Easy to build projects for everyone

Everyday ELECTRONICS

JAN. 80
45p

FREEZE-UPS • BURSTS • FLOODS
PROTECT YOUR HOME WITH THE
EE LOFT ALERT

SPRING-LINE REVERB UNIT

MAINS ON/OFF TIMER

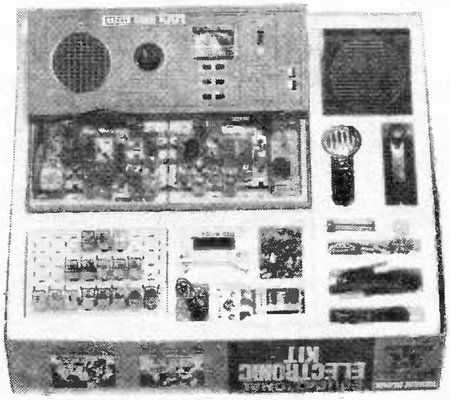
RADIO CONTROL RECEIVER

Australia 85c South Africa 85c New Zealand 95c Malaysia $2·75

ELECTRONI-KIT

DENSHI KITS—

SPECIAL OFFER



" . . . fun and entertainment as well as education"—

(EVERYDAY ELECTRONICS mag.)

The SR-3A kit (over 100 circuits) and the SR-3A de luxe kit (over 105 circuits) are available again, at little more than their 1977 prices

Circuits are constructed by plugging the encapsulated components into the boards provided, following the instruction manual. Technical details are also given concerning each project. The components are used over and over again and you can design your own circuits too, or use the kit as a useful testing board.

No previous experience of electronics is required but you learn as you build—and have a lot of fun too. The kits are safe for **anyone**.

SR-3A KIT £29·95

(16½×10×2½")

Build over 100 projects including 3-TR reflex radio receiver, 3-TR radio receiver with RF amplifier, 2-TR reflex radio receiver, 3-TR amplifier for crystal mike, 3-TR amplifier for speaker/mike, 3-TR signal tracer, Morse Code trainer, 2-TR electronic organ, electronic metronome, electronic bird, electronic cat, electronic siren, electronic gun, 2-TR sleeping aid, high voltage generator, discontinuity warning device, water supply warning device, photoelectric alarming device, 3-TR burglar alarm, 3-TR water supply warning device, 3-TR water level warning device, 3-TR photoelectric alarming device, Morse Code trainer with sound & light, discontinuity warning device with sound & light, water level warning device with sound & light, electronic metronome with sound & light, buzzer with sound & light, wireless mike, wireless telegraph set, wireless discontinuity warning device, wireless water level warning device, wireless water supply warning device, wireless photoelectric warning device etc. etc.

SR-3A de luxe KIT £39.95

(illustrated 16×14×3½")

Similar to SR-3A, more components including solar cell and additional Speaker unit plus sophisticated control panel.

All kits are guaranteed and supplied complete with extensive construction manuals **PLUS** Hamlyn's "All colour" 160 page book "Electronics" (free of charge whilst stocks last).

Prices include batteries, educational manuals, free book, VAT, p&p (in the UK), free introduction to the British Amateur Electronics Club.

Cheque/P.O./Access/Barclaycard (or 16p. for illustrated literature) to DEPT. EE.

ELECTRONI-KIT LTD.
RECTORY COURT, CHALVINGTON,
E.SUSSEX, BN27 3TD (032 183 579)

ELECTRONIC BOOKS

Ref.	Title	Price
126	BOYS BOOK OF CRYSTAL SETS	25p
200	HAND BOOK OF PRACTICAL ELECTRONIC MUSICAL NOVELTIES	50p
202	HANDBOOK OF IC EQUIVALENTS AND SUBSTITUTES	100p
207	PRACTICAL ELECTRONIC SCIENCE PROJECTS	75p
208	PRACTICAL STEREO AND QUADROPHONY HANDBOOK	75p
218	BUILD YOUR OWN ELECTRONIC EXPERIMENTERS LABORATORY	85p
221	28 TESTED TRANSISTOR PROJECTS	85p
222	SOLID STATE SHORT WAVE RECEIVERS FOR BEGINNERS	95p
224	50 CMOS IC PROJECTS	95p
225	A PRACTICAL INTRODUCTION TO DIGITAL ICs	95p
226	HOW TO BUILD ADVANCED SHORT WAVE RECEIVERS	120p
227	BEGINNERS GUIDE TO BUILDING ELECTRONIC PROJECTS	125p
RCC	RESISTOR COLOUR CODE DISC CALCULATOR	20p
BP1	FIRST BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES	60p
BP7	RADIO AND ELECTRONIC COLOUR CODES AND DATA CHARTS	25p
BP14	SECOND BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES	110p
BP25	HOW TO BUILD YOUR OWN ELECTRONIC WATCHES AND QUARTZ CONTROLLED CLOCKS	85p
BP32	HOW TO BUILD YOUR METAL AND TREASURE LOCATORS	95p
BP43	HOW TO MAKE WALKIE-TALKIES	125p
BP48	ELECTRONIC PROJECTS FOR BEGINNERS	135p
BP56	ELECTRONIC SECURITY DEVICES	150p
BP57	HOW TO BUILD YOUR OWN SOLID STATE OSCILLOSCOPE	150p
BP58	50 CIRCUITS USING 7400 SERIES ICs	135p
BP59	SECOND BOOK OF CMOS ICs PROJECTS	150p
BP61	BEGINNERS GUIDE TO DIGITAL TECHNIQUES	95p

Please add 20p p & p per book. No VAT on books. Send SAE for full list of Babani Books

DIL SOCKETS

8 pin	10p	20 pin	26p
14 pin	11p	24 pin	30p
16 pin	12p	28 pin	40p
18 pin	24p	40 pin	51p

IC INSERTION/EXTRACTION TOOL 50p

ANTEX SOLDERING IRONS

C-15W	380p
CCN-15W	400p
CX-17W	400p
X25	400p
C-15W Kit	570p
Spare Bits	50p
Stand	160p

VERO-BOARDS

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
S.F. Cutter	85p

TRANSISTORS

AC126/7	20p
AC128	20p
AC176	20p
AD149	70p
AD161/2	45p
BC107/8	11p
BC109	12p
BC177/8	17p
BC178	18p
BC182/3	10p
AC184	11p
BC212/3	11p
BC214	12p
BC548	16p
BCY71/2	22p
BC131/2	50p
MPSA12	50p
TIP31A	58p
TIP32A	68p
TIP33A	90p
TIP34A	115p
TIP41A	65p
TIP42A	70p
ZTX108	12p
2N2219A	22p
2N2222A	20p
2N2369A	20p
2N2646	50p
2N2926	8p
2N3053	25p
2N3055	48p
2N3442	140p
2N3773	300p
2N3819	25p
2N3702/2	42p
2N4123	27p
2N4401	27p
2N5191	83p
2N5194	90p
2N5245	40p
2N5401	50p
2N5457/8	40p
2N5459	40p
2N6107	
2N6254	130p
2N6247	190p
2N6290	65p
40673	75p
40871/2	90p

LINEAR ICs

CA3046	70p
CA3080E	72p
CA3089E	225p
CA3090	375p
CA3140E	50p
ICL8038	340p
LF356P	95p
LM301A	36p
LM309K	135p
LM311	120p
LM324	70p
LM339	75p
LM348	95p
LM377	175p
LM380	90p
LM381AN	160p
LM710	50p
LM741	20p
LM748	35p
LM3900	70p
LM3909	100p
LM3911	130p
LM4136	120p
MC1310P	150p
MC1458	55p
MC3340P	120p
MC3360P	120p
NE531	140p
NE555	22p
NE556	70p
NE567	175p
SN76003N	175p
SN76013N	140p
SN76013ND	120p
SN76023ND	120p
SN76033N	175p
TBA641B11	225p
TBA800	100p
TBA810S	110p
TCA940E	175p
TDA1022	600p
TL072	90p
TL074	150p
TL081	48p
TL084	130p
TL082	90p
ZN414	100p
ZN425E	400p
ZN1034E	200p

TTL/CMOS

7400	15p
7401	15p
7402	15p
7403	15p
7404	17p
7408	19p
7410	15p
7413	30p
7414	60p
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
7483	90p
7486	34p
7490	33p
7489	175p
7492A	46p
7493	33p
74107	34p
74121	28p
74123	55p
74141	70p
74154	100p
74157	70p
74160	100p
74161	100p
74164	120p
74198	150p

Also full 74LS Series available

	C-MOS
4000	
4001	19p
4009	40p
4010	50p
4011	19p
4013	50p

4016	45p
4017	80p
4018	80p
4019	45p
4022	100p
4023	22p
4024	50p
4027	50p
4030	55p
4046	110p
4050	49p
4049	40p
4051	80p
4059	600p
4069	20p
4070	22p
4081	22p
4098	120p
4411	£11
4502	120p
4503	70p
4511	150p
4516	110p
4520	90p
4528	120p
4584	90p

VOLTAGE REGULATORS

1 Amp +ve Plastic	
5V	70p
8V	70p
12V	70p
15V	70p
18V	90p
24V	90p
1 Amp —ve	
5V	90p
12V	90p
15V	90p

OTHER

LM317T	200p
LM323K	600p
78H05	625p
78MGT2C	140p
LM723	37p

OPTO-ELECTRONICS

Red Leds		Displays			
0·125"	13p	DL707	130p	TIL311	600p
0·2"	14p	DL747	240p	TIL321	120p
Green		FND500	110p	TIL322	120p
0·125"	16p	FND507	110p	3015F	200p
0·2"	20p	ORP12	90p		
Clips	3p	2N5777	45p		

MULTIMETERS

Pocket Multimeter	5·00	
LT22 (20K/V)	12·00	
Microtest 80R	16·00	P & P 0·75
Supertester 680R	33·50	P & P 1·00

STABILISED POWER SUPPLY

400mA 3V 6V 7·5V 9V 5·10

EXPERIMENTOR BREADBOARDS

No soldering suitable for DIL ICs

EXP325 (1 IC up to 22 pin)	170p
EXP 300 (up to 5 × 14 pin)	575p
EXP600 (up to 1 × 40 pin)	630p
EXP350 (up to 2 × 14 pin)	3·15

ULTRASONIC TRANSDUCERS

Rx & Tx 3·45 pr.

PROTO BOARDS SOLDERLESS BOARDS

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

PB 6	6 × 14 pin DIL ICs	9·20
PB 100	10 × 14 pin DIL ICs	11·80
PB 102	12 × 14 pin DIL ICs	22·95
PB 103	24 × 14 pin DIL ICs	34·45
PB 104	32 × 14 pin DIL ICs	45·95

(The above boards are suitable for all DIL ICs)

LOGIC PROBE £18·00
LOGIC PROBE KIT £15·75

SUBMINIATURE SWITCHES (Toggle)

SPST 60p SPDT 65p DPDT 70p
Push to Make 15p Push to Break 22p
Slide DPDT 18p

LOUDSPEAKERS

2½" 8R	85p	2½" 64R	80p
1½" 8R	80p		

VAT Rate. Please add 15% to your total.
Please send SAE for full list.
CALLERS WELCOME MON–FRI 9.30–5.30
SAT 10.30–4.30

Add 30p p & p (75p p & p for official orders)

TECHNOMATIC LTD

17 BURNLEY ROAD, LONDON NW10
(2 minutes from Dollis Hill Tube)
Tel. 01-452 1500 **Tlx. 922800**

MAGENTA ELECTRONICS LTD.

E.E. PROJECT KITS

Make us **YOUR No. 1 SUPPLIER OF KITS and COMPONENTS** for E.E. Projects. We supply carefully selected sets of parts to enable you to construct E.E. projects. Project kits include **ALL THE ELECTRONICS AND HARDWARE NEEDED**—we have even included appropriate screws, nuts and I.C. sockets. Each project kit comes complete with its own **FREE COMPONENT IDENTIFICATION SHEET.** We supply—you construct. **PRICES INCLUDE CASES UNLESS OTHERWISE STATED. BATTERIES NOT INCLUDED.** IF YOU DO NOT HAVE THE ISSUE OF E.E. WHICH CONTAINS THE PROJECT—YOU WILL NEED TO ORDER THE INSTRUCTIONS/REPRINT AS AN EXTRA—39p. each.

