD17 SD17
1.8mm TD18 SD18
1.9mm TD19 SD19
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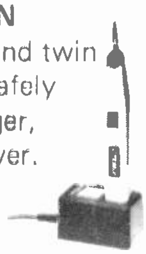

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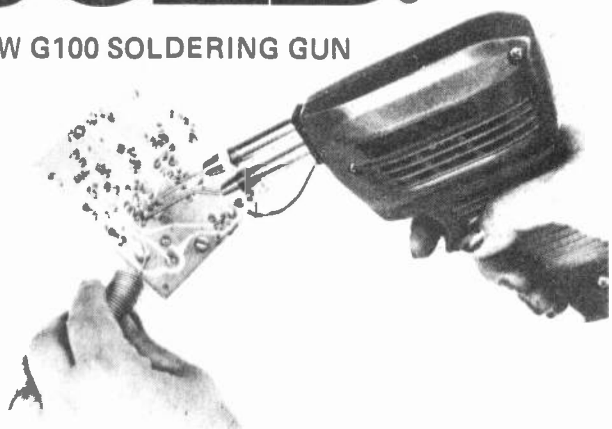
NEW G100 SOLDERING GUN



Safe 100 watt instant-heat, trigger operated tool. Heats and cools in seconds. With spotlight. For difficult or large joints, and shaping plastics. Ideal domestic and workshop tool. Complete with 2 spare tips, spanner, solder and flux **£14.11** including P & P and V.A.T.

LITESOLD

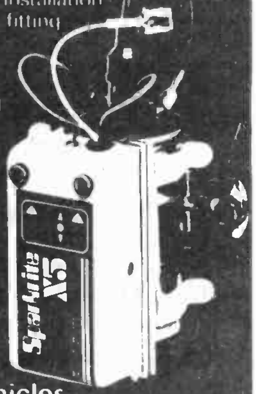
LIGHT SOLDERING DEVELOPMENTS LIMITED

All these advantages...

- Instant all-weather starting
- Smoother running
- Continual peak performance
- Longer battery & plug life
- Improved fuel consumption
- Improved acceleration/top speed
- Extended energy storage

..in kit form

SPARKRITE X5 is a high performance, top quality inductive discharge electronic ignition system designed for the electronics D.I.Y. world. It has been tried, tested and proven to be utterly reliable. Assembly only takes 1-2 hours and installation even less due to the patented 'clip on' easy fitting.



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14 pin	11p	24 pin	30p
16 pin	12p	28 pin	40p
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IC INSERTION/EXTRACTION TOOL 50p

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C-15W	400p
CCN-15W	415p
CX-17W	420p
X25	420p
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Spare Bits	50p
Stand	160p

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0·1 Copperclad

2½ × 5	55p
3¾ × 2½	48p
3¾ × 5	62p
3¾ × 3¾	56p
3¾ × 17	222p
V-Q Board for ICs No track cutting	105p
Pkt. of 100 pins	55p
Insertion Tool	100p
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TRANSISTORS

AC126/7	25p
AC128	25p
AC176	25p
AD149	70p
AD161/2	45p
BC107/8	11p
BC109	12p
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2N3053	30p
2N3055	48p
2N3442	140p
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2N3819	25p
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2N4123	27p
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LM710	50p
LM741	20p
LM748	35p
LM3900	70p
LM3909	100p
LM3911	130p
LM4136	120p
MC1310P	150p
MC1458	55p
MC3340P	120p
MC3360P	120p
NE531	140p
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NE556	70p
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7416	27p
7420	17p
7427	34p
7430	17p
7432	30p
7440	17p
7447A	60p
7448	80p
7450	17p
7470	36p
7473	30p
7474	24p
7475	36p
7476	35p
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7486	34p
7490	33p
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1 Amp +ve Plastic

5V	70p
8V	70p
12V	70p
15V	70p
18V	90p
24V	90p

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5V	90p
12V	90p
15V	90p

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12:30 pm 45
Hours mins secs
8 14 TH
Month date day
0:00 00
Min secs 1/10 1/100

6 digit, 11 functions, Hours, mins., secs., day, date, day of week, 1/100th, 1/10th, secs., 10X secs., mins. Split and lap modes. Back-light, auto calendar. Only 8mm thick. Stainless steel bracelet and back. Adjustable bracelet.

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SAME DAY DESPATCH.
M3 Price includes POST & PACKING

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12:30 pm 45
Hours mins secs
8 14 TH
Month date day
7:30 A
Alarm

6 functions plus Alarm. Conference signal, 5 minute snooze alarm, Conference signal sounds 4 secs. before main alarm to give advance warning and an option to cancel. Snooze sounds 5 mins. after main alarm and is always preceeded by the conference signal.

Price only **£9.95**

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M4 Price includes POST & PACKING

QUARTZ LCD ALARM CHRONOGRAPH with 12/24 display

12:30 pm 45
Hours mins secs
8 14 TH
Month date day
0:00 0
Min sec 1/10th
7:30 A
Alarm

Hours, mins, secs, day of week. Month, date, day of week, alarm, hour, mins., a.m./p.m. 24 or 12 hour display mode. Alarm test. Chronograph, lap time, stop watch 1/10 secs.

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M16 Price includes POST & PACKING

QUARTZ LCD Ladies Day Watch

Hours, mins., secs., day, date, back light, auto calendar.

12:30
Hours mins
8 14
Month date
:45
Secs

Fully adjustable bracelet. Only 25 x 20mm and 6mm thick. Silver or Gold.

Price only **£7.95**

M15 SAME DAY DESPATCH. P.&P. included

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Beautifully designed with a very thin bracelet.

12:30
Hours mins
8 14
Month date
:45
Secs

Hours., mins., secs., day, date, backlight and autocalendar. Bracelet fully adjustable to suit slim wrists. State Gold or Silver finish. Only 25 x 20 x 6mm.

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M13

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12:30
Hours mins
8 14
Month date
:45
Secs

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M1 SAME DAY DESPATCH. P.&P. included

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ALUMINIUM PANELS. 6 × 4—24p; 8 × 6—38p; 14 × 3—40p; 10 × 7—54p; 12 × 8—70p; 12 × 5—44p; 16 × 6—70p; 14 × 9—94p; 12 × 12—£1; 16 × 10—£1·16.
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EG Black plastic construction box with brushed aluminium facia size 6¼ × 4¾ × 2" £1·50
TAG STRIP 28-way 12p.
TAPE OSCILLATOR COIL. Valve type. 35p.
BRIDGE RECTIFIER 200V PIV ½ amp 50p. 4 amp £1·50 8 amp £2·50.
TOGGLE SWITCHES SP 30p. DPST 40p. DPDT 50p.
MANY OTHER TOGGLES IN STOCK. Please enquire.
PICK-UP CARTRIDGES ACOS, GP91 £2·00. GP94 £2·50.
SONOTONE 9TAHC Diamond £3·75. Magnetic £7
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt 15p.
CASSETTE MOTOR. 6 volt £1·00.

BAKER 50 WATT AMPLIFIER £65 Post £2

Superior quality ideal for Halls/PA systems. Disco's and Groups. Two inputs with Mixer Volume Controls. Master Bass, Treble and Gain Controls. 50 watts RMS. Three loudspeaker outlets 4, 8, 16 ohm. AC 240V (120V available). Blue wording on black cabinet.

BAKER 150 Watt AMPLIFIER 4 inputs £85.

DRILL SPEED CONTROLLER/LIGHT DIMMER KIT. Easy to build kit. Controls up to 480 watts AC mains. Post 35p **£3·25**

STEREO PRE-AMP KIT. All parts to build this pre-amp. 3 inputs for high medium or low gain per channel, with volume control and P.C. Board. Can be ganged to make multi-way stereo mixers. Post 35p **£2·95**

R.C.S. SOUND TO LIGHT DISPLAY MK 2

Complete kit of parts with R.C.S. printed circuit. Three channels. Up to 1,000 watts each. Will operate from 200MV to 100 watts signal source. Suitable for home Hi-Fi and all Disco Amplifiers. Cabinet extra £4·50. Post 50p **£18** Post 50p

200 Watt Rear Reflecting White Light Bulbs. Ideal for Disco Lights. Edison Screw 75p each or 6 for £4. Or 12 for £7·50. Post 30p per order.

MAINS TRANSFORMERS Post £1

250-0-250V 70mA, 6·5V, 2A .... £3·45
250-0-250V 80mA, 6·3V 3·5A, 6·3V 1A .... £4·60
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220V 45mA. 6·3V 2A .... £2·75
HEATER TRANSFORMER, 6·3V ½ amp £1·50 .... 3 amp £2·20
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs
2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 25 and 30V ...... £6·00
1 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 ...... £6·00
2 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 ...... £9·50
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5 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 .... £16·00

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12V, 750A .... £1·50	10V, 30V, 40V, 2 amp .. £3·50
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30V, 5 amp and 17V-0-17V, 2 amp .. £4·00	20V, 1 amp .... £3·00
0, 5, 8, 10, 16V, ½ amp .. £2·50	20V-0-20V, 1 amp .... £3·50
9V, 3 amp .... £3·50	30V-0-30V, 2 amp .... £8·00
15–0–15V 2 amp ...... £3·00	2 of 18V, 6 amp, each £11·00
30V, 2 amp .... £3·50	12-0-12V, 2 amp ...... £3·50
30V, 1½ amp .... £3·30	9V, ½ amp .... £1·50
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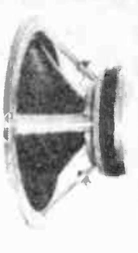
	32-0-32V 6·5A .... £11·00

BAKER SPEAKERS "STAR SOUND" Post £1·50 ea.



GROUP 45–12 £15
12in. 45 watt
4, 8 or 16 ohms.

GROUP 75–12 £24
12in. 75W professional model. 4, 8 or 16 ohms
Response 30 – 16,000.
With aluminium presence dome.

GROUP 100/12 £29
12 in 100W model
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8 or 16 ohms.

Send for leaflets on Disco, P.A. and Group Gear.

E.M.I. 13½ × 8in SPEAKER SALE!

With tweeter. And crossover. 10W. State 3 or 8 ohm. **£9·95** Post £1
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15W model £10·95 8 ohms Bass unit. Post £1
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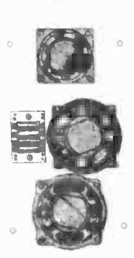
R.C.S. MINI MODULE HI-FI KIT 15 × 8½in 3-way Loudspeaker System, EMI 5in, Bass 5in, Middle 3in. Tweeter with 3-way Crossover and Ready Cut Baffle. Full assembly instructions supplied. Response = 60 to 20,000 cps 12 watt RMS. 8 ohm. £10·95 per kit. Two kits £20. Postage £1. Each kit.



RADIO COMPONENT SPECIALISTS 337 WHITEHORSE ROAD, CROYDON

Cash price includes VAT. Minimum post 30p. Components List 20p. Access & Barclaycard by Phone Open 9—6 Sat. 9—5 (Closed all day Wednesday) Tel. 01-684 1665

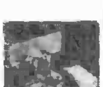
DISPLAY LIGHTING KITS

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

DL1000K

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

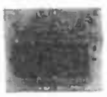
DLZ1000K



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

Optional Opto Input DLA1 **60p**

DIGITAL VOLTMETER/ THERMOMETER KIT



Based on the ICL 7106. This Kit contains a PCB, resistors, presets, capacitors, diodes, IC and 0.5" liquid crystal display. Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer using a single diode as the sensor. Requires a 3mA 9V supply. (PP3 battery) **£20.75**

24 HOUR CLOCK/APPLIANCE TIMER KIT

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

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

MINI KITS

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

TEMPERATURE CONTROLLER/THERMOSTAT

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

SOLID STATE RELAY

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

BAR/DOT DISPLAY

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

BURST FIRE/PROPORTIONAL TEMPERATURE CONTROLLER

Based on the TDA1024 Zero Voltage Switch this kit contains all the components required to make a "burst fire" power controller or a "proportional temperature" controller enabling the temperature of an enclosure to be maintained to within 0·5°C.
1·5KW **£5·25** 3KW **£5·55**

LEDs

0.1" Red	9p
0.1" Green	12p
0.1" Yellow	12p
0.2" Red	9p
0.2" Green	12p
0.2" Yellow	12p
0.2" clips	
Rectangular Red	20p
Rectangular Green	25p

CAPACITORS

Polyester 250V

0.01	6p	0.22	12p
0.022	6p	0.33	12p
0.033	7p	0.47	15p
0.047	7p	0.68	18p
0.068	7p	1.0	24p
0.1	7p	1.5	27p
0.15	11p	2.2	31p

Electrolytics A=Axial R=Radial

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

Tantalum (bead)

35V	0.1	7p	10V	22	12p
	0.22	7p	6.3V	33	12p
	0.47	7p		47	14p
	1.0	7p	3V	100	14p
25V	2.2	8p			
	4.7	9p			
	10	12p			

INTEGRATED CIRCUITS

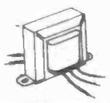
555 Timer	21p
741 Op. Amp	19p
AY-5-1224 Clock	£2.80
AY-5-1230/2 Clock/Timer	£4.20
AY-3-1270 Thermometer	£8.20
ICL7106 DVM (LCD drive)	£7.00
LM377 Dual 2W Amp	£1.45
LM379S Dual 6W Amp	£3.50
LM380 2W Audio Amp	80p
LM382 Dual low noise preamp	£1.00
LM386 250mW low voltage amp	75p
LM1830 Fluid Level Detector	£1.50
LM2907 I-v Converter	£1.40
LM3909 LED Flasher/Oscillator	55p
LM3911 Thermometer	£1.20
LM3914 Dot/Bar Driver	£2.10
MM57160 (stac) Timer	£5.90
MM74C911 4-digit display controller	£8.50
MM74C915 7-segment-BCD converter	98p
MM74C926 4-digit counter with 7-seg outputs	£4.50
S566B Touchdimmer	£2.50
S9263 Touchswitch 16-way	£4.86
TBA800 5W Audio Amp	58p
TBA810AS 7W Audio Amp	85p
TDA1024 Zero Voltage Switch	£1.00
TDA2020 20W Audio Amp	£2.85
ZN1034E Timer	£1.80

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

DISPLAYS

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

MINI TRANSFORMERS



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

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

D.I.L. I.C. SOCKETS

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

Soldercon Pins 50p/100

VOLTAGE REGULATORS

Available in 5V, 12V & 15V versions.
78L series 100mA pos. **26p**
79L series 100mA neg. **60p**
78 series 1A pos. **52p**
LM317T adjustable 1.2V-37V 1.5A **£1.80**

BOXES

Moulded in high impact ABS. Supplied with lids and screws. Black or white.
PB2 95x71x35mm **65p**
PB3 115x95x37mm **78p**

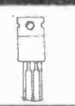
RESISTORS

¼W 22ohm-10M
Pack of 10 (one value) **10p**
10 packs (10 values) **80p**

ZENER DIODES

400mW 3.3V-30V **8p**
1.3W 7.5-30V **15p**

TRIACS



400V Plastic Case (Texas)

3A	49p	16A	90p
8A	58p	20A	165p
12A	80p	25A	190p

6A with trigger **80p**
8A isolated tab **65p**
Diac **18p**

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

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Access

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TRANSISTORS

Type	Price
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AC113	£0·23
AC115	£0·23
AC117	£0·35
AC117K	£0·39
AC121	£0·23
AC122	£0·16
AC125	£0·21
AC126	£0·21
AC127	£0·21
AC128	£0·18
AC128K	£0·30
AC132	£0·23
AC134	£0·23
AC137	£0·23
AC141	£0·25
AC141K	£0·35
AC142	£0·42
AC142K	£0·35
AC151	£0·23
AC153	£0·25
AC153K	£0·35
AC154	£0·23
AC155	£0·23
AC156	£0·23
AC157	£0·29
AC165	£0·23
AC166	£0·23
AC167	£0·23
AC168	£0·29
AC169	£0·23
AC171	£0·29
AC176	£0·21
AC176K	£0·30
AC178	£0·29
AC179	£0·29
AC180	£0·23
AC180K	£0·32
AC181	£0·23
AC181K	£0·32
AC187	£0·21
AC187K	£0·32
AC188	£0·21
AC188K	£0·32
ACY17	£0·40
ACY18	£0·40
ACY19	£0·40
ACY20	£0·40
ACY21	£0·40
ACY22	£0·40
ACY27	£0·40
ACY28	£0·37
ACY29	£0·58
ACY30	£0·40
ACY31	£0·40
AD130	£0·81
AD140	£0·69
AD142	£0·98
AD143	£0·86
AD149	£0·69
AD161	£0·40
AD162	£0·40
AD161/2	£0·81
AF124	£0·35
AF125	£0·35
AF126	£0·35
AF127	£0·37
AF139	£0·40
AF178	£0·69
AF179	£0·69
AF180	£0·69
AF181	£0·67
AF186	£0·58
AF239	£0·44
AL102	£1·38
AL103	£1·36
ASY26	£0·44
ASY27	£0·46
ASY28	£0·44
ASY29	£0·44
ASY50	£0·35
ASY51	£0·35
ASY52	£0·35
ASY54	£0·35
ASY55	£0·35
ASY56	£0·35
ASY57	£0·35
ASY58	£0·35
ASY73	£0·35
AU104	£1·61
AU110	£1·61
AU113	£1·61
BC107	£0·09
BC107A	£0·09
BC107B	£0·10
BC107C	£0·12
BC108	£0·09
BC108A	£0·09
BC108B	£0·10
BC108C	£0·12
BC109	£0·09
BC109A	£0·00
BC109B	£0·10
BC109C	£0·12
BC113	£0·18
BC114	£0·18
BC115	£0·22
BC116	£0·22
BC116A	£0·22
BC117	£0·23
BC118	£0·16
BC119	£0·29
BC120	£0·46
BC125	£0·20
BC126	£0·25
BC132	£0·21

Type	Price
BC134	£0·21
BC135	£0·17
BC136	£0·21
BC137	£0·21
BC139	£0·37
BC140	£0·35
BC141	£0·32
BC142	£0·25
BC143	£0·25
BC145	£0·53
BC147	£0·08
BC148	£0·08
BC149	£0·08
BC150	£0·23
BC151	£0·25
BC152	£0·25
BC153	£0·29
BC154	£0·22
BC157	£0·12
BC158	£0·12
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BC160	£0·30
BC161	£0·44
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BC168	£0·14
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BC169C	£0·12
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BC184L	£0·10
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BC187	£0·25
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BC212L	£0·10
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BC213L	£0·10
BC214	£0·10
BC214K	£0·10
BC225	£0·30
BC226	£0·41
BC227	£0·18
BC238	£0·18
BC251	£0·17
BC251A	£0·18
BC301	£0·32
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BC304	£0·44
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BC338	£0·17
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BC460	£0·44
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BC477	£0·23
BC478	£0·23
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BC547	£0·12
BC548	£0·12
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BC550	£0·16
BC556	£0·16
BC557	£0·15
BC558	£0·14
BCY30	£0·63
BCY31	£0·63
BCY32	£0·69
BCY33	£0·63
BCY34	£0·69
BCY70	£0·17
BCY71	£0·17
BCY72	£0·17
BCZ10	£0·69
BCZ11	£0·69
BCZ12	£0·69
BD115	£0·58
BD116	£0·92
BD121	£0·75
BD123	£0·75
BD124	£0·81
BD131	£0·40
BD132	£0·40
BD131/132mp	£0·92
BD133	£0·46
BD135	£0·44
BD136	£0·40
BD137	£0·40
BD138	£0·41
BD139	£0·41
BD140	£0·41
BD139/140mp	£0·92
BD155	£0·92
BD175	£0·69
BD176	£0·69
BD177	£0·78

Type	Price
BD178	£0·78
BD179	£0·86
BD180	£0·86
BD181	£0·98
BD182	£1·04
BD183	£1·09
BD184	£1·27
BD185	£0·78
BD186	£0·78
BD187	£0·86
BD188	£0·86
BD189	£0·90
BD190	£0·90
BD195	£1·04
BD196	£1·04
BD197	£1·09
BD198	£1·09
Type	Price
BD199	£1·14
BD200	£1·14
BD201	£0·92
BD202	£0·92
BD201/202mp	£1·96
BD203	£0·92
BD204	£0·92
BD203/204mp	£1·96
BD205	£0·92
BD206	£0·92
BD207	£0·92
BD208	£0·00
BD222	£0·00
BD225	£0·54
BD232	£0·63
BD233	£0·55
BD234	£0·63
BD235	£0·63
BD236	£0·67
BD237	£0·63
BD238	£0·69
BD239A	£0·58
BD240A	£0·58
BDX32	£2·53
BDY11	£1·50
BDY17	£2·07
BDY20	£0·92
BDX77	£1·04
BF115	£0·25
BF117	£0·58
BF118	£0·86
BF119	£0·86
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BF127	£0·68
BF152	£0·29
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BF154	£0·25
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BF198	£0·16
BF199	£0·16
BF200	£0·35
BF202	£0·40
BF222	£1·04
BF224	£0·20
BF240	£0·20
BF241	£0·20
BF244	£0·35
BF257	£0·29
BF258	£0·29
BF259	£0·40
BF262	£0·69
BF263	£0·69
BF270	£0·41
BF271	£0·36
BF272	£0·92
BF273	£0·41
BF274	£0·44
BF324	£0·40
BF336	£0·35
BF337	£0·35
BF338	£0·44
BF457	£0·43
BF458	£0·43
BF459	£0·44
BF596	£0·32
BFR39	£0·28

Type	Price
BFR40	£0·29
BFR79	£0·32
BFR80	£0·32
BFX29	£0·25
BFX30	£0·35
BFX84	£0·25
BFX85	£0·28
BFX86	£0·29
BFX87	£0·25
BFX88	£0·25
BFX90	£0·43
BFY50	£0·18
BFY51	£0·20
BFY52	£0·20
BFY53	£0·20
BIP19	£0·44
BIP20	£0·44
BIP19/20	£0·92
BSX26	£1·67
BSX19	£0·21
BSX20	£0·21
BSY25	£0·18
BSY26	£0·18
BSY27	£0·18
BSY28	£0·18
BSY29	£0·18
BSY38	£0·22
BSY39	£0·22
BSY40	£0·33
BSY41	£0·33
BSY51	£0·29
BSY95	£0·15
BSY95A	£0·15
BRY39	£0·52
BU105	£1·84
BU105/02	£2·24
BU204	£1·81
BU205	£1·81
BU208	£2·19
BU208/02	£2·59
MJE2955	£1·04
MJE3055	£0·69
MJE3440	£0·60
MP8113	£0·60
MPF102	£0·32
MPF104	£0·40
MPF105	£0·40
MPSA05	£0·23
MPSA06	£0·23
MPSA55	£0·23
MPSA56	£0·23
ND120	£0·86
OC20	£2·13
OC22	£1·73
OC23	£1·73
OC24	£1·55
OC25	£1·15
OC26	£1·15
OC28	£0·92
OC29	£1·09
OC35	£1·04
OC36	£1·04
OC41	£0·23
OC42	£0·25
OC44	£0·28
OC45	£0·23
OC70	£0·28
OC71	£0·17
OC72	£0·28
OC74	£0·30
OC75	£0·35
OC76	£0·40
OC77	£0·58
OC81	£0·25
OC81DD	£0·28
OC82	£0·28
OC82D	£0·35
OC83	£0·30
OC84	£0·44
OC139	£0·92
OC140	£0·92
OC169	£0·40
OC170	£0·40
OC171	£0·40
OC200	£0·44
OC201	£1·09
OC202	£1·38
OC203	£0·98
OC204	£1·04
OC205	£1·32
TIC44	£0·33
TIC45	£0·40
TIP29A	£0·46
TIP29B	£0·48
TIP29C	£0·51
TIP30A	£0·46
TIP30B	£0·48
TIP30C	£0·51
TIP31A	£0·46
TIP31B	£0·48
TIP31C	£0·51
TIP32A	£0·46
TIP32B	£0·48
TIP32C	£0·51
TIP41A	£0·51
TIP41B	£0·53
TIP41C	£0·55
TIP42A	£0·51
TIP42B	£0·53
TIP42C	£0·55
TIP2955	£0·69
TIP3055	£0·53
TIS43	£0·25
TIS90	£0·21
UT46	£0·23
ZTX107	£0·12

Type	Price
ZTX108	£0·12
ZTX109	£0·12
ZTX300	£0·14
ZTX301	£0·14
ZTX302	£0·18
ZTX303	£0·18
ZTX304	£0·23
ZTX330	£0·17
ZTX500	£0·15
ZTX501	£0·14
ZTX502	£0·18
ZTX503	£0·14
ZTX504	£0·29
ZTX531	£0·29
ZTX550	£0·18
2N388	£0·41
2N388A	£0·64
2N404	£0·23
2N524	£0·46
2N527	£0·58
2N598	£0·46
2N599	£0·53
2N696	£0·15
2N697	£0·14
2N698	£0·14
2N699	£0·37
2N706	£0·12
2N706A	£0·14
2N707	£0·55
2N708	£0·16
2N711	£0·35
2N717	£0·35
2N718	£0·29
2N718A	£0·58
2N726	£0·33
2N727	£0·33
2N743	£0·23
2N744	£0·23
2N914	£0·17
2N918	£0·35
2N929	£0·23
2N930	£0·21
2N946	£0·46
2N1131	£0·21
2N1132	£0·21
2N1302	£0·17
2N1303	£0·21
2N1304	£0·21
2N1305	£0·21
2N1306	£0·29
2N1307	£0·29
2N1308	£0·35
2N1309	£0·35
2N1599	£0·40
2N1613	£0·23
2N1711	£0·23
2N1889	£0·52
2N1890	£0·52
2N1893	£0·35
2N2147	£0·86
2N2148	£0·81
2N2160	£0·00
2N2192	£0·44
2N2193	£0·44
2N2194	£0·44
2N2217	£0·25
2N2218	£0·25
2N2218A	£0·23
2N2219	£0·23
2N2219A	£0·28
2N2220	£0·23
2N2221	£0·23
2N2221A	£0·25
2N2222	£0·25
2N2222A	£0·28
2N2368	£0·21
2N2369	£0·16
2N2369A	£0·16
2N2411	£0·29
2N2412	£0·29
2N2646	£0·54
2N2711	£0·25
2N2712	£0·25
2N2714	£0·25
2N2904	£0·21
2N2904A	£0·24
2N2905	£0·24
2N2905A	£0·23
2N2906	£0·18
2N2906A	£0·22
2N2907	£0·22
2N2907A	£0·25
2N2923	£0·17
2N2924	£0·17
2N2925	£0·17
2N2926G	£0·10
2N2926Y	£0·09
2N29260	£0·09
2N2926R	£0·09
2N2926B	£0·09
2N3010	£0·75
2N3011	£0·17
2N3053	£0·20
2N3054	£0·46
2N3055	£0·46
2N3391	£0·23
2N3391A	£0·25
2N3392	£0·23
2N3393	£0·23
2N3394	£0·23
2N3395	£0·25
2N3402	£0·24
2N3403	£0·24
2N3404	£0·33
2N3405	£0·48
2N3414	£0·18

Type	Price
2N3415	£0·18
2N3416	£0·33
2N3417	£0·33
2N3614	£1·15
2N3615	£1·21
2N3616	£1·21
2N3646	£0·10
2N3702	£0·09
2N3703	£0·09
2N3704	£0·08
2N3705	£0·08
2N3706	£0·08
2N3707	£0·09
2N3708	£0·08
2N3708A	£0·08
2N3709	£0·08
2N3710	£0·08
2N3711	£0·08
2N3772	£1·84
2N3773	£2·53
2N3819	£0·21
2N3820	£0·40
2N3821	£0·69
2N3823	£0·69
2N3903	£0·12
2N3904	£0·12
2N3905	£0·12
2N3906	£0·12
2N4058	£0·14
2N4059	£0·16
2N4060	£0·16
2N4061	£0·14
2N4062	£0·14
2N4921	£0·63
2N4923	£0·75
2N5135	£0·12
2N5136	£0·12
2N5138	£0·12
2N5172	£0·16
2N5194	£0·64
2N5245	£0·46
2N5294	£0·39
2N5296	£0·41
2N5457	£0·37
2N5458	£0·37
2N5459	£0·40
2N5551	£0·41
2N6027	£0·39
2N6121	£0·81
2N6122	£0·81
2S301	£0·58
2S302	£0·49
2S302A	£0·49
2S303	£0·64
2S403	£0·82
2S305	£0·92
2S306	£0·92
2S307	£0·92
2S321	£0·66
2S322	£0·49
2S322A	£0·49
2S323	£0·66
2S324	£0·82
2S325	£0·00
2S326	£0·82
2S327	£0·82
40311	£0·42
40313	£1·09
40316	£1·09
40317	£0·46
40326	£0·46
40327	£0·52
40346	£0·52
40347	£0·75
40348	£0·92
40360	£0·41
40362	£0·44
40406	£0·52
40407	£0·40
40408	£0·60
40409	£0·86
40410	£0·86
40411	£0·00
40430	£1·09
40476	£1·84
40494	£0·81
40495	£0·92
40512	£1·55
40594	£1·04
40636	£1·27

74 SERIES TTL ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0·10	7427	£0·28	7473	£0·29	74110	£0·41	74166	£0·90
7401	£0·13	7428	£0·30	7474	£0·29	74111	£0·67	74174	£0·75
7402	£0·13	7430	£0·15	7475	£0·33	74118	£0·92	74175	£0·71
7403	£0·13	7432	£0·25	7476	£0·29	74119	£1·36	74176	£0·67
7404	£0·13	7433	£0·35	7480	£0·51	74121	£0·28	74177	£0·67
7405	£0·13	7437	£0·24	7481	£0·98	74122	£0·45	74180	£1·73
7406	£0·25	7438	£0·24	7482	£0·78	74123	£0·46	74181	£0·67
7407	£0·25	7440	£0·14	7483	£0·67	74136	£0·60	74182	£0·81
7408	£0·15	7441	£0·58	7484	£1·01	74141	£0·63	74184	£0·81
7409	£0·15	7442	£0·46	7485	£0·78	74145	£0·63	74190	£0·78
7410	£0·13	7443	£0·81	7486	£0·25	74150	£0·78	74191	£0·71
7411	£0·20	7444	£0·81	7489	£1·96	74151	£0·55	74192	£0·69
7412	£0·17	7445	£0·75	7490	£0·37	74153	£0·55	74193	£0·67
7413	£0·28	7446	£0·69	7491	£0·74	74154	£0·94	74194	£0·71
7414	£0·58	7447	£0·55	7492	£0·40	74155	£0·58	74195	£0·69
7416	£0·26	7448	£0·64	7493	£0·35	74156	£0·58	74196	£1·21
7417	£0·26	7450	£0·13	7494	£0·86	74157	£0·58	74197	£1·21
7420	£0·13	7451	£0·13	7495	£0·58	74160	£0·87	74198	£2·13
7421	£0·23	7453	£0·13	7496	£0·58	74161	£0·71	74199	£2·13
7422	£0·18	7454	£0·13	74100	£0·98	74162	£0·71		
7423	£0·24	7460	£0·13	74104	£0·45	74163	£0·71		
7425	£0·22	7470	£0·29	74105	£0·44	74164	£0·78		
7426	£0·26	7472	£0·23	74107	£0·28	74165	£0·78		

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0·16	CD4015	£0·94	CD4026	£1·38	CD4043	£1·01	CD4070	£0·20
CD4001	£0·23	CD4016	£0·49	CD4027	£0·58	CD4044	£0·94	CD4071	£0·20
CD4002	£0·18	CD4017	£0·94	CD4028	£0·78	CD4045	£1·61	CD4072	£0·20
CD4006	£1·06	CD4018	£0·98	CD4029	£0·98	CD4046	£1·50	CD4081	£0·20
CD4007	£0·20	CD4019	£0·48	CD4030	£0·55	CD4047	£1·00	CD4082	£0·25
CD4008	£1·06	CD4020	£1·04	CD4031	£2·30	CD4049	£0·55	CD4510	£1·27
CD4009	£0·52	CD4021	£0·94	CD4035	£1·38	CD4050	£0·55	CD4511	£1·44
CD4010	£0·55	CD4022	£0·94	CD4037	£1·09	CD4054	£1·27	CD4516	£1·15
CD4011	£0·23	CD4023	£0·22	CD4040	£1·01	CD4055	£1·15	CD4518	£1·15
CD4012	£0·22	CD4024	£0·75	CD4041	£0·87	CD4056	£1·55		
CD4013	£0·48	CD4025	£0·22	CD4042	£0·83	CD4069	£0·20		

LINEAR ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CA3011	£1·12	LM301	£0·33	MC1312	£2·19	72710	£0·35	SL414A	£2·24
CA3014	£1·55	LM304	£1·84	MC1350	£1·38	UA711C	£0·37	TAA550B	£0·40
CA3018	£0·75	LM308	£1·15	MC1352	£1·61	72711	£0·37	TAA621A	£2·30
CA3020	£1·96	LM309	£1·73	MC1469	£3·39	UA723C	£0·52	TAA621B	£2·88
CA3028	£0·92			MC1496	£1·04	72723	£0·52	TAA661	£1·73
CA3035	£1·61			NE536	£3·06	UA741C	£0·28	TAD100	£1·50
CA3036	£1·15			NE550	£1·09	72741	£0·23	TBA120	£0·60
CA3042	£1·73			NE555	£0·23	741P	£0·23	TBA540	£2·42
CA3043	£2·13			NE556	£0·69	UA747C	£0·69	TBA641A	£1·84
CA3046	£0·51			NE565	£1·38	72747	£0·69	TBA641B	£2·53
CA3052	£1·84			NE566	£1·73	UA748	£0·40	TBA810S	£0·86
CA3054	£1·27			NE567	£1·96	72748	£0·40	TBA810	£1·13
CA3075	£1·73	LM380	£0·98	UA702C	£0·53	748P	£0·40	TBA820	£0·81
CA3081	£1·73	LM381	£1·67	72702	£0·53	SN76013N	£2·01	TBA9200	£2·88
CA3089	£2·30	LM3900	£0·67	UA703	£0·29	SN76023	£2·01	TCA270S	£2·30
CA3090	£4·14	MC1303L	£0·98	UA709	£0·29	SN76110	£1·73	TBA800	£0·92
CA3123	£2·19	MC1304	£2·19	72709	£0·53	SN76115	£2·19	ZN414	£1·15
CA3130	£1·07	MC1310	£1·09	709P	£0·29	SN76660	£0·86		
CA3140	£0·81			UA710C	£0·46				

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA110	£0·09	BAX13	£0·08	BY164	£0·59	OA10	£0·40	SD10	£0·07
AA120	£0·09	BAX16	£0·09	BY176	£0·86	OA47	£0·09	SD19	£0·07
AA129	£0·09	BY100	£0·25	BY206	£0·35	OA70	£0·09	IN34	£0·08
AAY30	£0·10	BY101	£0·25	BYZ10	£0·52	OA79	£0·12	IN34A	£0·08
AAZ13	£0·17	BY105	£0·25	BYZ11	£0·52	OA81	£0·12	IN914	£0·07
BA100	£0·12	BY114	£0·25	BYZ12	£0·46	OA85	£0·12	IN916	£0·07
BA102	£0·37	BY124	£0·25	BYZ13	£0·46	OA90	£0·12	IN4148	£0·07
BA148	£0·17	BY126	£0·17	BYZ16	£0·47	OA91	£0·12	IS44	£0·06
BA154	£0·14	BY127	£0·18	BYZ17	£0·41	OA95	£0·12	IS920	£0·07
BA155	£0·16	BY128	£0·18	BYZ18	£0·41	OA182	£0·15		
BA173	£0·17	BY130	£0·20	BYZ19	£0·41	OA200	£0·09		
BB104	£0·46	BY133	£0·24	OA5	£0·69	OA202	£0·09		

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2 amp Volts	T05 Case No.	Price	10 amp Volts		Price
100	TR12a/100	£0·36	100	TR110a/100	£0·89
200	TR12a/200	£0·59	200	TR110a/200	£1·06
400	TR12a/400	£0·82	400	TR110a/400	£1·29
6 amp Volts			**10 amp Volts**		
100	TR16a/100	£0·59	400	TR110a/400p	£1·29
200	TR16a/200	£0·70		**Diacs**	
400	TR16a/400	£0·89	BR100 £0·23	D32	£0·23

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Type	No.	Price
50v RMS	BR1 50	£0·23
100v RMS	BR1 100	£0·25
200v RMS	BR1 400	£0·29
400v RMS	BR1 400	£0·41

SILICON 2 amp

Type	No.	Price
50v RMS	BR2 50	£0·52
100v RMS	BR2 100	£0·55
200v RMS	BR2 200	£0·60
400v RMS	BR2 400	£0·67
1000v RMS	BR2 1000	£0·78

SILICON 10 amp

Type	No.	Price
50v RMS	BR 10 50	£1·73
200v RMS	BR10 200	£1·96

SILICON 25 amp

Type	No.	Price
50v RMS	BR25 50	£2·19
200v RMS	BR25 200	£2·53

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Push switch—Push to break	1979	£0·21

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WHITE	1982	£0·35
BLUE	1983	£0·35
YELLOW	1984	£0·35
LUMINOUS	1985	£0·35

Description	No.	Price
Miniature SPST toggle 2 amp 250V ac	1958	£0·81
Miniature SPST toggle 2 amp 250V ac	1959	£0·86
Miniature DPDT toggle 2 amp 250V ac	1960	£0·91
Miniature DPDT toggle centre off 2 amp 250V ac	1961	£1·07
Push-button SPST 2 amp 250V ac	1962	£1·04
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1503	MIL3331 (OPL212A)	3mm (·125)	YELLOW	£0·16
1504	ARL4850 (FLV117)	5mm (·2)	RED	£0·10
1505	MIL5251 (TIL222)	5mm (·2)	GREEN	£0·16
1506	MIL5351 (MV5353)	5mm (·2)	YELLOW	£0·16
1509	FLV111	5mm (·2)	CLEAR (ill. Red)	£0·13

SUPER 'HI-BRITE' TYPE

1521	MIL32	3mm (·125)	RED	£0·11
1522	MIL52	5mm (·2)	RED	£0·11
1514	ORP12	Light dependent resistor		£0·70
1520	OCP71	Photo transistor		£0·40

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RED Single Digit O/NO. 1523 £0·85
DL707 7 segment D P left (30" height) Common Anode
RED Single Digit O/NO. 1510 £0·92
DL527 7 segment D P left (50" height) Common Anode
RED Two-Digit Reflector O/NO. 1524 £2·08
DL727 7 segment D P right (510" height) Common Anode
RED Two-Digit light Pipe O/NO. 1512 £2·07
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Isolation Breakdown—Voltage 1500—continuous fwd. current 100 mA
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TEACH-IN 80

We can offer ex stock all the parts required (except battery and euroboard) for this series of projects as listed in the October issue of Everyday Electronics.