BABY ALARM. Nov. 79 £8·20
OPTO ALARM. Nov. 79 £5·36 inc. optional ports.
MW/LW RADIO TUNER. Nov. 79 £15·50 less dial.
3 FUNCTION GENERATOR. Nov. 79 £18·44 less pointer, case extra £7·18.
ONE ARMED BANDIT. Oct 79. £18·39. case extra £3·98.
HIGH IMPEDANCE VOLTMETER. Oct. 79. £16·22.
LIGHTS ON REMINDER. Oct. 79. £4·62.
SIGNAL LEVEL INDICATOR. Oct. 79. £4·81 (stereo).
UNIVERSAL OSCILLATOR. Oct 79. £3·89.
CHASER LIGHTS. Sept. 79. £18·95.
VARICAP M.W. RADIO. Sept. 79. £8·98.
SIMPLE TRANSISTOR TESTER. Sept. 79. £6·26.
ELECTRONIC TUNING FORK Aug. 79 £8·94. Suitable microphone & plug £1·59 extra.
WARBLING TIMER. Aug. 79. £6·25
9V POWER SUPPLY Aug. 79. £9·94 inc. pcb.
SWANEE WHISTLER Aug. 79 £3·19
TOUCH ON PILOT LIGHT Aug. 79 £3·06.
QUIZ REFEREE Aug. 79. £5·81.
SOLDERING IRON BIT SAVER. July 79. £10·19.
VOLTAGE SPLITTER. July 79. £3·37.
DARKROOM TIMER. July 79. £2·41.
WATER LEVEL INDICATOR. July 79. £4·60.
TREMOLO UNIT. June 79. £10·99.
ELECTRONIC CANARY. June 79. £4·99.
LOW COST METAL LOCATOR. June 79. £5·44. Handle & coil former parts extra £4·95.
METER AMPLIFIER. June 79. £4·19.
QUAD SIMULATOR. June 79. £9·26.
INTRUDER ALARM. May 1979. £16·44. Less Ext. Buzzer & Lamp and Loop Components.
SHORT WAVE CONVERTER. May 79. £15·36 inc. cases.
THERMOSTAT. 'PHOTO' SOLUTIONS. May 79. £15·75. Less socket, tube and grease.
SHAVER INVERTER. April 79. £13·68.
TRANSISTOR TESTER. April 79. £3·83.
TOUCH BLEEPER. April 79. £3·30.
ONE TRANSISTOR RADIO. Mar. 79. with Amplifier & Headset. Less case. £6·84.
TIME DELAY INDICATOR. Mar. 79. £3·99.
VERSATILE POWER SUPPLY. Mar. 79. £8·99.
CHOKE WARNING DEVICE. Apr. 79. £7·79.
AUDIO MODULATOR. Feb. 79. £1·56 less case and pins.
LW CONVERTER. Feb. 79. £6·46.
THYRISTOR TESTER. Feb. 79. £2·99.
ADJUSTABLE PSU. Feb. 79. £25·17. Case (horizontal layout) £5·21 extra.
LIGHTS REMINDER. Jan. 79. £4·59.
CONTINUITY TESTER. Jan. 79. £4·96 less case.
FUZZ BOX. Dec. 78. £5·32.
VEHICLE IMMOBILISER. Inc. PCB. Dec. 78. 5·57.
WATER LEVEL ALERT. Nov. 78. £6·25.
"HOT LINE" GAME. Nov. 78. £4·65 less case & rod.
AUDIO EFFECTS OSCILLATOR. Nov. 78. £3·77 inc. board.
FUSE CHECKER. Oct. 78. £1·91.
C.MOS RADIO. Oct. 78. £9·32.
TREASURE HUNTER. Oct. 78. £17·86 less handle & coil former.
GUITAR TONE BOOSTER. Sept. 78. £4·78 inc. p.c.b.
SOUND TO LIGHT. Sept. 78. £6·98.
FILTER. £1·53
SLAVE FLASH. Aug. 78. £2·97 less SKt.
LOGIC PROBE. July 78. £2·53.
IN SITU TRANSISTOR TESTER. June 78. £5·76.
VISUAL CONTINUITY CHECKER. June 78. £3·60 inc. probes.
FLASHMETER. May 78. £13·11 less calc and diffuser.
POCKET TIMER. April 78. £2·98.
WEIRD SOUND EFFECTS GENERATOR. Mar. 78. £4·57.
CHASER LIGHT DISPLAY. Feb. 78. £23·59 inc. p.c.b. case extra £5·21.
AUDIO VISUAL METRONOME. Jan. 78 £4·81.
RAPID DIODE CHECK. Jan. 78. £2·34.
AUTOMATIC PHASE BOX. Dec. 77. £9·18 inc. p.c.b.
VHF RADIO. Nov. 77. £14·36.
ULTRASONIC REMOTE CONTROL. Nov./Dec. 77. £15·70.
TREASURE LOCATOR. Oct. 77. £10·61 case extra. £3·33. Less handle, etc.
ELECTRONIC DICE. March 77. £4·77.
SOIL MOISTURE INDICATOR. June 77. £4·07 inc. probe.
PHONE/DOORBELL REPEATER. July 77. £6·38.
CAR BATTERY STATE INDICATOR. Sept. 78. £1·79 less case inc. PCB.
R.F. SIGNAL GENERATOR. Sept. 78. £18·17 less case.
TRANSISTOR TESTER. Oct. 77. £7·06 case extra £3·97.
ADD-ON CAPACITANCE UNIT. Sept. 77. £5·90.
A.F. SIGNAL GENERATOR. Aug. 78 less dial. £12·12.
QUAGMIRE. July 78. £8·23 less case pins & counters.
CATCH-A-LIGHT. Mar. 78. £8·04.
CAR SYSTEM ALARM. Feb. 78. £5·97.
HEADPHONE ENHANCER. Jan. 79. £2·60.
PASSIVE MIXER. Oct. 78. £3·72.
MIC AMP. Dec. 78. £2·80.
AUDIBLE FLASHER, Dec. 78. £1·21.

LATEST KITS: S.A.E. OR 'PHONE FOR PRICES

3 BAND SHORT WAVE RADIO

Simple trf design covering 1·2-24MHz. **Covers most amateur bands and short wave broadcast bands.** Five controls-bandset, bandspread, reaction, wavechange and attenuator. Uses an internal 9v battery—very low current consumption. The 3 coils are all mounted on the pcb—selection is by a wavechange switch. Use with headphones or a crystal earpiece. **Kit contains all the components required including the pcb and case.** Instructions are included with this kit. Headphones are not included—we recommend our high impedance mono headphones.

KIT £18·97 **HEADPHONES EXTRA £3·28.**

1980 ELECTRONICS CATALOGUE

MAGENTA'S CATALOGUE HAS BEEN CAREFULLY DESIGNED FOR E.E. READERS. PRODUCT DATA AND ILLUSTRATIONS MAKE THE MAGENTA CATALOGUE AN INDISPENSABLE GUIDE FOR THE CONSTRUCTOR. CATALOGUE INCLUDES CIRCUIT IDEAS FOR YOU TO BUILD. NO MINIMUM ORDER—ALL PRODUCTS ARE STOCK LINES. FIRST CLASS DELIVERY OF FIRST CLASS COMPONENTS. SEND FOR YOUR COPY AND SEE HOW EASY IT IS TO USE THE MAGENTA CATALOGUE! WRITE TODAY ENCLOSING 5 × 10p STAMPS.

MAGENTA ELECTRONICS LTD.

EN12, 98 CALAIS ROAD, BURTON-ON-TRENT, STAFFS., DE13 OUL. 0283-65435. 9-12, 2-5 MON.-FRI.

OFFICIAL ORDERS FROM SCHOOLS, UNIVERSITIES ETC. WELCOME. MAIL ORDER ONLY.

ALL PRICES INCLUDE 15% VAT AND FIRST CLASS POST. ADD 30p TO ORDERS UNDER £10 ENQUIRIES MUST INCLUDE S.A.E.

MAGENTA gives you **FAST DELIVERY BY FIRST CLASS POST OF QUALITY COMPONENTS & KITS.** All products are stock lines and are new & full specification. We give personal service & quality products to all our customers—**HAVE YOU TRIED US?**

ONE-ARMED BANDIT

Oct 79

Complete with 0·2″ LED's and all components. **£18·39.** Case extra **£3·98**

CHASER LIGHTS

Sept 79

Complete kit — with Case, plugs and sockets etc. **£18·95**

G. P. POWER SUPPLY

Feb 79

0-20V 0-1A. Variable with calibrated VOLTMETER and AMMETER

All components and Hardware **£25·17.**

Case (horizontal & layout) **£5·21** extra.

DOING IT DIGITALLY

Complete kit of top quality components as specified by EVERYDAY ELECTRONICS. Kit comes complete with free component identification sheets.
TTL TEST BED £28·84.
FIRST 6 months **COMPONENTS** £4·98.
COMPONENTS FOR PARTS 7, 8, 9 & 10 £10·98 includes: photocells I.C.'s, Resistors, Capacitors, thermistors, microphone, speaker, presets etc.
PART 11 £2·73. **PART 12** £3·19.
Reprints:—Part 1—78p others 39p each.

LOW COST METAL LOCATOR

E.E. June 79
WE HAVE MADE UP A *COMPLETE* HARDWARE KIT FOR THIS PROJECT, WITH HANDLE, COIL FORMER and SCREWS etc.
Everything you need for the project, including electronics and case **£10·39.**
Or separately:
Electronics & Case **£5·14.**
Hardware Kit **£4·95.**

TEACH IN 80

NEW SERIES—ALL COMPONENTS IN STOCK NOW FOR FAST DELIVERY. All top quality components as specified by Everyday Electronics. Out kit comes complete with **FREE COMPONENT IDENTIFICATION SHEET.** Follow this educational series and learn about electronics—Start today! **SEND £22·95 for the TUTOR DECK and ADDITIONAL COMPONENTS parts 1-6.** All orders sent by **FIRST CLASS POST.** Out kit contains all these parts:—

TUTOR DECK: METER, BREADBOARD, TRANSFORMER LEDS, POTENTIOMETERS, SWITCHES, SPEAKER, PLUGS, SOCKETS, BATTERY CLIPS, WIRE, CABLE, FUSES, FUSE-HOLDERS, KNOBS. **ADDITIONAL COMPONENTS. PARTS 1-6,** RESISTORS, PHOTOCELL, DIODES, CAPACITORS.

CASE WOODWORK KIT £4·98 extra. Complete kit for tutor deck woodwork, contains all the softwood, hardboard, ramin, panel pins, adhesive, screws, feet, strap-handle, and fixings. Cut to size and ready to assemble.

IDEAL SOLDERING EQUIPMENT FOR THE TEACH IN AND ELECTRONICS

ANTEX X25 SOLDERING IRON 25W **£4·98**
SOLDERING IRON STAND **£2·03**
SPARE BITS. Small. Standard, Large. **65p** each.
SOLDER. Handy size **78p.**
DESOLDER BRAID **69p**
HOW TO SOLDER BOOKLET **12p**
HEAT SINK TWEEZERS **15p.**
SOLDER BOBBIN **30p**
DESOLDER PUMP **£6·98**

SWING STORAGE DRAWERS £5·98.
MULTIMETER TYPE 3 100,000 o.p.v. with transistor tester ranges £39·95.
WIRELESS INTERCOM 2 STATION £42·95.
SIREN. 12V £5·95.
P.C.B. ASSEMBLY JIG. £11·98.
P.C.B. ETCHING KIT. £4·98.
A.M.-F.M. AIRCRAFT BAND PORTABLE RADIO £10·95.
WIRE STRIPPERS & CUTTERS £2·21.
ULTRASONIC TRANSDUCERS. £5·50 pair.
P.A. MICROPHONE coiled lead & switch £4·68.
STEREO MICROPHONE PAIR £10·95.
MULTIMETER TYPE 1. 1,000 o.p.v. with probes. 2″ × 3½″ × 1″. £6·98.
MULTIMETER TYPE 2. 20,000 o.p.v. with case and probes. 5″ × 3½″ × 1½″. £14·25.
F.M. INDOOR AERIAL. 57p.
TELESCOPIC AERIAL. 120 c.m. £2·08.
TELEPHONE PICK-UP COIL. 72p.
CRYSTAL MICROPHONE INSERT. 58p.
SPEAKERS MINIATURE. 8 ohm 87p. 64 ohm 98p. 80 ohm £1·28
PILLOW SPEAKER. 8 ohm 98p.
6″ ROUND SPEAKER. 8 ohm, 5W. £2·28.
CABINET SPEAKER. 8 ohm, 5W. 5″ speaker. Cabinet 10″ × 7″ × 4″. £6·75.
RE-ENTRANT HORN SPEAKER. 8 ohm S.W. Horn dia. 5½″. £5·27.
EARPIECES. Crystal 48p. Magnetic 18p.
STETHOSCOPE ATTACHMENT. Fits our earpieces 69p.
BUZZER. 6V 82p. 12V 85p.
MONO HEADPHONES. 2K. Padded. Superior. Sensitive. £3·28.
STEREO HEADPHONES. 8 ohm. Padded. £4·35.
INTERCOM. 2 Station. Desk. £7·48.
MICROPHONE DYNAMIC. 600 ohm. Cassette type. £1·38.
DENTISTS MIRROR. Adjustable. £2·44.
JEWELLERS EYEGLASS. £1·08p
TRIPLE MAGNIFIER. £1·63.
HAND MAGNIFIER. 3″ Lens. £3·43.
SPECTACLE MAGNIFIER. Clips on to spectacle frame. £4·65
ILLUMINATED MAGNIFIERS. 1½″ lens £1·10. 3″ lens £2·98.
POCKET TOOL SET. 20 piece. £4·09.
SCREWDRIVER SET. Six piece. £2·18.
Q MAX PUNCH. ⅜″ £2·14. ½″ £2·39. ⅝″ £2·41. ¾″ £2·50.
DRILL 12V. Hand or stand use. £10·95. Stand £6·88.
CAPACITANCE SUBSTITUTION BOX. Nine values, 100pF—0·22uF. £2·98.
QUICKTEST. Mains connector. £6·41.
PLUG IN POWER SUPPLY. 6, 7·5-9V d.c. 300mA. £4·05.
SPRINGS—SMALL. 100 Asstd. £1·08.
CROC CLIP TEST LEAD SET. 10 leads with 20 clips. £1·06.
DIMMER SWITCH. 240V. 800W. £4·48.
TRADITIONAL STYLE BELL. 3-8V. 70mm chrome gong. £1.60.
UNDERDOME BELL. 4-10V. Smart. Dia. 70mm. £2·27.
TOWERS INTERNATIONAL TRANSISTOR SELECTOR. New edition. £6·54.
F.M. TUNER CHASSIS. 88-108MHz. 9V d.c. £9·49.
MORSE KEY. High speed. £3·83.
PANEL METERS. 60 × 45mm. Modern style. 50uA, 100uA, 1mA, 1A, 25V d.c. £6·48.
NIGHT LIGHT. Plug type. £1·08.
CONNECTING WIRE PACK. 5 × 5yd. coils. 55p.
VERO SPOT FACE CUTTER. £1·09.
VERO PIN INSERTION TOOL. 0·1″ £1·48. 0·15″ £1·49.
RESISTOR COLOUR CODE CALCULATOR. 21p.

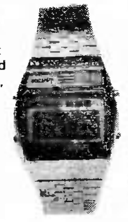
SEIKO MEMORY BANK

Calendar watch M354
Hours, mins., secs.
Month, day, date in 12 or 24 hour format all indicated continuously.
Monthly calendar display month, year and all dates for any selected month over 80 year period.
Memory bank function.
Any desired dates up to 11 can be stored in advanced.
2 year battery life.
Water resistant.
Metac Price

£79.50 **M11**

SEIKO Alarm Chronograph

With WEEKLY Alarm.
Hours, mins, secs, month, date, day, am/pm.
Weekly alarm – can be set for every day at designated time e.g. 6.30 am on Mon, Wed and Friday.
Alarm set time displayed above time of day.
Full stopwatch functions, laptime, split etc.



£89.95 **M10**

SEIKO Melody Alarm Chronograph

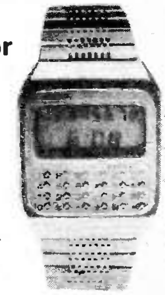
Chiming Alarm, plus chrono.
Hours, mins, secs, date, day, 24 hour alarm, 12 hour chronograph, 1/10th secs, Laptime, Back light, Stainless steel, mineral glass.

METAC PRICE

£92.95 **M19**

SEIKO Calculator Watch

Full specification calculator with memory, plus multi function watch.
Hours, mins, secs, day, date, backlight, Automatic calendar.
Long life battery.



£99.95 **M27**

CASIO CHRONO 95QS-3LB

Stainless steel case, water resistant to 66 feet.
Hours, mins, secs, am/pm, year, month, date, day.
Auto-calendar pre-programmed until the year 2029.
12/24 hour. Stopwatch function.
Range 7 hours. 1/100 sec. (Mode) Net time/lap-time/1st-2nd place times.
Dual time function.
Accuracy 15 secs per month.
Battery life approx 4 years.

£22.95 **M22**

CASIO LADIES 86CL-23B-1

Elegant slim line.
Stainless steel bracelet, fully adjustable.
Hour, mins, 10 sec symbol second by flash, am/pm.
Month, date, day.
Auto-calendar preprogrammed for 28th day in Feb.
Accuracy per month 15 secs.
Battery life approx 15 months.

£29.95 **M23**

CASIO F-200 Sports Chrono

Attractive Mans watch in black resin with mineral glass.
Hours, mins, secs, am/pm.
Month, date, alpha-numeric day.
Auto-calendar set 28th Feb.
Stopwatch working range 1 hour, units 1/100 sec. Mode, Net Time/lap/time/1st-2nd place times.
Accuracy approx 15 secs per month.
Battery 12 months.

£14.95 **M24**

CASIO ALARM CHRONO 81CS-36B

Hours, mins, secs, day, and also day, month and year perpetual automatic calendar.
100th sec chronograph to 7 hours.
Net time/lap/time/1st and 2nd place times. User optional 12/24 hr display. 24 Alarm. User optional, hourly chime.
Backlight, mineral glass, stainless steel.
Water resistant to 100ft.
Battery life approx 4 years.

£34.95 **M25**

BELTIME Chronograph

(9-Functions)
Hours, mins, secs, day, date, month, interchange feature, automatic calendar, backlight, Net time/lap/time.
Stainless steel bracelet.
Battery life 1 year.

£14.95 **M34**

BELTIME Multi Alarm

29 Functions
Hours, mins, secs, date, day.
Alarm, chronograph, Light.
Watch 8 functions, Alarm 4 functions, chronograph 17 functions.
Stainless steel bracelet.

£29.95 **M35**

CASIO F-8C 3 Year Battery life.

Hours, mins, secs, am/pm, date, day.
Auto calendar set 28th Feb.
Stopweatch function.
Accuracy 15 secs per month. Battery life approx 3 years.

£9.95 **M36**

CASIO CALENDAR 200 47CS-23B-1 Black. Stainless steel.

Hours, mins, 10 second symbol, second (by flash), am/pm. Month, day, date.
Auto-calendar set from 1901 to 2009.
Full month calendar display,
Dual time function.
Accuracy 10 secs per month. Battery life approx 15 months.

£59.95 **M37**

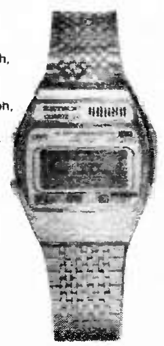
MELODY Multi Alarm Chronograph

Hours, mins, secs, Day, Date, Count-down alarm, Dual time zone, 1/100th sec stopwatch.
Lap/split time, 1st and 2nd place times, Melody test function.

£26.95 **M30**

DUAL TIME-ALARM CHRONOGRAPH

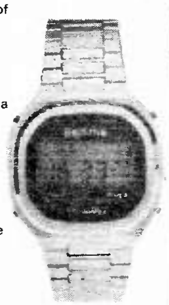
Incorporating module of world famouse Japanese watch manufacture.
Hours, mins, secs, days of week, month, day and date, 24 hour alarm, 12 hour chronograph, 1/10th secs, lap time, Back light, stainless steel case and bracelet, Mineral glass, Battery hatch, long life battery.



£35.00 **M12**

PICOQUARTZ Microprocessor Alarm Chronograph

Multilanguage–day of the week can be set to English, French, German, Italian or Spanish.
Chime – every full hour combined with a response signal, beeping at every pressing of the functions.
Can be switched off.
12-24 hour format.
Backlight.
Chrono – 1, full scale chrono with lap, counting hours upto 24 hrs. Mins, secs, 1/100th secs.
Two Alarm systems.
Two time zones.



£37.95 **M32**

SEIKO CHRONOGRAPH

Hours, mins, secs and day of the week.
Month date and day of the week.
Stopwatch display – Hours, mins, secs up to 12 hours (mins, secs, 1/100 secs up to 20 minutes).
Lap timing, Continuous time measurement of two competitors.
Stinless steel, mineral glass.

£56.00 **M33**

Metac ELECTRONICS & TIME CENTRES

North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

South of England
327 Edgware Road
LONDON W.2
Telephone: (01) 723 4753

U.K. RETURN OF POST MAIL-ORDER SERVICE ALSO WORLD WIDE EXPORT SERVICE

R.C.S. LOUDSPEAKER BARGAINS

3 ohm. 6 × 4in. £1·50. 7 × 4in £1·50. 8 × 5in. £2·50. 6½in. £1·80. 8in. £2·60. 10in. £3. 12in. £4.
8 ohm. 2½in. £1·50. 3in. £1·50. 5in. £1·50. 10in. £3. 12in. £4.
16 ohm. 6 × 4in. £1·50. 7 × 4in. £1·50. 5in. £1·50. 8in. £2·60. 10in. £3. 12in. £4. 10 × 6in. £3·50.

LOW VOLTAGE ELECTROLYTICS

1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V **10p.**
500mF 12V **15p**; 25V **20p**; 50V **30p**;
1000mF 12V **17p**; 25V **35p**; 50V **47p**; 100V **70p**; 1200mF/76V **80p**.
2000mF 6V **25p**; 25V **42p**; 420mF/500V **£1·30**.
2500mF 50V **62p**; 3000mF 25V **47p**; 50V **65p**.
3300 63V **£1·20**. 4700mF 63V **£1·20**. 2700mF/76V **£1**.
5000mF 6V **25p**; 12V **42p**; 35V **85p**. 5600mF/76V **£1·75**.

HIGH VOLTAGE ELECTROLYTICS

8/350V **22p**	8+8/450V **50p**	50+ 50/300V **50p**
16/350V **30p**	8+16/450V **50p**	32+32/450V **75p**
32/500V **75p**	16+16/450V **50p**	100+100/275V **65p**
50/350V **75p**	32+32/350V **50p**	150+200/275V **70p**

MANY OTHER ELECTROLYTICS IN STOCK

SHORT WAVE 100pf air spaced gangable tuner, **95p.**
TRIMMERS 10pF, 30pF, 50pF, **5p.** 100pF, 150pF, **15p.**
CERAMIC, 1pF to 0·01mF, **5p.** Silver Mica 2 to 5000pF, **5p.**
PAPER 350V-0.1 **7p**; 0·5 **13p**; 1mF 150V **20p**; 2mF 150V **20p**; 500V–0·001 to 0·05 **12p**; 0·1 **15p**; 0·25 **25p**; 0·47 **35p.**
MICRO SWITCH SINGLE POLE CHANGEOVER 20p.
SUB-MIN MICRO SWITCH, 25p. Single pole change over.
TWIN GANG, 385 + 385pF **80p**; 500pF slow motion **75p.** 365 + 365 + 25 + 25pF. Slow motion drive **85p.**
120pF **TWIN GANG, 50p**; 365pF **TWIN GANG, 75p.**
TWIN GANG 25pf slow motion **95p**
NEON PANEL INDICATORS 250V. Amber or red **30p.**
ILLUMINATED ROCKER SWITCH. Single pole. Red **65p.**
RESISTORS. 10Ω to 10M. ¼W, ½W, 1W, 20% **2p**; 2W, **10p.**
HIGH STABILITY. ½W 2% 10 ohms to 1 meg., **12p.**
Ditto 5%. Preferred values 10 ohms to 10 meg., **5p.**
RELAYS. 12V DC **95p.** 6V DC **85p.** 240V AC **95p.**
BLANK ALUMINIUM CHASSIS. 6 × 4—**95p**; 8 × 6—**£1·40**; 10 × 7—**£1·55**; 12 × 8—**£1·70**; 14 × 9—**£1·90**; 16 × 6—**£1·85**; 16 × 10—**£2·20**. **ANGLE ALI.** 6 × ¾ × ¾in.—**20p.**
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.**
PLASTIC AND ALI BOXES IN STOCK. MANY SIZES
VARICAP FM TUNER HEAD with circuit & connections. Some technical knowledge required **£4·95.**
TAG STRIP 28-way **12p.**
TAPE OSCILLATOR COIL. Valve type. **35p.**
BRIDGE RECTIFIER 200V PIV ½ amp **50p.** 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 £1

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. **£18**

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 75p

250-0-250V 70mA, 6·5V, 2A .... £3·45
250-0-250V 80mA, 6·3V 3·5A, 6·3V 1A .... £4·60
300-0-300V 100mA, 6·3V 3A .... £5·80
300-0-300V 120mA, 2 × 6·3V 2A C.T.; 5V 2A .... £10·00
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
3 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 .... £12·50
5 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 .... £16·00

12V, 100mA	£1·30	12V, 3 amp	£3·50
12V, 750A	£1·50	10V, 30V, 40V, 2 amp	£3·50
10-0-10V 2amp	£3·00	40V, 2 amp	£3·50
30V, 5 amp and		20V, 1 amp	£3·00
17V-0-17V, 2 amp	£4·00	20V-0-20V, 1 amp	£3·50
0, 5, 8, 10, 16V, ½ amp	£2·50	30V-0-30V, 2 amp	£8·00
9V, 3 amp	£3·50	2 of 18V, 6 amp, each	£11·00
20–0–20V 3 amp	£7·00	12-0-12V, 2 amp	£3·50
30V, 2 amp	£3·50	9V, ¼ amp	£1·50
30V, 1½ amp	£3·30	28V, 1 amp+28V 1 amp	£5·00
20V, 40V, 60V, 1 amp	£4·00	32-0-32V 6·5A	£11·00

BAKER SPEAKERS "BIG SOUND" Post £1 ea.