(a) **KIT 1 TUTOR DECK** (except Battery & Euroboard) **£14·00 inc. P & P AND V.A.T.**
(b) **KIT 2 ADDITIONAL COMPONENTS** for Parts 1-6 **£1·75 inc P & P AND V.A.T.**
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OR buy ALL the above 3 kits for the total price of £18·00 including P & P and V.A.T.

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Description	No.	Price
20mm × 5mm chassis mounting	506	£0·18
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1¼in. car inline type	508	£0·18
Panel mounting 20mm	509	£0·23
Panel mounting 1¼in.	510	£0·37

QUICK BLOW 20mm

Type	No.		Type	No.		Type	No.	
150mA	611	7p	1A	615	6p	3A	619	6p
250mA	612	6p	1·5A	616	7p	4A	620	10p
550mA	613	6p	2A	617	6p	5A	621	6p
800mA	614	8p	2·5A	618	7p			

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2·5A	628
250mA	623	2A	626	3·15A	629
500mA	624	1/6A	627	5A	630

All 8p each

QUICK-BLOW 1¼in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 8p each

Type	No.	Type	No.	Type	No.
1A	635	2/5A	638	4A	641
2A	637	3A	639	5A	642

All 6p each

NUTS AND BOLTS

BA BOLTS—packs of BA threaded cadmium plated crews slotted cheese head. Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1in. OBA	839	£1·38	½in. 4BA	846	£0·37
½in. OBA	840	£0·86	¼in. 4BA	847	£0·29
1in. 2BA	842	£0·75	1in. 6BA	848	£0·46
½in. 2BA	843	£0·52	½in. 6BA	849	£0·24
¼in. 2BA	844	£0·60	¼in. 6BA	850	£0·29
1in. 4BA	845	£0·51			

BA NUTS—packs of cadmium plated full nuts in multiples of 50.

Type	No.	Price	Type	No.	Price
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2BA	856	£0·55	6BA	858	£0·28

BA WASHERS—flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
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Type	No.	Price	Type	No.	Price
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2BA	852	£0·32	6BA	854	£0·25

AUDIO LEADS

No.	Type	Price
107	FM Indoor Ribbon Aerial	£0·69
113	3·5mm Jack plug to 3·5mm Jack plug length 1·5m	£0·86
114	5 pin DIN plug to 3·5mm Jack connected to pins 3 & 5 length 1·5m	£0·98
115	5 pin DIN plug to 3·5mm Jack connected to pins 1 & 4 length 1·5m	£0·98
116	Car aerial extension screened insulated lead. Fitted plug and socket	£1·44
117	AC mains connecting lead to rcassette recorders and radios 2 metres	£0·78
118	5 pin DIN phono plug to stereo headphone. Jack socket	£1·21
119	2 + 2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones. Length 0·2m	£1·04
120	Car stereo connector. Variable geometry plug to fit most car cassettes. 8-track cartridge and combination units. Supplies with inlined fuse power lead and instructions	£0·69
123	6·6m Coiled Guitar Lead Mono Jack plug to Mono Jack plug Black	£1·72
124	3 pin DIN plug to 3 pin DIN plug. Length 1·5m	£0·85
125	5 pin DIN plug to 5 pin DIN plug. Length 1·5m	£0·85
126	5 pin DIN plug to Tinned open end. Length 1·5m	£0·85
127	5 pin DIN plug to 4 Phono Plugs. All colour coded. Length 1·5m	£1·49
128	5 pin DIN plug to 5 pin DIN socket. Length 1·5m	£0·92
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1·5m	£1·21
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0·78
131	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 Length 1·5m	£0·95
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1·13
133	5 pin DIN plug to 2 Phono plugs Connected pins 3 & 5. Length 1·5m	£0·86
134	5 pin DIN plug to 2 Phono sockets Connected pins 3 & 5. Length 23cm	£0·78
135	5 pin DIN socket to 2 Phono plugs Connected pins 3 & 5. Length 23cm	£0·78
136	Coiled stereo headphone extension lead. Black, length 6m	£2·01
178	AC mains lead for calculators, etc.	£0·52

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V–0–6V 100mA	£1·04
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MINIATURE MAINS Primary 240V
with two independent secondary windings

No.	Type	Price
2024	MT280–0–6V 0–6V RMS	£1·84
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1 AMP MAINS Primary 240V

No.	Secondary	Price	
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2027	9V–0–9V 1 amp	£2·30	P & P 45p
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STANDARD MAINS Primary 240V
Multi-tapped secondary mains transformers available in ½ amp, 1 amp and 2 amp current rating. Secondary taps are 0–19–25–33–40–50V. Voltages available by use of taps. 4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25–0–25V

No.	Rating	Price	
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2035	240V Primary 0–55V @ 2A Secondary	£7·30	P & P £1

SPECIAL OFFER
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£1·50 P & P 86p

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INSTRUMENT CASES In two sections vinyl covered top and sides, aluminium bottom, front and back.

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156	11in	6in	3in	£2·92
157	6in	4¾in	1¾in	£1·79
158	9in	5¼in	2¼in	£2·43

ALUMINIUM BOXES Made from bright all. folded construction each box complete with half-inch-deep lid and screws.

No.	Length	Width	Height	Price
159	5¼in	2¼in	1½in	£0·85
160	4in	4in	1½in	£0·85
161	4in	2¼in	1½in	£0·85
162	5¼in	4in	1½in	£0·97
163	4in	2¼in	2in	£0·87
164	3in	2in	1in	£0·60
165	7in	5in	2½in	£1·43
166	8in	6in	3in	£1·82
167	6in	4in	2in	£1·18

SLOPE front aluminium boxes with black vinyl base and sides & aluminium back, top & front—strong construction easily accessable.

169	2 1/8in	5 3/8in	2¾in	12in	3½in	8in	£5·45
168	2 5/8in	7¼in	4in	16in	4¼in	11in	£8·31

Terms cash with order. Cheques/Postal Orders made payable to Bi-Pak at above address.

BARCLAYCARD VISA

Projects... Theory...

and Popular Features...

The theme this month is Safety First!

Over the last few years gas has become the most popular source of energy for domestic users. In the form of propane, gas is also widely used in caravans and boats.

Leakage of gas through badly made connections or defective pipes is an ever present hazard particularly in occasionally used installations such as the holiday home or boat. There can be unsuspected dangers lurking in permanent dwelling places, as well, especially where the property is old and still has the original gas mains installation.

Many users of gas will welcome a device that gives warning if an accumulation of gas builds up. The nose is not always a dependable sensor and certainly not as sensitive as the solid state device which is the "nose" element in our *Gas Sentinel*.

The electricity mains supply also receives some of our attention this month. It is not always safe to assume that the mains supply outlets have been correctly wired during installation. Sadly many cases come to light where the live and neutral connections have been reversed and sometimes the earth connection omitted.

When moving into a property, the new occupier would be wise to check all outlets with our *Mains Fault Indicator* prior to plugging in any electrical equipment. This valuable gadget is extremely simple and costs little to build.

From domestic establishments, fixed, floating or parked, let us now move outdoors and venture into another danger area—the road. And immediately we find a serious deficiency.

The motorist has his direction indicators, and rarely has to resort to hand signals. Most motorcyclists are similarly equipped. This leaves the push-cyclist practically alone, amongst all wheeled vehicle users, without the convenience and protection of illuminated signals to indicate his intentions to other road users.

This is something the cyclist can easily rectify for himself by building our *Cycle Direction Flasher*. Precise mechanical arrangements and installation details will depend upon the particular model of cycle, but the system described should be adaptable to individual needs without difficulty.

Safety First! The practicality of projects such as these, which enable the home constructor to help safeguard life and property, is one reason why electronics has become a great and worthwhile hobby.

Fred Bennett.

Our May issue will be published on Friday, April 18. See page 261 for details.

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.

Everyday ELECTRONICS

VOL. 9 NO. 4 APRIL 1980

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

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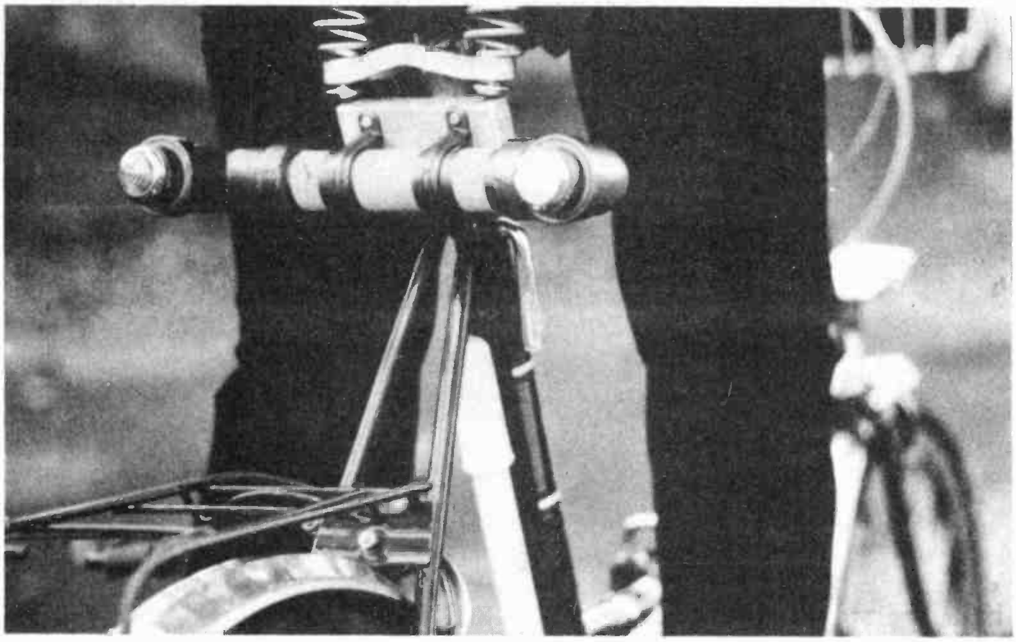
CYCLE DIRECTION FLASHER

By A. Partridge



When riding a bicycle along the road being seen is as important as seeing. This is especially so at night. Another requirement is for the driver of the car behind to know of your intention to turn left or right.

Although there is an obvious need for turn indicators in this situation, few bicycles are fitted with them. The project presented here fills this gap.

The circuit is based on a 555 timer i.c. generating a square wave which flashes one of the two lamps according to the setting of a switch. Because of its 200mA source ability it was decided that the i.c. was capable of driving the lamps directly although the bulbs used here have a slightly lower voltage rating than the battery to obtain increased brightness of the bulbs.

CIRCUIT DESCRIPTION

A 555 timer i.c., IC1 is wired as an astable multivibrator which forms the heart of this circuit (see Fig. 1).

When power is applied to the circuit capacitor C1 charges-up through external resistors R1 and R2. A voltage comparator on the chip sets a flip-flop in the i.c. when the voltage on the capacitor reaches 2/3 supply voltage.

At this point the transistor in the output stage (connected to pin 3) is driven high by the flip-flop and the capacitor begins to discharge through another resistor. As the voltage on the capacitor passes below 1/3 supply voltage another comparator resets the flip-flop (pin 3 goes low) and the cycle begins again. The square wave thus produced is available at pin 3.

In the circuit for the Cycle Direction Flasher R1, R2 and C1 have been chosen to give a flash-rate of about 0·5Hz—30 flashes per minute—approximately the rate of a car direction indicator.

The square wave from the i.c. is linked to one pole of S1. This switch is of the centre-off variety and when it is put into either of its on positions the square wave passes to the appropriate lamp which then pulses in sympathy with it.

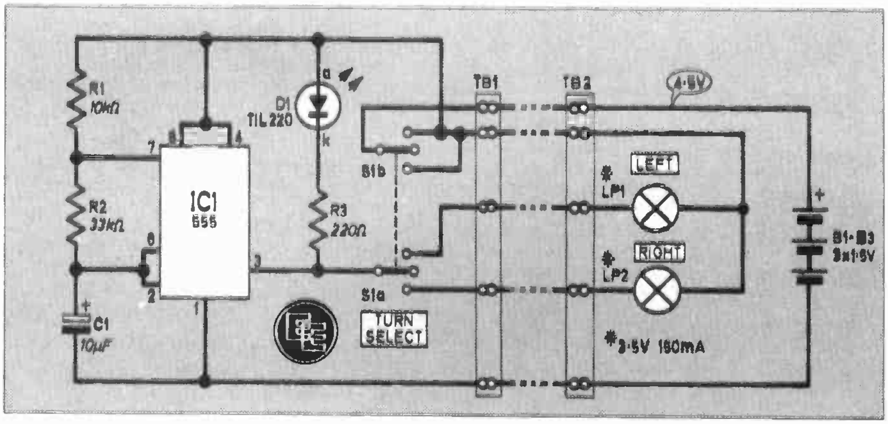
The second pole of this switch applies power to the circuit whenever it is moved to either of its "on" positions.

CONSTRUCTION starts here

CIRCUIT BOARD

Commence construction with the circuit board. This consists of a piece of 0·1 inch matrix stripboard 12 strips by 13 holes. A single mounting hole is first drilled in the position shown in Fig. 2. Remember to clean off any copper swarf from the edges with emery paper.

Fig. 1. Circuit diagram for the Cycle Direction Flasher.



Next, cut the copper strips as indicated in the diagram, using a spot face cutter or a hand-held twist drill.

Assemble the board beginning with the links and then the resistors, capacitor, and i.c. in that order, using a minimum of heat and solder for the i.c. in particular.

Use Veropins for external connections to the board.

DIECAST BOX

Next prepare the box to take the circuit board, wires and switch. It is recommended that a diecast box be used here as these are more easily sealed against the elements than most plastics boxes.

It is best to drill one hole each for the five wires entering the box rather than one large hole as the entry points will later be sealed with epoxy resin. A bunch of wires will be more likely to come loose than a single wire.

Fix the circuit board in place using nuts, bolts and spacers, and seal the screw holes with epoxy resin. Flying leads or Veropins should be soldered to the board prior to fixing it into the box.

Wire the leads from the board to the switch and complete the interwiring of the circuit board and switch within the box.

TERMINAL BLOCK

One of the 5-way terminal blocks, TB1, is then mounted outside the box according to Fig. 2 with short wires leading to it from the box and longer ones to the indicator unit at the rear of the cycle.

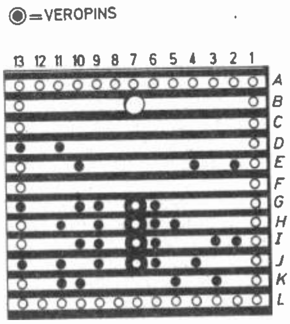
In this way a larger box will not be needed and the epoxy seal of the wires will not need to be broken if the box has to be removed. The connections to the terminal block should not be duly affected by the weather if it is mounted upside-down.

INSTALLATION

Mounting the box, battery and indicators onto the bicycle poses some problems. The box should be positioned on the handlebars or somewhere on the main frame where the switch is accessible.

Fixing the box in place is most easily accomplished by the method pictured in Fig. 3. Twin holes are drilled in the lid in which screws are placed with the heads inside the box. The lid is then held onto a member of the bicycle frame by a pipe-clip fitted over the screws and fastened with nuts and shakeproof washers.

If you have the appropriate equipment, you could of course tap the holes and mount the screws the other



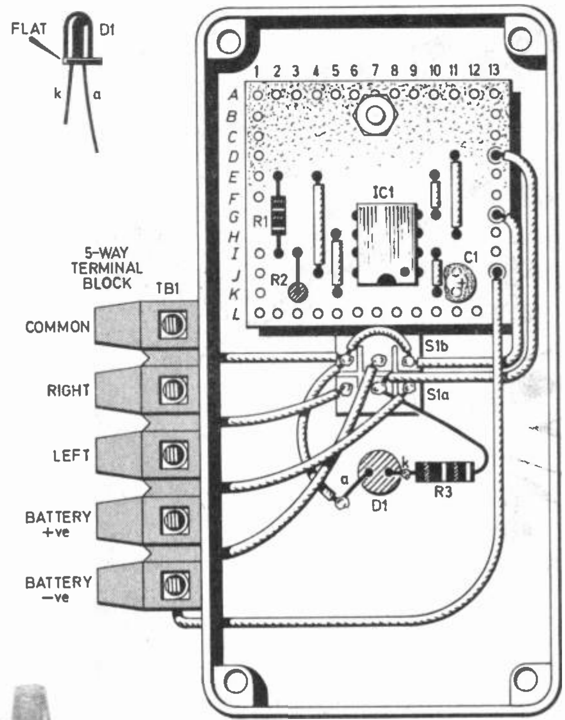


Fig. 2 (above). Interior of the control unit showing the circuit board layout, board mounting and interior wiring.

COMPONENTS approximate cost £11·00

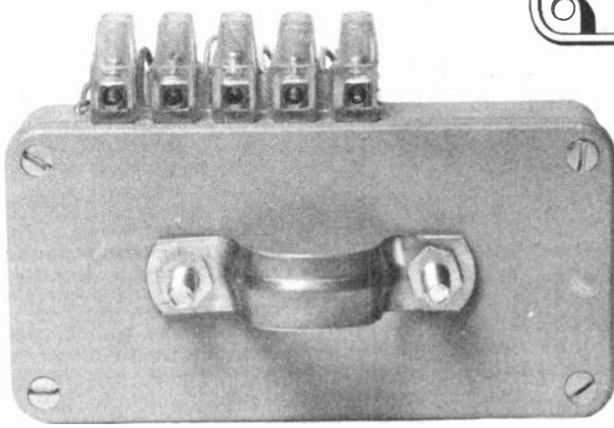
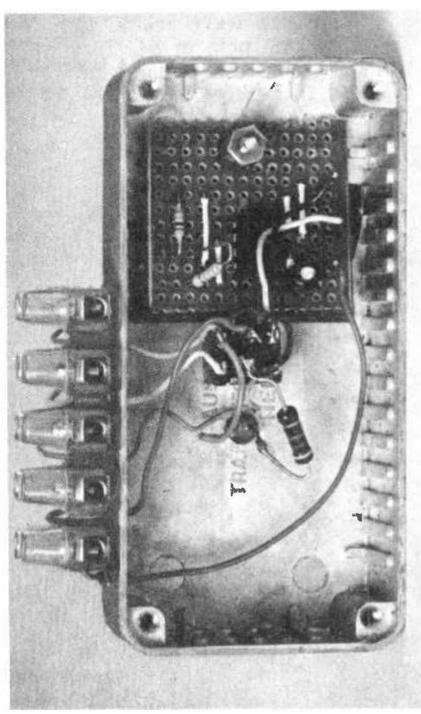


Fig. 3 (left). View of the rear of the control unit showing fixing bracket.



Layout of components inside the control unit.

COMPONENTS

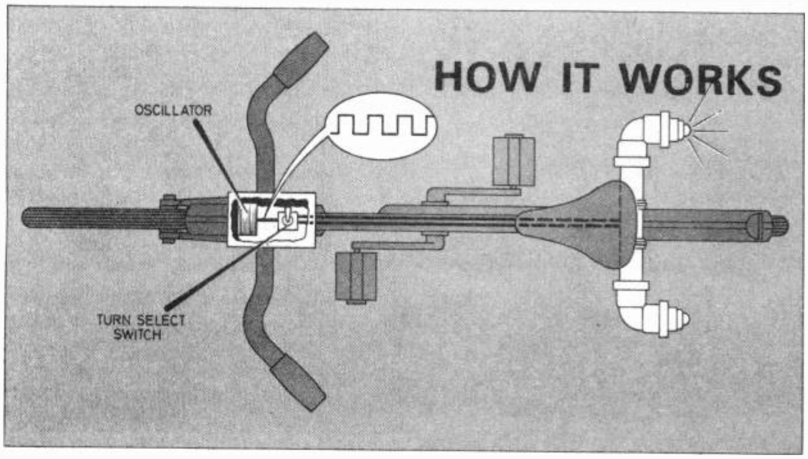
Resistors
- R1 10kΩ
- R2 33kΩ
- R3 220Ω
- All ¼W carbon ± 5%

Capacitor
- C1 10μF 16V elect.

See Shop Talk page 241

Semiconductors
- IC1 NE555 timer i.c.

Miscellaneous
- S1 d.p.d.t. centre-off toggle
- LP1,2 3·5V 150mA M.E.S. bulbs and panel lampholders (RS 565-226) (2 off each)
- B1,2,3 1·5V SP11 type cell (3 off)
- TB1,TB2 5-way screw terminal blocks (2 off)
- Stripboard, 0·1 inch matrix, 13 holes × 10 strips; diecast metal box; set of PP9 battery connectors; single screw terminal block; 1¼ inch plastic pipe; 90 degree elbows (2 off); clips (2 off); piece of wood for back plate; plastic end caps (2 off); 4 BA nut, bolt and spacer; interconnecting wire.



The box mounted on the handle-bars contains an electronic oscillator and a switch: the unit at the back contains the direction indicator lights and batteries. When the rider wishes to turn left or right he can indicate his intentions by moving the selector switch to the left or right position.

This has the effect of connecting power to the circuit from the batteries and routing a square wave which switches from full battery voltage to zero at a frequency of 0·5Hz (that is, turns on and off once every two seconds), to the appropriate rear bulb.

way round. In this instance waterproofing is achieved with four fibre washers between the clip and the lid, and the screw heads and the clip.

INDICATORS

Turning now to the indicators, these are built up from 1¼ inch plastic waste pipe and fittings and the whole assembly is seen in Fig. 4.

This unit houses the indicator lamps LP1 and LP2, and also the batteries and is designed to bolt onto the back of the cycle above the rear mudguard. Some experimentation may be necessary as there are bound to be differences between different machines.

Referring to Fig. 4, assembly should start by soldering a piece of wire about 50mm long onto each tag of the lampholders. If these wires have different coloured insulation this will be a great help in identifying them later on.

The lampholders are then glued in position in the elbows using "super glue" making sure that only the rear milled ring is glued and not the front retaining ring, see Fig 4(a). This front ring must be free in order to get at the bulbs in the lampholder.

BATTERY HOLDER

The next stage is to assemble the battery holder. Basically this consists of the centre tube with caps at each end holding the contacts and some foam packing to ensure a tight fit.

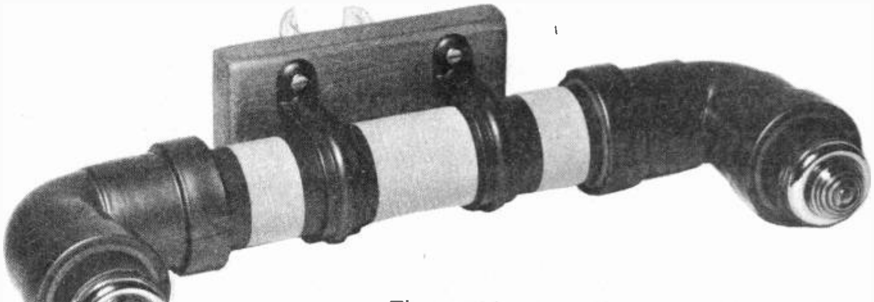
Starting off with the positive connection, the end cap (which can be anything from a standard part to a plastic pill box) is drilled so that the battery connector stud protrudes through the hole. Small holes are also drilled in this to take the wires from the RIGHT lamp holder and the positive contact.

The positive clip from a set of PP9 battery connectors is glued in position in the end cap and a length of wire is soldered to the connector. Then the whole is glued into the end of the tube forming the centre section of the assembly.

The negative battery cap is prepared in much the same way but instead of gluing it in position, a loop of wire is passed through two holes and knotted as this is to be used as a draw wire when battery replacement becomes necessary.

FINAL ASSEMBLY

Final assembly can now be started by first passing the wires of one of the bulb holders and that from the battery positive contact through the holes in the positive connector end cap. The common wire from the LEFT lamp holder is then passed



The completed rear indicator unit ready to be fitted to the bicycle.

The assembly with one of the lamp sections withdrawn. One elbow has been removed to reveal the battery compartment.

CYCLE DIRECTION FLASHER

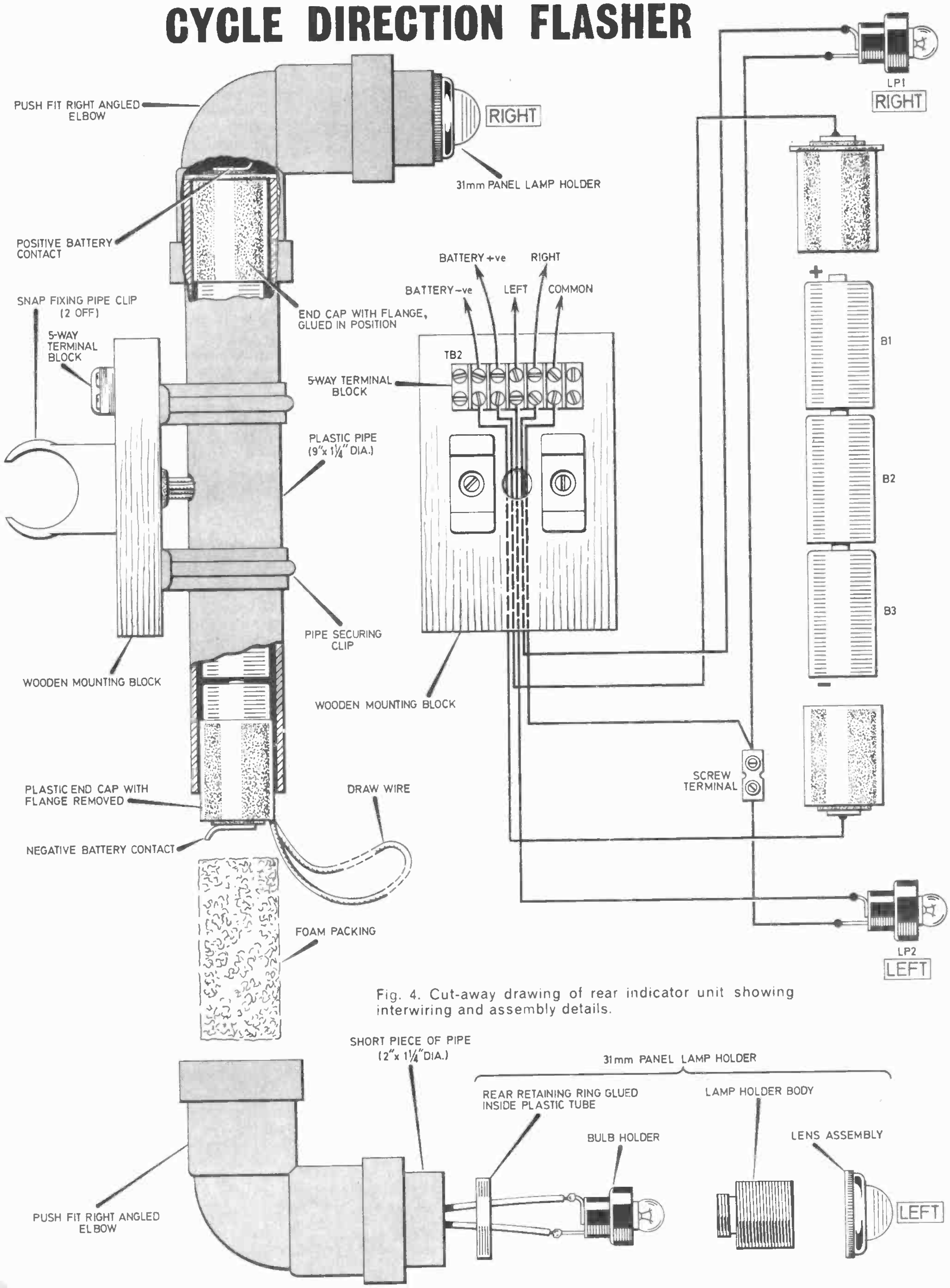
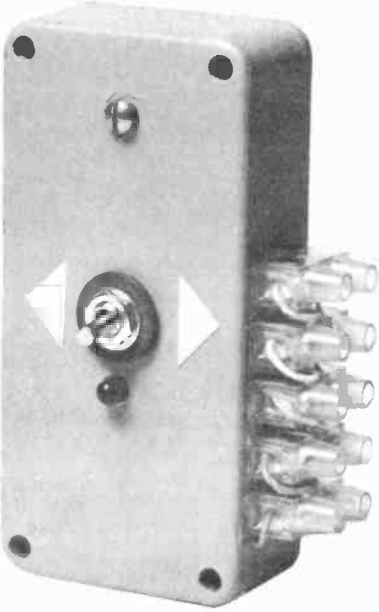
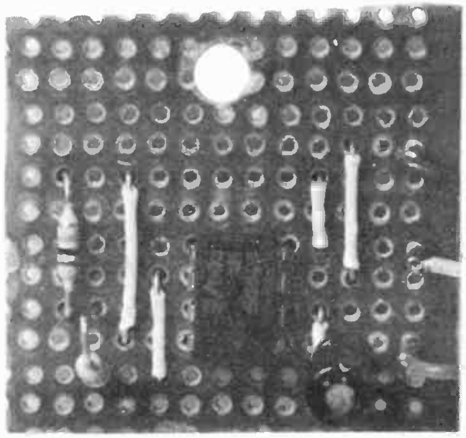


Fig. 4. Cut-away drawing of rear indicator unit showing interwiring and assembly details.

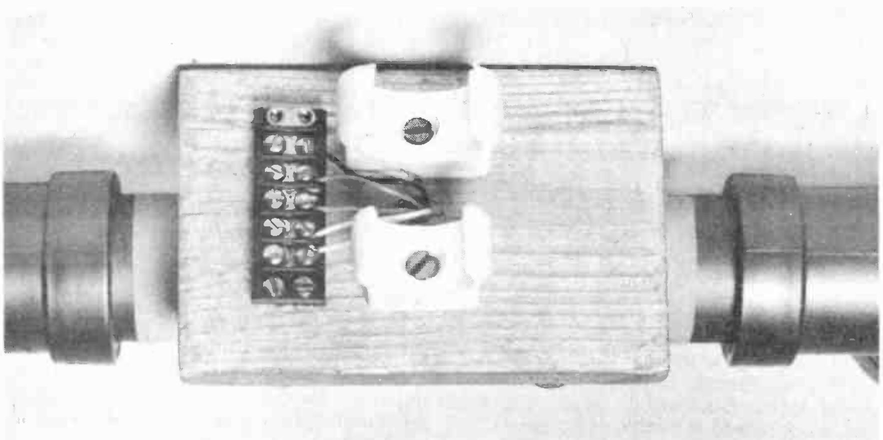
CYCLE DIRECTION FLASHER



Completed control unit with terminal block glued to side.



Layout of components on the circuit board.



The wooden mounting block to which the rear indicator unit is attached and the clips used to secure it to the bicycle frame.

through the negative connector end cap and joined to the common wire of the other lampholder using a single screw terminal connector block.

The remaining wires are then passed back through the negative connector end cap and all the cables are brought out through a hole in the middle of the tube. The three batteries are next pushed into the tube, positive terminal first. The negative connector end cap and the foam packing can now be inserted in position and the elbows pushed tightly onto the ends of the tube. They should not be glued as they will need to be removed in order to change the batteries.

The connecting wires are terminated on the painted wooden mounting block with the other 5-way screw terminal block (TB2). The assembly needs now to be fitted with clips/clamps to secure it to the bicycle frame. In the prototype plastic snap fixing pipe clips were employed to securely position the assembly on the saddle stem.

As cyanoacrylate glue is used throughout the usual precautions for this sort of adhesive must be followed.

TESTING

When all wiring is completed the unit may be tested. Connect the battery (observe correct polarity) and the lamps if not already connected.

Moving S1 into either ON position should cause the appropriate lamp to flash. If you wish to adjust the flash rate, change R1. Change R2 to change the length of time the lamp stays on for each flash.

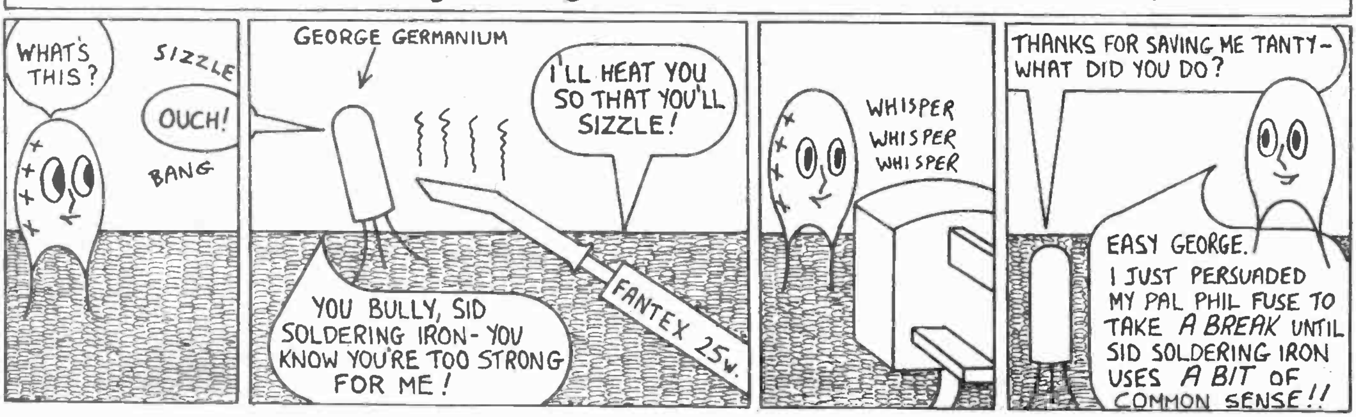
Any malfunctions are most likely due to a flat battery, incorrect switch wiring, or wrongly orientated components.

Finally, when the unit is operating properly, seal the box completely. The switch is sealed with a rubber washer on the outside of the box.

Ensure that all wires to the box are sealed with epoxy resin, likewise with any screws in the box and lid. Sealing the lid is achieved by setting the lid flange in a liberal amount of non-hardening elastic caulking compound. Finally the switch is weatherproofed by covering with a rubber cup. ⌑

The Adventures of Tanty Bead

By Matthew Reed



By Dave Barrington

Storage Cabinets

As this month's *Square One* concentrates on components, it seems appropriate to mention two new portable component storage cabinets..

A cabinet ideal for the storage of such items as resistors, transistors, i.c.s, capacitors, grommets and most small items is the latest product from Sumico.

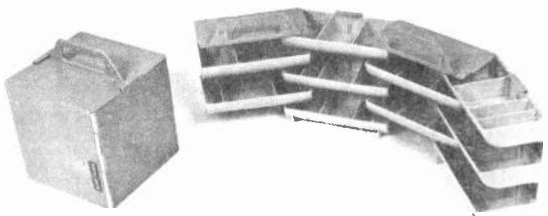
Measuring 254mm × 203mm × 165mm, the cabinet is made from strong plastic and has 15 "see-through" drawers with drawer dividers. The top of the cabinet incorporates a recessed carrying handle.

A feature of the cabinets is that they can be interlocked together to form a semi-permanent system for the workshop. For further details of stockists and prices readers should write to Sumico Ltd., Dept EE, 7 Clarence Road, Clare, Sudbury, Suffolk, CO10 8QN.

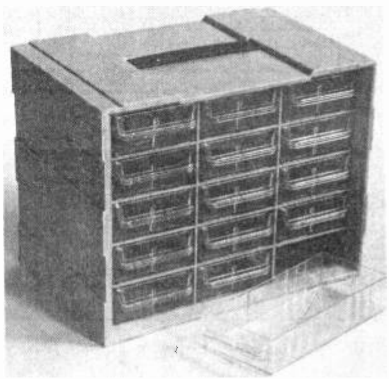
The Partfolio 200 "cube" available from Toolrange Ltd., is an unusual folding component tray system which offers up to 30 separate compartments. Rather like a collection of multi-shelf letter trays linked together, the cube when opened out extends to 800mm but when closed forms a 200mm cube, with carrying handle.

The system is supplied with compartment dividers and labels. Each individual tray measures 195mm × 95mm × 40mm and has divider slots to enable different size compartments to be made up.

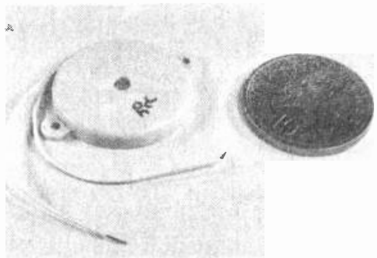
The Partfolio 200 is priced at £17·50 plus VAT and is available from Toolrange Ltd., Dept EE, Upton Road, Reading, RG3 4JA.



Toolrange Partfolio 200 cube.



Fifteen drawer component cabinet from Sumico.



Toko transducers from Ambit.

Piezo Ceramic Buzzer

A range of probably the smallest piezo ceramic sound transducers we have come across is now available from Ambit International. Being so small, not much larger than a 10 pence piece, these Toko transducers will make perfect hidden warning buzzers for simple alarm projects.

The buzzers are available as unmounted discs or encapsulated in plastic with mounting lugs. Operating from fairly low voltages one of the range, type PB-2720, needs as little as 1mA drive current.

Suggested application and drive circuits is included in the product data which is available along with the devices from Ambit International, Dept EE, 200 North Service Road, Brentwood, Essex, CM14 4SG. No price was available at the time of going to press.

CONSTRUCTIONAL PROJECTS

We cannot foresee many component buying problems this month but one or two special items need further mention.

Gas Sentinel

The main item on our list is the *Gas Sentinel* and as far as we are aware the gas sensor transducer is only available from Watford Electronics, the main distributor for these devices. We understand that they are also prepared to supply a complete kit of parts for this project.

The components list calls for a mains transformer with a secondary rated at 9V 1A. However, the prototype unit used a transformer with two 9V 400mA secondaries wired in parallel and is available from Watford Electronics as type 182.

Cycle Direction Flasher

The only item likely to cause any concern in the *Cycle Direction Flasher* is the plastic end caps. These are available from Home Radio (Components) Ltd., PO Box 92, 215 London Road, Mitcham, Surrey, CR4 3HD.

The plastic elbows and tubes should be available from most DIY shops.

As far as we have been able to ascertain, the 3·5V 150mA bulbs appear to be only available from Maplin Electronics.

No problems should be encountered in obtaining components for the *Mains Fault Indicator*, the *Auto Level Control* or the *Radio Control Charger Unit*.

Finally, we include a list of components suppliers for the last six parts, including this month's experiments, for the Teach-In 80 series.

SUPPLIERS OF KITS FOR TEACH-IN 80

These kits contain all items specified by Everyday Electronics (see below) *but excluding batteries.*

LIST A see October, 1979, page 634
LIST B see October, 1979, page 640
LIST C see April, 1980, page 253

All component requirements for the Teach-In 80 Series are covered by these three Lists.