Robustly constructed to stand up to long periods of electronic power. Useful response 30-16,000 cps. Bass resonance 55 cps.

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

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

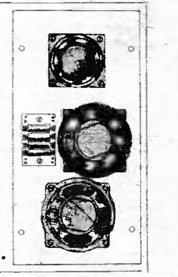
GROUP 100–15 15in. 100 watt 8 or 16 ohms. **£35**

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. *Illustrated* **£9·95** Post 75p
15W model 8 ohms Bass unit. **£10·95** Post 75p
GOODMANS 20 Watt Woofer Size 12 × 10in. 4 ohms. Rubber cone surround. Hi-Fi Bass unit. **£9·95** Post £1·60
GOODMANS TWIN AXIOM 8 8in. 8 ohm Hi-Fi Twin Cone Special unit £9·95 Post 50p

R.C.S. MINI MODULE HI-FI KIT 15 × 8¼in 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. One or two kits.



RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, CROYDON

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

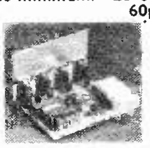
DISPLAY LIGHTING KITS

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 undirectional 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

DL1000K



DLZ100K

LEDS

0·1" Red **9p**
0·2"
Red **9p**
Green **12p**
Yellow **12p**
Square Red 5 × 2·5 × 9mm **20p**

SPECIAL OFFER
25 off 0·2" LEDS
Red **£1·50**
Green **£2·00**
Yellow **£2·00**

DISPLAYS

DL727 0·5" 2-digit CA **£1·50**
DL304/307 (pin compatible with DL704/707) 0·3" CA/CC Red **70p** DL847 DL850 (pin compatible with DL747/750) 0·8" CA/CC **£1·80**
0·2" LED CLIPS **3p**

LIQUID CRYSTAL DISPLAY
3½ digit 40 pin dil **£8·10**
SPECIAL IL74 Opto Isolator **45p.**

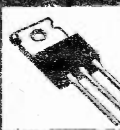
RESISTORS

¼W 22 ohm 10M E12 Series
Pack of 10 (one value) **10p**
10 Packs **80p**

SPECIAL OFFERS

2N3819—Fet	**20p**
TIS 43—UJT	**25p**
TIC 106 4A/400VSCR	**30p**
BC4 182L	10 for **50p**

TRIACS



400V Plastic Case (Texas)

3A	**49p**	16A	**90p**
8A	**57p**	20A	**165p**
12A	**70p**	25A	**190p**
6A with trigger			**80p**
8A isolated tab			**82p**
Diac			**18p**

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.

CT 1000K Basic Kit **£14·90**
CT 1000KB with white box (56 × 131 × 71mm) **£17·40**
Ready built **£22·50**

LIGHTING CONTROL KITS

Directly replace conventional light switches and control up to 300W of lighting. No mains rewiring. Insulated touchplates. Easy to follow instructions.

TD300K TOUCHDIMMER. Single touchplate with alternate action. Brief touch switches lamp on and off, longer touch dims or brightens lamp. Neon lamp helps find the switch in the dark **£6·50**
TDE/K Extension kit for TD300K for 2-way switching etc. **£1·50**
TSD300K—TOUCHSWITCH & DIMMER. Single touchplate, small knob controls brightness **£5·50**
TS300K—ON/OFF TOUCHSWITCH. Two touchplates **£4·30**
TSA300K—AUTOMATIC. Single touchplate. Time delay variable 2 secs. to 3½ mins. **£4·30**
LD300K—LIGHTDIMMER KIT **£2·90**

INTEGRATED CIRCUITS

555 Timer	**21p**
741 Op. Amp	**18p**
AY-5-1224 Clock	**£2·60**
AY-5-1230 Clock Timer	**£4·50**
AY-3-1270 Thermometer	**£8·20**
ICL7106 D.V.M. (LCD Drive)	**£7·10**
TDA1024 Zero Voltage Switch	**£1·10**
LM10C Op. Amp. 1·1V to 7V	**£2·99**
LM3911 Thermometer	**£1·00**
LM3914 Dot/bar Driver	**£2·60**
MM57160 (stac) Timer	**£5·95**
S566B Touchdimmer	**£2·50**
S9263 Touchswitch	**£4·85**
ZN1034E Timer	**£1·80**

All ICs supplied with data and circuit.

DIGITAL VOLTMETER/THERMOMETER KIT

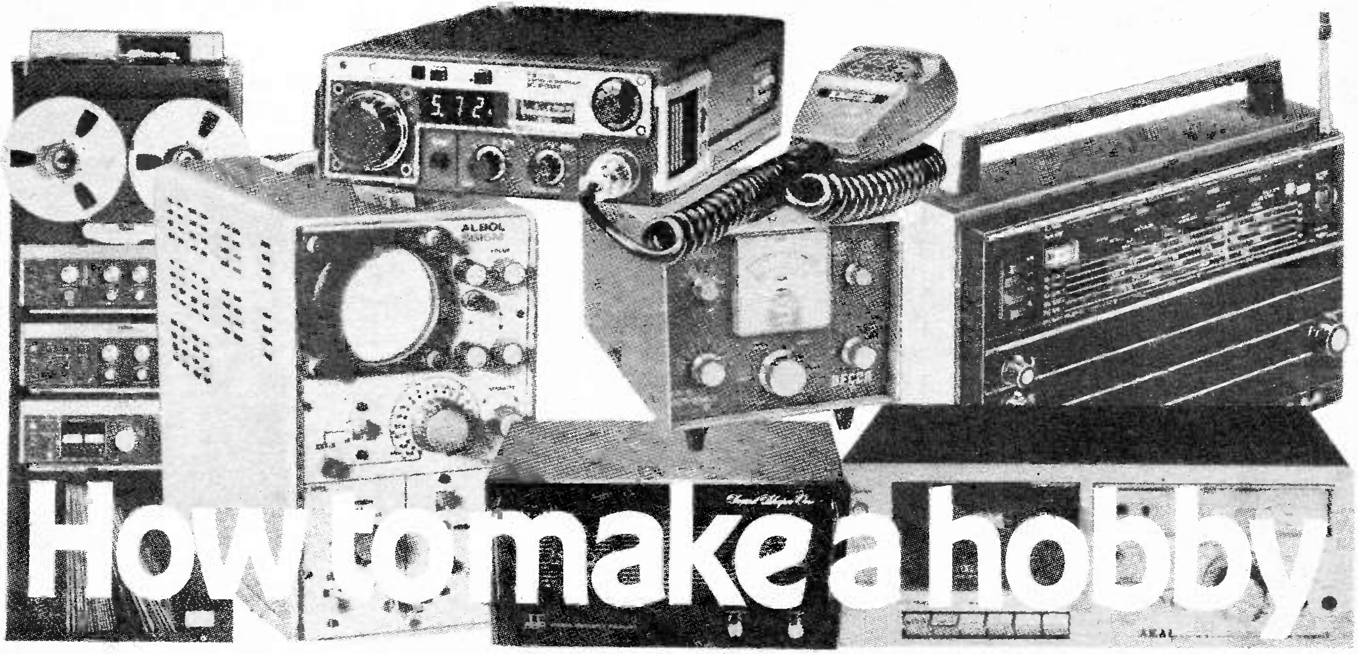
Based on the ICL7106. This Kit contains a PCB resistors, presets, capacitors, diodes, IC and 0·5" liquid crystal display.

Components are also included to enable the basic DV kit to be modified to a Digital Thermometer, using a single diode as the sensor. Requires a 3mA 9V supply (PP3 battery) **£20·75.**

ALL COMPONENTS ARE BRAND NEW AND TO SPECIFICATION. ADD VAT AT CURRENT RATE TO ABOVE PRICES PLUS 30p P&P, MAIL ORDER—CALLERS WELCOME BY APPOINTMENT.

TK Electronics (EE)

106 STUDLEY GRANGE ROAD LONDON W7 2LX. TEL. 01-579 9794



The opportunities in electronics, today, and for the future are limitless — throughout the world. Jobs for qualified people are available everywhere at very high salaries. Running your own business, also, in electronics — especially for the servicing of radio, TV and all associated equipment – can make for a varied, interesting and highly renumerative career. There will never be enough specialists to cope with the ever increasing amount of electronic equipment coming on to the world market.

We give modern training courses in all fields of electronics — practical D.I.Y. courses — courses for City & Guilds exams, the Radio Amateur licence and also training for the new Computer Technology. We specialise only in electronics and have over 40 years experience in the subject.

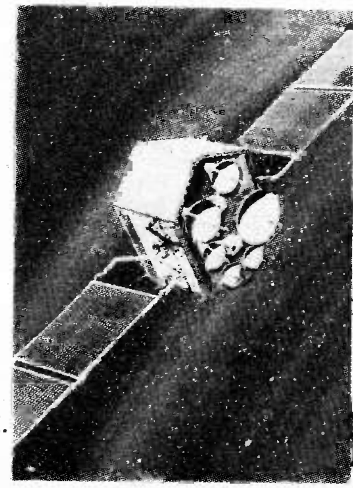
All the training can be carried out in the comfort of your own home and at your own pace.

A tutor is available to whom you can write at any time for advice or help during your work.

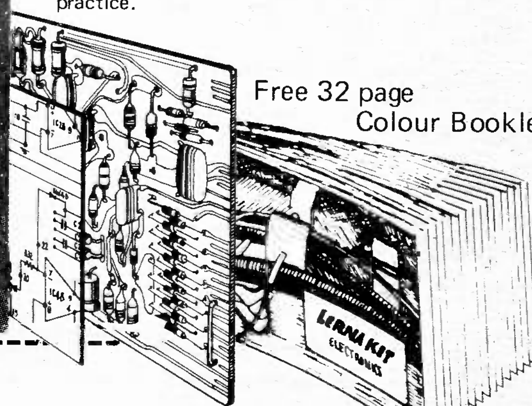
and a career.

COURSES AVAILABLE

- **CITY & GUILDS CERTIFICATES IN TELECOMMUNICATIONS AND ELECTRONICS.**
- **RADIO AMATEUR LICENCE.**
- **COMPUTER TECHNOLOGY WITH HOME TRAINING COMPUTER.**
- **DIGITAL ELECTRONICS.**
- **BEGINNERS PRACTICAL COURSE.**
- **RADIO AND TELEVISION SERVICE.**
- **AND MANY OTHERS.**



All students enrolling in our courses receive a free circuit board originating from a computer and containing many different components that can be used in experiments and provide an excellent example of current electronic practice.



Free 32 page Colour Booklet.

WE ARE AN INTERNATIONAL SCHOOL SPECIALISING IN ELECTRONICS TRAINING ONLY AND HAVE OVER 40 YEARS EXPERIENCE IN THIS SUBJECT.

EEA/1/80

NAME..

ADDRESS ....

....