SUPPLIER	LIST C	LISTS A, B & C
Bi-Pak, Dept. EE, P.O. Box 6, Ware, Herts.	£2·55	£18·00
Electrovalue Ltd., Dept. EE, 28 St. Judes Road, Englefield Green, Egham, Surrey.	£2·75	£24·90
Greenweld Electronics Limited, 443 Millbrook Road, Southampton.	£3·00	£24·25
Home Radio, 234-240 London Road, Mitcham, Surrey.	£7·50	£29·00
Magenta Electronics Limited, 98 Calais Road, Burton-on-Trent, Staffs.*	£2·83	£25·43
A. Marshall (London) Limited, Kingsgate House, Kingsgate Place, London NW6 4TA	£4·03	£25·50
T. Powell, 306 St. Paul's Road, Highbury Corner, London N.1.	£2·50	£22·50

All prices quoted are inclusive of VAT, postage and packing.

*Can also supply woodwork etc. for Tutor Deck, see advertisement.

automatic LEVEL control

by P.W.Bond

Restricts level range by compression and expansion of input signals. Useful for recording and disco work.

THIS PROJECT describes the operation and construction of a simple, but very effective, automatic level controller or ALC. The device allows signals from a nominated source to be kept at a fixed volume when feeding a tape or amplifier system.

To appreciate the need for such a unit it is necessary to consider what happens when one makes a recording using a microphone feeding a tape recorder which has a manual record level adjustment.

When the recording is being made the level control must be adjusted to maintain correct modulation of the tape. Very loud sounds which occur could produce unpleasant overload distortion when the tape saturates magnetically. Then, on the other hand, very quiet sounds can be lost in the hiss of unmodulated tape if measures are not taken to increase the recording level.

Similar volume variations are experienced when using a public address or a discotheque microphone. The ultimate object of any of these systems is that information must be conveyed with the least disturbance to intelligibility, and the ALC helps to achieve this.

PRINCIPLE OF OPERATION

The fundamental requirement of the ALC is that it must increase the amplification applied to low level signals and reduce the amplification applied to high level signals. The response of an ALC circuit in relation to a normal linear amplifier stage is shown in Fig. 1.

It can be seen that with the ALC connected the level of the input signal can vary quite considerably whereas the output level range is quite restricted.

The effect of reducing gain applied to high level input signals is called compression. And the opposite effect of increasing the gain applied to the lower level signals is called expanding.

The unit described here performs both of the above operations so it could be called a compressor-expander (frequently called a compander). However the professional companders have many facilities which are required for use in broadcasting and recording studios. This unit cannot match these, but it performs the basic operation at low cost.

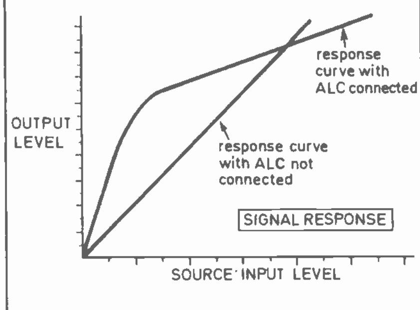


Fig. 1. Shows response curve of ALC in contrast to a linear gain amplifier.

A block diagram of the ALC and the circuit elements which are used to obtain the compression and expansion effects described above is shown in Fig. 2. It will be seen that a closed loop control system is employed, which means that the input of the system is controlled as a result of the output of the same control system.

The gain element is a single stage transistor amplifier which has negative feedback—negative feedback is a method of controlling the gain of an amplifier by feeding back a portion of the output such as to oppose the original signal. As more output voltage or current is fed back to the input of the amplifier the net gain is much less than normal, and the opposite is also true. The less feedback applied then the higher the gain of the amplifier stage.

The amount of feedback is variable and made dependent on the drain to source (channel) resistance of a field effect transistor. The channel resistance is dependant upon the voltage between the gate and source terminals of the f.e.t. What results is a simple voltage controlled amplifier.

CONTROL VOLTAGE

To control the gain the output signal must be continuously monitored. An a.c. signal for gain control is derived through a buffer amplifier which then drives the a.c. to d.c. converter which comprises a pair of diodes D1 and D2 which form a voltage doubler circuit. The output from the circuit is a voltage, the value of which is proportional to the output signal level. The d.c. voltage would normally be changing all the time with the output signal but a storage capacitor allows an approximate average value to be obtained.

The actual storage time controls the time taken for the voltage controlled amplifier to restore to its maximum. In the prototype the

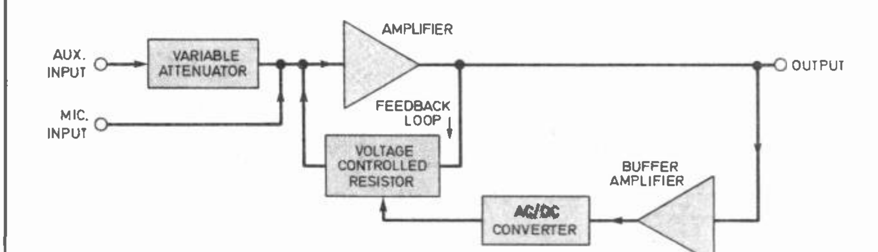


Fig. 2. Block diagram of the ALC.

value of the storage time is controlled by a potentiometer in order to make the device suitable for various applications.

The source signal can be fed to a fixed low level input MIC INPUT, e.g. low impedance microphone, and the higher level signals can be fed to the higher level auxiliary (AUX) input which is connected to a variable attenuator. This control avoids the possibility of the device continuously compressing.

CIRCUIT DESCRIPTION

The complete circuit diagram is shown in Fig. 3.

There are two inputs to the circuit as described but the circuit is so arranged that the LEVEL control is not connected when the low level input is used. This avoids unnecessary signal loss. This is achieved by wiring of the break action contacts of the low level input jack, SK1.

Under no signal conditions the f.e.t drain-to-source resistance has a low value of only a few hundred ohms and this with the low reactance of C3 shunts R3 thereby removing the a.c. feedback path for the amplifier. The amplifier stage consists of TR2 and its bias components, and with the feedback virtually removed the gain of the amplifier if fairly high.

Output from TR2 is fed to a second amplifier, TR3, which feeds a.c. signals to the a.c. to d.c. converter. Diodes D1 and D2 form a rectifier and voltage doubler, and the output appears across C9. The value of this voltage is directly proportional to the amplitude or "loudness" of the source signal and is negative with respect to the zero volt rail. This negative voltage is applied to TR1 gate terminal. The more negative the gate voltage the higher the drain-to-source resistance becomes, thereby having less shunt effect on

COMPONENTS

Resistors

R1 1·5MΩ
R2 6·8kΩ
R3 3·9kΩ
R4 1·2kΩ
R5 47kΩ
R6 10kΩ
R7 3·9kΩ
R8 1kΩ
R9 100Ω
R10 5·6kΩ
All ¼W carbon ±5%

See Shop Talk page 241

Potentiometers

VR1 25kΩ log. law
VR2 1MΩ carbon lin. law

Capacitors

C1	33μF 10V elect.
C2	3·3μF 6V elect.
C3	100μF 10V elect.
C4 to C6	8μF 10V elect. (3 off)
C7, 8	100μF 10V elect. (2 off)
C9	10μF 10V elect.

COMPONENTS approx. cost Guidance only
£4·50 excluding case

Semiconductors

TR1	2N3819 *n*-channel f.e.t.
TR2, 3	BC109 silicon *npn* (2 off)
D1, D2	1N914 small signal silicon (2 off)

Miscellaneous

S1	single-pole on/off toggle
SK1	switched jack socket
SK2, 3	mono jack sockets (2 off) or other sockets to suit equipment
B1	9V PP3

Stripboard: 0·1 inch matrix size 19 strips × 31 holes; connector to suit B1; 4BA fixings; case: aluminium/vinyl clad steel size 152 × 114 × 44mm; screened cable; control knobs (2 off); connecting wire.

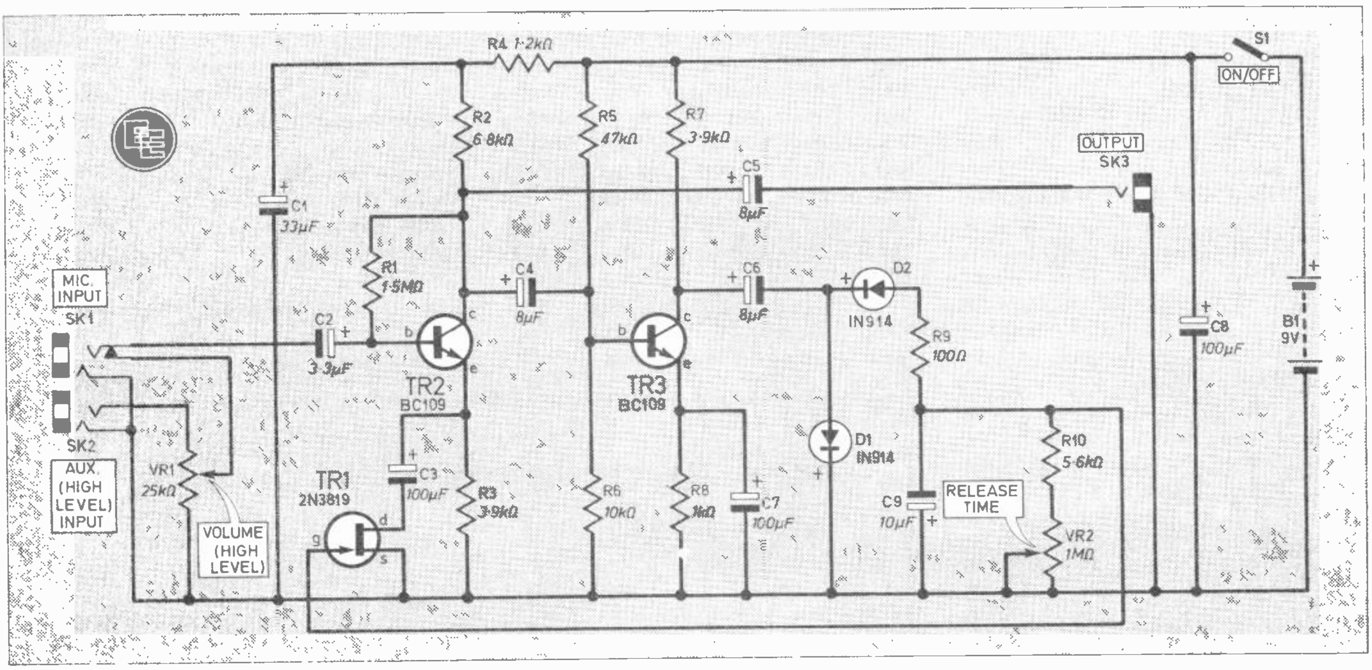


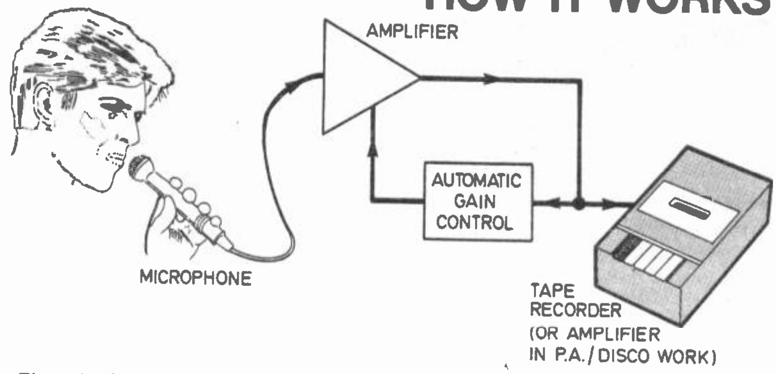
Fig. 3. The complete circuit diagram of the Automatic Level Control.

R3, increasing its negative feedback so reducing gain.

If the input signal falls to a low level, the voltage at the negative plate of C9 decays through VR2 and R10. The result is to restore the gain of TR1.

The time taken for the gain of the amplifier to restore is known as the recovery or RELEASE TIME. It is related to the discharge of C9 and if the parallel resistance is reduced C9 will discharge quicker; VR2 allows this time to be varied from a few milliseconds to a few seconds.

HOW IT WORKS



Electrical signals developed in the microphone are passed to the tape recorder via a low gain amplifier. The resulting amplifier output level is sensed by the automatic gain control circuitry which adjusts the gain of the amplifier in the required manner. Low level microphone signals are boosted whereas high level signals are subject to attenuation. In this way low level signals do not become overshadowed by inherent noise in the mic. system and high level signals are prevented from overloading the tape input which would otherwise cause distortion.

CONSTRUCTION starts here

CONSTRUCTION

The prototype was intended to be a general purpose unit for use with anything and everything where such a device would be advantageous. The case used was fairly small but large considering the circuit simplicity, and readers may wish to use the circuit board alone and mount the device in the case of the equipment for which it was built. If this is so, VR1 and VR2 can be replaced by preset type potentiometers.

The components are mounted on a single piece of stripboard; Fig. 4 shows the layout of the components on the topside of the board. There are no breaks to be made on the underside.

The board as shown is mounted using a single fixing hole with a thick insulated washer to isolate the board from the case. When mounting the components observe the correct polarity for the diodes, electrolytic capacitors and in particular the transistors.

Begin construction by mounting the resistors and capacitors followed by the semiconductors. Novice constructors are advised to use a heatshunt on the legs of the semiconductors to avoid thermal damage. Attach suitable lengths of flying lead to reach the chassis mounted components. Note that screened lead is used for some connectors.

Prepare the case to accept the sockets, switch and potentiometer, secure these in place, and then wire up according to Fig. 4.

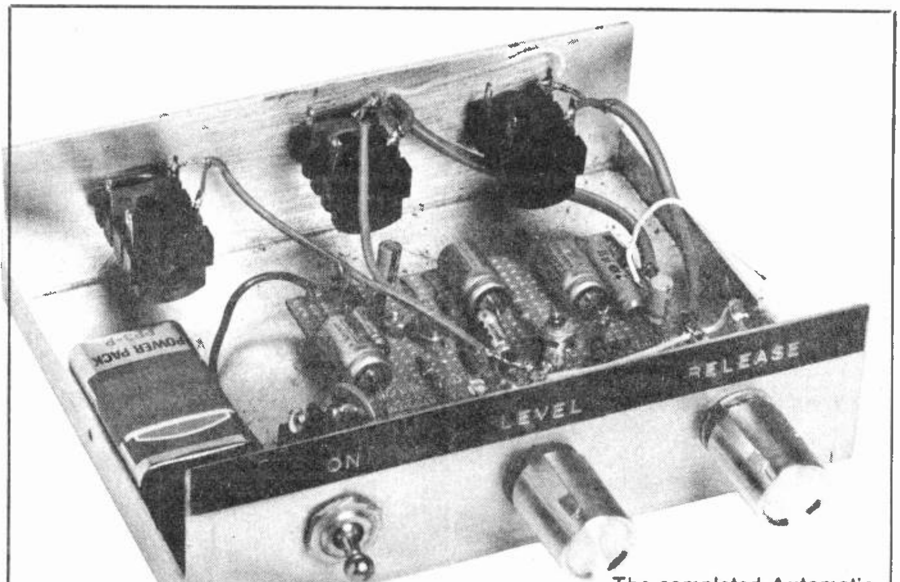
The prototype was designed for general purpose usage and the inputs were all standard jacks but by drilling the appropriate sized holes DIN, phono or banana sockets may be used.

Perhaps for the most versatile unit a selectable combination of sockets could be devised. Many microphones and guitars are connected to amplifiers and auxillary equipment by means of standard mono jack plugs and so SK1 could be a jack socket whereas the auxilliary input, SK2, would be a DIN or phono.

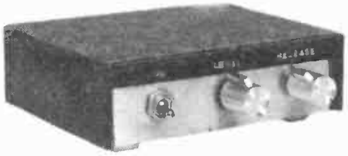
The completed unit was mounted in a commercially available case with a black vinyl lid. This gave the unit a neat appearance. The battery requirement is furnished by a PP3 and the use of double sided adhesive tape provides adequate support.

TESTING AND USE

Connect a microphone, low output type to SK1 or high output type to SK2, and the output of the



The completed Automatic Level Control with top cover removed.



AUTOMATIC LEVEL CONTROL

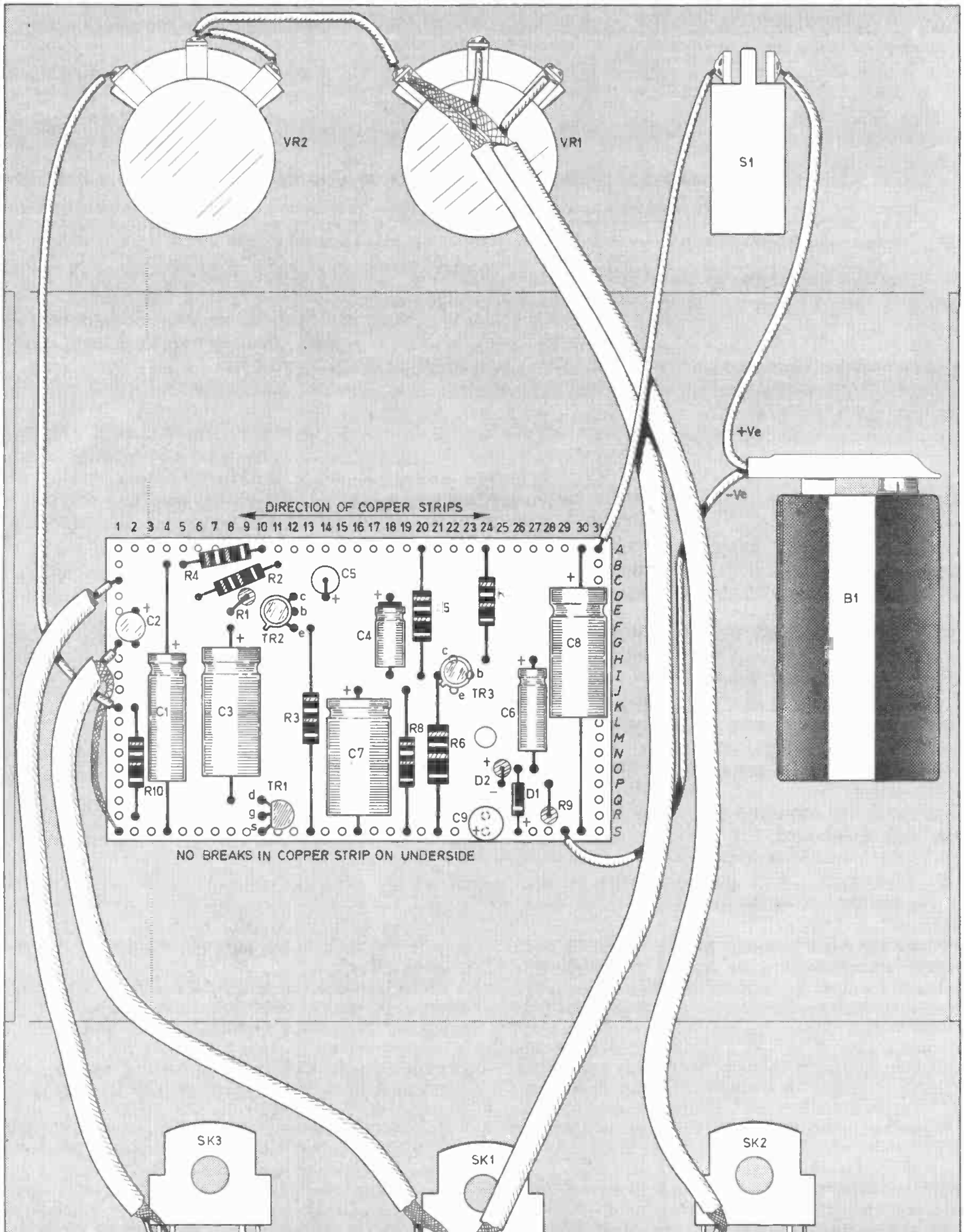
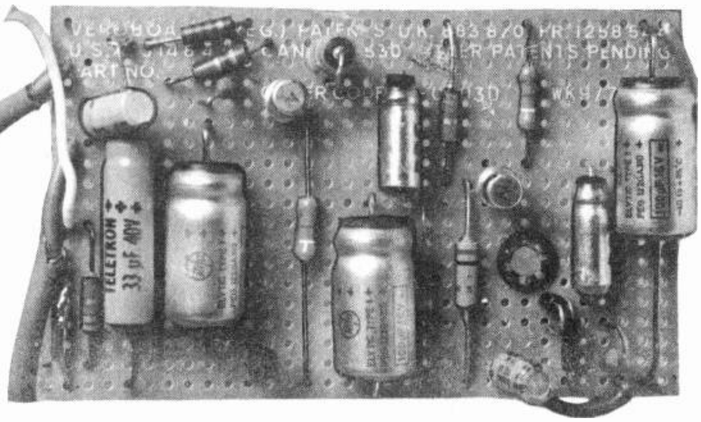


Fig. 4. Shows the layout of the components on the topside of the stripboard. In the prototype no breaks in the copper strips were found necessary around the single fixing-hole. Also shows full interwiring between board and case mounted components.



Layout of components on the completed circuit board.

unit to an amplifier input. A headphone output facility on the amplifier will be particularly useful and would eliminate possible positive feedback during the setting up.

With the unit switched on speak into the microphone. It should be possible to shout and whisper without hearing any distortion.

By turning the RELEASE TIME control fully anticlockwise the gain of the unit will restore to its maximum in a very short time. This will be perceived by an increase in background noise level.

If these results are not obtained then the wiring will have to be checked, particularly check for solder bridges on the circuit board. The 0.1 inch matrix stripboard is prone to short circuits through solder blobs bridging adjacent strips and care must be taken when soldering.

For high level signals SK2 input must be used and the attenuator adjusted to allow an undistorted output to be obtained.

For use with a tuner to record a programme onto tape, the high level input is used, and VR2 should be set to its midway position. This setting will prove to be adequate for both music of the pop and light variety and for talks and chat shows. However, where the music is much slower the recovery time can be much longer, which is achieved by advancing VR2 clockwise.

The input attenuator VR1 must be set to avoid excessive compression which will be evident by output volume reduction as the input reaches a high level.

A more compact version has proved particularly useful for the author when connected to the microphone circuit of a portable tape recorder. Then when the tape recorder was used for interview work, no adjustment of the microphone level was needed and the ALC was able to cope with the differing voice levels. For this type of application the unit needs a fast recovery time, i.e. VR2 fully anticlockwise. ⌑

BOOK REVIEWS

TELEVISION & RADIO 1980

Price £2·50
Size 230mm × 190mm
Publisher Independent Broadcasting Authority
ISBN 0 900485 34 5

ONCE again its a pleasure to read the "behind the scenes" stories of our independent television and radio services.

This year's edition gives a fairly concise guide to the many aspects of programming, technical developments and advertising controls; i.e. code of practice on what's acceptable and unacceptable material and details of better viewing and listening.

The handbook must be one of the very few publications that has not increased in price from last year and retained the same number of pages (224) and abundant illustrations. Unfortunately, the printing and visual appearance does not measure up to the high standards set by previous editions. However, the 1980 edition is still very good value for money.

Perhaps this criticism is a bit harsh and may be due to the growth in local broadcasting and trying to pack a "quart into a pint". Maybe, with the increasing growth and interest in local radio it's time a separate book dealing solely with radio was issued.

It seems paradoxical that having just read the section on their plans and optimisms for the 80s, comes news that the proposed launching of the new channel may be delayed due to lack of funds. D.G.B.

ELECTRONIC PROJECTS INDEX No.2 1978

Compiler M. L. Scaife
Price £1·30
Size 297 × 210mm 48 pages (Paperback)
Publisher North Tyneside Metropolitan Borough Council, Libraries and Arts Dept., North Shields, Tyne and Wear
ISBN 0142-1565

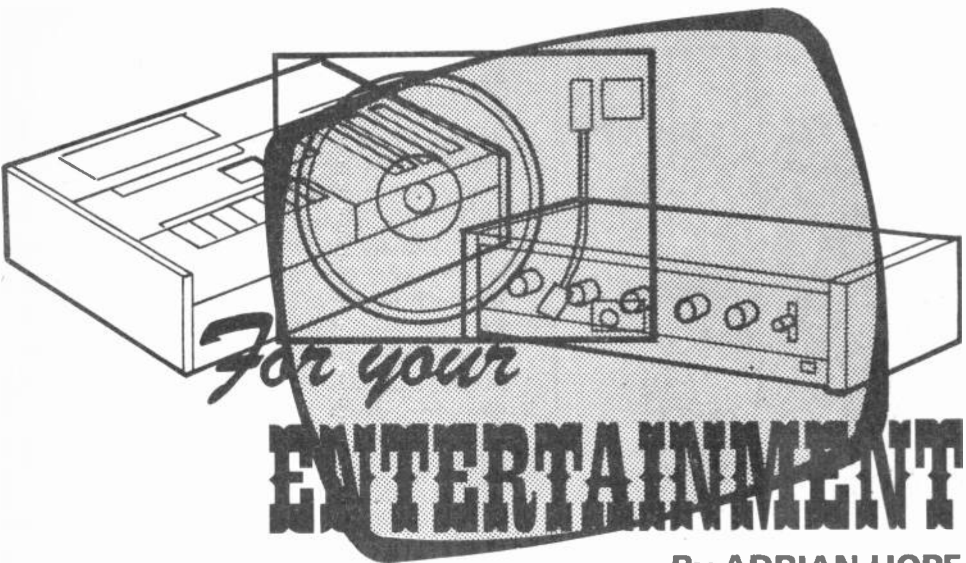
THIS is a guide to constructional projects published during 1978 in 16 well-known magazines which in total cover practically the entire field of d.i.y. electronics. It carries on (in the same style and format) from Electronics Projects Index 1972-1977 published at the beginning of 1979.

Projects are listed under 36 headings: an extensive list of subjects which itself is quite revealing as to the wide extent of electronics applications.

Individual entries give magazine title, issue and page numbers, then brief details including component complement and usually the form of construction e.g. P.C.B., Veroboard.

The largest section is Measuring and Test Instruments with 127 individual items listed, runners up being Music Effects and Musical Instruments (50 projects), Amplifiers (40), Automobile (37), P.S.U. (37), Games (34). Other subject groupings including Alarms, Calculators, Locks, Metal Locators, Receivers, Timekeeping, run to 30 or less projects each.

If this predominance of Test Gear and P.S.U. articles truly reflects the general demand, one is lead to the conclusion that the electronics constructor is essentially serious-minded and puts his working tools and instruments before all other kinds of projects. F.E.B.



For your ENTERTAINMENT

By ADRIAN HOPE

Breaking a Monopoly

The Post Office monopoly is now finally crumbling. Shortly after Sir Keith Joseph's historic statement promising a new era of freedom and enterprise for U.K. telecommunications, the Post Office issued a press release which was surprisingly not extensively reported. "From next year", reads the press release "customers will be able to buy as well as rent telephone answering machines".

Until now, of course, anyone wanting to install a machine to answer their telephone and record messages has had to rent one from a Post Office approved supplier. These machines are remarkably complicated beasts. I know; I once bought a couple of ex-rental machines.

Over the last year, all manner of relatively inexpensive, but very efficient and electronically simple answering machines have been coming in from the USA either in traveller's suitcases or by bulk import for open sale in the increasing number of shops now offering "illegitimate" telephone gadgetry. It was a foregone conclusion that once the government had decided to chip away the Post Office monopoly telephone answering machines would be the first gadgetry to become legitimate for subscriber purchase and connection.

The government aims eventually to replicate the USA situation where the telephone company's monopoly ends at the front door, just like the gas, water and electricity supplies. But it will take time to make such a wholesale change and the use of "illegitimate" subscriber owned telephone answering machines is now so widespread that it's the obvious place to start with a change.

In some parts of the country the Post Office has already been recommending local suppliers of USA equipment when subscribers enquire about telephone answering machines. The Post Office has put on a brave face about the official *volte face* over answering machines, claiming that rentals were previously required "so that the machines could easily be traced for modification when necessary" and that it's "progressive developments in the manufacture of these machines" that have made possible a change in attitude. But the writing is now on the wall. Perhaps, appropriately, the new scheme comes into operation after April 1, 1980.

Cordless Telephone

However, despite misleading publicity to the contrary, for the foreseeable future, you will not, repeat not be able to use cordless telephones. Advertisements have recently been appearing in the national press offering a cordless phone which is "easy to install".

The publicity material which is sent off to anyone who writes in for further details claims that "Following more press announcements on Sir Keith Joseph's plans for the Post Office services, we are giving you a great opportunity to be one of the first people to take advantage of this exciting new technology . . . our phones are easy to install and are completely compatible with the British system."

The cordless 'phone being offered for sale (at around £250) may well be easy to install and may well be completely compatible with the British telephone system, but it relies for its cordless connection on a radio link that is 100 per cent illegal under our old friend the Wireless Telegraphy Act 1949. This, of course, is the law which makes the use of CB sets illegal. The penalties for using a radio cordless telephone are in fact the same as for using a CB walkie-talkie: up to £400 fine and/or three months in jail.

In the USA such cordless 'phones are, like CB, legal. Moreover, there is no ban on importing them into the UK provided of course duty and VAT is paid. This is because those on sale in the UK work on the 1·6–1·8MHz and 49·8–49·9MHz.

In an effort to curb the spread of CB, a 1968 modification to the W.T. Acts outlawed the importation of 27MHz transceiver equipment. But this does not prevent the import of equipment operating on other frequencies. There is also nothing to prevent the advertisement or sale of such equipment.

But the acts do make it illegal to *use* such transceivers in the UK. What's more the Post Office can object to the connection of any unauthorised equipment to a subscriber's line, and if necessary disconnect at the exchange.

So although importing, advertising and selling a radio link wireless telephone is legally in the clear, the poor customer who pays his honest £250·00 is in anything but clover. He stands to have his telephone cut off by the Post Office and be fined and jailed into the bargain.

Incidentally, the public files of the British Patent Office reveals that one of the British Post Office's main suppliers, STC is now working on an infra-red linked cordless telephone. This will be both legal and much more secure in use.

Whereas a wireless link spreads signals at least 100 yards around the system and so enables anyone in that area to eavesdrop on telephone conversations (incidentally it also gives officialdom an easy opportunity to detect illegal use) the infra-red link won't stray outside the wall of the user's home.

X-ray Time

Until a few years ago radiographers, who operate the X-ray examination equipment in our hospitals, grew tired of reassuring patients that there was no need to remove their wrist watches before examination. Now they are growing tired of saying just the opposite.

Many British hospitals are posting notices advising X-ray patients to *remove* their watches before examination. The turnaround dates back to a warning letter published in a medical journal.

Although ordinary mechanical hour- and minute-hand watches are unaffected by X-rays, it seems that the same may not be true of electronic watches. There have now been several reports of digital watches stopping while the wearer is being X-rayed. Sometimes they start again. Sometimes they don't. In one case a watch simply skipped an hour.

A leading watch manufacturer quizzed on the problem has confirmed that the CMOS chips used in a digital watch certainly can be affected by high levels of radiation, and also intense magnetic fields. In some cases the chip recovers and in others simply stops working. But the simple truth is that no one really knows whether the relatively low levels of radiation used in hospitals for routine examinations are, or are not, significant.

Tests carried out have also been inconclusive because there are any number of different types of electronic watches, all with different thicknesses of shielding metal around the chip. Also there are all manner of different medical X-ray techniques, all involving a different dose on the patient's wrist.

Play Safe

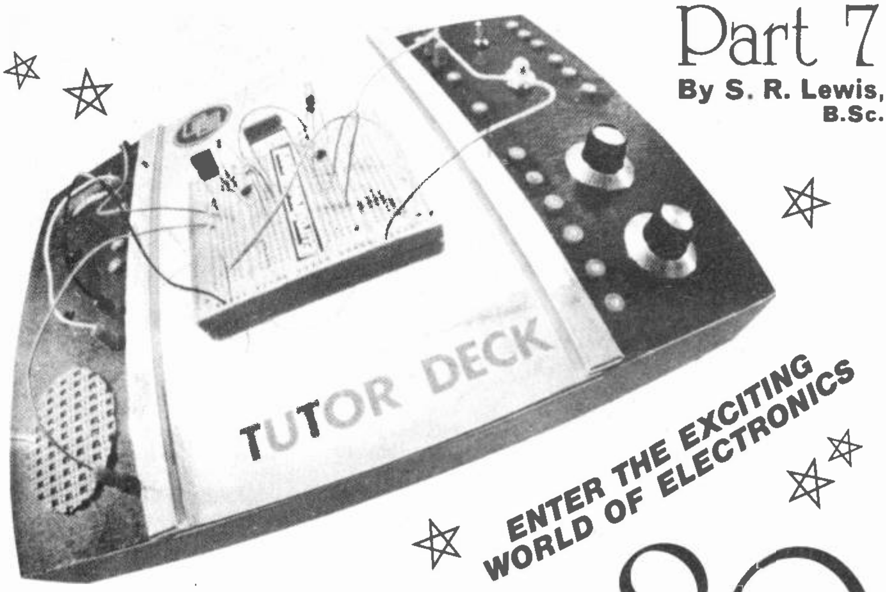
The manufacturer acknowledged that "there is still somewhat of a grey area in CMOS technology" and it may well be years before enough incidents have been correlated to give a clear picture of the true situation. In fact, now that hospitals are "playing safe" and advising patients to remove their watches, we shall probably never know.

Similarly, we shall probably never now know whether there was any real basis in the suggestion of a few years ago that high level X-ray inspection equipment at airports presented a risk to electronic equipment. The airlines have also "played safe" and there is now hardly an airport left in the world which uses high dosage baggage inspection equipment.

Anyone who constructs electronic prototype equipment, whether for a hobby or for business, would however be well advised to keep all chips well clear of X-ray radiation (and strong magnetic fields) until the matter is resolved.

Part 7

By S. R. Lewis, B.Sc.



TEACH-IN 80

THE transistor is undoubtedly the single most important device in electronics today. Although its actual operation is only fully understandable with a knowledge of advanced physics, we do not need to know exactly what is going on inside a device in order to make use of it.

The term **transistor** is today used to refer to many different types of device. There are **bipolar transistors, field effect transistors (f.e.t.s.), unijunction transistors** and many others. Each has its own special characteristics and is particularly suitable for specific applications.

The type of transistor with which we will be concerned in this part of the series is the **bipolar** type, the most common type of discrete transistor.

THREE TERMINALS

All of the devices that we have looked at so far were relatively simple to understand since they had only two terminals. Any current entering one terminal could only leave by the other terminal.

The first noticeable fact about transistors is that they have three terminals, so current entering any terminal could appear at either of the other terminals or, in fact, both.

To make any sense of transistors we must be quite sure which terminals we are referring to, and to this end each is given a special name. The problem of lead identification on real transistors is complicated by the fact that there is a multitude of different **packages** in which the transistor **chips** themselves are mounted and enclosed.

Each type of transistor (by which we mean chip not package) has a unique code number (OC71, BC108, 2N3055, etc) but different manufacturers may put the same type of chip in different packages.

The diagram in Fig. 7.1 shows the lead identification for some common transistor packages but, be warned: if you come across a transistor serial number that you have not met before, the only certain way to identify the leads is to check with published data, either in the form of transistor data books or tables which quite often appear in electronics magazines or, if this proves unsuccessful, direct from the manufacturer's own data.

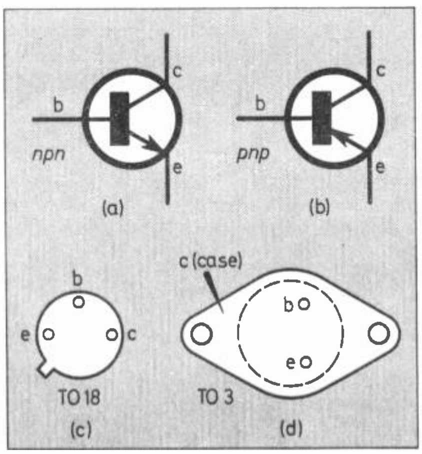


Fig. 7.1. (a) and (b) show the circuit symbols for *npn* and *pnp* transistors respectively. (c) and (d) show the lead identification for two common types of transistor package. The packages are seen looking at the leads.

The three leads are labelled **emitter (e), collector (c),** and **base (b)** and we must always make sure that the transistor is connected with these leads in the right place or damage could be done.

GERMANIUM AND SILICON

There are two main types of material from which transistors are fabricated. The early transistors used **germanium,** a brittle white metal which is quite rare. Today's technology is centred around **silicon,** a non-metal with chemical properties quite similar to carbon. It occurs naturally in abundance as silica (of which sand is the impure form).

The advances in recent years have been in ways of purifying the silicon and of growing very precise crystals. Whilst germanium transistors are still used to some extent in specialist applications, silicon is now used almost exclusively.

Silicon transistors have the advantage that they are much less prone to a destructive process known as **thermal runaway** which can destroy a transistor if the circuitry around it is not carefully designed.

The problem is that the **leakage currents** through germanium transistors could be quite high and these leakage currents increase dramatically with temperature. Since the increased current caused heating of the transistor there was a vicious circle (or, to give it its technical term, **positive feedback**) which eventually destroyed the device through overheating.

In silicon transistors the leakage currents are virtually negligible and so the heating effect which they produce are not of any importance.

The higher leakage currents through germanium also meant that the circuitry around them was slightly more complicated, which is another factor in favour of silicon.

The symbol for the transistor (see Fig. 7·1a and b) does not distinguish between the two types of transistor and so one must refer to transistor data to determine the material from which a particular transistor is made.

PNP AND NPN

If we look at the diagram showing the internal construction of a transistor we will find that it is like the diode we looked at earlier with a *p-n* junction but another oppositely doped section has been added on the end.

The oppositely doped section can be added at either end (Fig. 7.2) thus producing two types of transistor: *npn* and *pnp*. The symbols for these two types is different, the arrow on the emitter lead being reversed.

It might be thought that simply adding another junction to the first would simply form a double diode as indicated in Fig. 7.3 and, up to a point this is so. If the emitter lead is left open circuit and the base-collector terminals only are used then we would have something that appears exactly like a diode. Similarly if the collector is left open circuit then the base-emitter behaves like a diode.

The interesting and useful thing is that when the base-collector junction is reverse biased then the forward current through the base-emitter junction is able to control the current through the collector. But not only does the base current control the collector current, we also find that only a tiny base current is needed in order to control quite large currents through the emitter.

So far the description has used fairly vague terms like "through" rather than "into" or "out of" and this is to keep the description applicable to both *npn* and *pnp* transistors.

CURRENT AMPLIFIER

To sum up the operation of a transistor in one sentence we could say that a small current flowing into the base of a transistor controls a much larger current flowing into the collector. To put it

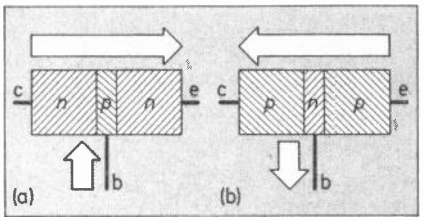


Fig. 7.2. The doping of the various sections of *npn* and *pnp* transistors. The arrows indicate the flow of conventional current through the two types when operated in their normal modes. In real transistors the base layer is very thin in relation to the collector and emitter sections.

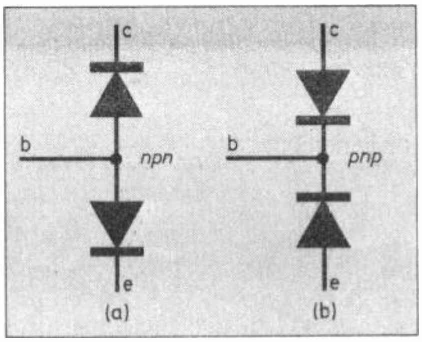


Fig. 7.3. When viewed in isolation the base-emitter and base-collector sections of a transistor appear as diodes. It is when the base-collector junction is reverse biased and the base-emitter is forward biased that the transistor becomes interesting.

another way: the transistor is a current amplifier.

If we look back at the symbol for a transistor we see that the emitter lead has an arrow on it. This arrow indicates the direction of flow of conventional current when the transistor is used in its normal operating mode. The direction of the arrow is used to differentiate between the *npn* and *pnp* types of transistor.

When one looks back at circuits from say fifteen years ago one finds that nearly all of them were built using *pnp* transistors. Today there is an overwhelming preponderance of *npn* transistors with *pnp* types only occurring occasionally. The change is not simply due to fashion it reflects changes in manufacturing technology.

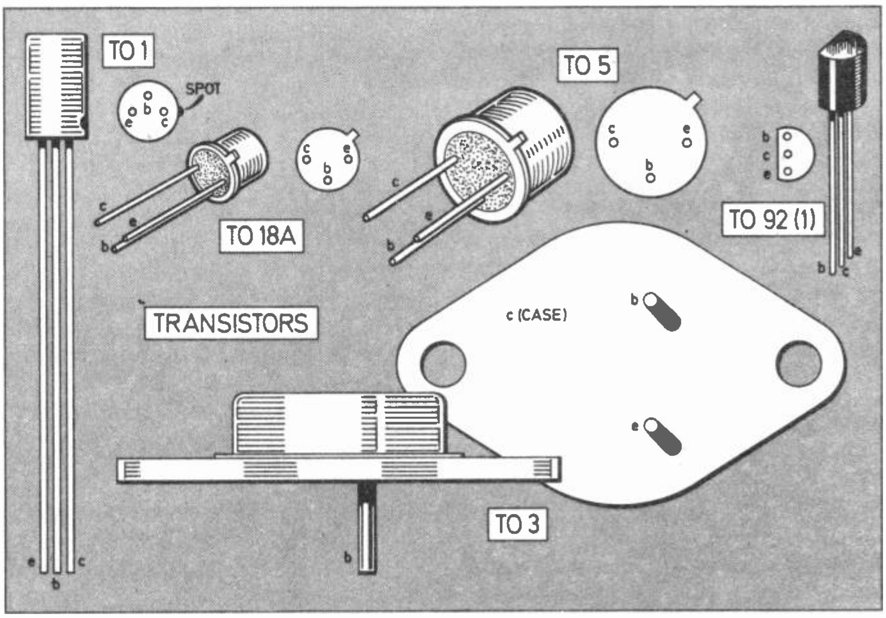
CURRENT GAIN

Since no current can "disappear" inside the transistor all current entering the device must appear as current leaving it. Thus we can say that the emitter current (that is current leaving the transistor) must equal the sum of the base and collector currents (those entering the transistor). Using mathematical notation:

$$I_e = I_b + I_c$$

where I_e is the emitter current, I_b the base current and I_c the collector current.

What can we deduce from this starting point? If the base current is zero (as will be the case when it is left open circuit) then the emitter current will be the same as the collector current. If the collector current is zero (collector open circuit) then the based current will be the same as the emitter current.



Some typical transistor packages (all to scale) with identification of leads or pins. The TO3 package is used for high power transistors, all other examples are small signal transistors.

There are two ways in which the emitter current can be zero: either $I_c = -I_b$ (the same current flows into the base and out of the collector) or both collector and base current are zero.

Let us connect up an actual circuit on the Tutor Deck to see exactly how the transistor (type BC108) behaves.

The circuit is shown in Fig. 7.4 and it will be seen that we have connected the emitter of the transistor to the 0V line and put a meter in the collector circuit which then goes up to +18V. In the base of the transistor we have a resistor which can be connected to the 18V line by pressing the switch S2.

When the switch is not pressed we see that the current through the collector is virtually zero. The only current that is flowing is what is termed the "leakage current" and, for the BC108, it can be taken as negligible.

When the pushbutton is pressed we see that the meter swings well over indicating a current into the collector of about two to 16mA. How much current was flowing in the base when this current was flowing in the collector?

PART 7 QUESTIONS

7.1. The arrow on the transistor symbol is on the:
a) emitter
b) base
c) collector

7.2. The gain (h_{FE}) of a transistor is quoted as being 100. What is collector current at a base current of 10μA:
a) 10μA
b) 100μa
c) 1mA

7.3. The collector current in a transistor is measured as being 10.4mA whilst the emitter current is 10.6mA. What is the h_{FE} of the transistor:
a) 104
b) 52
c) 53

7.4. P_{tot} (max) for a transistor is quoted as being 500mW. When the collector to emitter voltage is 2.5V what is maximum current that can be taken through the collector:
a) 200mA
b) 500mA
c) 100mA

7.5. If $I_{c\,(max)}$ is 150mA and h_{FE} is 110-800 what is the maximum base current that should be fed into the transistor assuming there is no limitation on the collector current:
a) 1·36mA
b) 187·5μA
c) 1mA

PART 6 ANSWERS

6.1. b) 6.2. c) 6.3. c) 6.4. b) 6.5. a)

BASE CURRENT

To work out the base current to a fair degree of accuracy we can make a few assumptions. The base-emitter junction is in effect a forward-biased silicon diode.

In the section of this series on diodes we noted that the forward voltage drop across a silicon diode never exceeded about 0·7V. In fact, the assumption is perfectly valid for the transistor base-emitter junction.

Now 0·7V is under five per cent of the supply voltage of 18V so ignoring it will only introduce a five per cent error. The base current is therefore given (approximately) by the supply voltage divided by the base resistor (R1). This works out to be 18μA.

What we have been measuring is perhaps the most important characteristic of the transistor: its **d.c. current gain.** The current gain is defined as the collector current divided by the base current and it is given the symbol h_{FE} or sometimes β.

$$h_{FE} = \frac{I_c}{I_b}$$

Now this figure depends to some extent on the collector current in question and tends to be lower at very low and very high currents than it is at medium currents. The terms "low", "high" and "medium" will vary from transistor to transistor, medium being between 1 and 10mA for the BC108.

The manufacturer's data states that h_{FE} can vary between 110 and 800 which is a very wide range. See if the transistor on which you are making the measurements falls within this range.

If we return to the first equation that we derived we can eliminate one of the terms, namely I_c and get the emitter current in terms of the base current and h_{FE}.

$$I_e = I_c + I_b$$
$$I_e = (h_{FE} \times I_b) + I_b$$
$$I_e = (h_{FE} + 1) \times I_b$$

What this is saying is that the emitter current will be only different from the collector current by the magnitude of the base current and, since this is so small, it will be difficult to measure any difference between the two.

To check that the emitter current is as predicted, it might be thought that it is simply a matter of moving the meter to the emitter lead of the transistor, but doing this introduces a complication into the circuit which it is important to appreciate.

The meter itself (if by "meter" we take to mean the meter and its shunt resistor in parallel) has a resistance and thus any current that flows through it will produce a voltage drop by Ohm's Law. When it is placed in the emitter lead the emitter current which we are trying to measure will produce a voltage drop which effectively reduces the voltage across the base resistor R1.

We are expecting an emitter current of about 10mA so what will be the voltage drop across the meter at this current? By application of Ohm's Law we find that it will be about 0·1V. Fortunately this voltage is very small and it can again be ignored in comparison with the total voltage across the meter, transistor and base resistor (see Fig. 7.5).

As before, virtually no emitter current flows when the base is open circuit. When the button is pressed the reading on the meter should be indistinguishable from the previous reading, confirming the calculations.

CONFIGURATIONS

What we have looked at in the previous section are the two most commonly used transistor configurations. They are given the names "common emitter" and "common collector" respectively. The adjective "common" is used to describe the terminal whose voltage is fixed either by connecting to the power supply rail or to some other invariant voltage.

EXPERIMENT 7.1: COLLECTOR V. BASE CURRENT

Components needed: BC108 transistor, 10Ω ¼W resistor, 1MΩ ¼W resistor.

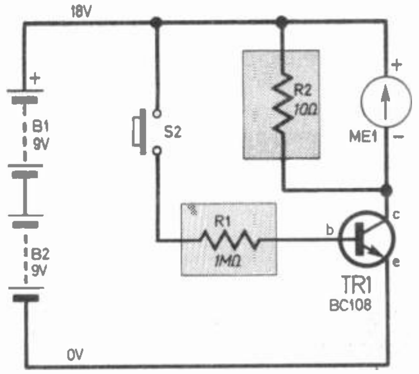


Fig. 7.4 (a)

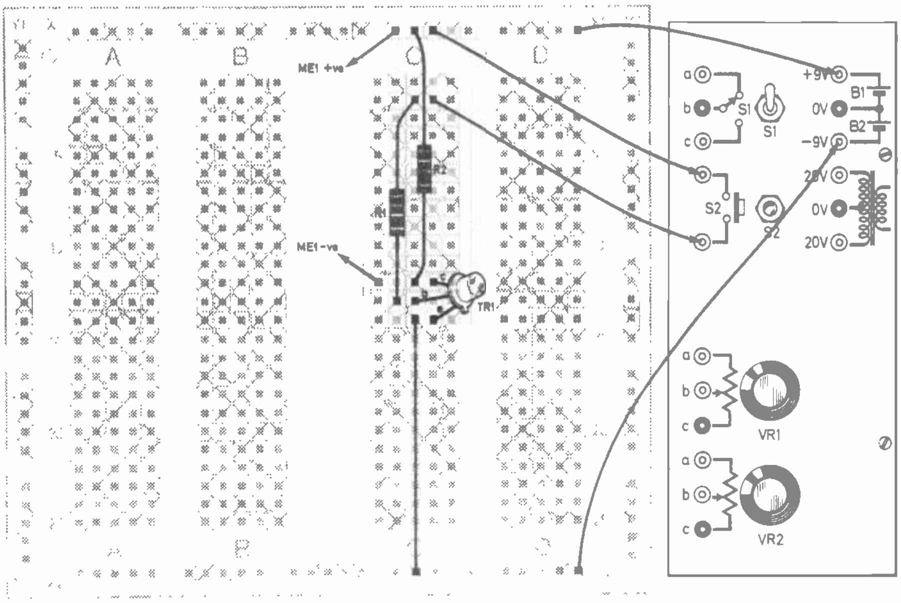
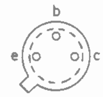


Fig. 7.4 (b)

Fig. 7.4. (a). Circuit of Experiment 7.1 and (b) the layout of the components on the Tutor Deck.



UNDERSIDE VIEW OF BC108

The circuit for this experiment is shown in Fig.7.4a and the layout on the Tutor Deck in Fig.7.4b.

The meter on the Deck itself can only measure current in the order of a few hundred microamps so a 10 ohm resistor (called a shunt resistor) is placed in parallel with it so that the resulting meter-resistor combination appears to be able to measure much higher currents.

Depending on the full scale current of the meter and its internal resistance, the effective full scale reading of the meter will vary but if both of these are known then the full scale current is given by

$$I = \frac{R_m \times I_{fsd}}{10} + I_{fsd}$$

A typical 100μA meter has an internal resistance of around 1700 ohms giving a full scale reading of just over 17mA.

Note that the meter reads virtually zero when the base is open circuit.

EXPERIMENT 7.2: EMITTER CURRENT V. BASE CURRENT

Components needed: as above

This is a repeat of the previous experiment except that the meter has been moved to the emitter lead of the transistor. See text for further description of this circuit. The circuit is shown in Fig.7.5a and the layout on the Tutor Deck in Fig.7.5b.

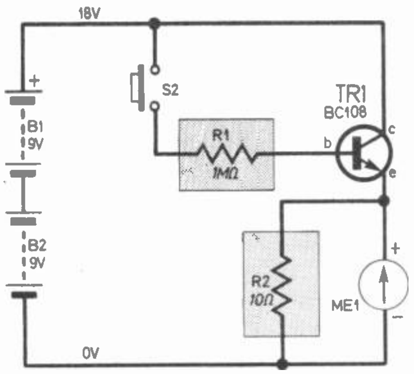


Fig. 7.5 (a)

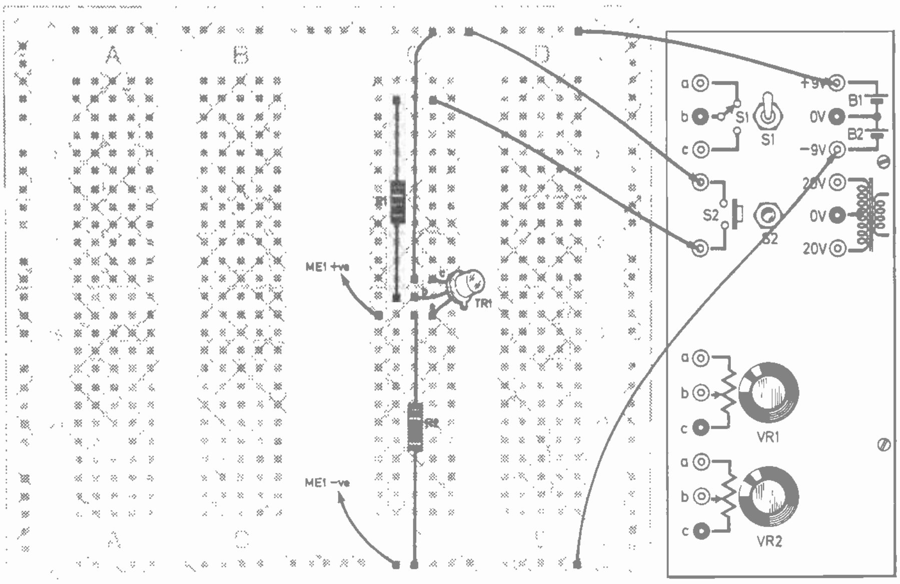
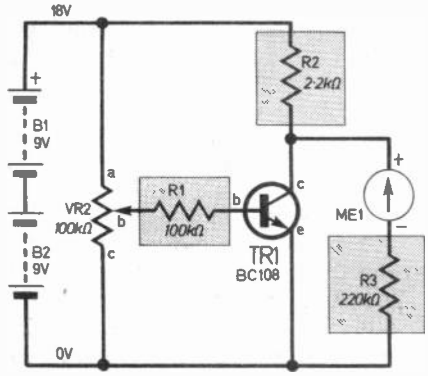


Fig. 7.5 (b)

Fig. 7.5 (a). Circuit of Experiment 7.2 and (b) the layout of the components on the Tutor Deck.

EXPERIMENT 7.3: VOLTAGE AMPLIFICATION (COLLECTOR RESISTOR)

Components needed: BC108 transistor, 100kΩ ¼W resistor, 2·2kΩ ¼W resistor, 220kΩ ¼W resistor.



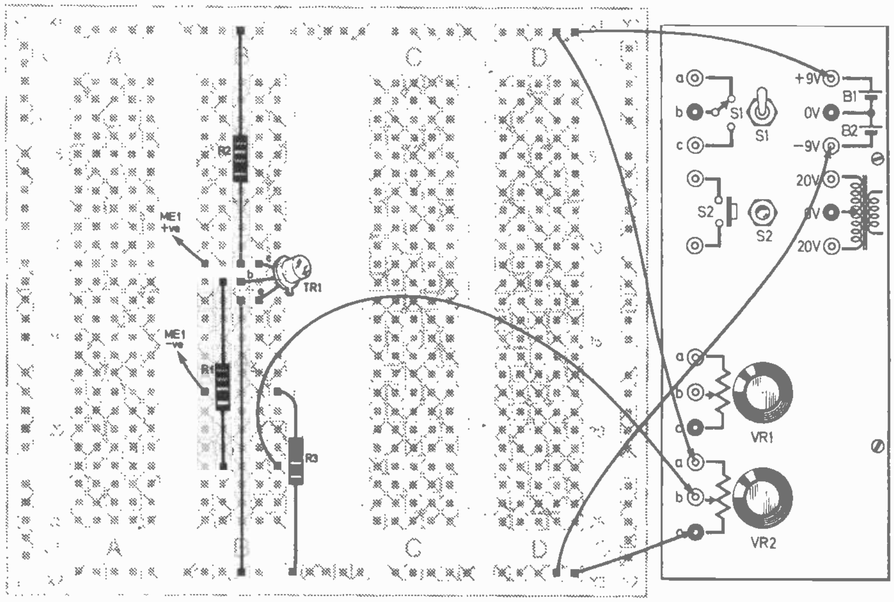


Fig. 7.6 (a) Fig. 7.6 (b)

Fig. 7.6 (a). Circuit of Experiment 7.3 and (b) the layout of the components on the Tutor Deck.

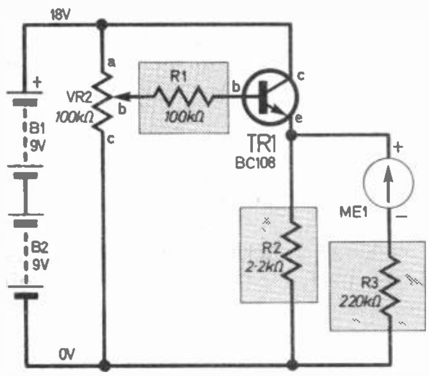
The circuit for this experiment is shown in Fig.7.6a and the Tutor Deck layout in Fig.7.6b.

Use the scale which we produced for the potentiometer in association with the 100kΩ potentiometer on the Tutor Deck. The meter is used in this circuit as a voltmeter since a resistor has now been placed in series with it. The full scale reading of the meter will correspond with 220kΩ × I_{fsd} (or about 22V for a 100μA meter). The internal resistance of the meter is not important here as it will be small in comparison with the 220kΩ resistor.

Note down the meter readings for various settings of the potentiometer scale. These readings do not have to be in volts, they can simply be in meter divisions; we are really just acquiring some figures for comparison with the next experiment. However, knowing that the meter is reading 22V full scale gives a feeling for the sort of voltages we are looking at.

EXPERIMENT 7.4: VOLTAGE AMPLIFICATION (EMITTER RESISTOR)

Components needed: as above



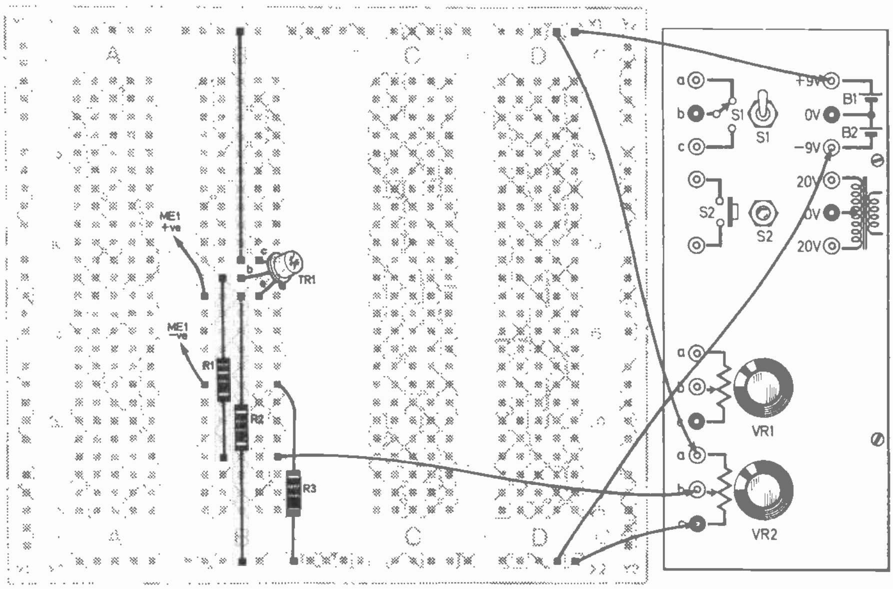


Fig. 7.7 (a) Fig. 7.7 (b)

The circuit of the next experiment is shown in Fig.7.7a and the layout in Fig.7.7b. This is very similar to the previous experiment but this should not mislead you into believing that the circuit behaves in the same way.

Taking a few meter readings for different settings of the potentiometer soon reveals that this circuit is much "better behaved" than the previous circuit in that the output tends to follow the setting of the potentiometer much more closely than in Experiment 7.3.

Fig. 7.7 (a). Circuit of Experiment 7.4 and (b) the layout of the components on the Tutor Deck.

The third configuration "common base" where the base is held at a fixed voltage and the collector current is used to control the emitter current is not often encountered and so will not be described here.

TABLE 7.1
Typical Transistor Data

Type	Material	Application	P_{tot} (max)	$I_{c(max)}$	V_{ceo} (max)	V_{ebo} (max)	h_{FE}	$f_{t(typ)}$
BC108	Si *npn*	Gen. purpose	360mW	100mA	20V	5V	110–800	250MHz
BC478	Si *pnp*	Gen. purpose	360mW	150mA	−40V	−6V	110–800	150MHz
2N3055	Si *npn*	High power	115W	15A	60V	7V	20–70	1MHz

VOLTAGE AMPLIFICATION

We have seen how the transistor can be used to amplify a small current, but often we are more interested in amplifying small voltages. The first thing that we must do is convert the voltage that we wish to amplify into a current so that this can be fed into the base of the transistor.

The simplest way is to put a resistor of the appropriate value in series with the input voltage. This is possible but one must be very careful to make sure that whatever the input voltage, the transistor is operating as it should. We shall examine this problem in more detail when we look at the transistor as a linear amplifier.

To convert the output current into a voltage is much less of a problem although one must be clear about what effect this has on the operation of the transistor.

Fig. 7.6 shows a resistor (R2) inserted in the collector lead of the transistor. The meter has now been moved out of the circuit and acts as a voltmeter since it has a series resistor. We are now using a potentiometer to vary the base current of the transistor.

Note how the meter reading varies as the potentiometer is varied. The great trouble with this circuit is that the results will vary according to the gain of the transistor. In an actual circuit it would be very awkward if the gain of the transistor had to be selected for the circuit to work properly.

In Fig. 7.7 the resistor has been moved to the emitter. It turns out that the circuit behaves much more predictably now—we have somehow made the spread in gain of the transistor much less important. This is because we have produced what is called an "emitter follower" circuit. This will be examined more closely in Part 9, but you might try working out what is going on in this case.

TRANSISTOR DATA

Table 7.1 shows transistor data as might appear in a catalogue. What do all the terms mean and why have these in particular been chosen?

The first column is the type of the transistor to which the following data refers. Only three are shown here, two low current type, one *npn* and one *pnp*, and one power transistor.

The next column shows the material from which the transistor is made and whether *npn* or *pnp*.

The next column gives a quick guide to any special features of the transistor, if there are any. The first two are simply general-purpose types with nothing special about them, whilst the 2N3055 is a high power type.

The next column gives a power rating of the transistor and is designated $P_{tot\ max}$. This is the total power that can be dissipated by the transistor without damage.

Now, the base current is usually very small as compared with the emitter or collector currents and the emitter and collector currents only differ by the base current.

The power dissipation of a transistor can thus be approximated by multiplying the voltage from collector to emitter by the current into the collector.

$$P_{tot} = V_{ce} \times I_c \text{ (approx.)}$$

Thus the voltage across the collector to emitter times the collector current for a BC108 should not exceed 360mW.

This does not imply that the current through the collector can be 360mA if the collector to emitter voltage is 1V as there is a limitation on the collector current and this is given in the next column headed $I_{c\ max}$.

The next column is headed $V_{ceo\ max}$ and this is read as the maximum collector to emitter voltage that the transistor can withstand with the base open circuit. This voltage is important as it limits the power supply rail which can be used with the transistor. It effectively says that a BC108 cannot be used with a voltage rail of more than 20V unless special precautions are taken.

The next column is the maximum reverse voltage that the base-emitter junction can withstand without damage, assuming the collector is open circuit. Note that it is quite low and does not vary much between low current transistors such as the BC108 and high power transistors like the 2N3055.

In linear circuits one would not usually expect that voltages large enough to reverse bias the base-emitter junction will ever exist but in switching circuits one quite often finds large reverse voltages being potentially generated.

The column headed h_{FE} gives the d.c. current gain of the transistor. The BC108 and BC478 both have very high gains whilst the power transistor has a much lower gain.

The last column gives a frequency (f_t) for each transistor which is that at which the gain of the transistor drops to unity.

It is an unpleasant fact of life that the gain of transistors drops off as the frequency of the applied voltage is increased.

Next month we will look at the use of transistors as switches.

ADDITIONAL COMPONENTS FOR PART 7 ONWARDS (LIST C)

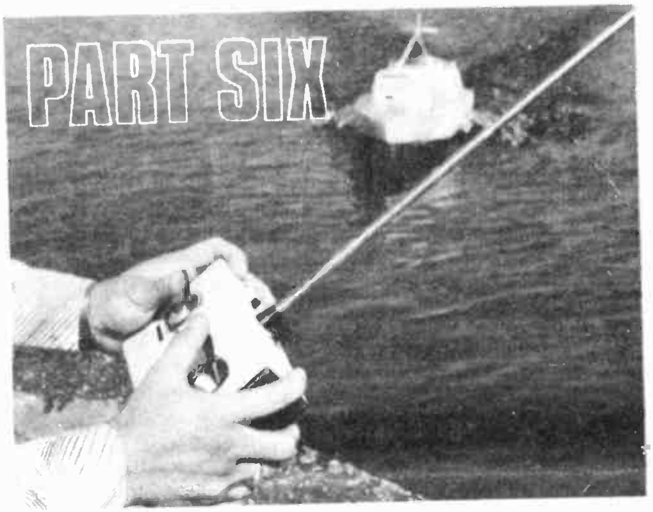
Resistors
2 off 330 ohm
2 off 2·2 kilohm
2 off 22 kilohm
2 off 68 kilohm
2 off 220 kilohm
2 off 470 kilohm
1 off 1 megohm
All ¼W carbon ± 20%

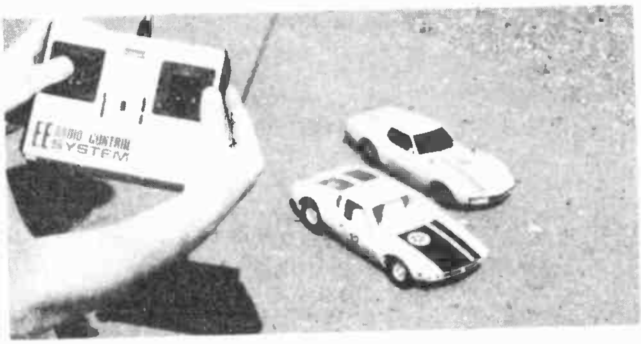
Capacitors
2 off 0·01μF polyester
3 off 0·022μF polyester
2 off 10μF 16V (or higher) electrolytic, axial lead

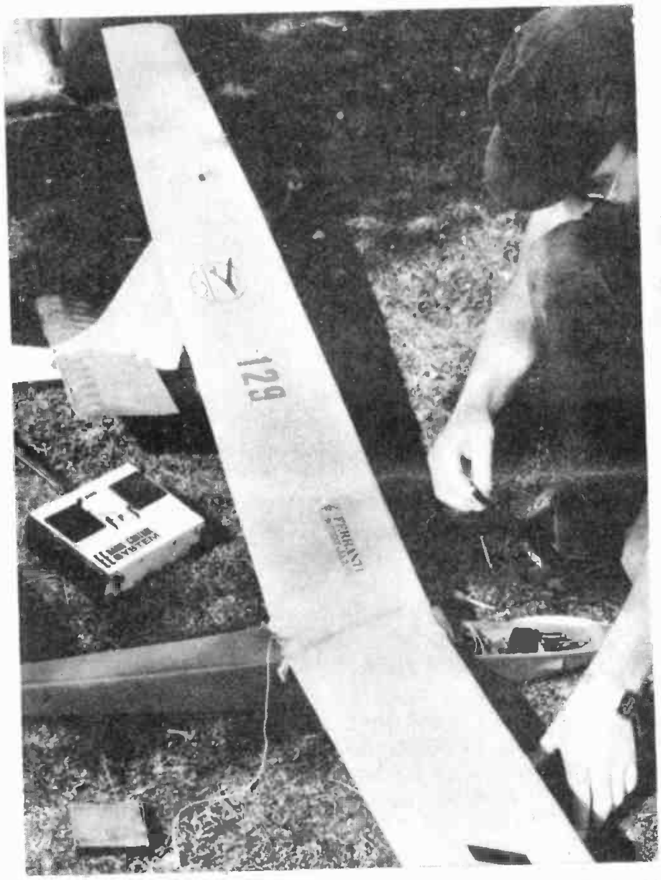
Transistors
4off BC108 *npn* silicon bipolar
1 off BC178 *pnp* silicon bipolar
1 off 2N3819 *n*-channel f.e.t.

Integrated Circuits
1 off CA3140 linear MOS f.e.t. operational amplifier
1 off CD4024 (or HEF4024 or MC14024) CMOS 7-stage binary counter

For details of suppliers of the above components see *Shop Talk* (page 241)







By L. ARMSTRONG ● H. DICKINSON ● W. WILKINSON

EE RADIO CONTROL SYSTEM

BATTERY CHARGER · SYSTEM SETTING-UP & FAULT FINDING

IN this sixth and final part to the series we provide full details for the construction of the battery charger, which will be used to re-charge the Nicad batteries used in the transmitter and receiver, and also describe the setting up of the pulse width now that all the system equipment has been covered.

As with all projects of this size, there will be some constructors who will have problems of some form or other therefore information has been included to try and point the constructor towards the area where the fault may lie.

BATTERY CHARGER CIRCUIT

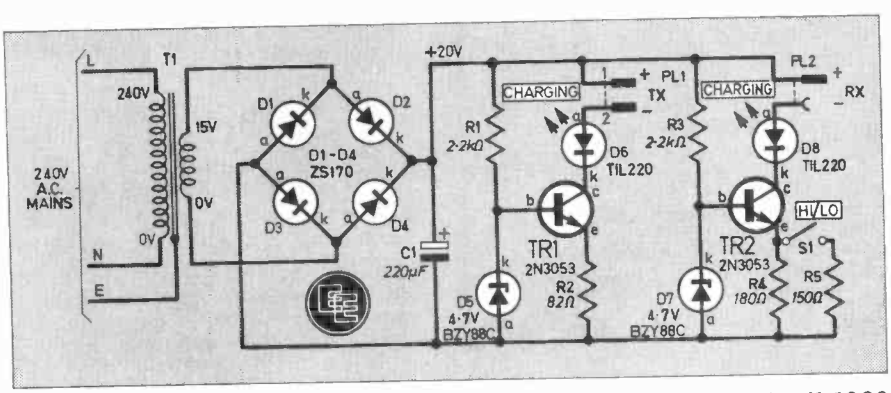
The charger unit described here for charging the batteries is of the constant current type, the circuit is given in Fig. 6.1.

The secondary of the mains transformer T1 provides 15V which is rectified by the bridge circuit composed of diodes D1-D4. The output is smoothed by C1 and the resultant 20V d.c. applied to two separate constant current transistors TR1, TR2.

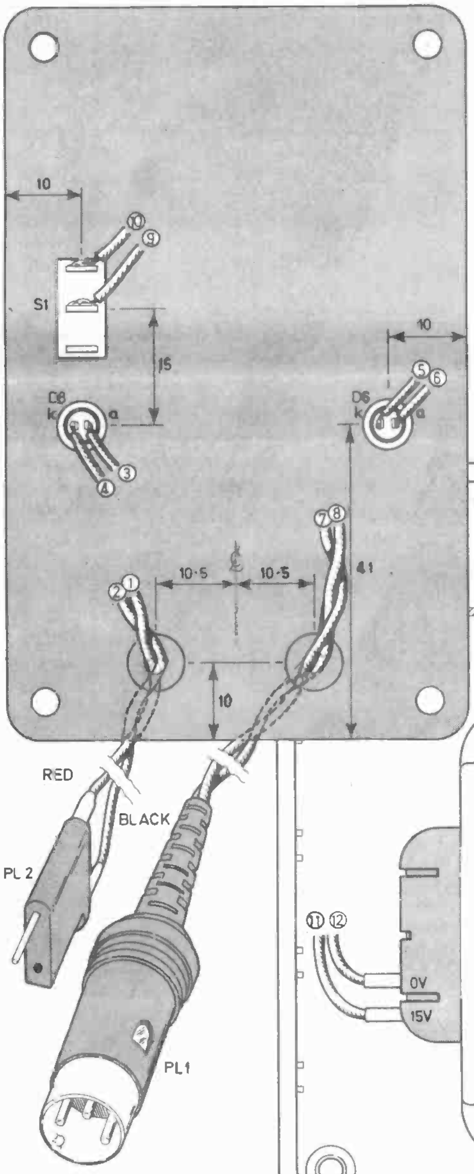
If we consider the transmitter section, the Zener D5 provides a reference voltage with R1 supplying the current through it. If D5 is 4·7V then the emitter of TR1 is 0·7V below this at 4V, therefore this voltage across R2 will define a current through the emitter. With R2 being 82 ohms the current is approximately 50mA.

This current as well as flowing through the batteries undergoing charge (via PL1) also flows through

Fig. 6.1. Circuit of the battery charger.



BATTERY CHARGER



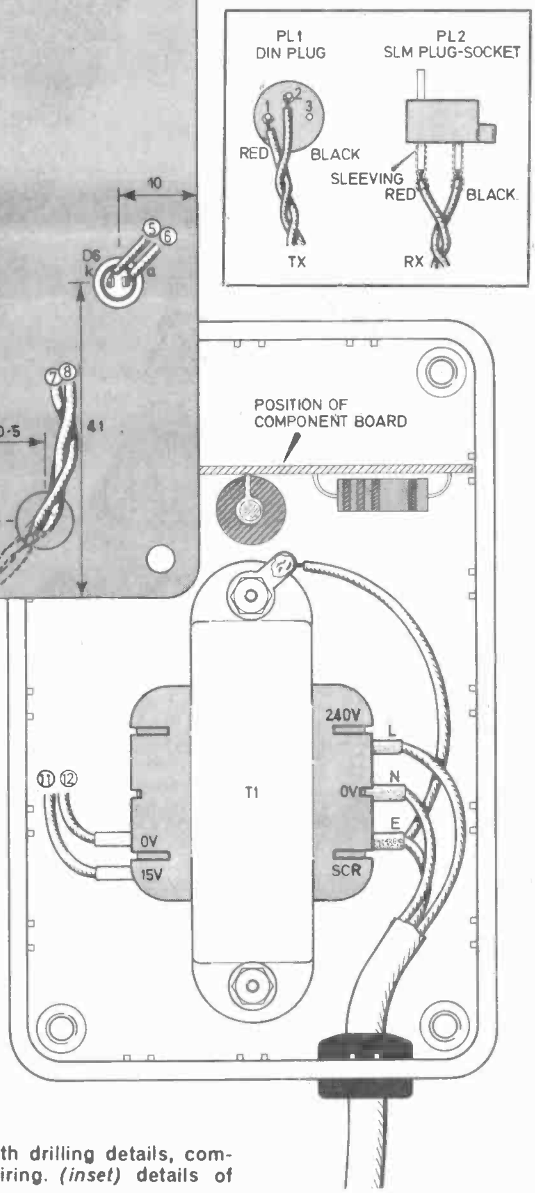


Fig. 6.3. Case and lid with drilling details, component assembly and wiring. *(inset)* details of plug wiring.

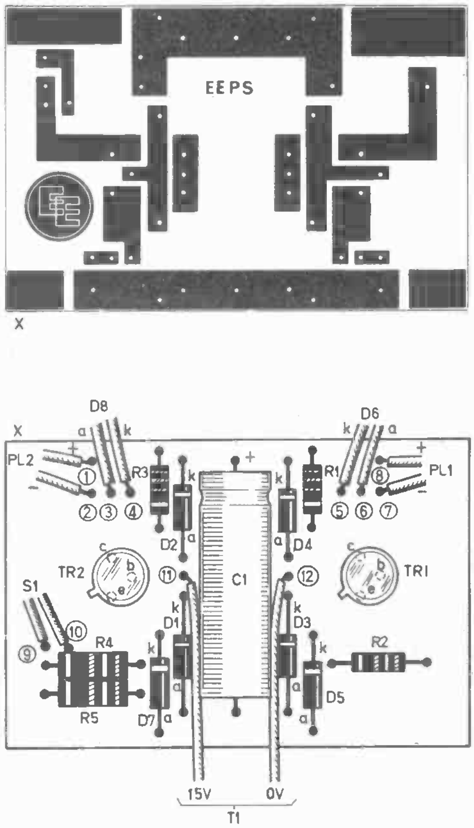
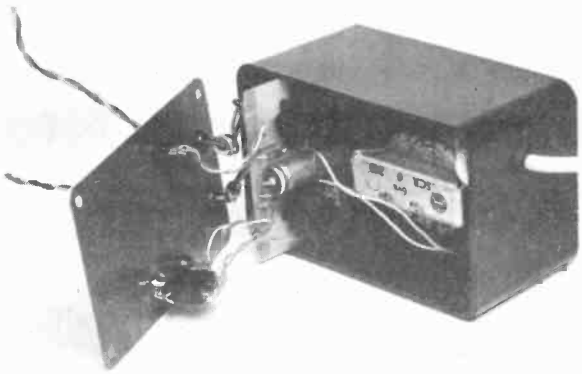


Fig. 6.2. Circuit board (a) p.c.b. pattern, actual size (b) component layout on other side of board.



COMPONENTS

BATTERY CHARGER

Resistors

R1	2·2k Ω	¼W ±5%
R2	82 Ω	¼W ±2%
R3	2·2k Ω	¼W ±5%
R4	180 Ω	¼W ±2%
R5	150 Ω	¼W ±2%

Capacitor

C1 220µF electrolytic 25V

Semiconductors

TR1, 2	2N3053 *npn* (2 off)
D1-4	ZS170 or similar 0·5A rectifier (4 off)
D5, 7	BZY88C4V7 4·7V Zener (2 off)
D6, 8	TIL220 l.e.d. (red) with mounting clips (2 off)

Miscellaneous

PL1	DIN plug 3-way
PL2	Plug-socket 2-way (SLM)
S1	Miniature s.p.d.t. switch
T1	Mains transformer. 0-240V primary: 0-15A 200mA

Samos Case 100 × 65 × 50mm (West Hyde). TO5 heatsinks (2 off). Grommet $\frac{3}{32}$in. (2 off). Grommet ¼ in. internal diameter. Connecting wire.

the series l.e.d. D6 which acts as an indicator to show that the batteries are in fact charging.