Block Caps Please

Post now, without obligation, to:-

BRITISH NATIONAL RADIO and ELECTRONICS SCHOOL P.O. Box 156, Jersey, Channel Islands.

Projects... Theory... and Popular Features...

No doubt some rueful rememberances of last winter will be awakened by this month's cover picture. Hopefully we shall not suffer the same severe and treacherous conditions in the opening months of '80. But there's no knowing, so it will be prudent to emulate the Boy Scouts and be prepared. Which leads us to the *Loft Alert*.

Apart from fire, flooding is probably the most frightening and damaging catastrophe that can happen to our homes. Extensive flooding can occur because quite small defects such as bursts in pipes or frozen ball cocks are undetected in sufficient time to take remedial action.

To be forewarned is to be forearmed. Hence the importance of our *Loft Alert*. The wise householder will build and instal this monitoring system without delay. Then regardless of the severity of the winter, the occupants can at least be relieved of anxiety concerning the state of things up a'loft.

As will be immediately apparent, the usefulness of this device is by no means limited to the winter months. Any time of the year defects or malfunctioning of parts in the water system can occur, which could lead to a disastrous situation.

A further reassuring feature provided by our *Loft Alert* is an instant "system check" facility. And being battery operated it is entirely independent of the mains supply.

As from next month the price of EVERYDAY ELECTRONICS will be increased to 50p. Considering that you could pay this sum for a mere Christmas or birthday card, there can be no question that EE is value for money. Nevertheless we realise any increase could be a serious blow to the younger reader. If so, we suggest an approach to Dad for a subsidy. It should not be difficult to convince him that his investment will be returned with interest in the form of useful projects for the home in the course of the coming year.

As we leave '79 and enter '80, all of us on EVERYDAY ELECTRONICS thank our readers for your support and encouragement as often expressed in your letters to us.

Best wishes for the New Year.

Fred Bennett.

Our February issue will be published on Friday, January 18. See page 27 for details.

Everyday ELECTRONICS

VOL. 9 NO. 1 JANUARY 1980

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

Back Issues
Certain back issues* of EVERYDAY ELECTRONICS are available worldwide price 70p inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. In the event of non-availability remittances will be returned.
* *Not available:* October 1978 to July 1979.

Binders
Binders to hold one volume (12 issues) are available from the above address for £3·75 (home and overseas) inclusive of postage and packing. Please state which Volume.

Subscriptions
Annual subscription for delivery direct to any address in the UK: £8·50, overseas: £9·50. Cheques should be made payable to IPC Magazines Ltd., and sent to Room 2613 Kings Reach Tower, Stamford Street, London SE1 9LS.

OUR REGULAR FEATURE FOR BEGINNERS

SQUARE one

Is on page 61

FREEZE-UPS • FLOODS • BURSTS

AVOID THESE HAZARDS WITH OUR

EE LOFT ALERT

By S. E. Dollin, B.Sc.

THE Loft Alert is an electronic warning system designed to warn the householder of an overflowing water tank, burst or leaking water pipes, and also the approach of freezing conditions. It consists of three sensing circuits which, when activated, give a visible and audible warning and shows which channel has been activated so that remedial action may be taken quickly before great damage is done.

An important feature of this unit is the fact that it is battery operated making it immune from the mains power failures that are possible during the winter months when this system will be most needed. This also makes installation very much easier and safer. Provision is made for an extension warning device or lamp which can be mains or battery operated.

PRINCIPLE OF OPERATION

The system can be broken up into several distinct stages. When a fault, say a burst pipe, is detected, this produces a voltage which is fed to the appropriate latching circuit. This has the effect of lighting an l.e.d. and applying a "high" input to the OR gate which results in its output going high. This arrangement is necessary to prevent sensor circuits interacting and interfering with each other.

The output of the OR gate is fed via a voltage clamp circuit to the alarm circuit.

This voltage clamp (TR1) is designed to keep the output from the OR gate firmly at 0V when in the off condition. This is necessary as pin 4 of the following astable multivibrator must be kept at 0V to prevent it turning on when no alarm signal is present, since the output from the OR gate is a little above 0V in its low state.

When the astable is running (pin 4 high) the associated l.e.d. flashes until the alarm condition is removed and the latch reset.

The alarm signal (stepping clamp voltage) is also processed to produce a trigger pulse for the monostable which energises a relay. The relay contacts supply power to an audible warning device for a length of time. This alarm is muted when the monostable times out.

CIRCUIT DESCRIPTION

The complete circuit diagram of the Loft Alert is shown in Fig. 1. The sensors for water overflow and leakage are identical in principle. Water bridges two contacts and causes a signal voltage to be applied via resistors R1 (R9) to the gate of thyristors CSR1 (CSR3). When this happens the thyristor conducts and the cathode rises to a little below battery voltage thus illuminating D1 (D5).

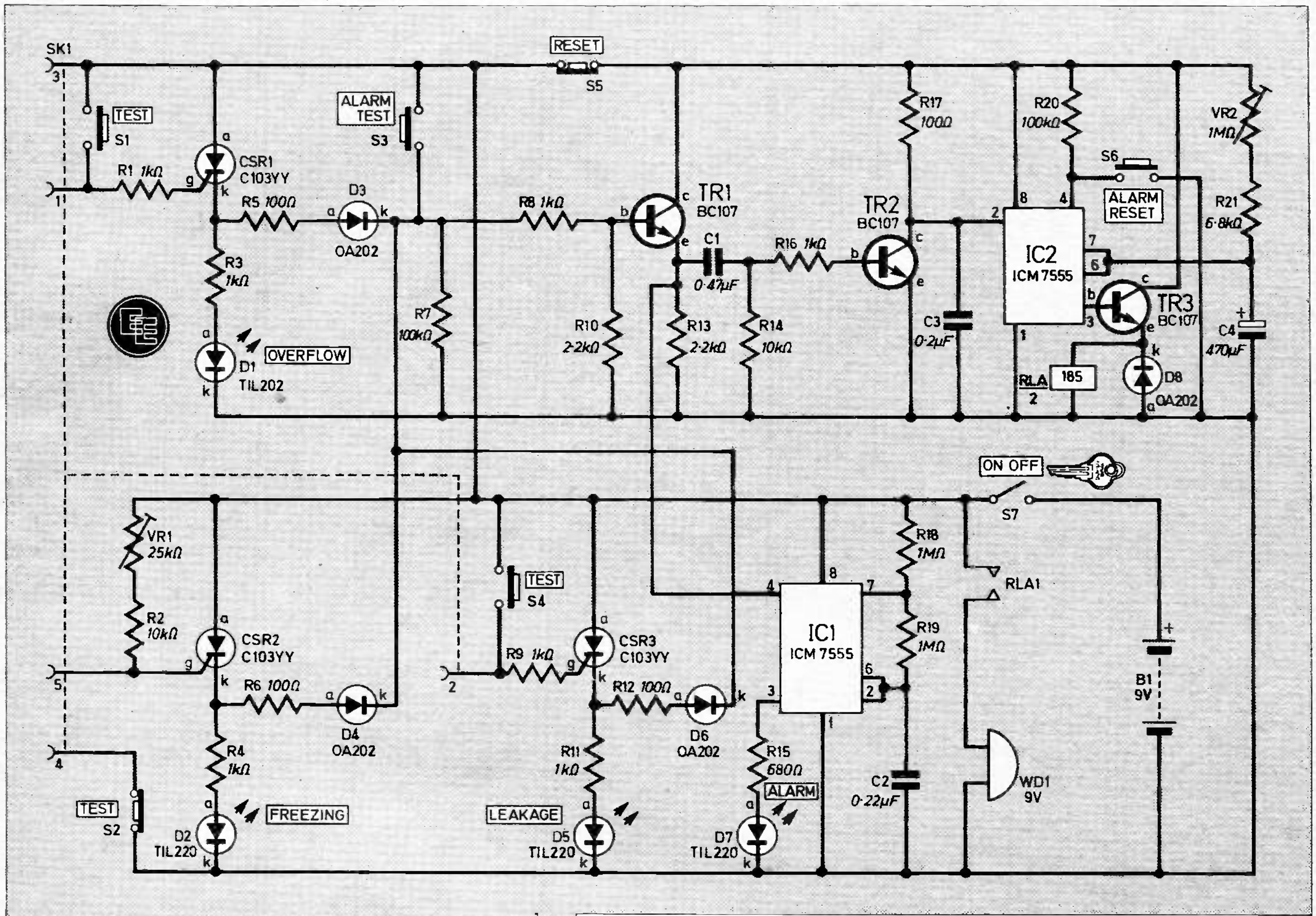
The operation of the freezing detector is slightly different but the effect is to produce a voltage at the thyristor gate when the temperature drops to, or approaches freezing.

The resistor R2, potentiometer VR1 and thermistor RTH1 form a potential divider chain. At room temperature the thermistor has a low resistance of about 1 kilohm. This means that the voltage on the gate of CSR2 is near to zero. However as the temperature falls the resistance of thermistor RTH1 rises causing the voltage across it to rise. At a certain thermistor resistance the voltage across the thermistor is sufficient to turn on the thyristor thus causing the voltage on the cathode to rise to just below battery voltage which lights up D2.

The thyristor cathodes are all wired into a discrete 3 input OR gate made up of D3, D4, D6 and R5, R6, R8, R10.

ALARM CIRCUITS

The output of the OR gate is fed via R8 to the base of TR1. This stage is the voltage clamp and is simply a transistor switch. The emitter is at 0V until a high from the OR gate



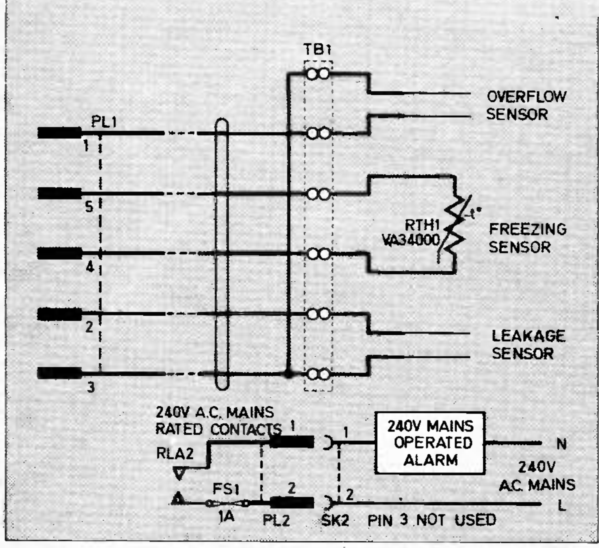
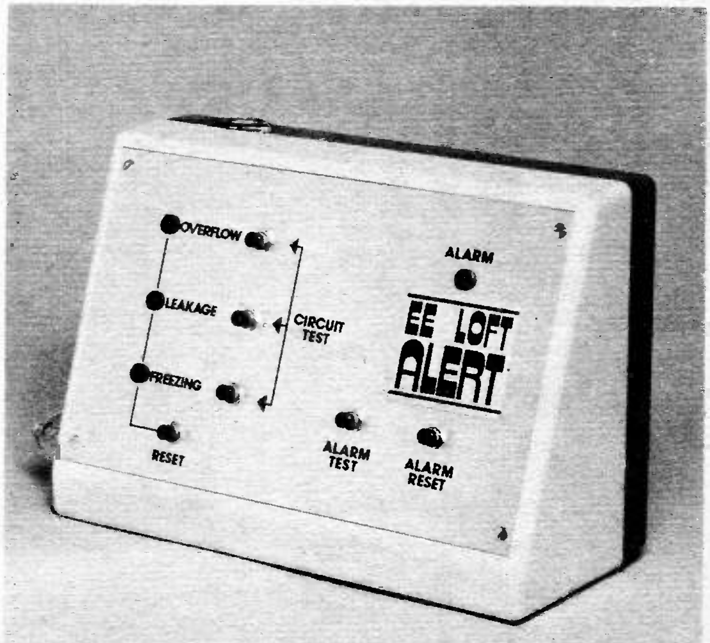


Fig. 1. Complete circuit diagram of the Loft Alert.

appears on the base whereupon the transistor switches on and the emitter voltage rises to just below the positive rail voltage.

At this point the signal takes two paths. The first is to the reset pin of IC1 (pin 4) wired as an astable multivibrator. Pin 4 is used here as an inhibit input.