A similar circuit arrangement is provided for the receiver section. Here alternative charging currents are provided for by adjustment of TR2 emitter resistor. With S1 in the "High" position, R4 is in circuit, but when S1 is set to "Low" R5 is inserted in parallel with R4, thus reducing the effective emitter resistance. The "High" position current is 50mA, to suit 500mA and 600mA cells. The "Low" position current is 22mA to suit 225mA and 300mA cells. The receiver battery is connected via PL2.

Remember that when charging the current goes into the positive side of the cell so the positive side of the battery is connected to the +20V line whilst the negative side goes to the l.e.d.

CHARGER CONSTRUCTION

The charger construction is relatively simple and straightforward. The components for the p.c.b. should be inserted in their corresponding positions according to Fig. 6.2, and then the wires can be attached. The wires to the l.e.d.s, switch and transformer come off the component side whilst the outputs to the batteries come from the copper side.

The lid for the case is drilled as in Fig. 6.3 after which the l.e.d.s, switch and grommets can be inserted, making sure that the clips are used to hold the l.e.d.s in place.

Two holes should be drilled in the case base for the transformer, dependent upon its size, together with a hole in the case side large enough to accept the large grommet for the mains cable.

The plugs for the transmitter and receiver battery packs are attached as in Fig. 6.3 with the receiver plug having a length of sleeving over the soldered joints (see *inset*). When wiring up the switch make sure that it is connected correctly for the "High" and "Low" currents.

TESTING

When construction is completed, one last overall check is always worthwhile. Plug the unit in and with the multimeter set to the 100mA d.c. range connect across the output pins of the DIN connector and the meter should read around 50mA. Then check the receiver side and the currents should measure 50mA on the "High" range and 22mA on the "Low".

If no current flows check the polarity of the l.e.d.s as these can be easily inserted the wrong way round. When the meter is connected and current flows the l.e.d.s should light up and on the receiver the "Low" range should produce an intensity slightly lower than for the "High" range.

TABLE 6·1

CHARGING TIMES

Capacity (mA H)	Charging Current	Charging Time (hours) Flat	3 hrs. use	2 hrs. use	1 hr. use	Conditions
225	22mA	14	12	10	5	2 Servo's + Rx
300	22mA	18	12	10	5	2 Servo's + Rx
500	50mA	14	10	8	4	2 Servo's + Rx
500	50mA	14	14	10	5	4 Servo's + Rx
600	50mA	18	14	10	5	4 Servo's + Rx
500	50mA	14	10	8	4	Tx
600	50mA	18	10	8	4	Tx

LENGTH OF CHARGE

Charging is usually carried out for a specified period of time dependent upon the capacity of the cells. Table 6.1 gives a rough guide to charging time against the state of charge, that is how long the battery has been used for and battery capacity.

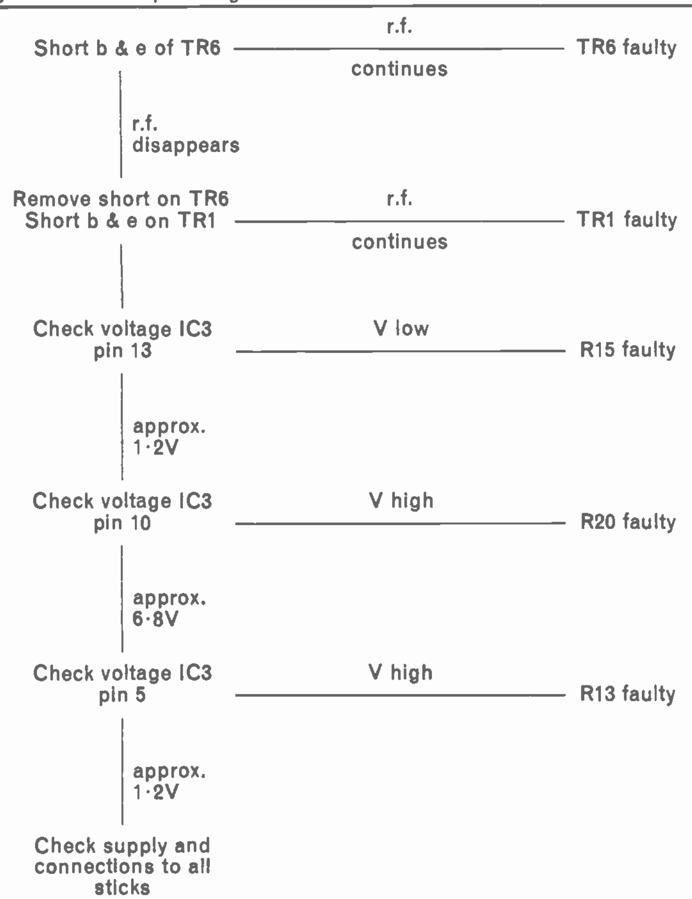
Although in the transmitter and receiver we recommend the use of 500mA cells the other capacities are included for completeness and because they are readily available to the modeller and may be purchased instead.

As seen from Table 6·1 we have given these recommended charging times for when the batteries are only partly discharged. These can be used regularly. However it is strongly recommended that at least once a month the batteries are given a full discharge followed by a full recommended charging period to ensure the life of the cells. It should also be pointed out that at the charging currents involved no damage is done to the cells should they be left on longer than the periods specified.

TABLE 6.2b

TRANSMITTER FAULT FINDING CHART

If there is plenty of r.f. present but no modulation the following chart may be of some use. All voltages are with respect to ground.



SETTING UP PULSE WIDTH

The procedure to be described here (as mentioned in the final paragraph of Part 2) is for those constructors who have no access to an oscilloscope nor have any other R.C. equipment to make use of.

Up to this stage the constructor should have tuned up the transmitter and the receiver as described in Parts 2 and 3 and all that remains is to set up the pulse width. This is done by first choosing a servo and by removing the potentiometer body to find out where the wiper is and to mark its position on the output disc.

Now replace the pot body and rotate the output disc by hand so that the wiper is in the middle of the pot track, and so has an equal distance to rotate in either direction to reach the end of the pot track.

With the sticks in the neutral position on the transmitter, plug the servo into the receiver and with both transmitter and receiver on, the servo should now rotate to some position at either side of its centre position. By adjusting VR7 (on the transmitter) the servo can be made to come back to this central position.

TABLE 6.2a

TRANSMITTER FAULT FINDING CHART

If it is not possible to tune VC1 and VC2 to get r.f. then the fault could be in one of many places. The following sequence may be of some assistance. All voltages are with respect to ground.

Cannot tune.
No r.f.

Short c & e of TR6

Cannot tune and no r.f.

Check voltage on base of TR5 — ≠6V — Check R24 & R25

approx. +6V

Check voltage on emitter of TR5 — ≯6·7V — TR5 faulty

approx. +6·7V

Remove crystal.
Connect 470Ω resistor between TR7 base & +9·6V.
Check voltage at base of TR7 — ≯0·7V — TR7 or its connections faulty
— =0V — R30 faulty

approx. 0·7V

Check remaining Components in particular the crystal.
Check VC1 for no short between vanes

Can tune and Get r.f.

Remove short on TR6.
Short c & e on TR1 — no r.f. — TR6 faulty

r.f.

Remove short on TR6.
Disconnect R18 from IC3b & connect R18 to +9·6V — no r.f. — TR1 faulty

r.f.

Reconnect R18.
Short b & e of TR3 — no r.f. — Current source faulty

r.f.

Remove short on TR3.
Check voltage on pin 10 of IC3 — Low — R19 faulty

approx. 4·8V

Check voltage on pin 3 with all sticks at Neutral — approx. 1·2V — IC3c,d faulty

low voltage

Check voltage on pin 5 — ≠1·2V — Check R12 R13

=1·2V

Check all stick connections and IC1 and IC2

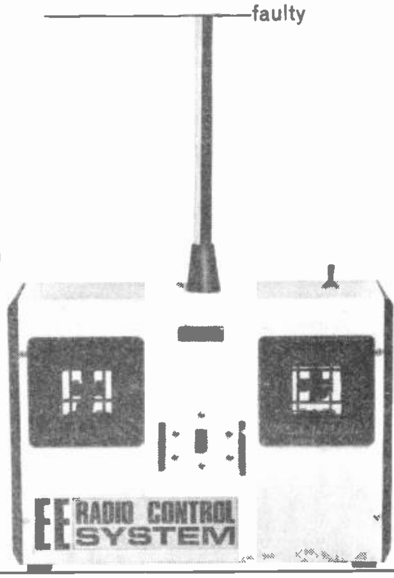


TABLE 6.3
RECEIVER FAULT FINDING CHART

SYMPTOM	CURE
1. ICI pin 2 voltage low	*(a)* caused by shorted track *(b)* C5 faulty or incorrect polarity *(c)* check value of R1 *(d)* IC1 faulty or incorrectly inserted
2. TR1/2 emitter voltages incorrect	*(a)* too high—either collector/base short on track or faulty transistors(s) *(b)* too low but *(5)* O.K. } suspect R8 or more probably a base/emitter short in TR1 or TR2
3. Can IF transformer T3 low volts	*(a)* D1 incorrectly wired or faulty *(b)* C11 incorrectly wired or faulty
4. TR1/2 collector at low or 0 volts	*(a)* T1/T2 windings open circuit
5. A.G.C. supply (collector of TR3) low or at 0 volts	*(a)* D2 faulty or incorrectly inserted *(b)* TR3 faulty
6. TR3 base greater than 0·6V	*(a)* D2 faulty or incorrectly inserted
7. TR4 collector low or 0 volts	*(a)* D3 faulty or incorrectly inserted *(b)* TR4 faulty
8. TR4 collector very high	*(a)* check value of R13 *(b)* both TR5 and TR6 faulty
9. TR6 collector low	*(a)* check base TR5 is + 1·3V approx. If not check position, value and polarity of D3, R11 and C15. *(b)* TR5 faulty

TABLE 6.4
SERVO UNIT FAULT FINDING CHART

SYMPTOM	FAULT	CURE
Servo hunts from side to side	*(a)* Pot connected wrong way round	Swap round connections to pot ends (A & B in Fig. 4.5)
	(b) Poor wiper contact	Remove pot body and very carefully bend the wiper contacts up
	(c) Dirty or damaged pot	Remove pot body and remove any signs of dirt DO NOT remove the lubricating grease on the surface. Inspect for damage and replace if necessary
	(d) C2 wrong value or faulty	Replace C2
Servo rotates continuously	*(a)* Pot connections wrong way round	As *(a)* above
	(b) One of the pot connections open circuit	Re-solder both ends of each pot wire
	(c) R3 or R6 wrong value or open circuit	Check and replace as required
No movement from the servo at any time	*(a)* Open circuit power leads	Re-solder to connector and p.c.b.
	(b) Motor connections open circuit or both shorted to case	Check connections
Servo glitches at switch-on then no further movement	*(a)* input lead open circuit	Check connection
	(b) C1, or C3 or R1 faulty	Replace components
Servo moves in one direction only	*(a)* Blown output transistor	Replace transistor
	(b) Shorted connection to motor case or across p.c.b. gap	Remove short
Servo overshoots its intended position	*(a)* R4 or R6 too high value or open circuit	Check components and if O.K. lower value to 250kΩ or even 220kΩ if overshoot is bad

By moving the relevant stick the servo should move giving a TOTAL movement of between 90 degrees with only full stick movement, and 90 degrees with full stick *and* trim movement. All the other servos will react in a similar fashion, however these do not have to be taken apart as only this first servo is used to set the gear up.

FAULT FINDING

The faults to be described are the more common ones to be expected, generally from poor soldering rather than from faulty individual components. Obviously not all component faults can be described. However if you do suspect a component then the best advice would be to find someone who has access to an oscilloscope and practise your "crawling" to seek help.

The faults we have mentioned have been encountered during the development of the prototype, and its predecessors, and with duplicate systems that have been built by colleagues and friends of the authors.

If you do suspect a fault the first thing to do is to switch off and check the p.c.b. again. Feeling for a hot component is always a good start, then when all possible visual checks have been carried out make use of the fault finding tables.

There is one table for each individual part of the system, that is transmitter, receiver, servo and speed controller then one general table for the system as a whole.

Constructors who already have a R.C. system of some sort should make use of this to help locate faults. For example, use your transmitter with the E.E. receiver to check that the E.E. receiver is O.K.

RECEIVER FAULT FINDING

Should the receiver take excessive current (normal current about 12mA) when connected to a 4·8 volt supply, there are four possible causes:

(1) Shorted track on p.c.b.

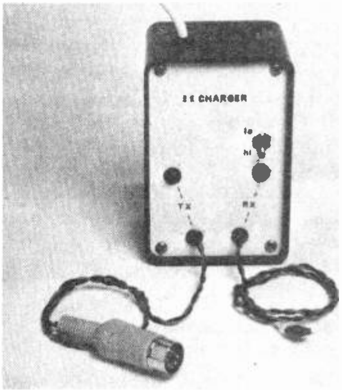
(2) Short in wiring or wiring loom to plugs etc.

(3) Capacitor C16 faulty or incorrectly inserted

(4) Decoder IC2 faulty or incorrectly inserted.

The rest of the circuitry is isolated from the supply by the 100 ohm resistors R1 and R2 and any shorts after these resistors will show up in the d.c. voltage measurements as described in the receiver article (Part 3).

If however the receiver tunes up as described and the d.c. voltages are correct but the receiver will not drive a servo, the most likely cause is that the sync pulse from the transmitter is



not long enough to enable the sync pulse detector in the receiver to reset the decoder IC2.

The waveforms can be checked on an oscilloscope if one is available which will show that the collector of TR6 remains low all the time and that no sync pulse is present.

Whether a scope is available or not, try reducing R11 to 68 kilohms or shunt the present R11 with say 150 kilohms to obtain the same effect. This enables C15 to charge up more quickly, thus allowing the use of a shorter sync pulse.

Note: Whilst pulses appear at TR4 collector, capacitor C15 is discharged by each pulse via D3 thus ensuring TR5 remains off and TR6 on.

During the sync pulse time, C15 charges up via R11 until sufficient voltage is available at TR5 base to turn it on. When TR5 turns on, TR6 turns off and its collector rises to +4·8V thus resetting the decoder IC2.

If the sync pulse is too short C15 does not charge up sufficiently to turn on TR5, and hence TR6 collector remains low and no resetting of decoder IC2 occurs.

If this does not work and an oscilloscope is not available, try the following d.c. measurements with the transmitter on and in close proximity to the receiver.

INITIAL MEASUREMENTS

Collector TR3—typically +1V d.c. under strong signal conditions).

Collector TR4—typically +4·2V d.c.

Collector TR6—typically +2V d.c.
If TR6 incorrect, switch off transmitter and check the sync pulse detector as follows:

Base TR5—+1·3V approx.

Collector TR6—+4·5V approx.

Short out TR4 collector to emitter.

Check TR5 base—less than 0·6V—if not, D3 faulty or incorrectly wired.

Check TR6 collector—1V approx.—if not suspect TR5/TR6.

If the receiver voltages are incorrect but the board has no solder shorts, the possible faults are listed in Table 6.3 (note—transmitter off).

Table 6.4 continued

Servo sluggish	*(a)* TR3 or TR2 or both wrong way round	Turn round transistors and replace
	(b) R2 or C5 wrong value R4 or R6 too low in in value	Check values and change if required
	(c) Motor or gearbox tight in its movement	Replace motor if it is a fault. Grease gearbox (silicon grease only) and tighten screws carefully and not too tight

TABLE 6.5
SPEED CONTROLLER FAULT FINDING CHART

SYMPTOM	FAULT	CURE
Motor runs but relay fails to changeover	*(a)* Monostable pulse width wrong	*(1)* Adjust VR2 *(2)* Check connections around timing components R4, R5, C3.
	(b) Relay drive faulty	*(1)* Check by shorting c & e of TR5 or TR4 to establish which is faulty
Relay changes over but motor fails to run	*(a)* Relay contacts faulty	*(1)* Clean and adjust contacts *(2)* Check connections to contacts
	(b) Motor faulty	*(1)* Check by disconnecting motor from speed controller and trying it on a battery
	(c) Motor drive faulty	*(1)* Check by shorting c & e of TR6 or TR7 to establish which is faulty
Neither relay or motor work	*(a)* Drive battery flat	*(1)* Recharge
	(b) Battery connections faulty	*(1)* Check and reconnect
	(c) No input signal to chip	*(1)* Try another channel on receiver to see if receiver is faulty *(2)* Check wiring to plug *(3)* Check connections around C1 and pin 14 of IC
Motor runs in both directions at full speed but never stops	*(a)* No deadband	*(1)* Check deadband capacitor C4
	(b) Drive transistor short circuit collector-base or collector-emitter	*(1)* Check by shorting b-e of TR7. If motor continues then TR7 faulty
	(c) Pre-drive transistor short circuit collector-base or collector-emitter	*(1)* Check by shorting b-e of TR6. If motor continues then TR6 faulty
Motor runs in both directions at high speed but has a stationary position on control stick	*(a)* Expansion circuit faulty	*(1)* Check expansion capacitor C5 *(2)* Check expansion resistors R3 in particular and potentiometer VR1
Motor runs in "reverse" for forward movement of the control stick on transmitter	*(a)* Pulse width change opposite from that required	*either* *(1)* Reverse stick plug in transmitter *or* *(2)* Reverse connections to the motor NB—DO NOT REVERSE DRIVE BATTERY POLARITY*

**To avoid excessive drain on the drive battery it is better to set up the transmitter and speed controller such that the direction of movement of the vehicle is forward when the relay in the speed controller is de-energised.*

TABLE 6.6

OVERALL SYSTEM FAULT FINDING CHART

SYMPTOM	AREA OF FAULT Transmitter	Receiver	Servo	CURE
One servo not functioning in one channel only	Open circuit lead or incorrectly wired plug or socket	Open circuit lead or incorrectly wired socket		Check wiring
	Pot wiper open circuit on stick assembly			Using a meter on resistance range check that pot functions. If not then remove pot body and bend wiper in the case of the cermet pot
	Connection between SK1 and IC1 open circuit			Check soldering and using meter check the offending resistor (R4—R10)
One servo not functioning on any channel			Fault on individual servo	Refer to servo chart
No movement of any servo on any channel	Crystal not fitted or damaged	Crystal not fitted or damaged		Insert or replace cyrstal
	Wrong crystal i.e. receiver crystal in transmitter	Wrong crystal		Change around crystals
	No transmitter output due to poor tuning	Poor tuning of receiver		Run through tuning-up procedures again
	Incorrect wiring of channel plugs	Incorrect wiring of output leads	Incorrect wiring of plugs	Could be due to wiring the first plug or socket wrong from which the rest were copied, so check the wiring again

SOME FINAL POINTS

Having now completed the system with all parts functioning correctly it is now worth mentioning a few points in connection with the use of the equipment.

If you have used the Nicad batteries, always keep them well charged. In the case of dry batteries, carry a spare set around with you so that you are never stuck on a Sunday or an evening with a set of flat batteries. If you do not intend to use the equipment for a long period remove the dry batteries in case they leak and ruin the inside of the case.

The receiver should always be properly looked after and always mounted in foam rubber to absorb the shocks of bumps and crashes whether installed in boat, car or aircraft. With boats a watertight compartment is always useful. If you do have a bad crash check the equipment properly before you use it again, and in the case of the receiver giving it a tune-up will do no harm.

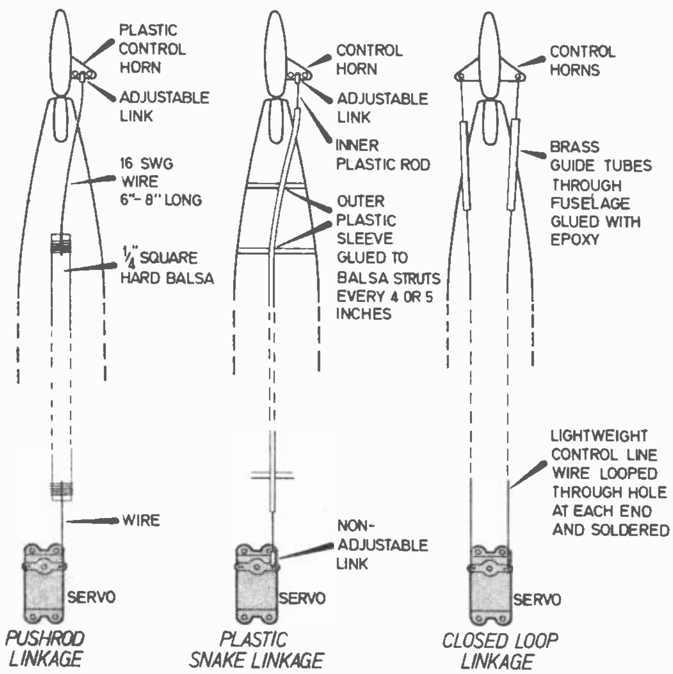


Fig. 6.4. Typical servo linkages.

SERVO LINKAGES

In the previous parts, mounting and positioning details have been outlined to give the newcomer an idea how to install the equipment. However, it must be borne in mind that the servos are very precise in their movement so always give them good linkages to the control function they are going to operate.

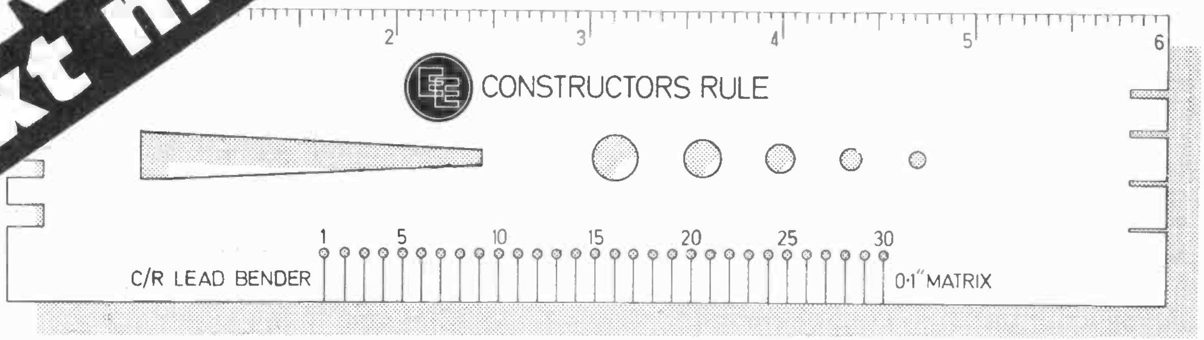
The ideal linkage, whether it is a pushrod, plastic "snake" or closed linkage, should have no slack in it, yet should not be tight enough to put a strain on the servo. These three types of linkage are shown in Fig. 6.4.

With these few hints we conclude, hoping that you have many enjoyable hours with your equipment, with as few mishaps as possible. Good luck and good flying, boating and driving. ⌑

FREE next month

A valuable multi-purpose tool specially designed to aid the electronics constructor. This double-sided 6 inch plastics rule incorporates:

★ Metric and Imperial scales
★ Wire and sheet metal gauges (s.w.g.)
★ Bolt and drill gauges (BA and metric)
★ BA clearance drill sizes
★ Resistor and capacitor lead bender



PRE-TUNED 4-STATION RADIO

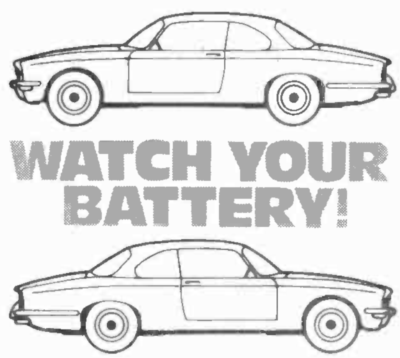
A t.r.f. radio to receive Radios 1, 2, 3 and 4. These four stations are switch selectable thus eliminating the need for a tuning dial. Incorporates a loudspeaker.

SOLID-STATE DUAL LINE GAME

Pit yourself against this electronic game playing computer.
This analogue device uses a transistor/resistor matrix to work out the best position to try and block your move and win the game by completing a line.

LIGHTS WARNING SYSTEM

This unit will sound a buzzer or flash a light to remind you that your lights are on when the ignition is turned off. Requires no setting or cancelling of switches. Includes a parking facility.

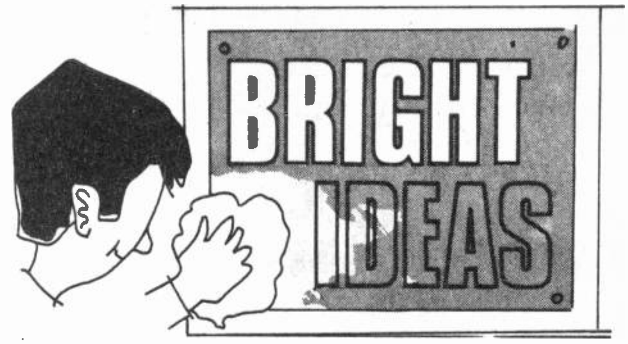


BATTERY VOLTAGE MONITOR

A very simple project designed to keep an "eye" on the state of your car battery. Fitted to the instrument panel, this unit will give continuous readout of battery voltage.

Everyday ELECTRONICS

MAY 1980
ISSUE ON SALE
FRIDAY, APRIL 18
Price 50p



Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

HAND HELD CASES

When recently faced with the problem of housing a transmitter for an ultrasonic remote control system, I found a very cheap, simple and attractive solution to the problem. This could be useful for many hand held projects.

A short length of $1\frac{1}{4}$ inch diameter grey plastic waste water pipe was used in my project (there are other sizes) to hold at one end a PP3 battery held in place with foam plastic, with the circuit board, push button switch and the transducer at the other end. These were held in place with a more rigid foam plastic (the type sometimes used for packing i.c.s) and secured with Araldite. The case appearance can be further improved by the use of transfer lettering or paint.

Denis Williams,
Llandudno,
Gwynedd.

CHANGING REED SWITCH ACTION

Reed switches have "normally open" contacts; "normally closed" types are unobtainable whilst changeover are not too easy to obtain and are much more expensive.

With reed coil switches it is possible to reverse normal action. All that is required is to put a suitable magnet outside the coil to cause the reed contacts to close. Current through the coil will now cause the reed switch to open. If it does not work one way, reverse the polarity of the current flow in the coil.

A. R. Smith,
Wallington,
Surrey.

PLEASE TAKE NOTE

Morse Practice Oscillator
(February 1980)

Note that capacitor C1 should be connected to point *B*15 and not *A*15 as shown in Fig. 2.

Simple S.W. Receiver
(February 1980)

We apologise for the following errors which appeared in the diagrams for the Simple S.W. Receiver.

In Fig. 3 from pin 1 of the coil holder the flying lead should go to *I*9 on the circuit board and not *H*9. The flying lead from pin 4 should go to C1 alone and an extra flying lead should come from pin 3 to *E*9 on the circuit board.

Fig. 4. Annotations SK1 and SK2 should be transposed. The flying lead from C1 should go to L1 pin 4 only.

Fig. 5. The flying lead from position *E*9 should be labelled L1 pin 3, not L1/C1. Capacitor C2 on board should be marked C5.

SQUARE one FOR BEGINNERS

STOCKING UP

Every constructor accumulates a stock of components in a surprisingly short space of time. But when starting in this hobby, the question usually arises what kind of components should one obtain to form an initial stock.

Resistors, capacitors, transistors and diodes—these are the mainstay of electronic circuits. A carefully selected collection of such components will be a valuable working stock to draw upon whether for building projects or performing experimental "lash-ups".

This month we suggest a range of resistors that the new constructor should purchase.

The resistors listed in Table 1 are values that are most frequently encountered when building electronic circuits. They will satisfy possibly 75 per cent of needs.

A small number of additional components will usually have to be purchased to complete the complement of a given project. However with the majority of parts already in stock, construction work can often be started on whilst awaiting the arrival of the additional "specials".

Some retailers offer discount rates for quantities of such small items as resistors and capacitors. This is another good reason for purchasing a fairly large selection.

The quantities against each type of component are the minimum it is suggested the new constructor should obtain. If resources permit, it would be wise to multiply all these quantities by a factor of two or even five, say.

CARBON RESISTORS

The cheapest kind of fixed value resistor is made of a carbon composition, or a carbon film. Physical size depends upon the wattage rating. Quarter watt resistors will suit many requirements. They measure about 8mm in length and have a diameter of about 2·5mm.

For our initial stock ½ watt resistors (which measure about 10mm by 3·5mm diameter) might be the better choice. This size resistor can of course be used perfectly safely whenever ⅛, ¼ or ½ watt is actually called for in the Component List.

Carbon resistors do not have precise ohmic values, but are available with various percentage tolerances of the nominal value. For most purposes 5 per cent resistors are ideal, and are readily available. (Higher tolerance resistors, such as 10 and 20 per cent, are also in fact suitable for many applications.)

TABLE 1

CARBON COMPOSITION OR CARBON FILM RESISTORS ½W ± 5%

Ohms	Qty	Ohms	Qty	Ohms	Qty	Ohms	Qty	Ohms	Qty	Ohms	Qty
10	1	12	1	15	1	18	1	22	1	27	1
100	2	120	1	150	1	180	1	220	2	270	1
1k	2	1·2k	2	1·5k	2	1·8k	1	2·2k	2	2·7k	1
10k	5	12k	1	15k	2	18k	1	22k	2	27k	2
100k	2	120k	1	150k	1	180k	1	220k	1	270k	1
1M	1	1·2M	1	1·5M	1	1·8M	1	2·2M	1	2·7M	1
33	1	39	1	47	1	56	1	68	1	82	1
330	2	390	1	470	1	560	1	680	1	820	1
3·3k	1	3·9k	1	4·7k	5	5·6k	1	6·8k	1	8·2k	1
33k	1	39k	1	47k	2	56k	1	68k	1	82k	1
330k	1	390k	1	470k	1	560k	1	680k	1	820k	1
3·3M	1	3·9M	1	4·7M	1	5·6M	1	6·8M	1	8·2M	1

JACK PLUG & FAMILY... BY DOUG BAKER

MANY types of gas or fumes, if released and allowed to accumulate, are insidious killers; consequent explosions from large concentrations can wreck property and cause many thousand pounds worth of damage.

A small investment on this project could well prove to be money well spent. Whilst this device obviously cannot prevent leakages arising, it will detect the presence of a surprising variety of fumes and vapours, as well as common smoke, and will then relay a warning signal well before any dangerous accumulations can build up.

The unit has been designed to be flexible in its application and use. It can be either battery or mains powered.

GAS DETECTED

The Gas Sentinel will detect the presence of domestic gas (methane) and Calor Gas (propane) the latter making it eminently suitable for use in boats and caravans when operated from a battery supply. Also, carbon monoxide, a constituent of smoke, will trigger the alarm giving the unit the additional feature of being a fire detector. However, large volumes of smoke are required to trigger the alarm.

REMOTE SENSING

Because the actual sensor is located remotely to the main unit, this means that the sensor can be mounted right in the heart of potential trouble spots (e.g. next to propane cylinders, alongside the gas cooker/fire) whilst the main unit and alarm can be positioned in any convenient place.

The Gas Sentinel employs a solid-state gas sensor device which makes the construction of a low-cost and easy-to-build gas detector a reality for the amateur enthusiast.

THE SENSOR

The sensor used in this project is from the TGS family. The family types differ in operating voltage as well as sensitivity to individual gases. Of these sensors, type TGS813 is used in this application. A diagram showing details of this appears in Fig. 1.

The TGS813 comprises a resin housing measuring 10mm high by 17mm diameter (excluding terminal pins). In the top of the housing is a very fine mesh window, with a smaller mesh window in the base. Stand-offs are moulded into the underside, allowing gas and smoke to pass through the sensor.

Inside the housing is the sensor element, consisting of a ceramic tube with a semiconductor-material coating. Electrodes are taken from the sensor to terminal pins. The sensor is heated by a filament inside the tube; the increased temperature of the semiconductor improves the sensitivity and response time of the unit.

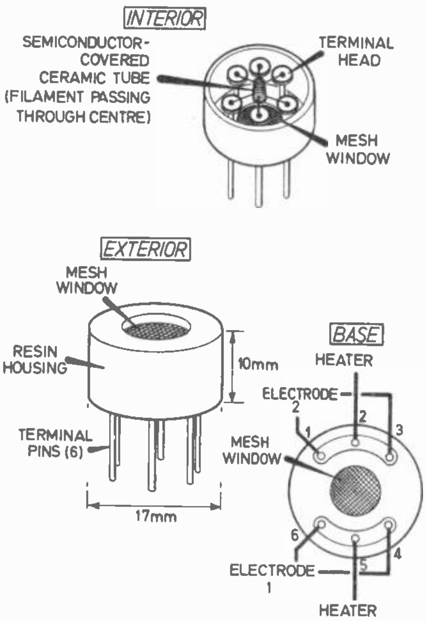


Fig. 1. Various details of the TGS 813 gas sensor.

Connections for the electrodes and filament are taken to six external pins in the base: the sensor must always be used in conjunction with a special socket to which wires may be soldered. The base connections for the device are also given.

For practical purposes, pins 1 and 3 can be considered to be joined together, as can pins 4 and 6.

The maximum permissible circuit voltage is 24V, and the filament is rated at 5V 130mA. Fig. 2 shows how the resistance of the semiconductor element alters with varying concentrations of several gases. The sensor will also respond to accumulations of smoke.

CIRCUIT DESCRIPTION

The circuit diagram of the Gas Sentinel is shown in Fig. 3. Here two

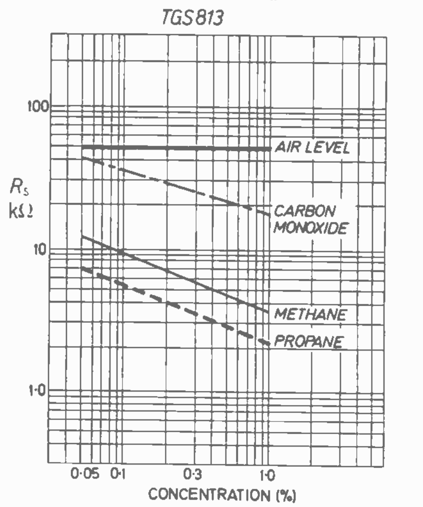


Fig. 2. Graph showing the variation of sensor resistance with concentration of different gases reaching sensing element.

BE ON YOUR GUARD IN THE HOME, BOAT OR CARAVAN

By A. R. Winstanley

power supply options are shown to cater for the environment in which the unit is to be employed. The mains supply is recommended when the unit is installed in the home, whereas the battery version is for use in boats, caravans and other places where mains is not available.

In the mains supply version, mains voltage enters the unit via S1 and FS1 and stepped down in voltage by T1. The resulting voltage (about 9V a.c. is rectified by a bridge rectifier consisting of four diodes encapsulated in one package with four lead-outs. The resultant d.c. is smoothed by C1 to give nominally 12V d.c. which forms the supply rail to the rest of the circuitry.

With the battery supply unit, a 12V battery is used which is switched to the circuit by means of S1 via FSI to provide the 12V d.c. supply at the same point as the mains version.

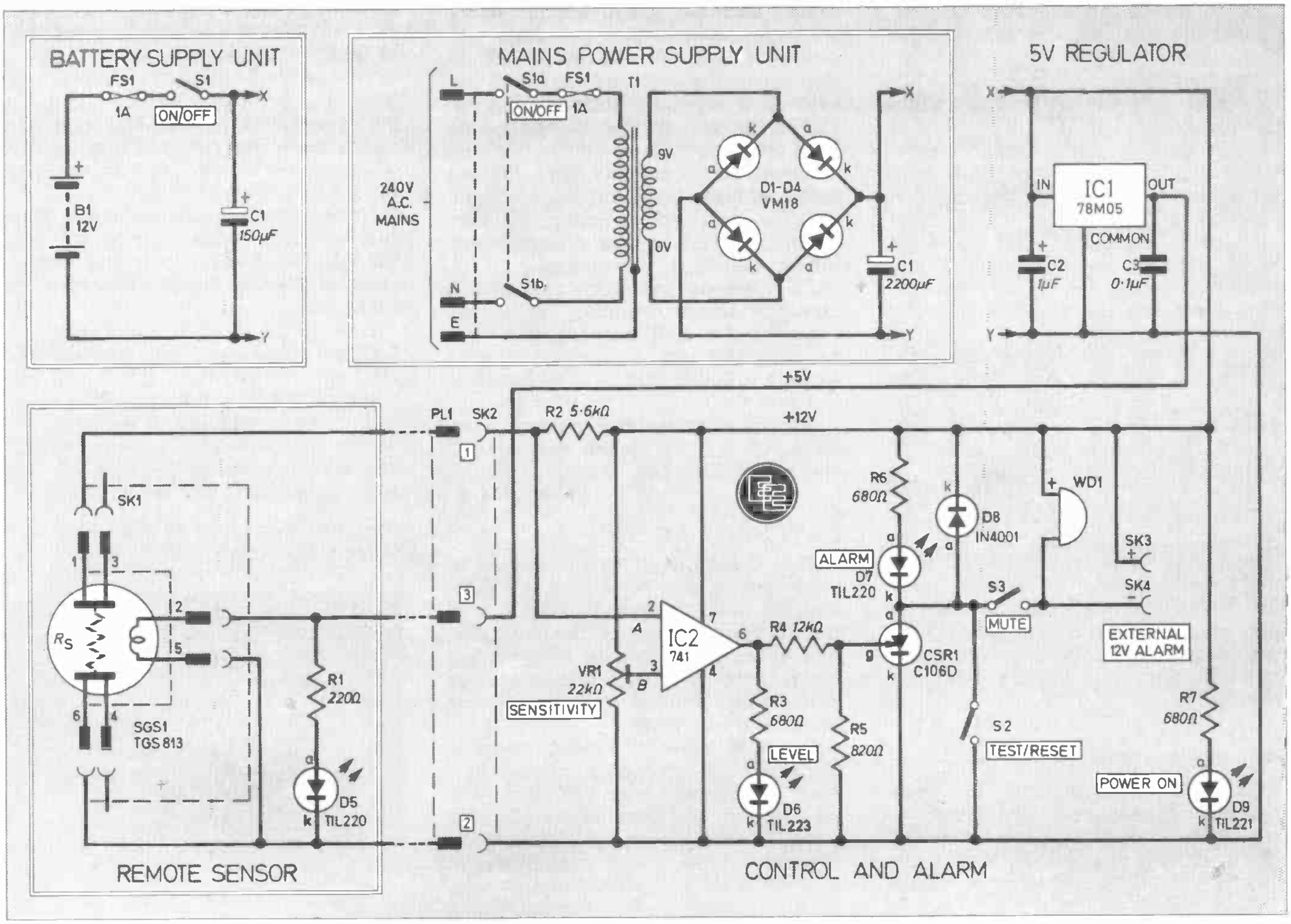
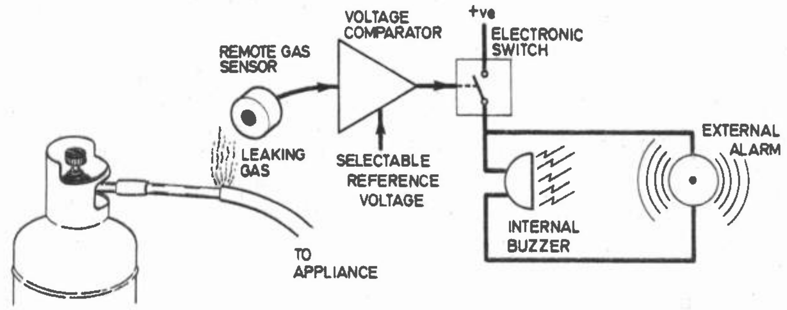


Fig. 3. The circuit diagram of the Gas Sensor with optional power supplies.