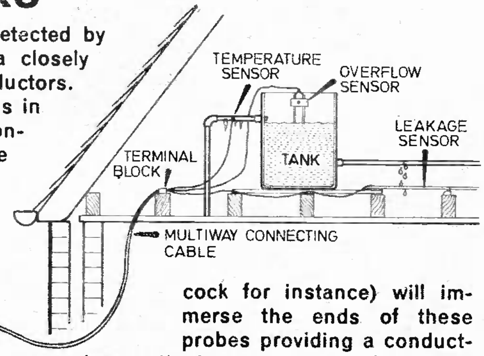


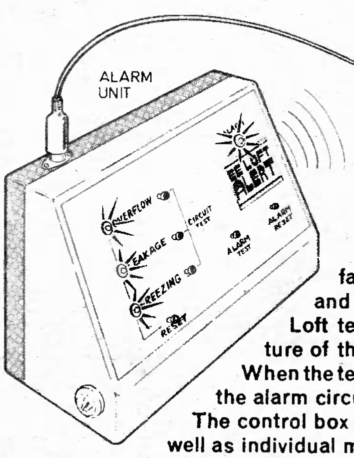
Front view of the EE Loft Alert showing front panel layout and lettering.

HOW IT WORKS

The presence of water is detected by simple probes made up of a closely spaced pair of uninsulated conductors.

To sense overflow conditions in the main tank a pair of fixed conductors is hung over the side such that their ends are just above the normal water level. Any abnormal rise in this level (caused by a faulty ball cock for instance) will immerse the ends of these probes providing a conducting path between them. This will enable an electrical signal to be passed to the electronic circuitry thus actuating the alarm systems.





To sense burst pipes or other leakage in the plumbing, a sensor consisting of two closely spaced wires is run directly beneath the pipe work. Dripping water falls on these wires completing the circuit and setting off the alarm.

Loft temperature, or more precisely the temperature of the water pipe, is monitored by a thermistor. When the temperature falls to near 0 degrees Centrigrade the alarm circuit is triggered.

The control box features both visible and audible alarms as well as individual monitoring of all circuits. This unit is installed in some convenient position in the house such as on the landing.

As soon as the voltage on this pin rises above about 0·4V the i.c. turns on and stays on so long as the "high" voltage to pin 4 is maintained. This causes the l.e.d. attached to pin 3 to flash on and off until the alarm is reset.

The other signal path is to IC2, another 555 i.c., this time wired as a monostable. This activates the relay coil for a certain time period after which the coil is deactivated. The inbuilt audible alarm (and extension alarm) is on for this time period *(t)* which is governed by the formula:

$$t = 1{\cdot}1 \times (VR2 + R1) \times C4 \text{ seconds}$$

where the resistance is in ohms and capacitance in farads. The maximum time period obtainable is about 8 minutes which can be altered by VR2.

To trigger this arrangement pin 2 needs to be grounded momentarily. When the alarm is triggered TR1 emitter goes to and remains at a level of about 8V. This voltage step is applied to the *RC* network R14 and C1 which produces a positive-going voltage spike at the base of TR2. The transistor momentarily switches on and its collector drops to 0V. This negative-going voltage spike is applied to pin 2 of IC2 causing it to trigger and energise the relay via buffer amplifier TR3 for time *t*.

Circuit test switches S1, S2 and S4 simulate an alarm condition by causing a voltage to be applied to the thyristor gates. The alarm test switch S3 when operated applies a voltage to R8 thus simulating alarm conditions. Switch S6 grounds pin 4 of IC2 thus resetting it and S5 breaks the supply to reset the thyristors.

CONSTRUCTION starts here

CIRCUIT BOARD

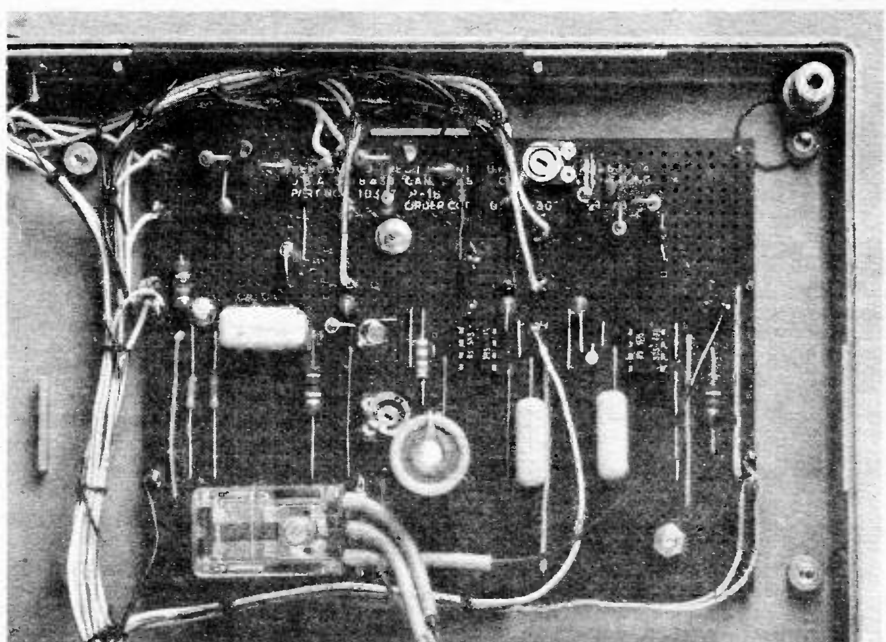
Construction should start with the circuit board. This consists of a piece of 0·1 inch matrix stripboard size 50 holes by 36 strips. It is advisable to make the breaks in the copper strips and drill the mounting holes before mounting components. Assembly is quite straightforward, although it is advisable to start with the resistors, then larger passive components and finally the transistors (see Fig. 2).

The i.c.s are mounted in sockets and the relay is mounted straight on to the board. It should be secured by glueing or by tightly wrapping a loop of insulated wire around the body and securing under the board well away from any copper strips used for electrical connections.

Veropins have been placed in locations on the board where connections to panel-mounted components are made. This makes interwiring and testing very much easier.

CASE

The prototype unit is housed in a Verobox type 202-21032D.



The completed circuit board mounted in position on the inside back panel of the case.

EE LOFT ALERT

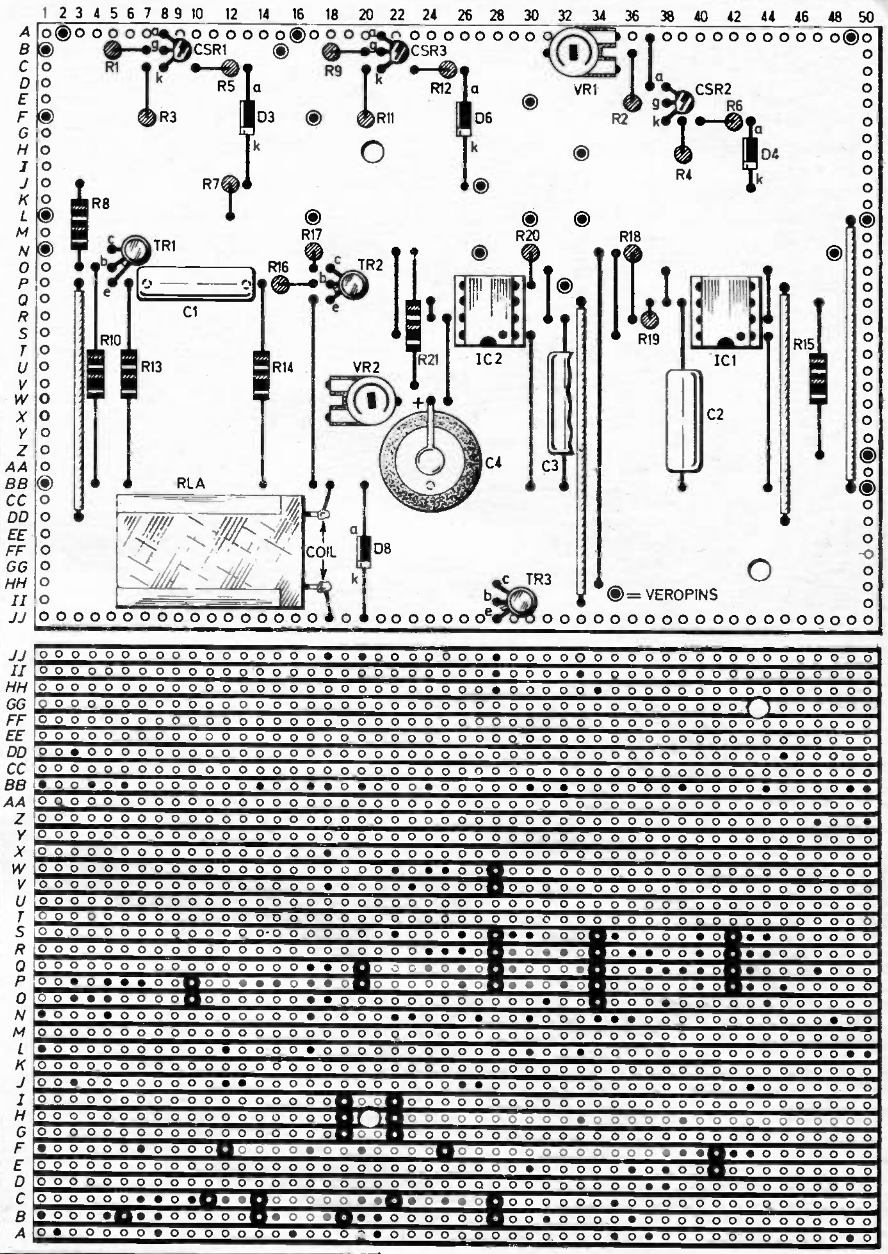


Fig. 2. Stripboard layout. Note that connections to off-board components are made via Veropins situated at appropriate locations on the strip-board. For wiring details of the relay see Fig. 3.

COMPONENTS

See **Shop Talk** page 19

Resistors

R1	1kΩ
R2	10kΩ
R3	1kΩ
R4	1kΩ
R5	100Ω
R6	100Ω
R7	100kΩ
R8	1kΩ
R9	1kΩ
R10	2·2kΩ
R11	1kΩ
R12	100Ω
R13	2·2kΩ
R14	10kΩ
R15	680Ω
R16	1kΩ
R17	100Ω
R18	1MΩ
R19	1MΩ
R20	100kΩ
R21	6·8kΩ

All ¼W carbon ± 5%

Potentiometers

VR1	25kΩ horizontal miniature preset
VR2	1MΩ horizontal miniature preset

Capacitors

C1	0·47μF ceramic or plastic
C2	0·22μF ceramic or plastic
C3	0·2μF ceramic or plastic
C4	470μF 25V elect.

Semiconductors

IC1,2	555 CMOS timer i.c. (2 off)
TR1,2,3	BC107 *npn* silicon (3 off)
CSR1,2,3	C103YY or MCR102 thyristor (3 off)
D1,2,5,7,	TIL220 l.e.d. or similar (two red, one yellow, one green)
D3,4,6,8	OA202 or similar small signal silicon diode (4 off)

Miscellaneous

S1,3,4,6	miniature push-to-make single pole switch (4 off)
S2,5	miniature push-to-break single pole switch (2 off)
S7	single-pole key operated on/off switch
SK1	5-pin DIN socket
SK2	miniature mains cable socket
PL1	3-pin miniature mains chassis plug
PL2	5-pin DIN plug
RLA	miniature 12V relay, 185 ohm coil resistance with two sets mains rated normally open contacts
WD1	miniature 9V audible warning device
RTH1	GM102 or VA3400 glass bead type thermistor
TB1	6 way screw terminal block
B1	9V type PP9

Stripboard: 0·1 inch matrix 36 strips × 50 holes; 5-way multi-core cable (or ribbon cable); connecting wire; twin-core 3A mains cable (for extension alarm); case (Verobox 202-21032D or similar); Battery connector clips; hardboard, panel pins, tinned copper wire, 2 pin plug and cable (for sensors).

COMPONENTS approximate cost £20 excluding case and sensors

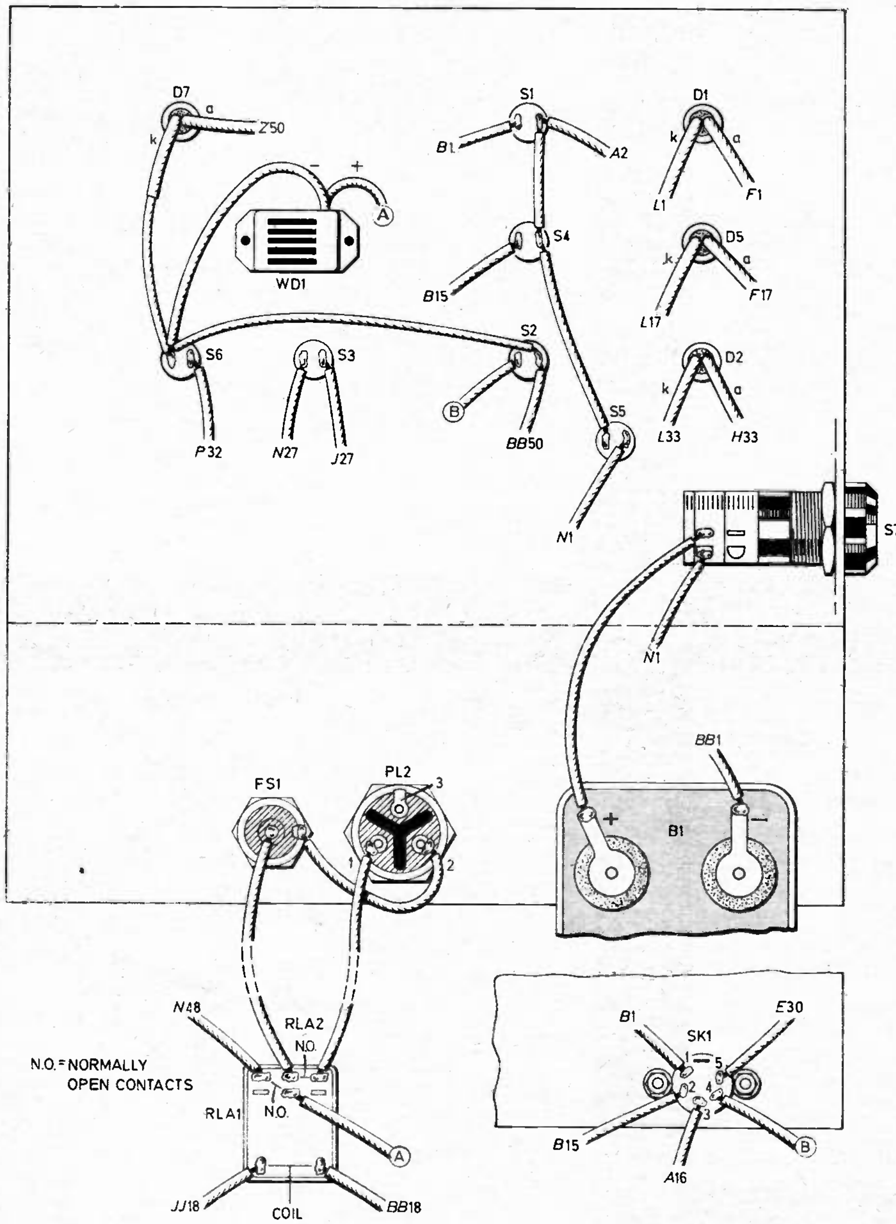


Fig. 3. Internal layout. Note that all letter/number combinations refer to Veropin locations on the main circuit board and single letters to other locations. SK1 is mounted on the top of the case and FS1 and PL2 on the bottom.

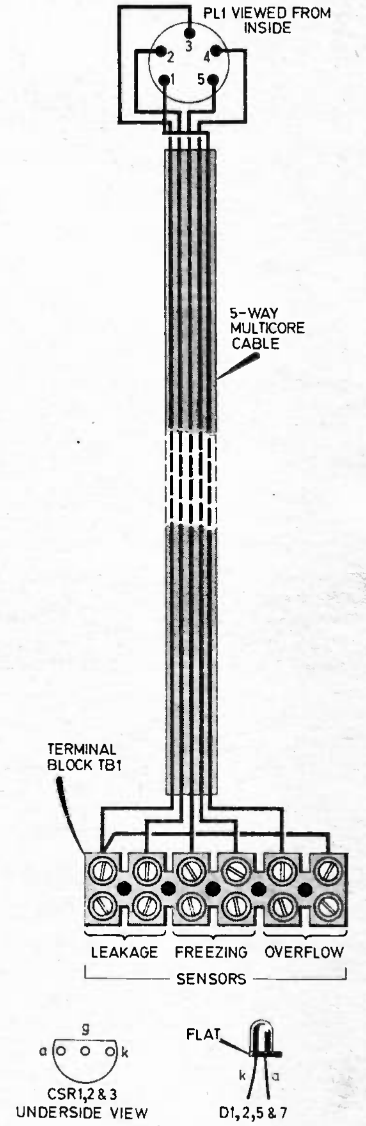
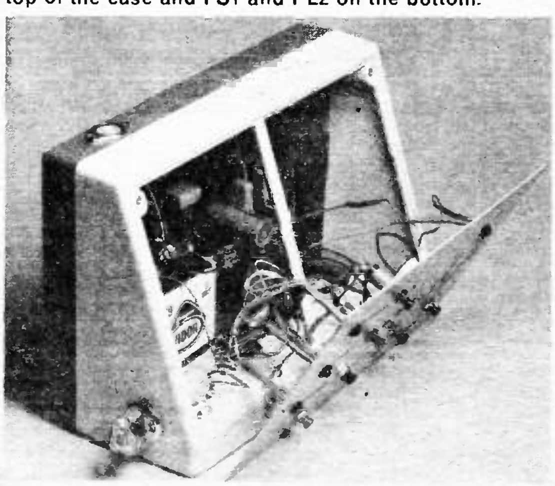
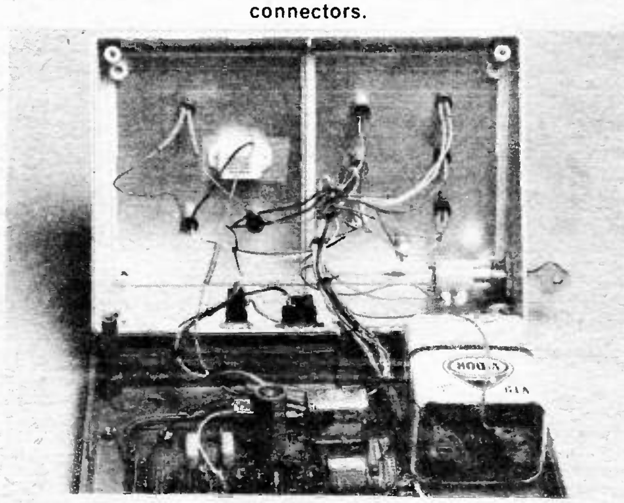
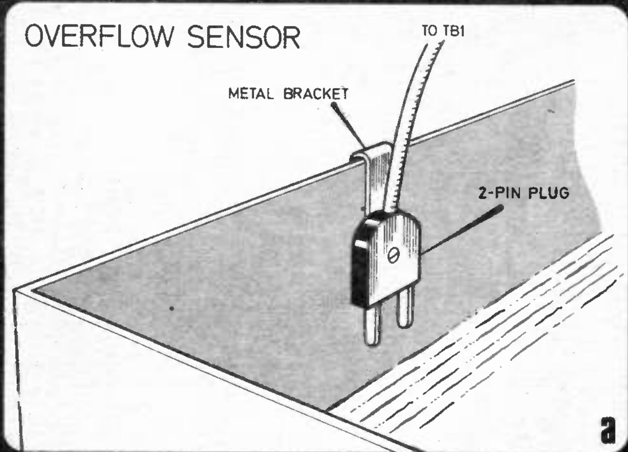


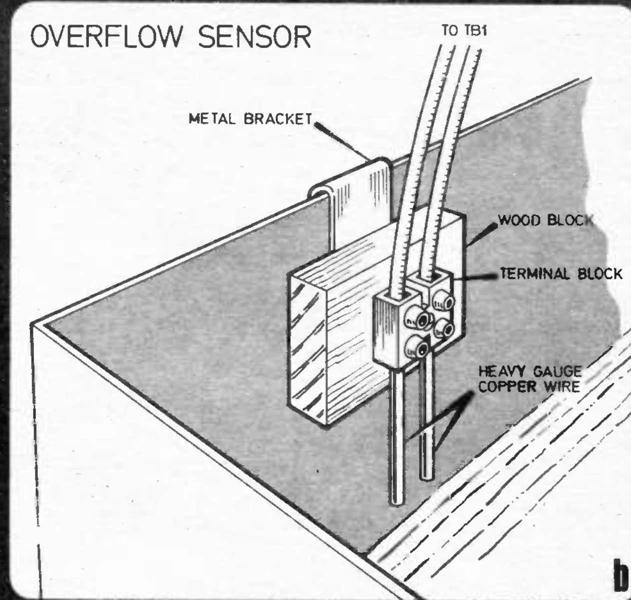
Fig. 4. Wiring of the interlinking cable from the unit to the sensors and its connectors.

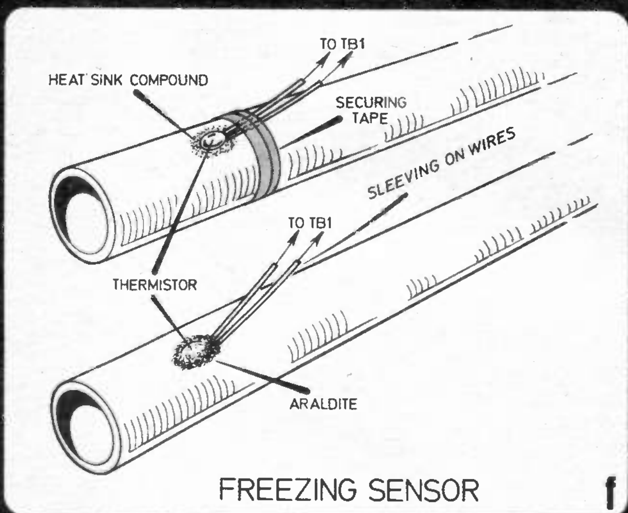


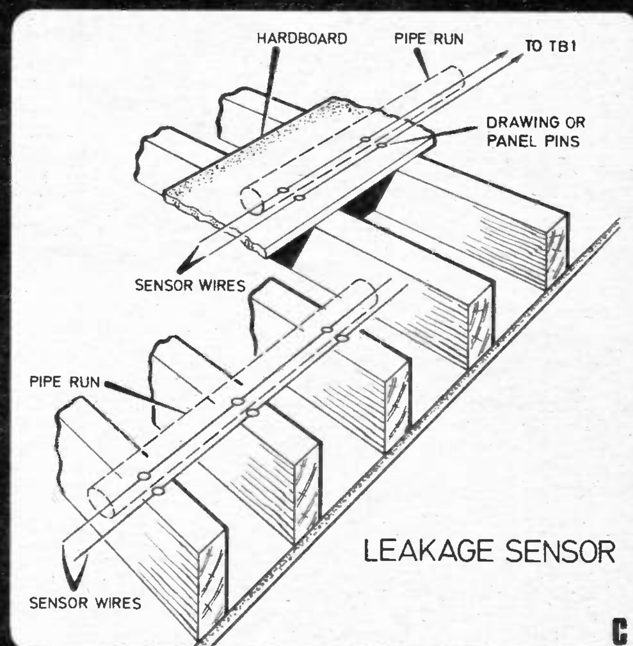


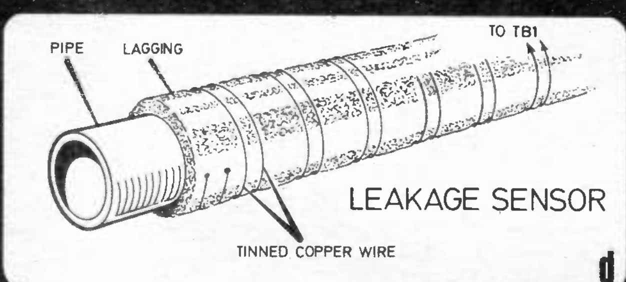
EE LOFT ALERT
SENSOR CONSTRUCTION & INSTALLATION











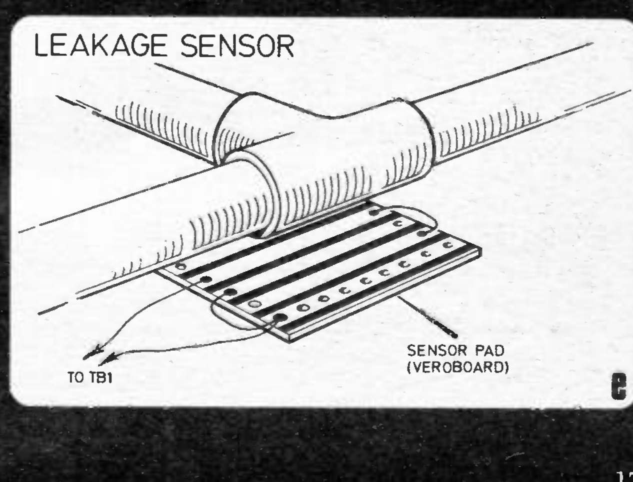


Fig. 6. Some suggested ideas for the sensors. Remember that if there is more than one sensor for any one circuit then these must be wired in parallel. For those whose pipes run along the top of the joists, leakage detection can be made easier by fastening the detector wires to short lengths of hardboard which are placed between the joists and under the pipe in question.