HOW IT WORKS



Gas or other toxic vapours reaching the sensing element in the sensor affect its conductivity and causes the voltage level into the comparator to change. When this passes the set reference level, the comparator output turns on the latching electronic switch and sounds the alarms. The alarms continue to sound even if the gas concentration reduces, until manually reset.

The gas sensor itself requires a 5V 150mA supply for its heater filament, and this is provided by IC1, a 5V 500mA regulator fed from the 12V rail. The p.c.b. layout has been devised to suit the μA78M05UC voltage regulator, so if an alternative type is considered the lead-out configuration must conform exactly with that shown.

In the mains version, the 12V supply is unregulated, and in reality measured only 10-11V. The voltage available at the alarm output sockets was only 10V. So if this outlet is used to drive a relay, ensure that it operates at 10V.

Diode D9 indicates that power is being applied to the circuitry and should of course be on all the time that the unit is in use, whether mains or battery supply.

SGS1 is the gas sensor. Its resistive semiconductor element, R_s, forms a potential divider with R2. As R_s decreases, due to an increased concentration of ambient gas levels, the voltage at SGS1/R2 junction will be reduced.

This voltage is referred to the inverting input (pin 2) of IC2, an operational amplifier connected as a simple comparator. A variable resistor VR1 determines the voltage at the non-inverting input (pin 3) of the comparator, and this voltage can be adjusted by rotating VR1 as necessary.

COMPARATOR ACTION

The output voltage of the comparator depends upon the inputs at pins 2 and 3 of IC2. If the voltage at pin 3 exceeds that at pin 2 then the output goes high, being at a voltage almost equal to the positive supply rail. Similarly the output goes low if the two input voltages are reversed.

By varying the setting of VR1, the switching point of IC2 can be adjusted. The effect of this is to alter the SENSITIVITY of the circuit, so that the alarm will sound at a required gas or smoke concentration.

Once pin 6 goes high—the sensor having detected gas at the necessary triggering level—then the LEVEL indicator diode D6 will illuminate to show that the ambient gas level has reached a value determined by VR1. The l.e.d. will extinguish once the level drops again.

When the comparator output switches high, this is fed via attenuator R4 and R5 to the gate terminal of CSR1 causing the thyristor to turn on.

This device normally assumes a high resistance blocking state between anode and cathode, but will be triggered into a conductive state when a suitable signal is received at the gate.

Once conducting, the thyristor completes the circuit to the ALARM l.e.d. and this illuminates.

LATCHING ACTION

The ALARM l.e.d. will continue to glow even if the output of IC2 falls and D6 extinguishes. This is due to the latching action of the thyristor. The main characteristic of a thyristor is that once it is triggered into conduction, it will remain in this state until it is reset.

It can be reset by several methods. If power is removed temporarily from the circuit, once switched back on again it will resume its blocking state. Another means of resetting the thyristor is to short the anode to cathode. This is accomplished by temporarily closing S2. Once opened again, the thyristor will resume its high resistance state, unless a trigger signal is present at the gate in which case the device will conduct once more.

Connected in parallel with the ALARM indicator is a miniature audible warning device, WD1. This consumes only 15mA when operating, and provides an audible indicator that the gas level being monitored by SGS1 has reached the required alarm level.

Provision has been made in this design for an external alarm to be connected at SK3 (+) and SK4 (−). This must be rated at 12V 500mA *maximum* (see later), and can take the form of a lamp, buzzer, relay, or combination of these.

If a relay is used, an e.m.f. suppression diode is required to short out any high reverse voltages which tend to appear across the relay coil just after power is removed from the relay; D8 accomplishes this.

CONTROLS

Switch S2 has a dual function. Apart from resetting the thyristor as described earlier, it will also complete the circuit to the alarm. If closed, therefore, it will cause the alarm to operate, and this is useful in testing the external alarm set-up. S2 is a biased (spring-loaded) type so that it is normally open.

The MUTE switch S3, if opened, silences the internal audible warning device WD1, and also removes power from the external alarm. This is necessary if the gas level is high for a long period of time.

Under these circumstances, the thyristor cannot be reset at S2 until the gas level drops because a constant triggering signal is present at CSR1 gate.

One could switch off the Gas Sentinel altogether, but this will not tell you when the gas level has dropped to below the triggering level. The most convenient course of action is obviously just to silence any audio alarms by opening S3. This will disconnect the external alarm

Rear view of prototype showing inlet/outlet sockets, fuse and internal alarm.

Straight-on view of completed unit.

as well as WD1, but D7 will remain alight. Then the user should wait for D6 to extinguish before resetting the alarm completely at S2. Switch S3 can then be closed once more. In practise this is a very neat solution.

The MUTE switch comes in handy when initially switching on the unit. During warming up, the resistance of the sensor temporarily drops to a low value (2 to 3 kilohms). The op-amp detects this and triggers the alarm. The MUTE switch, if opened while sensor is warming up, will prevent any audio alarm sounding unnecessarily. Warming up, on the prototype, takes about 30 seconds, and the sensor is ready for use once the LEVEL l.e.d. has extinguished, the alarm has been reset and S3 has been closed.

The l.e.d., D5, fitted to the remote sensor case should always be illuminated when the unit is switched on. This shows that voltage is being applied to the filament of the sensor.

PRINTED CIRCUIT BOARD

A professional finish, coupled with higher reliability, is achieved by using a p.c.b. to carry the complete circuit. This also makes for easier construction, and helps to ensure that the circuit will work first time.

The Gas Sentinel circuitry is very neatly accommodated in a Verobox Series II Casebox type 2066. This measures 155 x 92 x 52mm. It has one aluminium front panel which slots into a moulded bezel-type surround.

Any other plastic or metal case of suitable dimensions can be employed, but the specified box lends itself to compact construction and a professional appearance.

The remote sensor is mounted with its socket on a small Verobox type 1413E. This particular case measures 72 x 47 x 25mm and is moulded in black ABS. Again, any other suitable box can be used. Details of construction of this are given later.

CONSTRUCTION starts here

P.C.B. COMPONENT ASSEMBLY

Construction should commence with the printed circuit board. This is shown full size in Fig. 4a. There are a few points to watch concerning what should otherwise be a straightforward assembly procedure. The layout of the components on the top side of the board is shown in Fig. 4b.

If the battery version is to be built, the bridge rectifier should be omitted and the battery supply wired up as indicated in Fig. 4c. Note the value of C1.

IC2 is an 8-pin d.i.l. device and to make later replacement easier, should this prove necessary, it should be mounted in a suitable d.i.l. socket. This also prevents thermal damage arising during soldering.

The bridge rectifier specified here is a VM18 400V 1A type. This is encapsulated in a 4-pin d.i.l. package. Do not attempt to adapt a d.i.l. socket for use here, but solder it straight in, observing the d.c. polarity markings. Any other 1A type can be used if it is physically compatible with the p.c.b. It may be possible to bend the leads of the cheaper W005 device to make it fit the p.c.b., but ensure

COMPONENTS

COMPONENTS approximate cost £13 (battery) £15 (mains) excluding cases

Resistors

R1	220Ω	R5	820Ω
R2	5·6kΩ	R6	680Ω
R3	680Ω	R7	680Ω
R4	12kΩ		

All ¼W carbon ± 5%

Capacitors

C1	150μF 12V elect. *(battery version)*
	2200μF 16V elect. *(mains version)*
C2	1μF 35V tantalum
C3	0·1μF polyester type C280

Semiconductors

D1-D4	VM18 1A 400V bridge rectifier *(mains version)*—see text.
D5	TIL220 red l.e.d.
D6	TIL223 yellow l.e.d.
D7	TIL220 red l.e.d.
D8	1N4001 silicon diode
D9	TIL221 green l.e.d.
IC1	μA78M05 5V 500mA voltage regulator i.c.—see text
IC2	741 differential op-amp 8-pin d.i.l.
CSR1	C106D 4A 400V thyristor
SGS1	TGS813 semiconductor gas sensor (Watford)

Miscellaneous

VR1	22kΩ standard size preset potentiometer
S1	s.p. on/off toggle *(battery version)*
	d.p.d.t. sub-miniature toggle *(mains version)*
S2	s.p.c.o. sub-miniature biased off toggle
S3	s.p.c.o. sub-miniature toggle
FS1	1A 20mm fuse
SK1	TGS 6-pin socket
SK2	3-pin DIN socket
SK3	4mm insulated (red)
SK4	4mm insulated (black)
PL1	3-pin DIN plug to suit SK2
WD1	12V 15mA audible warning device
T1	mains primary/9V 800mA (or 1A) secondary or two 9V 400mA secondaries wired in parallel [latter, type 182 Watford] *(mains version)*

See **Shop Talk** page 241

Printed circuit board: 66 × 50mm; 8-pin d.i.l. socket for IC2; 3-core miniature mains wire (connection to remote unit); mains cable (power to unit); small rubber grommet; nuts, bolts, washers; aluminium for IC1 heatsink; cases: Vero series II Casebox (65-2066A) (mains unit), Vero type 301 (74-1413-E) (remote unit); lens clips for panel l.e.d.s 2, red, 1 green, 1 yellow, self adhesive cabinet feet (4 off); 20mm panel mounting fuseholder.

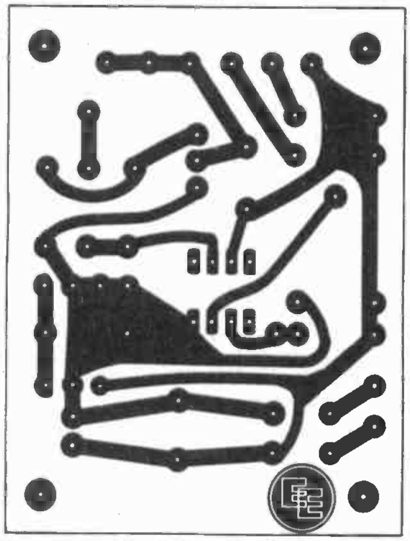


Fig. 4a. The master pattern of the p.c.b. underside shown full size. The black areas represent the copper remaining after etching.

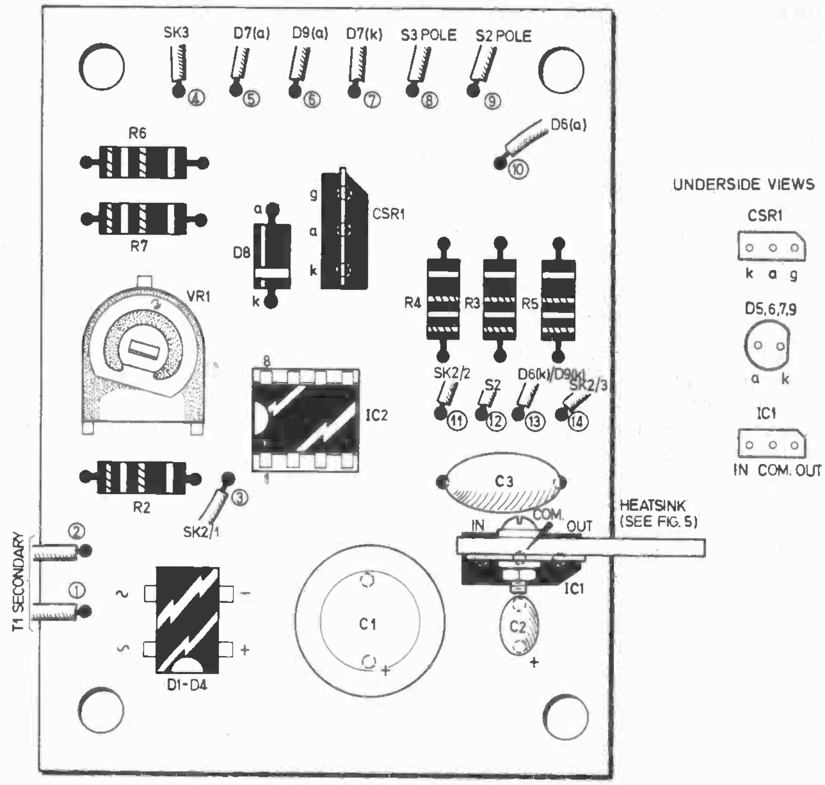


Fig. 4b. The layout of the components on the top of the p.c.b. and wiring details to off-board components.

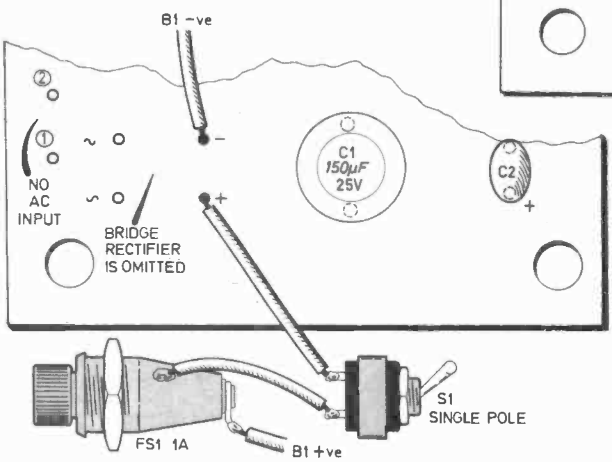


Fig. 4c. Shows modification to board layout, fuse and on-off switch for battery version.

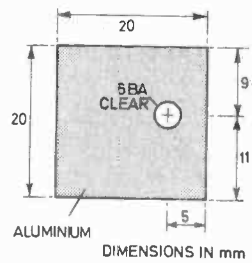
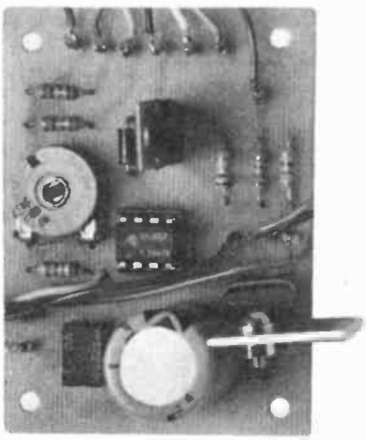


Fig. 5. Dimension and drilling details for the regulator heatsink.



The prototype printed circuit board removed from its case.

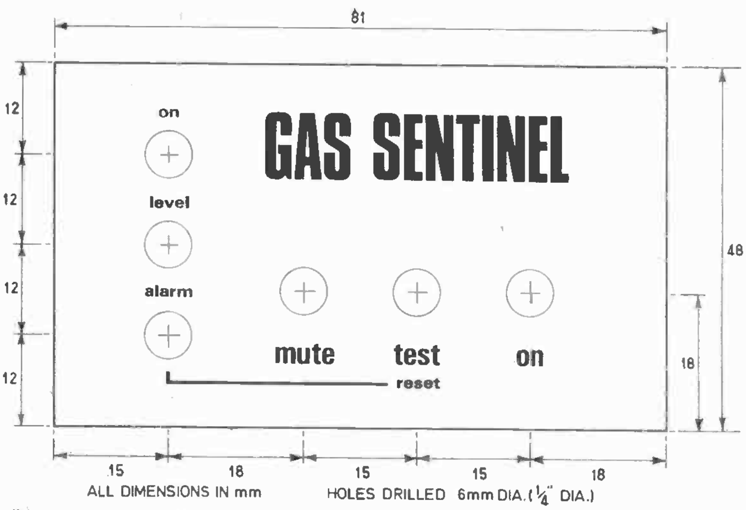


Fig. 6. Drilling information for the front panel, shown actual size for the specified case. Can be used as a template and/or front panel label.

that none of the leads can short circuit. The VM18 was used simply to make the p.c.b. copper track design slightly easier.

It is extremely important that the electrolytic smoothing capacitor C1 is soldered in the right way round. A radial lead (p.c. mounting) type is used, and the negative lead-out is clearly marked. Similarly, the tantalum bead capacitor has its polarity clearly marked, and this must be observed.

VR1 is a standard-sized preset, and not the more usual subminiature component; the one used on the prototype has a plastic knob fitted which helps in adjusting this control.

Care needs to be taken to ensure that the semiconductors are not overheated during soldering. A small heatsink used on the lead being soldered will help prevent any damage arising. Also, note the base connections for IC1 and CSR1. A chamfer on the plastic case identifies the output of the regulator and thyristor gate respectively.

IC1 is best fitted with a small heatsink as seen in Fig. 5 to help dissipate heat generated by the regulator. The heatsink does not require a mica insulation kit. C1 and IC1 are located closely together, but there should be enough clearance between the two. Note, however, that the heatsink is pointing to the perimeter of the p.c.b. and indeed overlaps it.

Check the completed printed circuit board for dry joints, reversed polarities of components, and adjacent tracks which may inadvertently have been abridged with solder.

CASE COMPONENTS

Construction can proceed with the case. With this design, some care needs to be exercised to ensure that everything is going to fit into place. For example, the positioning of the p.c.b. within the case in relation to the switches on the front panel is very important. The components on the circuit board must not touch any of the wiring to the switch tags.

Drill the aluminium panel as illustrated in Fig. 6, and after this the panel may be lettered as desired.

As usual, use small rub-down lettering and then spray on two or three coats of protective lacquer. Take care not to get dust or fluff on to the varnish while it is drying. Alternatively, Fig. 6 may be cut out or copied and glued to the front panel. Now fit the front panel mounted components.

Before finalising the location of the p.c.b. within the case, it would be better to experiment with its position in relation to the mains transformer and assembled front panel. Similar care should be taken to make certain that the transformer will not touch any other parts once the case is closed up. The transformer used in the prototype had dimensions 50 x 42 x 44mm. Also it had two 9V 400mA secondary windings that were connected in parallel. In the diagrams, the secondary has been shown as a single winding having a current rating equal to 800mA.

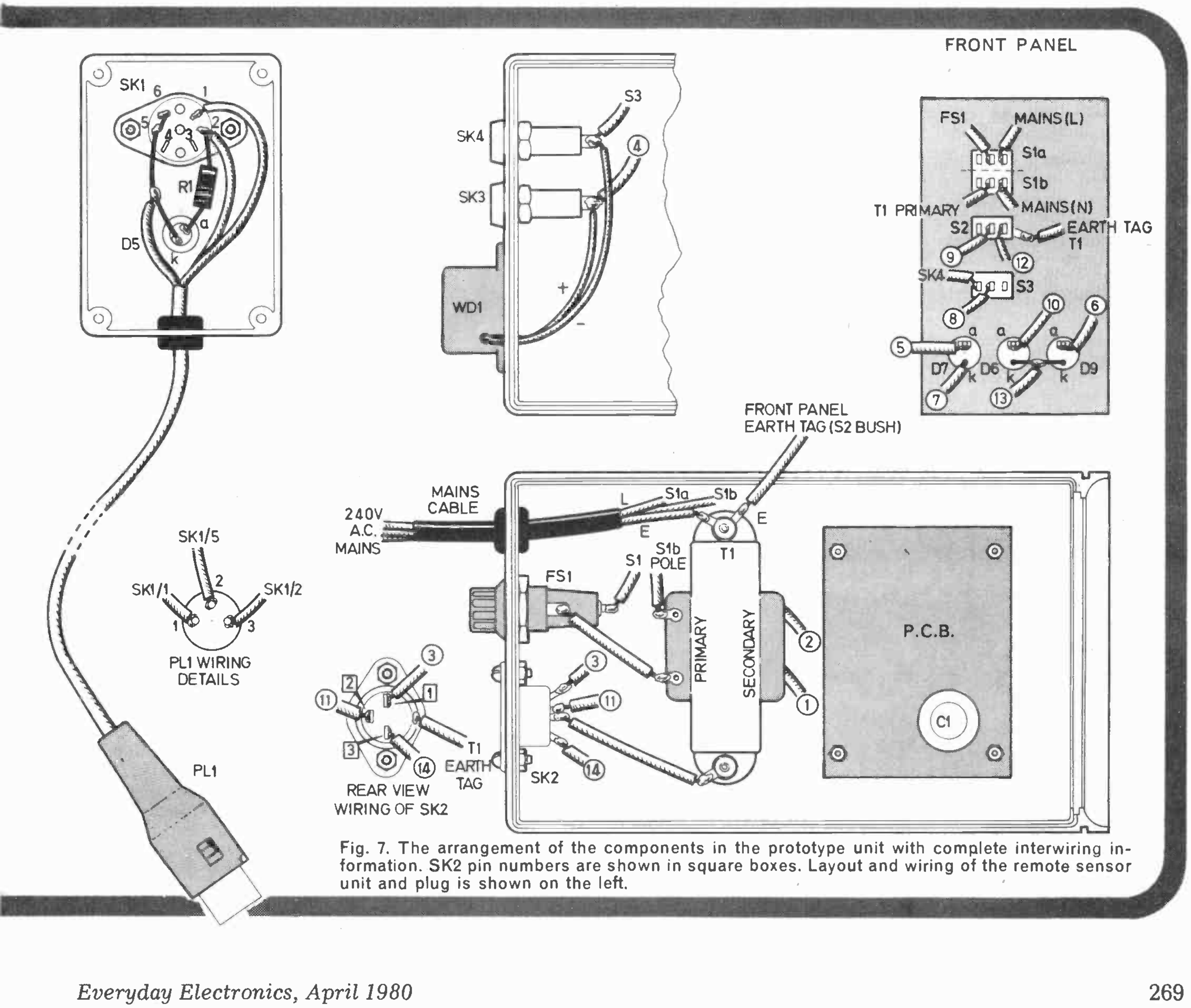
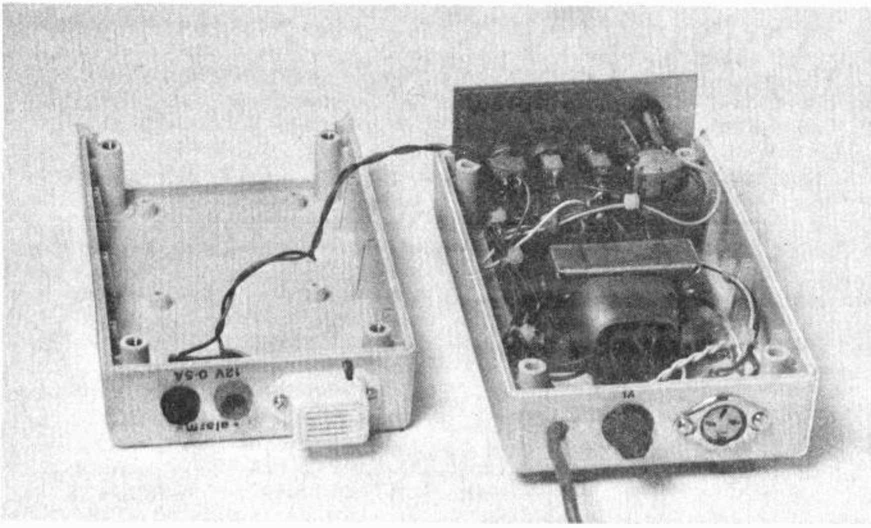


Fig. 7. The arrangement of the components in the prototype unit with complete interwiring information. SK2 pin numbers are shown in square boxes. Layout and wiring of the remote sensor unit and plug is shown on the left.



The completed control unit with top removed to show the close density of components.

On the bottom half of the case at the rear is mounted the 3-pin DIN socket, fuseholder and mains cable inlet; this last hole should have a grommet fitted.

On the top half at the rear there are the two 4mm sockets (SK3 and SK4) plus the audible warning device. The two sockets must clear the transformer completely when the case is fixed together. WD1 requires a small hole nearby to enable the leads to pass through to the terminals of SK3 and SK4.

INTERWIRING

There is quite a lot of interconnecting to be carried out, and Fig. 7 gives details; 3 amp mains wire is suitable for the mains interwiring.

The earth input from the mains is connected to the metal bracket of T1 with a solder tag under one of the transformer mounting bolts. The front panel is similarly earthed by placing a larger solder tag under one of the toggle switch nuts. The metal body of the DIN socket should also be earthed: an earth terminal tag may already be fitted to the socket, and this can be used.

The remainder of the wiring can be carried out with general purpose flexible hook-up wire. Try to use as many different colours as you can, in order to make subsequent checking and tracing easier.

Insulate any connections with p.v.c. sleeving as required. This is especially true of any mains voltage connections.

Readers may have noticed that the appearance of the front panel was improved by using "lens-clips" of the appropriate colour to mount the light-emitting diodes. Also, the rather small tangs of the toggle switches were made more manageable, and more attractive, by employing coloured push-on plastic caps.

REMOTE SENSOR UNIT

The final part of construction is the remote sensor unit; Fig. 8 gives all necessary details. The socket for the sensor requires an 18mm diameter hole to be cut: as this hole will still be visible once the socket is bolted in from behind, the cut-out should be as perfectly round as possible if a pleasing appearance is to be maintained.

In fact a perfect hole can be cut in the ABS plastic case using a Q-Max chassis cutter.

A cable length of 5 metres has proved successful, but it is anticipated that much greater lengths can effectively be used. Miniature 3-core mains cable is suitable for this.

It would be possible to mount the sensor on the main unit itself, thereby dispensing with the need for a remote unit. In this case, you would need to ensure that there is adequate clearance behind the socket once the unit was closed up, and the sensor would need to be mounted on top of the casebox.

A remote sensor, however, enables it to be positioned exactly as required, whilst the control unit can be in some other more convenient position (e.g. the bedside table).

Check over all wiring before proceeding to the next stage.

TESTING AND SETTING UP

Insert IC2 into its socket if you have not already done so. Also plug the sensor into its socket on the remote unit (either way round will do).

The unit should not be plugged into the mains during these tests.

Before switching on, try to test that the completed model is earthed correctly. Using an ohmeter on a low ohms range, check:

(i) The resistance between the earth pin on the mains plug and transformer mounting bracket registers a very low resistance.

(ii) Similarly check that the front panel is correctly and soundly earthed.

Set VR1 to middle position and S3 to MUTE (i.e. S3 open). Plug in and switch on. The green POWER ON l.e.d. should light, as should D5 on the remote unit.

After a few seconds the LEVEL and ALARM l.e.d.s should suddenly illuminate at the same time. This is perfectly in order and is attributable to the sensor warming up. This should be accompanied by the temperature of the sensor cell slowly rising.

Presently the LEVEL indicator should extinguish, leaving the ALARM l.e.d. on. Close S3; this should cause the audible warning device to sound. Then operating S2 (TEST/RESET) should silence the buzzer and extinguish D7 (ALARM).

Pressing S2 again should then operate the alarm circuitry once more, this time in the TEST mode.

One method of testing the sensor (without gassing yourself) is to pour a little lighter fuel or petrol on to a cotton wool pad and place this near to the sensor cell. Depending on the setting of VR1, the alarm should be triggered and the LEVEL l.e.d should illuminate.

The Gas Sentinel should then be operated for a few hours to make sure that everything is in order.

Over a period of about one week the SENSITIVITY control, VR1, should be adjusted until the desired level of sensitivity is obtained. The reason for the extended period of adjusting is that false alarms may initially be given because, for example, very high levels of cigarette smoke may trigger the alarm. This tendency should eventually be cured by altering the setting of VR1 accordingly until maximum sensitivity without false alarms is attained.

LOCATION OF THE SENSOR

The gas sensors are affected by changes in humidity and ambient temperature. It is important therefore to position the remote unit away from direct heat (e.g. radiators, fires, lights, etc.) and also away from steam.

In use it is advisable to check occasionally to see that the mesh window of the sensor has not become blocked with dust or dirt, as this will impair its performance. *Do not clean the mesh with any liquids or aerosols.*

The life of the sensor is claimed to be approaching ten years under normal operating conditions. Should replacement prove necessary, this will be signified by much poorer response of the unit to the "lighter fuel" test mentioned above. Replacement of the gas sensor is a simple matter. ⌑

Everyday News

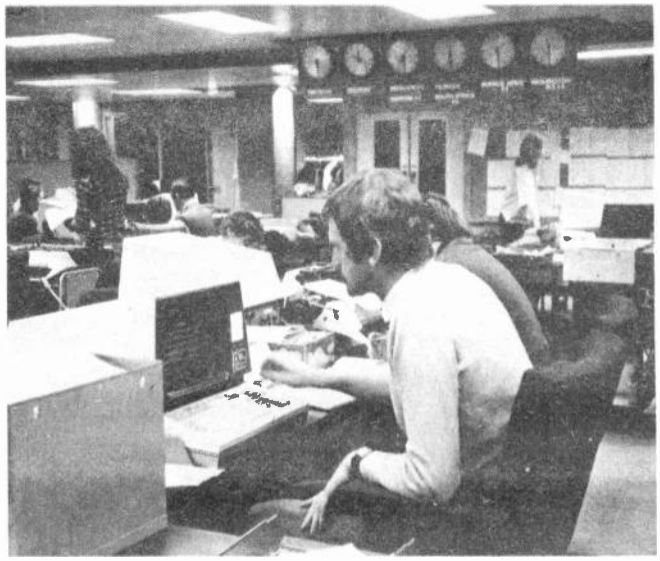
ELECTRONICS MAKES THE HEADLINES

At the BBC External Services the scripts of news stories, talks and features (some 30 million of them in a year) are now distributed electronically to more than 200 outlets in Bush House, the London headquarters of the BBC's Overseas broadcasting.

The broadcasters, journalists and translators in the 38 different language sections at Bush House no longer have to wait, sometimes up to two hours, for the scripts to be copied and delivered by hand. Now, they can get their stories in seconds from a visual display unit (VDU) or a printer, in their office.

At the heart of the Electronic Distribution System (EDS) are two mini-computers and an array of disc storage units. The scripts are written into the system on 64 VDUs in various parts of the building.

There are 39 VDUs in the central newsroom where journalists dictate their stories to copytakers who type them into the system. Once a story has been written, the journalists can instruct the computer to direct it to specific language sections and, shortly after, it will be printed in their individual offices.



The System

For the technically minded, the EDS is controlled by two General Automation 16/440 mini-processors. Both are in continuous operation and receive the same input, but only one of them provides any output. When a fault occurs, the standby processor is ready to take over immediately.

Each processor is associated with a 2-megabyte fixed-head disc and a 24-megabyte disc-pack drive. New material entered each day is "dumped" onto magnetic tape and later transferred to microfiche for archival storage.

Each of the 137 VDUs distributed around the building can undertake full text editing, but only those in the news, talks and features areas are free to amend the stories in the central store. Hard copies can be demanded from 85 medium speed, 120 characters per second (c.p.s.), Lear Siegler 200 printers and 36 low speed 10c.p.s., Transtel printers.

The system can accommodate individual talks of up to half an hour, or about 5,000 words. A single story can take as many as 15 "pages" on a VDU, with each page accommodating up to 2,048 characters.

Pay—TV

The Home Secretary, Mr William Whitelaw, MP, announced in the House of Commons that a consultation letter was being sent out inviting comments from both broadcasting authorities, film and cinema representatives and other interested parties on pay television pilot schemes over cable systems.

In reply to a written question from David Mudd, MP, the Home Secretary said on the basis of comments received he would then decide the circumstances and conditions in which subscription television might be authorised. He invited written comments by May 31 and said that in addition to those organisations specifically consulted, he would be pleased to receive comments from any other organisations or individuals who would like to send them.

ELECTRONICS FOR TEACHERS

A four-day (March 31-April 3) and a one-week (July 14 to 18) course on Basic Electronics and Electronic Applications for Teachers is being run by Salford University. They are also offering a series of microprocessor courses from April 14 to 18.

For full details of all courses available, contact The Administrative Assistant (Short Course), Room 110, Registrar's Dept, University of Salford, Salford M5 4WT.

The Department of Electrical Engineering Science at Essex University will be holding its annual Electronics Summer schools for teachers during July 7 to 11. Three courses will be run simultaneously.

For further details contact the University of Essex, Department of Electrical Engineering Science, Wivenhoe Park, Colchester CO4 3SQ.

If you are one of those lucky people who happens to own an Apple Computer System and always had a yearning to write and play back your own synthesised music, then the latest plug-in cards from Microsense Computers Ltd are for you.

Known as the ALF Music Synthesiser, the plug-in cards allow you to write your own synthesised music and play it back through your hi fi.

The traditional music staves are displayed on the video monitor or TV screen and, using paddle controls, you simply enter each note directly onto the staves. Adjustment by pitch, envelope, decay, sustain and volume all within the full piano range of eight octaves (24 notes per octave) can be made.

Field tests of a viewdata system start in West Berlin and Dusseldorf this year. First reports indicate that the Germans are showing much greater interest than the British have shown for the BPO's Prestel equivalent.

Comput-a-horse

The French state-owned horse-racing betting organisation is to install several thousand betting terminals in cafes and bars throughout the country. These will enable punters to place their bets right up to the "off".

—ANALYSIS

FADED IMAGE

The decade of the 1960s was one of glory for electronics. The transistor and microelectronics had arrived to pave the way for all sorts of technological miracles such as communications satellites and the ultimate triumph of the first men on the moon and their safe return to earth.

But microelectronics could be applied in other ways and at the start of the 1970s electronics started hitting the headlines in an entirely different way. In 1972 the news of "dirty tricks", the attempted electronic bugging of the Watergate building in Washington was the start of the biggest political upset for years.

By the late 1970s the microchip, the latest electronic miracle, was already being branded as "a menace". And in the first month of the present decade there was uproar over the revelation that the British Post Office has a modern centre for phone-tapping.

The new British phone-tapping complex has been represented as particularly sinister simply because it is modern. It is said to have a capacity (not actual usage) of 1,000 lines which is not very many for a population of 55·8 million using 22 million telephones. But, horror of horrors, worse is to come. It is alleged that tape transports are voice-operated, that individual callers can be electronically recognised through their voice-prints, and that conversations can be automatically printed out in hard copy.

If true, then the Post Office Engineering Department deserves congratulations. How splendidly efficient compared with old-fashioned methods of shorthand writers with earphones clamped over their ears, chain-smoking while waiting for calls. If eavesdropping is necessary in the interests of the community (*and it always has been*) the new and better method is no more sinister in principle than the old.

There is plenty of room for debate on the microchip. But, apart from purely technical merits, not on the chips themselves. How they are applied is a human problem. The chip itself is neutral and harmless.

Brian G. Peck

CB NEWS

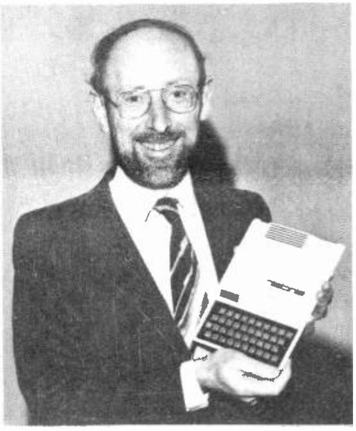
The British authorities are delaying any decision on authorising CB radio for the time being, contenting themselves with the announcement that whatever future decisions are made, 27MHz operation will be out, thus discouraging potential users from wasting their money buying equipment for that band.

Meantime, the Irish Government has banned CB radio and warned both dealers and the public that illegal usage will lead to prosecutions.

A National Committee for Legalisation of Citizens Band Radio has been formed in an effort to focus attention on the growing numbers of people calling for the introduction of CB in the UK.

The new National Committee, under the chairmanship of Lewisham councillor Theo Yard, will pool together the efforts of CB clubs around the UK. Theo Yard commented, "Our aim is the establishment of a legal CB system in the UK as soon as possible."

SINCLAIR STRIKES AGAIN!



Clive Sinclair, of pocket calculator and micro-television fame hit the headlines again last month when his firm, Sinclair Research, announced the arrival of their new baby—the ZX80 personal computer.

This "pint-sized" machine (it is small and light enough to be carried in your brief-case) is a powerful, full facility computer and costs under £100; the kit is £20 cheaper. This remarkable price has been made possible by the dramatic reduction in component count, a tenth of most other comparable performance computers by application of new design techniques, a super ROM and touch sensitive keyboard. The keyboard has single-stroke keyword entry which eliminates the need for much tiresome typing. The ZX80 plugs into a standard TV (to produce a black-on-white display) and is powered by an external 9V supply via a suitable mains adaptor.

MICRO SHORTAGE HITS RETAILERS

Next time you try to order certain i.c.s you may be in for a surprise. A recent survey of some of the larger component retailers has revealed a considerable shortage of logic devices, especially in the CMOS and 74LS ranges. Prices and deliveries are uncertain and the inevitable black market is blossoming.

This shortage of microchips is not particularly new nor is it confined to the retail end of the market. However, semiconductor users supplied through electronics industry distributors (and this includes most retail outlets) are hardest hit. Delivery times of six to nine months are not uncommon and some retailers are still waiting for January shipments.

The enormous increase in demand for computer based products has, to some extent, taken the industry by surprise and has contributed greatly to the present shortage in production. Companies placing orders for "safety-first" reasons have also been criticised.

There is, however, some comforting news for the hobbyist. Component shortages tend to move in cycles and many suppliers believe it is only a matter of time before the i.c.s become plentiful again. Whether this is true or not, only time will tell, but it is significant to note that major companies such as ICL remain concerned about future supplies.

CURTAIN CALL

Poland is now the 91st country which Britain's phone users can now dial direct.

One of the places that can be dialled direct is the 16th century royal capital of Krakow where Pope John Paul was cardinal archbishop.

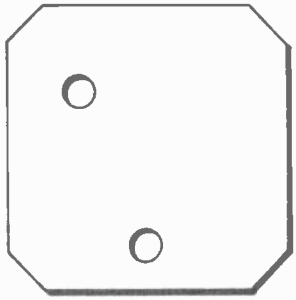
Over 15,000 calls a month are received from Poland and about the same number are made from Britain.

Golden Oldies for Video

The RCA company has acquired 12 classic Charlie Chaplin films and five NBC specials, including "Victory at Sea", for its catalogue of video disc programmes. They also have an option on the original 26 episodes of the World War II television epic.

Some 300 titles are planned in the first year after the RCA "SelectaVision" video disc appears on the market in the early part of 1981.

BY F.G. RAYER



MAINS FAULT INDICATOR

A STANDARD mains outlet has *L* (Live), *N* (Neutral) and *E* (Earth) sockets. Power for appliances is obtained from the *L* and *N* sockets, but the Neutral is at low potential relative to earth, so *L* and *N* will not be interchangeable. The Earth is used to ground the metalwork of appliances, or act as a conductor for fault current which will result in the Live circuit being interrupted.

When an appliance is correctly connected by means of a 3-core cable, maximum safety is obtained for the user. Short circuits from *L* to *N*, or *L* to *E*, will result in the fuse in the live (*L*) circuit blowing or operation of a trip, so that the appliance is not dangerous to handle.

Proper protection is not obtained if *L* and *N* circuits are reversed at the outlet, or Neutral or Earth omitted. The fault indicator plug described here shows the situation when wiring is correct at the outlet, and also four fault conditions. Some of the latter, and especially an omitted earth, can be dangerous for the user.

CIRCUIT AND OPERATION

The circuit diagram for the Mains Outlet Fault Indicator is shown in Fig. 1. The neons LP1 and LP2 receive current through their series limiting resistors R1 and R2. Resistor R3 is from *L* and *N* in the plug to allow a path to LP2 in case of an "open circuit Neutral".

When the plug is inserted into a mains outlet socket, a correctly wired output will pass current via R1 to illuminate LP1; LP2 remaining off. An output with the Live lead disconnected (open circuit) will be obvious by both LP1 and LP2 failing to light.

If the Live and Neutral mains wiring have been reversed this will allow current, via R2, to illuminate LP2; LP1 remaining off. A complete lack of an earth connection will be indicated by both neons being alight, current flowing via R1, LP1, LP2 and R2.

If an open circuit Neutral is present current will pass through R1 to LP1, and R3 and R2 to LP2. In this condition both neons will be illuminated.

The only correct indication is LP1 ON and LP2 OFF, see Table 1. Any other indication means that the outlet must be fully investigated, by a qualified electrician, before using it.

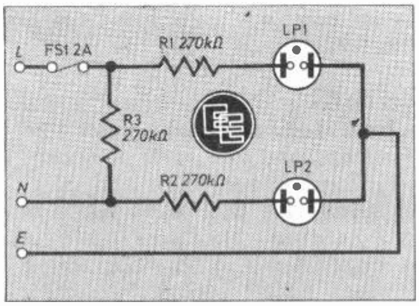


Fig. 1. Circuit diagram for the Mains Fault Indicator.

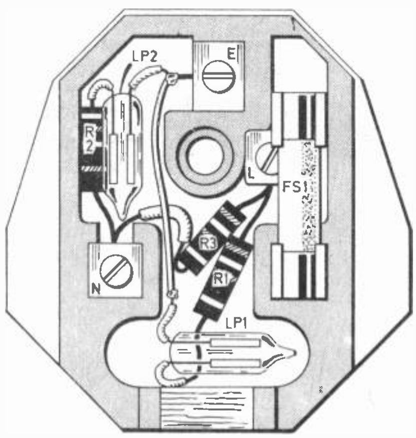


Fig. 2. Layout of components and wiring.

COMPONENTS

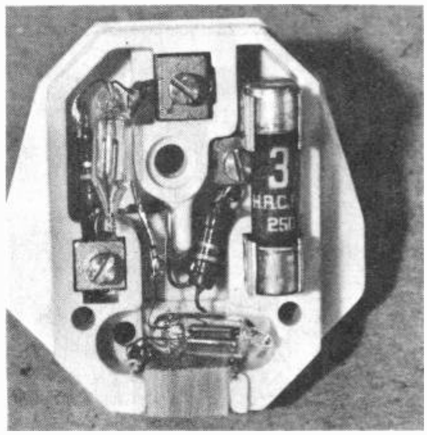
Resistors
R1, 2, 3 270kΩ or 330kΩ to suit neons (3 off)
¼ W carbon ± 5%

Miscellaneous
LP1, 2 70 to 90 volt wire-ended neons (2 off)
FS1 2A or 3A fuse
Standard flat pin 13A type plug

Approx cost Guidance only
£0.90 (see page 241)

PLUG ASSEMBLY

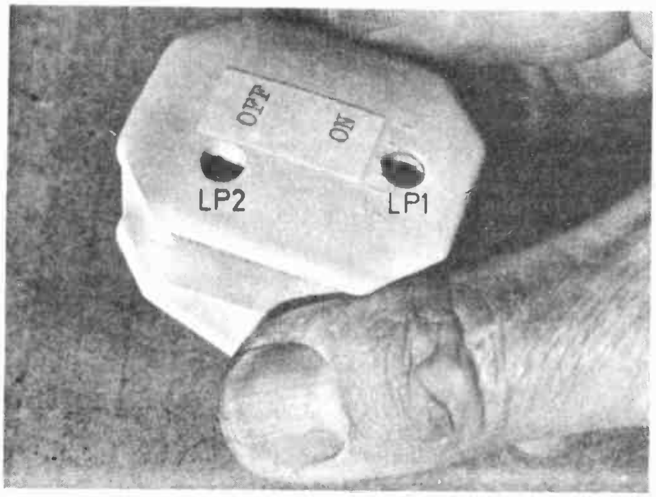
A standard flat pin 13A plug is used to house the components and the positioning and wiring is shown in Fig. 2. Grip a stout wire in the *E* terminal of the plug and solder one end of both neons to this. Twist one end of R1 and R3 connecting leads together, and fold over to give more grip, and secure with the *L* terminal. Similarly secure R2 and R3 at the *N* terminal. Resistor R1 is then soldered to LP1 and R2 to LP2.



Mains Fault Indicator with cover removed. One end of R3 should be covered with insulating sleeving to avoid shorting to the heavy gauge wire.

To avoid any possibilities of short circuits when wiring, particularly to the heavy gauge earth wire, it is recommended that the leads from the neons and one end of R3 (*N* terminal) be insulated with plastics sleeving.

Keep the neons about as high as the fuse, with electrodes horizontal. Fit a 2A or 3A fuse. The



Front cover of the plug showing viewing windows and suitable lettering indicating lamp state for correct conditions at outlet.

Table 1: Operating Conditions

OUTLET	LP1	LP2
Correct (Current via R1 to LP1)	ON	OFF
Live open circuit (No current to LP1 or LP2)	OFF	OFF
L and *N* reversed (Current via R2 to LP2)	OFF	ON
No Earth (Current via R1, LP1, LP2, R2)	ON	ON
Neutral open circuit (Current via R1 to LP1, and via R3 and R2 to LP2)	ON	ON

flexible cord securing grip is removed and the mains cable inlet hole blocked with a wooden plug cemented in.

Drill viewing holes about 6 to 9mm in diameter directly over LP1 and LP2 in the plug cover and cement pieces of transparent material over these holes inside the cover before replacing it.

TESTING

The fault indicator can be tested by inserting it in a socket which has a 3-core cord and plug, and simulating the faults listed in the operating conditions table at the plug. *Remove the plug from the wall outlet before removing its cover or changing connections to it.*

To test outlets, insert the plug in the usual way. *Only LP1 should light.* In other cases a qualified electrician should look at, test and correct the circuit or plug connections, as necessary.

If the indication is correct at a wall outlet but not when an extension lead is added for remote use, connections at the extension plug and socket need to be examined. ☐

Yes Dear!

I have just been watching a film called "The Stepford Wives". For the benefit of those of you who do not know the story, it is about a quiet American town in the backwoods, where all the men have disposed of their wives and replaced them with exact replicas. Externally they are identical to the originals, but inside they are all wires, chips and various other electronic devices.

They are, needless to say all very beautiful but have the advantage that they can be programmed to enjoy housework, and always do their husbands slightest bidding without argument. It set me thinking, "an unusual occurrence", and I thought just imagine this happening. You could build your own dolly bird, make her beautiful, curvaceous, like any film star and she would hurry to obey your slightest whim.

I was just about to write to EVERYDAY ELECTRONICS to ask when they were going to publish an article, on how to construct your very own sweetie pie, when wiser thoughts prevailed. Would I really prefer this lovely pneumatic creature that hasn't the word "No" in her vocabulary to my present model, who, when I say I can't take her out, tries the effect of bouncing crockery off my head?

Such is the perversity of human nature, that I know in advance the answer would be "No". That I think is the weakness in the story. I think it could have been made into a hilarious comedy with all the models going wrong and running amok but the producers tried to treat it seriously and it wouldn't stand up to such treatment. However, it left me wondering if one day all this may be feasible, if so I shall look at electronics with renewed interest.

Mail Order

Now, before I'm reminded that I am not employed as a film critic, let me hurriedly return to my brief. I was most annoyed to see the postal rates put up yet again. We absorbed the last one without passing the increase on to our customers but there is a limit, after which we have no option but to try and recoup some of the increase. I feel it is particularly hard on the electronic constructors, who are dependent on mail order for so many of their supplies.

The only advice I can offer, is to take advantage of suppliers offering a fixed postal rate, as many of us do, and send fewer, but larger orders. I believe some retailers actually offer to send goods post free, if the order is over a certain value.

A Good Connection

My regular readers may recollect that about two or three years ago I was very scathing about the fact, that the good old Bulgin P73 Mains Socket was suddenly condemned, by the madarins of the common market as unsafe. Consequently Messrs. Bulgin had to derate it from 250 volts a.c. down to 50 volts d.c.

I was therefore delighted when I saw that a well known and respected component supplier, had found a way round it. In the preamble to the description they simply say "These plugs are not suitable for making external mains connections to equipment for domestic use as defined in The Electrical Equipment (Safety) Regulations 1975". After which they proceed to rate them as before at 250 volts a.c. at 5 amps.

This means that you and I can carry on using them in the same way as before, and a good thing too, because when all is said and done, the P73 is a very useful and robust mains connector.

RADIO WORLD

By Pat Hawker, G3VA

Long-range VHF

Almost everyone who listens at all regularly on v.h.f.—broadcast or amateur stations—soon becomes aware of the marked extension to the distances over which signals travel during "tropospheric" weather conditions; and also (during summer months in the UK) during the seemingly random "Sporadic E" conditions. Fresh light on both these phenomena has been reported recently.

The presence of water vapour at heights up to about 6,000ft combined with the existence of a "temperature inversion" (i.e. the air becoming warmer instead of cooler with increasing height) results in the bending and ducting of v.h.f. signals. Such conditions occur often in periods of fine warm anticyclonic weather and also during the misty days of late autumn and spring.

A good "tropo opening" is regarded as bad news by broadcast engineers since it brings a big increase in the number of complaints of "patterning" on TV pictures or break-through of foreign languages on sound; but the same conditions are warmly welcomed by amateurs who find they can then make contact with stations as much as four times farther away than in "normal" conditions. On 144MHz British amateurs have made contacts of some 2,000km; and on 432MHz up to about 1,500km although these distances are exceptional.

Much less known is the fact that tropospheric ducting is not confined to v.h.f./u.h.f. signals but can also enhance ground wave signals on frequencies between 20-30MHz (and possibly sometimes even on much lower frequencies). It has been shown that over a 235km sea path, signals may become as much as 20dB stronger than normal when there is super-refraction or tropospheric ducting.

At the other end of the frequency scale, at 10,000MHz, sea-path ducting has enabled British amateurs to span the distance from St. Ives, Cornwall to Portpatrick, Scotland using extremely low power (a few milliwatts). This was achieved in August 1976 but it has had a rather unexpected result: with an "over 500km" record achieved, enthusiasm for further tests appears to have declined and the 10GHz "record" has now passed to Italian amateurs who last year exceeded 600km in the more favourable Mediterranean climate where super ducts form more readily than in our turbulent weather.

The other phenomenon, Sporadic E, is at last becoming more fully understood. Amateur observers and scientists over the past two years have produced fairly positive evidence linking Sporadic E with tiny metallic particles from burned out meteors and meteorites.

These particles become caught up in wind shears in the upper atmosphere, some 50-60 miles above the Earth, becoming ionised from the action of the Sun to form highly reflective layers that descend slowly as the day progresses. This has the effect that signals from about 20 to 100 MHz (and occasionally extending as high as the 144MHz amateur band) can be received at good strength over distances up to about 1,000 miles.

Sporadic E layers thus seem to be basically metallic and are not layers of ionised gases as are the other layers of the ionosphere on which short-wave propagation depends.

3D for TV?

With many engineers in many countries working on ways in which television broadcasting could be extended, there is still doubt as to the most likely outcome. One possibility is the introduction of a second sound channel with better "separation" than is possible with the conventional pilot-tone stereo system used for sound radio.

The second channel could be used for stereo, or as a second-language channel, or possibly even as an additional radio broadcast channel. For instance some engineers believe we could consider using the line sync periods for carrying sound since it is now possible to build receivers with very stable line oscillators that need only an occasional sync pulse to keep in step with the studio cameras.

Then again, there is still interest in the idea of three-dimensional (3D) television which would give a better illusion of solidity, particularly if this could be achieved without the viewer having to wear special coloured glasses. In a recent English-language broadcast from Radio Moscow it was stated that 3D TV is being studied in Leningrad and has already been introduced for closed-circuit applications in order to provide better remote-handling instruments in nuclear plants. But apparently 3D TV for the home is not being given priority, although it was claimed that one such system had been tested some years ago and had proved to be quite effective for black-and-white pictures but attention has now turned to colour.

A number of inventors have described 3D TV systems in the UK but I do not feel there is much chance of any of these being adopted in the foreseeable future.

Another idea being proposed is multi-focus photography in connection with TV film cameras, and a computer-aided system with digital processing was described recently at the National Film Theatre. Those of us present at that meeting came away disappointed that no firm evidence was presented to show that these ideas have reached the stage where real results can be demonstrated or what, even if the system proves technically feasible, would be the cost of introducing such a process.

A big advantage would be that the viewer would not have to change his set, as for most other possible innovations.

Radiophone services

Citizen's band was originally introduced in the USA to appeal to people who, having no special technical interest in radio communication, nevertheless felt a need to have two-way communication facilities in their vehicles; in fact a sort of poor man's London Radiophone service.

The Post Office system, of course, has many more features than CB and is tied in with the normal telephone service. "Selective calling" techniques mean that a user is alerted to receive only calls specifically intended for his "number" and the use of various automatic channelling systems and multiple base stations is all intended to provide a first-class, if rather expensive, public service throughout the London area.

How effective is the system at present? Can a user, who will have paid some £1,500 for equipment from one of the three "approved" manufacturers, pays about £15 a quarter to the Post Office plus 25p per call, be reasonably sure of receiving and making calls whenever he wants to?

It would seem, from a report by Ian Priest, G8PML in the newsletter of the UK FM Group (London) that the system works—but only "with a lot of luck and a great deal of difficulty". Outgoing calls from mobiles seem reasonably easy; the main problem is that the system tends to become overloaded at some times of the day and then the user, when called, finds he cannot seize a free channel, sometimes for as long as 20 minutes or so—by which time his caller is likely to have given up and rung off.

The answer would seem to be that the Post Office needs much more "channel space" in other words a bigger chunk of the radio spectrum; and again that would allow them to reduce the two years or so "waiting period" for would-be subscribers. But is this practicable? One has the feeling that with any reasonable number of channels, the extra subscribers would soon be experiencing similar problems of overload.

Radio Antarctic

The Racal Company tells me that more than 100 tonnes of equipment and supplies—including high-frequency radio equipment—is being flown over the Antarctic permafrost for members of the Transglobe Expedition in the mountains of the Borga Massif.

The expedition, which recently arrived in the Antarctic under the leadership of Sir Ranulph Fiennes, will camp for the Antarctic winter before pushing on to the South Pole and then on round the world by its polar axis. The expedition by six men and one woman will last some three years using Land Rovers, an adapted trawler and powered sledges.

The radio network is being established at a cost of some £130,000. Much will depend on the skill of Giles Kershaw who will make the airlift in a light aircraft. The company say "Should anything go wrong the members of the team would be left without adequate supplies during the worst part of the year. One hundred per cent reliable radio communications are essential."

Radio communication near the Poles is often very far from being reliable due to the difficult propagation conditions, so we had better keep our fingers crossed.

You will not be too late

For most of the bargains listed in the newsletter reprinted below, even though it is our JAN/FEB issue, because the part of the newsletter with the items in short supply is not reprinted. However, you will receive the whole of our MARCH/APRIL newsletter if you send us an order this month and as an extra inducement we will send you our MAY/JUNE newsletter directly it is printed, which is usually about two months before it can appear in this magazine.

SERVICEMAN'S SNIP is something which probably every one of our readers could usefully use, even though he may already have one or more of the expensive kind, we refer to the "Safe Block" as used for quick hook-ups to the mains. We offer a complete kit to make a safe block—has all usual features, fuse, spring grip for wires, automatically switches off when you make connection, tough rugged plastic outer case. Price of kit £2·50 + 37p.

6 WAVE BAND SHORT WAVE RADIO KIT
Brandspread covering 13·5 to 52 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit, includes case materials, six transistors and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy, if you have an amplifier to connect it to on a pair of high resistance headphones. Special price to get this kit off the ground is £11·95 inc. VAT and postage.

CONSTRUCTOR'S SNIP
6v lamp transformer with 230v mains primary. This has fixing clamp and is in fact a normal transformer usually listed at £2·50. We are offering this at only £1 including postage and VAT and for good measure we are including free plans and diagrams for two very popular items. 1. Sound to light adaptor. 2. Whistle op. switch. Secure this bargain by ordering parcel ref. 8J1.

THIS MONTH'S AMPLIFIER SNIP
This is a stereo amplifier rated output 8 watts per channel. Complete and with tone control panel. Unused but please expect to have to rectify some small fault. We understand these were made for a high class music centre and hope to be able to supply the circuit diagram. Price £2 + 30p.

ARE YOU A BIG SOLDER USER?
If so, you will be interested to know we can supply Ersin multi-core solder 18 gauge 60–40 normal for electronic work on half kg reels. Price £8·50 + £1·27.

REMOTE Control of your sound to light, no direct connection to amp or speaker. Kit includes made up amplifier, microphone, case switch, etc. £3·50 + 52p.

80W TUBULAR ELEMENTS
Brass-encased with beaded flex ends. Standard replacement in most absorption type refrigerators, but also dozens of other uses, airing cupboard heater, etc. Price £1·50 + 22p.

750W FLAT METAL CASED ELEMENT
Made for Hotpoint Safety Kettle, this measures 5" long, 2½" wide, and is about ⅛" thick—very useful for contact heating. Price 95p + 14p.

BLOWER—EXTRACTOR
This can be either depending on how you mount it. We refer to the Compact mains operated air mover, made by the famous Smith Company. The air comes in at the centre and is blown out through an oblong side outlet. One use is as a solder flux fume extractor, saves inhaling this nasty stuff. Another use is as a draft reducer. Blow up polythene tubing with this and the polythene will expand into the gaps and so reduce draft and heat loss. Other uses, cooling, hot air distribution, cooking smell removing, etc. We have 4,000 of the fans. Price £250 per 100 plus VAT and carriage. Sample quantities £3·00 + 45p, post £1·00.

HEAVY DUTY MICROSWITCH
For machines and other places where they may be exposed to dust and grit. The opening shaft is rubber encased and the switch metal, cased. Price £1·50 + 22p. **NOTE:** We have over 100,000 microswitches in stock covering 50 or so types so please let us have your enquiries. Special offer 10 different, price £1·50 + 22p.

BURGLAR ALARM CONTROL PANEL
Contains labelled connection block, latching relay, test switch and removable key control switch. Simplifies the whole installation, all you have to do is to take wires to pressure pads and to alarm bell. Price £6·00 + 90p. With complete diagram.

PRECISION MAINS OPERATED CLOCK
For only £1·50 + 22p. Sounds unbelievable but that's what you can have if you send your order right away. The clocks which have large clear dials were made by the famous Smiths Company for use with their domestic cooker switch and are brand new and guaranteed.

15-0-15v @ 2 AMP
Mains transformer, upright mounting primary and secondary wound on separate bobbins with fixing lugs. Price £3 + 45p. Post 60p.

25-0-25v @ 750 mA
Mains transformer C core construction, heavily varnished for dead quiet operation. Upright mounting with fixing lugs. Price £2·75 + 41p. Post 50p.

25 WATT MID-RANGE SPEAKER 5¼"
Made by Goodmans so there's none better. 4 ohm coil. Price £3·50 + 45p. Post £1·00.

8 OHM TWEETER
Made by Goodmans. 3½" square, 4" across fixings. Price £1·50 + 22p. Post 30p.

ROTARY SOLENOID
As most customers know we have solenoids of the normal types for pulling and pushing through a magnetic assembly. We have now acquired some which have a rotating action, D.C. operated. A shaft which comes out of the centre, rather like a motor spindle, travels approx. 90°. Price £5 + 75p.

THREE POSITION ROCKER SWITCH
10 amp changeover with a centre off standard size clip fixing pushes into hole size approx. 1" × 7/16" which is standard for many rockers. Special bargain this month, 10 for £2·00 + 30p.

¼ H.P. MOTORS
Normal base mounting, ex-computers but tested, 230-240v 50 hz. good length spindle, mostly American make. Price £8·50 each + £1·27 + carriage £2·50.

WATERPROOF HEATING WIRE
As used for electric blankets, etc. This has dozens of other applications—in gloves or socks for people with poor circulation are obvious uses. One unusual use suggested by a customer is a 'grow' bag heater. The wire which consists of an element wound on glass fibre then PVC covered has a resistance of 60 ohms per yard. The price is 20p + 3p per yard.

TELEPHONE PICK-UP coil attaches by suction to phone body, enabling conversation to be recorded, put through amp or headphones. Price £1 + 15p.

TRANSDUCERS
As used remote control T.V. receivers. Price £1·50 + 22p.

PANEL METERS AND INSTRUMENTS

2½" ROUND PANEL METERS
All flush mounting through 2½" round hole, with flange makes item 3" wide approx. Made to stringent Ministry specifications. We have the following types in stock, all are moving coil unless otherwise stated. **VOLTMETER** Scaled 0-200 volts, res. 2,500 o.p.v. Price £2 + 30p. **MICRO AMPMETER** 500 UA—scaled 0-5. Price £2·50 + 38p. **MILLIAMP METER** 500 MA—scaled 0-500 mA. Price £2 + 30p. **AMPERE METER** Hot wire, scaled 0-9 amp. Price £2 + 30p. **DUAL RANGE** Scale calibrated 0-10v and 0-500v flush mounting this has internal resistor for the 10v range but would require ext. resistor for the 500v range. A very sensitive 20k per volt movement. Made for G.P.O. so obviously very good. Price £3·00 + 45p.

0-1 MA PANEL METER
2" square made by Sifam for Ferrograph for peak level indication, so reads right to left—1 milliamp f.s.d., scaled 0-1. Price £3 + 45p.

INSTRUMENT PANEL METER
Oblong size approx. 4¾" × 4½" f.s.d. in 7·6 microA which is a very sensitive m.c. movement. Internal resistance is 2000 ohms. Pointer has a right to left movement and there is a mirrored scale calibrated ·1, ·2, ·3 . . . 2 to 2, finishing with the infinity sign. The meter could be used for resistance indications or the scale could be replaced quite easily. These were obviously very expensive instruments but we will supply at £7·50 + £1·03. Limited quantity only.

0-500 VA PANEL METER
Oblong size 2¾" × 2½" approx. made by Sifam for Vortexion, internal res. 1400 ohms. Twin scale top reads 0-100, bottom reads —20 . . . +30 db. Price £3 + 45p.

0-1 MA 240° PANEL METER
A large 240° scale instrument size approx. 4½" square at the front and 4½" deep. Intended for panel mounting, its scale is calibrated 0-7 and it was intended to be used as rev. counter. Price from the maker would we feel sure be about £25. Our price £12·00 + £1·80 each, post £2·00. We have a similar instrument with different scales, contact us if you are interested.

VU METER
Edgewise mounting, through hole size 1⅞" × ½" approx. These are 100 micro amp f.s.d. and fitted with internal 6 volt bulb for scale illumination, also have zero reset. The scale is not calibrated but has very modern appearance. Price £2·50 + 38p.

BALANCE METER
Edgewise mounting 100 UA centre zero. Price £2·00 + 30p.

1¾" SQUARE PANEL METER
Eagle full vision plastic front. 50 UA Price £4·00 + 60p. 1 mA Price £3·50 + 53p.

LARGE PANEL MOUNTING MOVING COIL METER
Size 5" × 4" 200-0-200 UA. It has a plain scale, also it is a fairly easy job to reset the pointer to the left-hand zero position and thus obtain a 0/400 UA movement. Made by Sangamo Weston. Price £6 + 90p.

GALVANOMETER 7-0-7 UA f.s.d.
Moving coil precision laboratory instrument of extremely high sensitivity (0·3 UA per division). Size approx. 6½" × 2½" × 2". Price £12 + £1·80.

ACOS 'G' METERS
For use with transducers and accelerometers. These are precision instruments. They measure 'G' in three steps, 0-10, 0-100 and 0-1000 directly on a large clear meter scale 0-1. Price £12 + £1·80.

CHARGE-DISCHARGE PANEL METER made for military so of good quality. Fitted with shunt this reads 50-0-50 amp, hole size 2" dia. with flange for flush panel mounting. Price £2·50 + 38p.

0-10V DC MOVING COIL PANEL METER
Another military model flanged for flush panel mounting through round hole size 2" dia. Range easily extended by adding a series resistor. Price £2·00 + 30p.

0-100 UA
Fine moving coil instrument sealed into glass case, mounts flush through 2½" dia. hole and we supply this complete with mounting flange. Price £3·00 + 45p.

LABORATORY METERS
In beautifully made teak case, size 8" × 8½" × 5½", the sort of instrument we used at school. Very clear mirrored scale reads AC 0-150v. Calibrated at 1200-2000 cps. Price £15 + £2·25 + postage £2.

LABORATORY METERS
In case made of tough plastic. Very clear mirrored scale reads DC 0-150v. Price £7·50 + £1·13 + postage £2.

4" SQUARE PANEL MOUNTING moving coil movement with scale for multi-range test meter made for the Taylor Electric Co., a truly beautiful instrument with mirrored scale, end stops and zero adjustment. If you have contemplated building a 20,000 o.p.v. multi-tester then this is your chance. Price £4·50 + 68p.

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0-25 MA moving coil made for the G.P.O. A very useful instrument especially when panel space is limited. Price £2·50 + 38p.

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Panel mounting instrument gives very clear readings of voltages between 20kv and 40kv. Scale 4½" dia. surface mounting, few only £8·50 + 68p.

MULTI-TURN POT WITH KNOB
100k lin, approximately ¼ watt rating as used in many T.V. receivers, makers Ref. 7802 412-00051. Suitable for fine control of resistance in general circuitry. Price 40p + 6p.

T.V. DIPLEXER
On plastic moulding size 2¼" × 1½". We are able to offer these at such a low price that they can be used as T.V. aerial sockets only. Price 10 for £1 + 15p.

STEREO HEADPHONE LEAD
Black curly 10ft approx. terminations, stereo jackplug one end—miniature two pin plugs on other. Price 50p + 7p.

COMPONENT BOARD
Ref. W0998. This is a modern fibreglass board which contains a multitude of very useful parts, most important of which are: 35 assorted diodes and rectifiers including four 3 amp 400v types (made up in a bridge), 8 transistors type BC 107 and 2 type BFY 51, electrolytic condensers, SCR 2N5060/62 100v DC and 100uf 25v DC, and over 100 other parts including variable, fixed and wire wound resistors, electrolytic and other condensers. A real snip at £1·00 + 15p.

SUPER 2N3055
Transistor RCA 52360, in our experience this does all the 3055 can do but does it better, we have good stock of these, price 50p + 7p.

SPEAKER CABINETS
Simulated teak finish, nice handy size 11" × 8" × 4½" approx., modern black sponge type front, price £2 + 30p, post £1·50. Special price to bulk buyers.

12v SUBMERSIBLE PUMP
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E.H.T. MAINS TRANSFORMER with inductance control, normal primary, secondary output by our equipment, 3·5 kv 3 mA. E.H.T. voltage can be varied by applying a DC voltage to the lower normally unused bobbin. We are not sure how much the voltage may be increased or decreased but using a 9 volt battery we seem to get a rise or fall of about 50 volts. Ex unused P.S.U.'s. Price £2 + 30p. Post 40p.

ARMY 46 SETS
As made for and used in the Second World War, we have a few or these in good condition but without accessories. Price £10 + £1·50 + post £1·50.

TANGENTIAL HEATERS
Made by Solatron, these are replacements in many popular heaters, alternatively, they require only a simple case or could be fitted into the bottom of a kitchen unit or bookcase. At present both 2K and 3K models are in stock at £5·20 + 78p for 2K and £6·05 + 90p for 3K, post £1·50 per heater. Heater control switch enabling full heat, half heat or cold blow and connection data. Price 75p + 12p.

RECORD PLAYER MOTORS
As fitted to Magnavox, B.S.R., Garrard, etc. 2 pole motors £1·50 + 22p + post 35p. 4 pole (note these are also fitted to some tape recorders) £2 + 30p, post 40p per motor. An interesting point about these motors is that often when you have to fit a replacement, the stator (the part with the winding on) can usually be replaced separately, this often makes the replacement possible as most rotors have an end cap which is special as it is stepped to facilitate speed changes.

A DOOR SWITCH
Neat tubular pattern for letting into door frame. All you have to do is drill a ⅛" dia. hole and chisel out for the fixing. This is a changeover switch, so can be used in opening or closing circuits. Price 50p + 7p.

CROUZET SKELETON MICROSWITCH
Crouzet Ref. 319/C. This is a changeover switch with unlimited uses, contacts rated 10 amps stackable and very lightweight, snap action. Price 25p + 4p.

MINI DECADE THUMB WHEEL SWITCH
Stackable, panel hole size 1½" high and approx. ⅜" for each switch. Matt black with white figures—gold plated break before make contacts. Price 75p + 12p.

ROCKER SWITCH
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LOW TORQUE MICROSWITCH
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LIGHT DEPENDENT RESISTOR ORP12
A cadmium sulphide l.d.r. with clear end window—resistance reduces as light increases, dark resistance 1 meg plus, sunlight resistance 100-200 ohms. Price 75p + 12p.

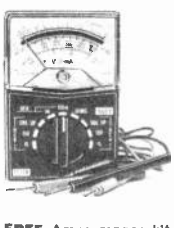
SUB MINI TRIMMING POTS
Wire leads suit ·1 matrix board—top adjusting available in following values: 10 ohms, 10 k, 20 k, 50 k, 100 k, 200 k, 250 k, 500 k and 1 meg. Price 45p + 7p.

MULTI-TURN POT
1⅛" cermet—20 turn metal cases with three leads for p.c.b.—multi-contact wiper ensures minimum noise and excellent stability—slipping clutch end stop, one value only at present this is 2 kw. Price 55p + 8p.

POWERFUL LOW SPEED MOTOR
230v or 115v mains driven. 45 r.p.m. approx. at 50 Mz 60 r.p.m. at 6 Mz. This is somewhat larger than average—size is approx. 2¾" dia. × 2½" deep, ¼" dia. shaft ⅜" long—mountable from front or rear, this is extremely powerful, in fact the writer could not stop it by hand. Price £3·75 + 56p + post 40p.

HEAVY DUTY MAINS RELAY
With three c/o 15 amp contacts—fitted with plastic dust cover, this has push on tags for quick connections. Price £2·75 + 41p.

MAINS OPERATED WATER PUMP
Most readers will know that we stock the Jabeco drill pump which was made to work with most portable drills, the price is still £2·25, but due to rise shortly. Also we have coupled this to an 110 rpm motor, mounted them on a metal chassis and offer this as a general purpose pump. It is suitable for most liquids and certainly for water and will lift the liquid up to quite a head. Price £9·50 + £1·10, post £1·00 + 8p.



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WORKSHOP MATTERS

By Harry T. Kitchen

Discipline

"What", you may well ask, "has discipline to do with our workshop?". A great deal as I intend to explain if you read on.

Most of us are guilty of a lack of discipline in our lives, and this can insinuate itself into our hobby unless we make a determined effort to maintain some form of discipline. Such an effort is well-worth while since it enables us to make the most of our limited time; this increased efficiency manifests itself as improved output, and hence pleasure.

Discipline begins with keeping a clean, tidy workshop. Let us now explore the extension of discipline to the keeping of records of your activities, particularly if you are well advanced, and hence have more to forget. Remember that memory is a most unreliable assistant—well, mine is, to be honest.

Note Carefully

Notes of your experiments, of circuits built — successfully or otherwise — will prove invaluable since you can learn from your own mistakes by back-tracking, as a source of future inspiration, guidance, and as a means of easing trouble-shooting if necessary. A good stout A4 sized note book is not expensive, and is large enough to record most circuit details; if the circuit is too large, it is usually possible to break it down into sections.

Record also all relevant calculations, however elementary, all voltages and currents, the effects of circuit changes, in short everything. By doing so you will build up an invaluable diary of your workshop activities. In time it is quite possible that you will be able to guide others who may be struggling or have done something wrong in their constructional activities.

You should also keep a record of ideas for future action, matters that you have read about, and so on. It is debatable whether you should use two note books, one for current projects, the other for future projects. It depends on your ambitions and the scale of your activities. I personally use two such note books; one an A4 for current work, the other an A5 in which I make notes of articles that I think that I may wish to refer to later.

Stock Control

In an earlier article I covered the purchasing of components. If your activities are modest, then you will probably have no problem keeping an eye on your stocks. If on the other hand you are into constructional work in an ambitious way, then it is worth thinking about some form of "stock control", as this will enable you to check on your existing stock and to update it if necessary.

Again, a note book is handy and you can allocate pages to different components and the quantity in stock. As the stocks are used up you alter the quantities until a time arrives when re-ordering is necessary. I would suggest that re-ordering is effected before you actually run out of any component.

This method also has the advantage that it high-lights components that are much used, as well as those that are little-used or used not at all.

Experimental Aids

Under the somewhat non-committal heading of experimental aids come all sorts of things that are difficult to classify, are perhaps unheard of outside professional circles, but which make the life of the experimenter that bit easier. These can be either home-made or bought-out.

An extremely useful piece of equipment is the old-fashioned "bread board", literally a piece of board onto which all the components were attached as best possible. A modern equivalent that I myself used was a piece of s.r.b.p. board onto which turret tags were rivetted at intervals of ¼in. Components went on one side, connections on the reverse.

A similar board could be built using 0·1in matrix plain, pierced, board using Vero pins or similar. The ultimate, manufactured version, is the T-Dec and its variants, and exceedingly useful I find them, though I do on occasion find myself short of room and wishing for another board to slot in.

Breadboards

Breadboards, home-made or manufactured, provide you with the facility of trying out circuits before plunging into the traumas sometimes associated with building a circuit untried. This applies particularly to home-grown circuits, since you have the facility of changing components with relative ease.

Breadboards have one or two snags, though, and it is as well to consider these. The circuit, or rather the components comprising it, is strung out somewhat, and this is unavoidable to some extent.

With r.f. or high gain circuits feedback may be a problem. Also, the final layout, be it p.c.b. or matrix board, may not have quite the configuration that it had whilst strung out on the bread board; you may now have feedback that you didn't with the bread board.

Connecting Leads

A useful adjunct to the bread board is a set of connecting leads. These take various guises, but are in essence varying lengths of connecting wire, typically 14/0076 or its metric equivalent, with crocodile clips, banana plugs, and the like to terminate them.

Large and small croc clips, large and small banana plugs, in all possible combinations; you will need them all, so useful are they for connecting to power supplies, meters, other boards, and so on.

Substitution Boxes

Resistance and capacitance substitution boxes seem to have gone out of fashion, yet I wouldn't be without mine. Built many years ago, the resistance range covers 10ohms to 10megohms in six switched decades using the normal E12 range of ¼ watt 5 per cent carbon film resistors.

The capacitance box covers from 0·1µF to 1000µF. Up to 2·2µF the capacitors are polyester; over that electrolytic; voltages cover 400V (polyester) to 16V (electrolytic).

Such boxes are not by any means difficult to build, nor expensive.

Switching offers resistor/capacitor values and their multipliers. For instance, the basic resistance range covers 10ohms to 91ohms, the next is 100ohms to 910ohms and so on, with one switch selecting the value, the other the multiplier. Similarly with the capacitance box.

The latter is of somewhat less use, certainly on the electrolytic side due to the wide tolerance of such capacitors, typically −50 per cent to +100 per cent. Below 0·1µF stray capacitance tends to nullify the usefulness. Even so, a capacitor substitution box serves as a very useful "pointer" towards the required value.

Restrictions

In using such boxes, it is essential to remember that resistors have wattage restrictions, capacitors voltage restrictions. What this means is that you must not gaily place them in positions where the makers of the resistors and capacitors did not intend them to go.

Do so and you may be amazed at the amount of smoke a resistor exudes, or the amount of foil in an electrolytic capacitor!

"I'll try this silic and chips I've heard so much about"

BOOK REVIEWS

ELEMENTS OF ELECTRONICS—BOOKS 1, 2 and 3

Author	F. A. Wilson
Price	£2·25 each
Size	180 × 108mm 200 pages (approx.) each
Publisher	Bernard Babani
ISBN	0 9001 6282 1 (Book 1) 0 9001 6283 X (Book 2) 0 9001 6284 X (Book 3)

One of the latest additions to electronics education literature is this set of books, described by the publishers as an "on going series of books aimed at the absolute beginner".

The ultimate aim of the series is to enable anyone to have an inexpensive but comprehensive introduction to modern electronics although on the evidence of the first three volumes you would have to wade through nearly three books of theory before you even approached modern electronic techniques.

That apart, volume 1 gives a good grounding in basic electrical theory which is later expanded to include a.c. theory in Book 2. The electronics proper really starts in Book 3. Entitled "Semiconductor Technology", it concentrates on transistor theory although there are also short sections on logic i.c.s. and op.-amps.

Generally speaking, presentation is quite good although it is let down from time to time by poor drawing and inconsistencies in the text that didn't ought to be there book of this kind.

S.E.D

QUESTIONS AND ANSWERS—INTEGRATED CIRCUITS

Author	R. G. Hibberd
Price	£1·55
Size	165 × 110 112 pages
Publisher	Newnes Technical Books
ISBN	0 408 00466 5

The concept of presenting information in question and answer form is not new. A great number of educational aids and instruction manuals have been written in this style with varying degrees of success and this book certainly ranks amongst the more convincing.

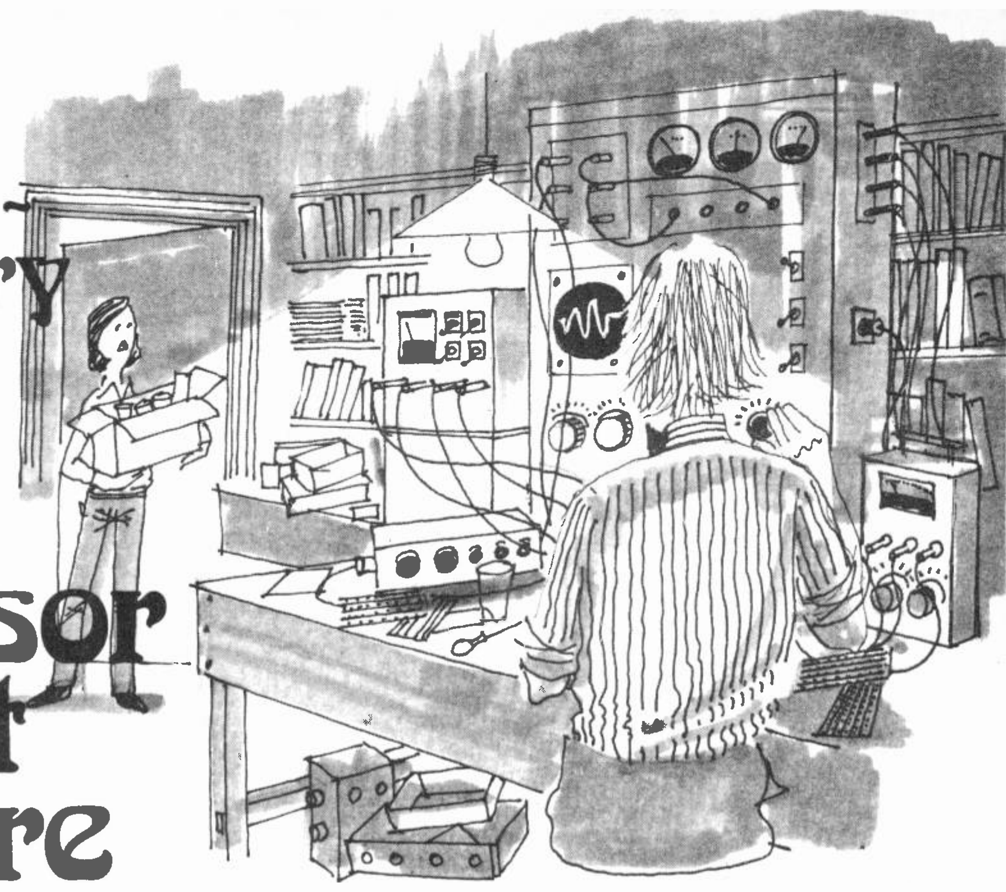
In any publication of this sort the selection and order of questions is all important and here R. G. Hibberd has apparently been very successful.

Each question prepares the reader for the next (with one or two exceptions), and the accompanying artwork is particularly crisp and clear especially for the small page size.

The book, which is not in fact new but a revised edition of an older publication, answers a number of general questions on i.c. technology as well as more specific points on the separate chip families—linear, MOS, digital, bipolar, etc. There are new sections on CMOS, NMOS, and VMOS technologies and microprocessors are looked at for the first time.

S.E.D.

The Extraordinary Experiments of Professor Ernest Eversure



by Anthony John Bassett

IN LAST month's issue, the Prof. left his visitors Tom, Maurice and Bob, trying to solve the problem of what happens to the trigger-points of a Schmitt trigger when control potentiometers are used to move the two trigger-points closer together until the point of zero hysteresis is reached, and passed. Maurice has been tackling the problem by mental concentration and deductive reasoning.

MENTAL APPROACH

After some careful consideration of the factors involved, Maurice announced:

"As the controls are adjusted to give less and less hysteresis, the circuit will respond to smaller and smaller signals, until eventually as the point of zero hysteresis is approached, it should become possible for the circuit to be triggered by really minute signals. It seems to me that the sensitivity of the circuit would approach infinity, and its behaviour would also come to approach that of an "infinite gain amplifier".

"Prof., is it really possible to obtain such a high performance from such a simple two-transistor circuit?

"I think that Bob is in the process of finding out—and he is certainly looking very excited about it".

PRACTICAL APPROACH

Whilst Maurice had tackled the problem mentally by use of reasoning, Bob had used a practical approach and built up a special experimental Schmitt Trigger circuit (Fig. 1).

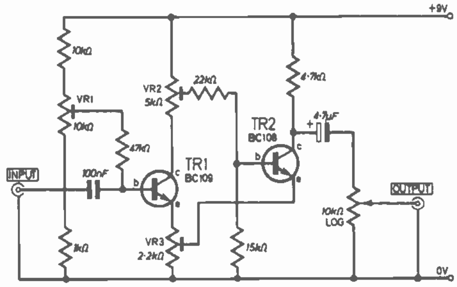


Fig. 1. Experimental Schmitt trigger circuit.

He set VR3 so that its wiper was near to the end of the track connected to the emitter of TR1, and VR2 so that its wiper was near to the collector of TR1. Now by connecting a multimeter to indicate the voltage at the collector of TR2, and moving the wiper of VR1 back and forth a few times, Bob found the two trigger points.

At one point of adjustment of VR1 the collector voltage of TR2 suddenly became high (about 9 volts) and at the other point it suddenly fell to about 3 volts. A guitar signal fed to the input from a pre-amplifier sounded very harsh and crackly at first, but as Bob carefully adjusted VR2 so that the trigger-points came closer together, there came a point where a less crackly but intensely "fuzzy" sound was produced.

HELIUM BALLOON RADIO AERIAL

At one point of adjustment of VR1 and VR2, the circuit became very sensitive to the slightest vibration of the guitar strings, and also began to pick up radio signals, so I decided to test it as a radio receiver. I launched the Prof's. Helium Balloon Radio Aerial.

"Wow, Bob, What's that?" Tom asked.

"Look outside, Tom you'll see it", Bob replied.

"It is a long piece of aerial wire carried up by a gas-filled balloon. With this it is easily possible to receive a wide range of radio frequencies, and I thought that, with a sensitive receiving circuit it might be possible to receive radio signals from space".

As Bob manipulated a tapped tuning-coil and a tuning capacitor a huge variety of radio signals could be heard from the loudspeaker of the audio amplifier, but he could not tell Maurice which of these signals might have come from outer space!

PASSING POINTS

"What I still would like to know" Maurice told Bob, "is what exactly happens when you adjust VR2 so that trigger points coincide, then pass each other?"

"That's easy," Bob replied. "The Schmitt trigger effect disappears and the circuit becomes a high-gain amplifier. As the wiper of VR2 approaches closer to the positive supply connection, the gain becomes lower and lower. By adjusting the wiper of VR1, two points can still be found; these are the positive saturation points of the amplifier beyond which it will not amplify any further in a positive direction, and the negative saturation point beyond which it will not amplify any further in a negative direction.

As VR2 is adjusted back down towards the point of zero hysteresis or backlash the gain rises and the two saturation points approach closer together until a point of very high gain is reached, and as VR2 is adjusted beyond this, two trigger-points appear, and we have our Schmitt effect again!"

HIGH GAIN

"It is fascinating to think that you can obtain enormously high gain from a couple of cheap transistors in such a simple circuit!" The Prof. observed, and whilst Bob and Maurice were contemplating the possibilities of this for all sorts of oscilloscopes, amplifiers and signal detectors, the Prof. walked off with the electric guitar which Bob had been using to test his Schmitt trigger fuzz circuit!

A few moments later their contemplations were interrupted by some extraordinary guitar sounds which, although very fuzzy, seemed to be also extraordinarily rich and full in tonal character.

SPLITTER BOX

It was Tom, playing the guitar through a number of fuzz boxes all at once. The guitar was plugged into a signal splitter box from which a number of jack leads took the signal to the various fuzz boxes, each of which was plugged into a different amplifier.

There were both valve amplifiers and transistor amplifiers, so that "valve sound" was mixed with "transistor sound" and together with the different effects of the various fuzz boxes this contributed to the extraordinarily rich and full sound of the guitar which Tom was happily playing.

"Now with many fuzz box circuits the main problem is circuit noise. They produce just the sound the guitarist wants whilst he is playing, but during any pause or quiet spot in the music a loud hiss can be heard. This can be remedied by a circuit known as a "noise drive gate" whose function is to act as an attenuator, preventing the passage of this annoying hiss when the guitarist is not playing.

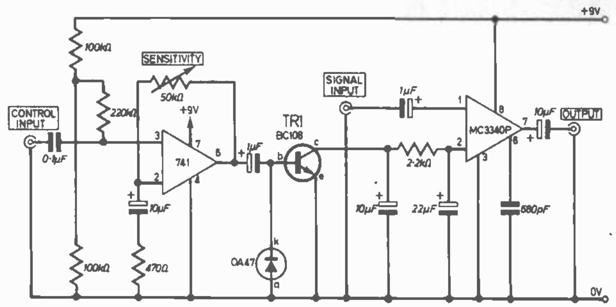


Fig. 2. Noise drive gate circuit.

The attenuator circuit will open its "gate" to let the sound through whilst the guitarist is playing, then quickly shut it again to cut out the hiss when he is not playing. Many commercial noise-drive gates are expensive, but here is a circuit (Fig. 2) which can easily be built in a very small space and will fit into most fuzz boxes. The CONTROL INPUT of the noise gate is derived from the first or second pre-amplifier stage of the fuzz box; a suitable connection point can easily be found on most fuzz boxes, usually at the collector of the transistor.

From this CONTROL INPUT signal the circuit, after adjustment of the SENSITIVITY control, will very rapidly detect whether or not the guitar is playing, and the attenuator circuit then quickly either shuts off or lets through the signal."

To be continued

BOOK REVIEWS

ELECTRONICS—LEVEL 3

Author B. F. Gray
Price £4·95
Size 215 × 140mm 201 pages
Publisher Longman
ISBN 0 582 41135 1

Ask any student what he wants out of a textbook and he will probably tell you that it should be clearly written, well set out, contain few irrelevancies and of course be inexpensive. In an already overcrowded market such as educational publishing, mistakes can be very costly, although in this case the author has avoided most of the major pitfalls.

This is the last in a series of three electronics texts and is written specifically for students studying the TEC Level III Electronics syllabus. However other readers who are fascinated by the theory behind many of their favourite projects need not be put off, as good presentation and a well thought out text make even the more extreme parts palatable.

Topics covered include f.e.t.s, voltage amplifiers, noise, feedback, oscillators and op-amps, and the book closes with a chapter on the ubiquitous microprocessor. Worked examples are included at all stages and only a rudimentary mathematical knowledge is assumed.

S.E.D.

MICROPROCESSORS FOR HOBBYISTS

Author Ray Coles
Price £2·95 (Limp Covers)
Size 230 × 155mm 85 pages
Publisher Newnes Technical Books
ISBN 0 408 00414 2

This is a very good introduction to the microprocessor, that chip which yesterday was an esoteric subject but is now part of everyday technology. It is based on a series of articles published in Practical Electronics three years ago—and one of the first comprehensive popular technical accounts of the microprocessor to be written for the non-professional.

It says much for Mr Coles early perceptivity of (1) the microprocessor's potential power and influence and (2) the bewilderment this new development would cause to non-experts that his text is just as fresh and relevant today. It deserves the more permanent form and the chance to reach an even wider readership that this new presentation now affords.

The MPU chip, programming techniques, and peripheral chips are explained. Then come sections on home computers and software which will be valuable to the would-be computer owner. The extensive glossary explains those buzz terms peculiar to the world of microelectronics and computing.

Written primarily for the electronics enthusiast, the book will also be of assistance to the non-electronics person who is interested in computing but wishes also to obtain an insight into what lies behind the keyboard.

F.E.B.

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4011	20p	4040	110p	4093	50p
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AC128	16p	BCY72	14p	ZTX300	16p
AC176	18p	BD131	35p	ZTX500	16p
AD161	38p	BD132	35p	2N3053	18p
AD162	38p	BD139	35p	2N3054	50p
BC107	8p	BD140	35p	2N3055	50p
BC108	8p	BFY50	15p	2N3442	135p
BC108C	10p	BFY51	15p	2N3702	8p
BC109	8p	BFY52	15p	2N3704	8p
BC109C	10p	MJ2955	98p	2N3706	9p
BC147	7p	MPSA06	20p	2N3819	15p
BC148	7p	MPSA56	20p	2N3905	8p
BC177	14p	TIP29C	60p	2N3906	8p
BC178	14p	TIP30C	70p	2N5459	32p
BC182	10p	TIP31C	65p	2N5777	50p
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BC184	10p				
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1N4148 — £1.40/100.

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		7473	20p	74145	55p
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7404	12p	7486	20p	74157	40p
7408	12p	7490	25p	74164	55p
7410	10p	7492	30p	74165	55p
7413	22p	7493	25p	74174	55p
7414	39p	7496	45p	74177	50p
7420	12p	74121	25p	74190	50p
7430	12p	74123	38p	74191	50p
7432	18p	74125	35p	74192	50p
7442	38p	74126	35p	74193	50p
7447	45p	74132	45p	74196	50p
7448	50p	74141	55p	74197	50p

FULL DETAILS IN CATALOGUE!

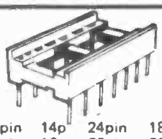
OPTO

LED's	0.125in.	0.2in	each	100+
Red	TIL209	TIL220	9p	7.5p
Green	TIL211	TIL221	13p	12p
Yellow	TIL213	TIL223	13p	12p
Clips	3p	3p		

DISPLAYS

DL704	0.3 in CC	130p	120p
DL707	0.3 in CA	130p	120p
FND500	0.5 in CC	100p	80p

SKTS



Low profile by Texas

8pin	8p	18pin	14p	24pin	18p
14pin	10p	20pin	16p	28pin	22p
16pin	11p	22pin	17p	40pin	32p

3 lead TO18 or TO5 socket. 10p each
Soldercon pins: 100:50p 1000:370p

PCBS

VEROBOARD

Size in.	0.1in.	0.15in.	
2.5 x 1	14p	–	Vero Cutter 80p.
2.5 x 3.75	45p	45p	
2.5 x 5	54p	54p	Pin insertion tool 108p
3.75 x 5	64p	64p	
3.75 x 17	205p	185p	
Single sided pins per 100	40p	40p	

Top quality fibre glass copper board. Single sided. Size 203 x 95mm. 60p each.
'Dalo' pens. 75p each.
Five mixed sheets of Alfac. 145p per pack.

RESISTORS

Carbon film resistors. High stability, low noise 5%.
E12 series. 4.7 ohms to 10M. Any mix:

	each	100+	1000+
0.25W	1p	0.9p	0.8p
0.5W	1.5p	1.2p	1p

Special development packs consisting of 10 of each value from 4.7 ohms to 1 Meg-ohm (650 res) 0.5W £7.50. 0.25W £5.70.

METAL FILM RESISTORS

Very high stability, low noise rated at ¼w 1%. Available from 51ohms to 330k in E24 series. Any mix:

	each	100+	1000+
0.25W	4p	3.5	3.2

POTENTIOMETERS

Preset vertical or horizontal 100ohms – 1M . . . 6p
Rotary 5K-2M2 Log or Lin single . 28p
Rotary 5K-2M2 Log or Lin double 80p
Slide 60mm travel 5K-500K Log or Lin, single . . . 60p
Suitable knobs for above with coloured caps in red, blue, green, grey, yellow and black. Rotary controls 14p each. Slide type 12p each.

CAPACITORS

POLYSTYRENE

High quality foil type. 63V working, 5% tol.
22pf to 1000pf . . . . 6p each
1500pf to 0.01uF . . . . 8p each

TANTALUM BEAD

each

0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 & 2.2uF @ 35V 8p
4.7, 6.8, 10uF @ 25V 13p
22 @ 16V, 47 @ 6V, 100 @ 3V . . . 16p

MYLAR FILM

0.001, 0.01, 0.022, 0.033, 0.047 . . . 3p
0.068, 0.1 . . . . 4p

POLYESTER

Mullard C280 series
0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1. 5p
0.15, 0.22 . . . . 7p
0.33, 0.47 . . . . 10p
0.68 . . . . 14p
1.0uF 17p

CERAMIC

Plate type 50V. Available in E12 series from 22pF to 1000pF and E6 series from 1500pF to 0.047uF 2p

MINIATURE TRIMMERS

Miniature film type, in 1.4pF – 5pF, 2pF – 22pF, 2pF – 22pF, 2pF – 10pF, 5.5pF – 65pF. 18p each

RADIAL LEAD ELECTROLYTIC

63V	0.47 1.0 2.2 4.7 10	5p
	22 33 47	7p
	100	13p
	220	20p
25V	10 22 33 47	5p
	100	8p
	220	10p
	470	15p
	1000	23p

CONNECTORS

JACK PLUGS AND SOCKETS

	unscreened	screened	socket
2.5mm	9p	13p	7p
3.5mm	9p	14p	8p
Standard	16p	30p	15p
Stereo	23p	36p	18p

DIN PLUGS AND SOCKETS

	plug	chassis socket	line socket
2pin	7p	7p	7p
3pin	11p	9p	14p
5pin 180°	11p	10p	14p
5pin 240°	13p	10p	16p

1mm PLUGS AND SOCKETS

Suitable for low voltage circuits, Red & black.
Plugs: 6p each Sockets: 7p each.

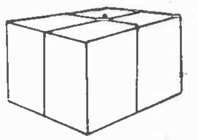
4mm PLUGS AND SOCKETS

Available in blue, black, green, brown, red, white and yellow. Plugs: 11p each Sockets: 12p each

PHONO PLUGS AND SOCKETS

Insulated plug in red or black 9p
Screened plug 13p
Single socket . 7p Double socket . 10p

SPRING SPECIALS



Set of 4 AA (HP7) Rechargeable Cells	~~500p~~	450p
PP3 Rechargeable cell	~~450p~~	410p
Pack of 10 miniature slide switches	~~150p~~	120p
Pack of 10 push to make switches	~~150p~~	120p
Pack of 10 push to break switches	~~200p~~	150p
Murata Ultrasonic Transducers, per pair	~~350p~~	300p
Resistor Development packs. 10 off, each value from 4.7 ohm to 1M ¼w	~~570p~~	500p
½w	~~750p~~	650p
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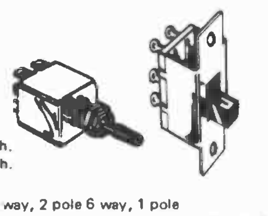
Ceramic Development pack 10 off, each value 22pF to 0.1uF, 310 caps.	~~595p~~	525p
LED pack, 10 off, each type 0.2 Red, green, yellow	~~350p~~	300p
Pack of 10 CA3080 Transconductance amps.	~~700p~~	620p
Pack of 10 LM301AN Op. amp.	~~260p~~	230p
Pack of 10 LM380N 2W Audio Amp	~~750p~~	620p
LM380 +LM381 and data	~~235p~~	180p
Pack of 3 LM3909 LED flasher	~~185p~~	150p
Pack of 10 TL081 Jfet Op. amp.	~~450p~~	320p
MM57160 Stac. Timer + data	~~600p~~	550p
SN76477 Sound generator + data	~~240p~~	200p
Pack of 2 ZN414 AM chips	~~160p~~	130p
SS-2 Breadboard	~~1085p~~	990p
Expo Reliant Drill	~~665p~~	570p
Expo Titan Drill	~~1030p~~	920p
Drill stand for above	~~1200p~~	1100p
Pack of 8 2708 Eprom	~~4720p~~	4500p
Pack of 8 2114 Ram LP 300ns	~~3125p~~	3000p
Pack of 8 4116.	~~4560p~~	4300p

SWITCHES



TOGGLE

Subminiature toggle. Rated at 2A.
SPST 52p. SPDT 62p. DPDT 69p.
Standard type. Rated at 1.5A.
SPST 34p. DPDT 48p.

SLIDE

Miniature	DPDT	15p each.
Standard	DPDT	15p each.

ROTARY

Available in 4 pole 3 way, 3 pole 4 way, 2 pole 6 way, 1 pole 12 way . . . . 43p each
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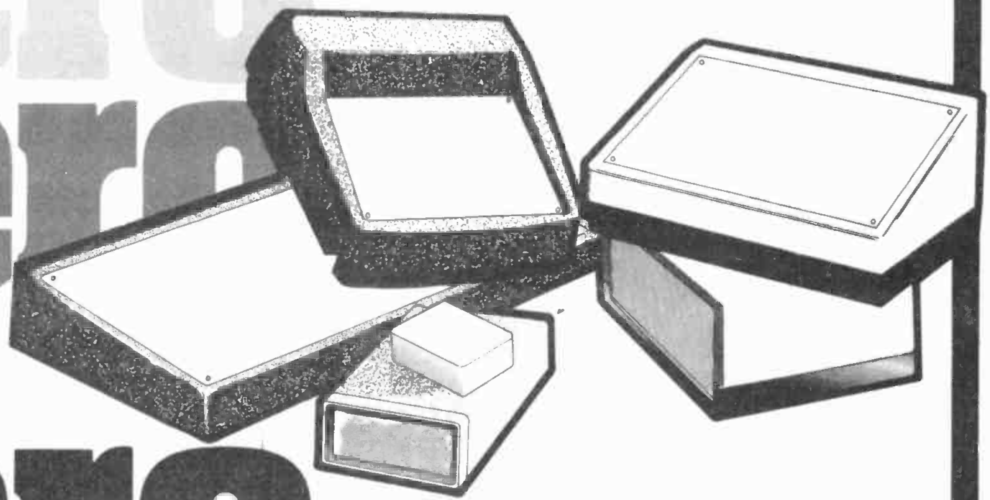

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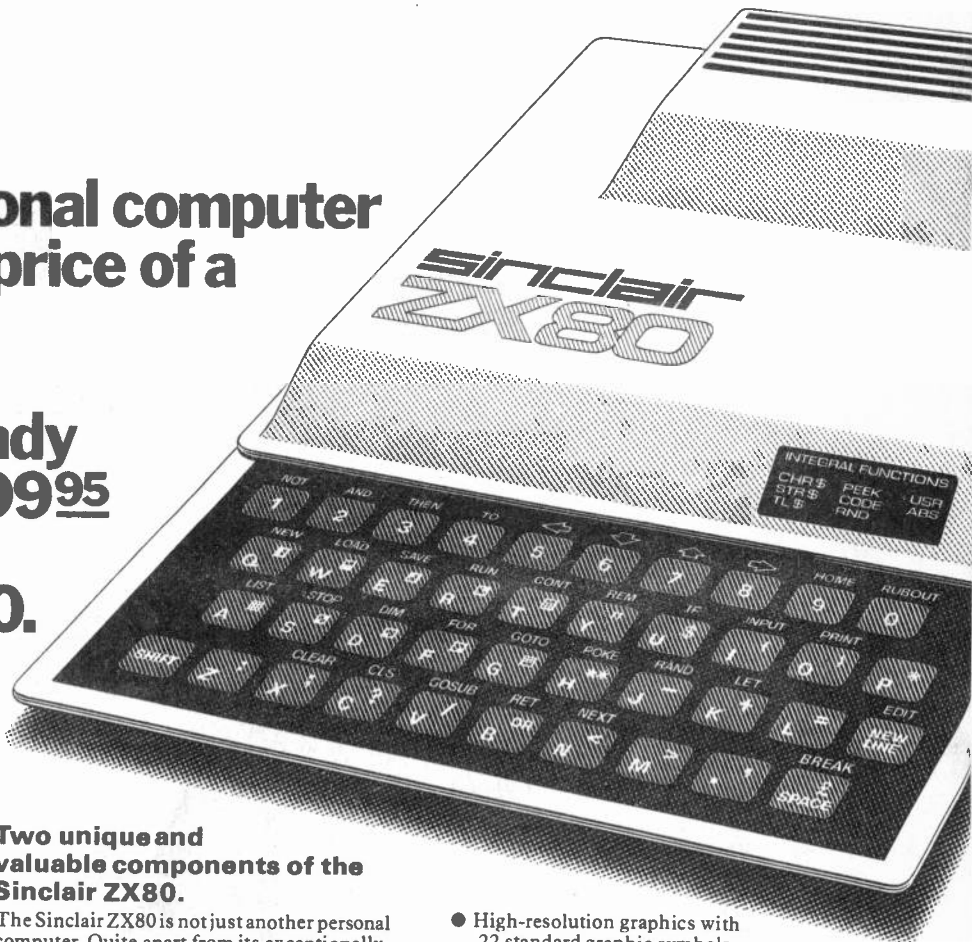

A complete personal computer for a third of the price of a bare board.

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The Sinclair ZX80.

Until now, building your own computer could easily cost around £300 – and still leave you with only a bare board for your trouble.

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Your ZX80 kit contains...

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- Complete components set, including all ICs – all manufactured by selected world-leading suppliers.
- New rugged Sinclair keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to any portable cassette recorder (to store programs) and domestic TV (to act as VDU).
- FREE course in BASIC programming and user manual.

Optional extras

- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately – see coupon).
- Additional memory expansion board plugs in to take up to 3K bytes extra RAM chips. (Chips also available – see coupon.)

*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon).

Two unique and valuable components of the Sinclair ZX80.

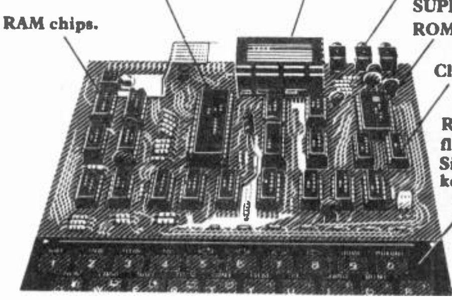
The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter... offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input – to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

...and the Sinclair teach-yourself BASIC manual.

If the features of the Sinclair interpreter listed alongside mean little to you – don't worry. They're all explained in the specially-written 96-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. (Available separately – purchase price refunded if you buy a ZX80 later.)



lete computer kit.

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The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed onto fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer, because the ZX80's brilliant design packs the RAM so much more tightly. (Key words, for instance, occupy just a single byte.)

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The Sinclair ZX80. Kit: £79.95. Assembled: £99.95. Complete!

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	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
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4028	45p
4029	60p
4030	20p
4033	80p
4034	150p
4035	50p
4037	90p
4040	55p
4041	45p
4042	40p
4043	30p
4044	50p
4046	75p
4048	50p
4049	26p
4050	26p
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4053	45p
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7411	15p	18p
7412	15p	
7413	15p	30p
7414	45p	65p
7416	16p	
7417	24p	
7420	10p	16p
7426	15p	
7427	15p	
7430	10p	16p
7432	12p	18p
7437	12p	20p
7438	13p	25p
7440	12p	22p
7441	52p	
7442	26p	45p
7443	42p	
7444	42p	
7445	42p	
7446	42p	
7447	46p	68p
7448	42p	48p
7450	13p	
7451	13p	20p
7453	13p	
7454	13p	16p
7460	13p	
7470	26p	
7472	24p	
7473	16p	28p
7474	19p	25p
7475	26p	40p
7476	25p	30p
7480	35p	
7481	60p	
7482	45p	
7483	45p	58p
7485	60p	68p
7486	20p	30p
7489	99p	
7490	29p	40p
7491	49p	
7492	29p	
7493	28p	40p
7494	69p	
7495	45p	62p
7496	48p	
74100	79p	
74107	19p	32p
74121	22p	
74122	35p	
74123	35p	55p
74125	30p	40p
74126	29p	40p
74132	44p	60p
74141	49p	
74150	53p	
74151	39p	49p
74153	45p	49p
74154	65p	120p
74156	39p	78p
74157	39p	45p
74161	49p	75p
74163	49p	79p
74164	55p	75p
74165	59p	
74166	69p	
74175	55p	58p
74176	49p	
74180	60p	
74181	125p	
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74190	69p	78p
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·47uF & ·56uF	9p
·68uF	11p

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8 pin	7·5p
14 pin	9·0p
16 pin	10·0p

Solder con pins 100 40p

8083 Function Generator for MARCH project £2·20

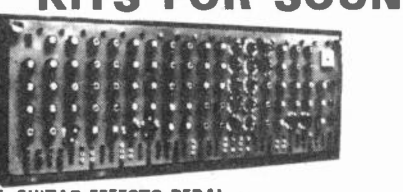
CAPACITORS:—
ELECTROLYTIC. RADIAL LEAD

Values	16V	40V	63V
1uF	3p	3p	3p
2·2uF	3p	3p	3p
3·3uF	3p	3p	3p
4·7uF	3p	3p	3·5p
10uF	3p	3·5p	4·5p
22uF	3p	4p	5·5p
33uF	3·5p	4·5p	5·5p
47uF	4p	5p	6·5p
68uF	6·5p	7p	7·5p
100uF	4·5p	8p	9p
150uF	7p	9p	11p
220uF	6p	10p	14p
330uF	7·5p	14p	16p
470uF	8p	16p	20p
680uF	11p	20p	25p
1000uF	12p	21p	34p
2200uF	22p	42p	—

TRANSISTORS:—

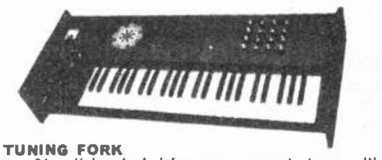
	Standard	A	C
TIP 29	27p	30p	40p
TIP 30	32p	35p	40p
TIP 31	32p	35p	41p
TIP 32	38p	40p	45p
TIP 41	50p	52p	58p
TIP 42	45p	48p	59p
2N3055 (TO3)			33p
2N3054			33p
BC108			7p
BC107			7p
BC184L			5p

KITS FOR SOUND EFFECTS AND OTHER PROJECTS



PHONOSONICS

DEPT EE83, 22 HIGH STREET,
SIDCUP, KENT DA14 6EH



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Basic parts with panel switches — KIT 42-2 — £5·55
PCB & layout chart — PCB 42A — £1·57
Text photocopy — ·28

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PCB & layout chart — PCB 56A — £1·78
Text photocopy — ·68

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P.E. AUTO-WAH UNIT
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Basic comps, panel switches, PCB & chart — KIT 58-2 — £5·31
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P.E. THREE-CHANNEL SOUND-TO-LIGHT
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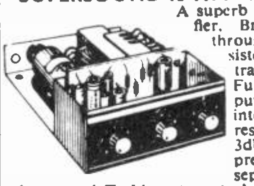

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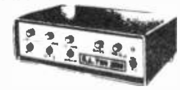

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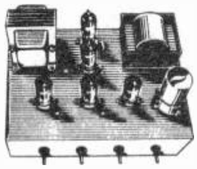

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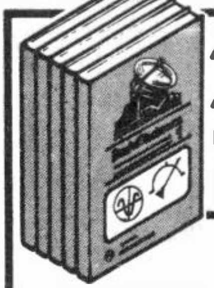

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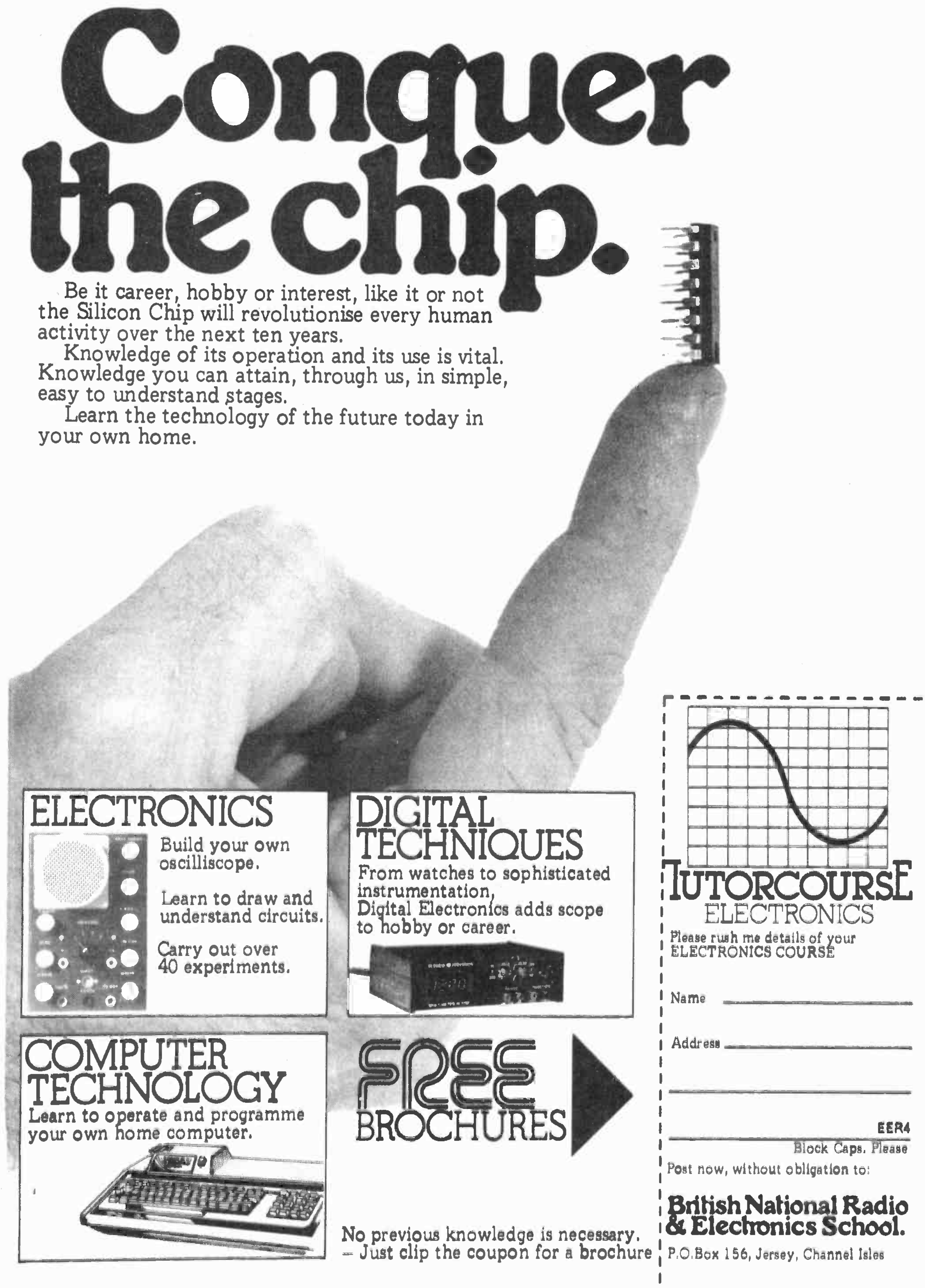
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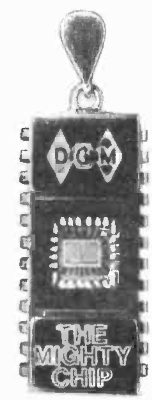

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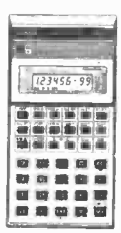

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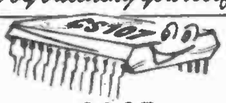

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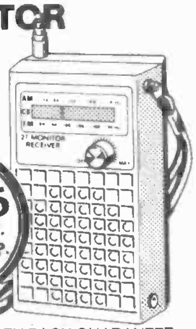

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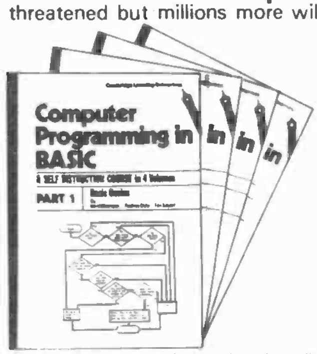

Book1 Computers and what they do well; READ, DATA, PRINT, powers, brackets, variable names; LET; errors; coding simple programs.
Book 2 High and low level languages; flowcharting; functions; REM and documentation; INPUT, IF....THEN, GO TO; limitations of computers, problemn definition.
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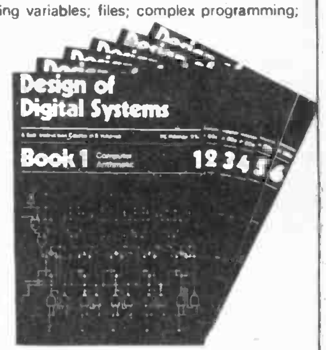

Book 1 Octal, hexadecimal and binary number systems; conversion between number systems; representation of negative numbers; complementary systems.
Book 2 OR and AND functions; logic gates; NOT, exclusive-OR, NAND, NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws; canonical forms; logic conventions; karnaugh mapping; three state and wired logic.
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Book 5 Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding.
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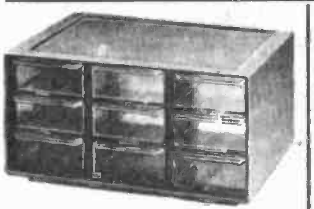

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If bought individually parts plus case would cost over £47 but we are offering this for ONLY £31·95 + £1 p & p.
Simply send a cheque or P/O for £32·95 for immediate despatch.

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70	Mylar Capacitors
50	Polyester Capacitors
56	Electrolytic Capacitors
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Altogether 614 components.
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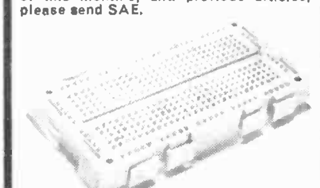
Now contains 200 sq. ins. copper clad board, 1lb. Ferric Chloride, DALO etch-resist pen, abrasive cleaner, two miniature drill bits, etching dish and instructions. £4·95

KITS OF BITS FOR EE PROJECTS

We supply parts for nearly all EE projects—for a detailed components list of this month's, and previous articles, please send SAE.



VEROBLOC BREADBOARD

New from Vero, this versatile aid for building and testing circuits can accommodate any size of IC. Blocs and be joined together. Bus strips on X & Y axis—total 360 connexion points for just £3·70.

VU METERS

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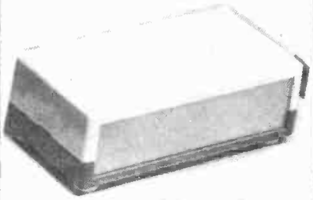

VEROCASE SALE!!

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We are again supplying all parts required for this major series which started last October. The price for all the Tutor Deck parts is £19·50. Also supplied *without* breadboard for £13·50. The price for the additional components required for Parts 1-6 is £2·00 and Parts 7-12 is £3·00. All prices include VAT and Postage. Reprints of parts 30p per month

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Ref	Amps	Price	P & P
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3	2·0	6·35	1·10
20	3·0	6·82	1·31
21	4·0	8·79	1·31
51	5·0	10·86	1·52
117	6·0	12·29	1·67
88	8·0	16·45	1·89
89	10·0	18·98	1·89
90	12·0	21·09	2·24
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152	250	14·61	1·73
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213	1·0	0·5	2·90	0·90
71	2	1	3·86	0·90
18	4	2	4·46	1·10
85	0·5	2·5	6·16	1·10
70	6	3	6·99	1·10
108	8	4	8·16	1·31
72	10	5	8·93	1·31
116	12	6	9·89	1·52
17	16	8	11·79	1·37
115	20	10	15·38	2·39
187	30	15	19·72	2·39
226	60	30	40·41	O.A.

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207	500, 500	0-8-9, 0-8-9	3·05	·85
208	1A, 1A	0-8-9, 0-8-9	3·88	·90
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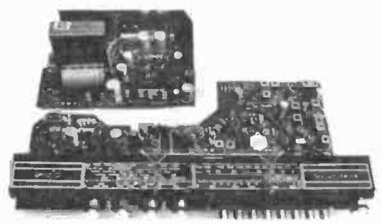

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