Assembly can begin by mounting the mains chassis plug PL2, fuse holder FS1 and 5-pin DIN socket SK1 in the case. Next the completed circuit board is bolted to the back of the case using 6BA countersunk bolts and nuts. The front panel is next marked out and drilled to accommodate the panel-mounted components.

Finally the internal wiring is completed as shown in Fig. 3. Although this layout is by no means critical, care should be taken to make sure front panel components do not foul internal parts if another layout or case are used.

A 5-pin DIN socket is used as the termination for the sensor inputs and the spare set of relay contacts are wired via a 1A fuse to a miniature mains chassis plug PL1 to act as an on/off switch for the extension alarm. Great care must be taken with this especially if it is likely to be used for switching mains voltage.

It is possible to connect any sort of mains device to this plug, for example a lamp, bell or buzzer, up to a maximum power rating of 250 watts for the relay specified.

The battery simply sits in the space next to the circuit board and a simple clamp is fitted to hold it in position.

Finally to secure the device against accidental switch-off, a key switch is used as the master on/off switch. This is not vital and can readily be replaced by any other on/off switch to reduce the overall cost of the system.

THE SENSORS

The sensor input to the unit is via a 5 pin DIN plug, hence it is necessary to run a length of 5-way cable from the unit to the loft. This is then connected to a 6-way screw terminal block as shown in Fig. 4.

Basically there are three types of sensor—one for overflow, one for leakage and one to detect freezing conditions. Various ideas for the sensor are shown in Fig. 5.

The overflow sensor is very simple, and consists of two electrodes mounted in the cold water tanks above the usual water level. See Fig. 5(a) and (b). A convenient ready-made sensor is available in the form of a 2-pin razor plug. This is robust with pins far enough apart so that when the level subsides there isn't any moisture left behind bridging the gap.

The other method uses a 2-way screw terminal block with short wires forming the probe. Care should also be taken to site this sensor far enough above the water level so that it isn't accidentally triggered by rushing water as the tank fills.

LEAKAGE DETECTOR

The leakage detector in practise is a little more complicated. One method is to have twin runs of tinned copper wire about 2mm apart beneath all pipes at risk fitted to the joists vertically beneath the pipe run.

Alternatively the wire can be fastened onto hardboard in a straight line using panel pins. This assembly can then be laid underneath the pipework, perhaps on a slight slant so any dripping water will run down on to the wires and set off the alarm.

If the pipes are lagged then two parallel lengths of tinned copper wire could be wrapped around the length of the lagging. See Fig. 5 (c) and (d) for details.

If complete pipe-run monitoring is not considered essential a number of small sensors consisting of stripboard with alternate strips bridged and placed under particularly risky spots could be tried. All of these sensors would of course be wired in parallel. This is shown in Fig. 6 (e).

FREEZING SENSOR

The freezing detector is straightforward as it consists simply of a miniature bead thermistor. This is attached to either the tank ballcock or pipe most susceptible to freezing. For a permanent arrangement, the thermistor can be glued to the pipe using Araldite. Alternatively the thermistor can be coated in a heatsink compound and taped to the pipe, see Fig. 5 (f).

Readers will no doubt be able to adapt these ideas to their own circumstances or even invent better ideas of their own. In any event if more than one sensor is used for a particular channel, they should all be wired in parallel.

All the sensors are terminated in the loft at a 6-way screw terminal block TB1 to which the 5-way cable to the unit is attached.

SETTING UP

Once the unit has been assembled its function can be tested using the built-in test buttons. When any of the CIRCUIT TEST buttons is pressed the relay coil should be activated causing WD1 to sound, diode D7 should flash and the l.e.d. associated with the particular circuit should light up. Pressing ALARM RESET will mute WD1 and pressing RESET will reset the whole device.

Similarly the alarm devices alone can be tested by pressing ALARM TEST and reset by pressing ALARM RESET.

Having built and tested the unit the freezing circuit should be set up next. To do this, the thermistor should be temporarily attached to the unit via the 5-pin DIN socket, and fastened to the side of a metal container with adhesive tape. A mixture of water and ice is then poured into the container and the temperature of the container is allowed to stabilise. The potentiometer VR1 is then adjusted until the alarm just triggers under these conditions.

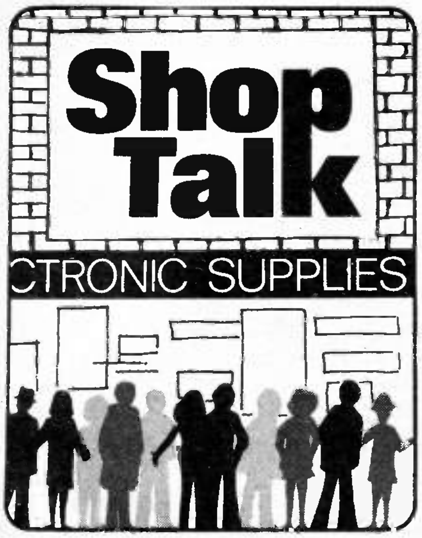
At this point the sensors in the loft can be installed and the 5-way cable run down to the unit. Extension warning devices can be attached via PL2, the battery checked and the device is ready for use.

USING THE DEVICE

The Loft Alert has been designed to have a very low quiescent current consumption in the standby condition (typically less than 0·4mA), to allow the unit to be battery powered and left on continuously. Under these conditions the specified life of the PP9 battery will be close to its shelf life which is about one year.

However, should the alarm be triggered, the current consumption during the alarm period reaches about 70mA. This means that once the alarm condition has been dealt with the battery should be checked before the system is reset and left, to make sure that it was not exhausted whilst the alarm was activated.

Assuming the unit is going to be in regular use, periodic inspection and checking of the sensors and battery is a good idea and a half-yearly overhaul is certainly recommended. ⌑



By Dave Barrington

Light Controller

It would seem that Discos do not have the monopoly on special effects this year. We are reliably informed that the measure of a good festive party this season will be its lighting effects—what's happened to stimulating conversation and good food?

Aimed more at the disco market with a price tag of £99, including VAT, the latest "light controller" from TUAC should create a stir.

The Starchaser 4000 is an extremely versatile four-channel (750W per channel) lighting control console offering 16 distinctive and varied lighting patterns. Basic light effects are selected by four switches, but by using another five switches it is claimed that the operator has a possible 1000 different patterns and effects at his finger tips.

Use of automatic gain control (a.g.c.) is a standard feature, and zero reference triac firing circuitry is incorporated to minimise r.f. interference. Also featured are two audio control modes giving a single shot and an audio controlled sequencing facility. Both audio control modes are designed to be "bass sensitive" being triggered by instruments such as drums and bass guitar.

A master dimmer allows all channels to be faded simultaneously. A crossfade facility enables each channel light to be brightened and dimmed at a controlled rate, producing a merging effect.

The crossfade switch also has a short on or "flash" position which reduces the lamp on time of any channel during sequencing to produce a simulated "strobe" effect.

The Starchaser 4000 is available direct from Tuac Ltd, or from selected stockists. Further information and addresses of stockists can be obtained from Tuac Ltd, Dept EE, 121 Charlmont Road, London SW17 9AB.

Link-up

Readers embarking on our new *Teach-In 80* beginners series may like to investigate the latest link-wire kit for breadboards from Lektrokit for possible use with the *EE Tutor Deck*.

Although intended for their own range of breadboard systems they will fit most commercial matrix boards. Each kit contains 350 wires and comes in a plastic compartmentalised box. All of the wires are of solid tinned 22 a.w.g. with p.v.c. insulation sleeving.

Fourteen different lengths are included ranging from 0·1in, for linking adjacent holes on a 0·1in matrix board, to wires with a 5in span. All wires have both ends stripped and bent to 90 degrees and each group of wires has a different coloured sleeving for easy identification of individual link wires.

For more information and addresses of local stockists, readers should write to Lektrokit Ltd., Dept. EE, Sutton Industrial Park, London Road, Earley, Reading, RG6 1AZ.

Good Trading

Due to remarkable trading response during 1978/9, Newbear Computing Store recently decided to reorganise its operations for 1980 under three divisions.

Catering for business, industrial and educational requirements, Newbear Systems will be supplying microcomputers built to professional standards with matching peripherals and software.

The growth of the demand for technical books has meant the forming of Newbear Books. Several hundred titles are available "off-the-shelf" and services offered include, a claimed, 24 hour turnround on mail order.

Starchaser 4000 from TUAC.

The Components Division holds very large stocks and includes a wide range of microcomputer components, including kits from Acorn, Nascom and Bearbag 77-68 series. A comprehensive range of integrated circuits are also stocked.

A further result of their good trading figures, has been the opening of a new 1500 sq. ft. Northern branch store at Mersey House, 220 Stockport Road, Cheadle Hulme, Cheshire.

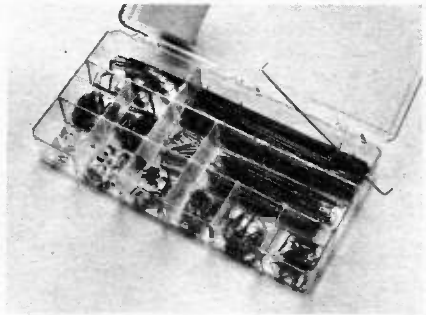
The latest piece of information we have received from Newbear is the announcement of a Christmas Sale.

A number of ex-demo microcomputers and peripherals are being offered to callers at the Newbury (40 Batholomew Street, Newbury RG14 5LL) and Northern showrooms. A large range of components, keyboards and other small items will also be available at reduced prices.

Small Orders

Another well established company who have long recognised the enormous potential of the amateur electronic constructors' market is Neosid Ltd.

A major supplier of ferrite components, coil assemblies and plastics coil formers, this company has now formed a Small Order Division to cater for the amateur's special needs.



Lektrokit Link-wire pack.

A Small Order Catalogue is available from Neosid Small Orders, Dept EE, P.O. Box 86, Welwyn Garden City, Herts, AL7 1AS. Send a large self stamped addressed envelope.

Constructional Projects

As the *EE Loft Alert* is likely to be our most popular project, and be tackled by the less experienced as well as the more advanced constructor, we recommend that only first grade components be used.

The thyristor type C103YY is available from R.S. retail outlets. A type MCR102 from Maplin and the 2N5060, 2N5061 from Watford Electronics can be used.

If any other type of bead thermistor than that specified is used it will obviously mean circuit "tuning". The type used in our unit was an RS Components miniature bead type (stock No. 151-136) equivalent for the VA3400.

Any relay may be used provided the coil resistance is above 100 ohms and will operate with a voltage of 6 to 9V. A suitable type is the Keyswitch SM2P/12/185 which is a nominal 12V type but works down to 5V. Another two types which seem suitable are the Maplin FX27E and the Watford RL.

Part three of the *EE Radio Control System* this month deals with the Receiver.

We understand that designer approved parts for the complete EE System are available from Cheshire Model Supplies Ltd., 55 Cheadle Road, Cheadle Hulme, Cheshire.

Because of the small size of the receiver, and the "dense packing" of components on the printed circuit board it is essential that the specified types of capacitors and resistors are used. Resistors rated at up to ¼W should be suitable, but ⅓W types (as available from Electrovalue Ltd) are recommended.

The firm S.L.M. (Model) Engineers Ltd., Chiltern Road, Prestbury, Cheltenham, Glos., can supply control pots, cases and those other items specifically indicated "SLM" in our components lists. They do **not** however supply standard circuit components.

The short spring-line module called-up in the *Spring-Line Reverb Unit* is only available from Maplin Electronic Supplies, stock No. XL08J. All other components for this project are readily available from most advertisers.

The ZN1034E timer i.c. for the *Mains On/Off Timer* is listed by C. N. Stevenson, T.K. Electronics, Technomatic and Watford Electronics.

No buying problems are envisaged for the *Uniboard 9V Power Supply* project.

UNIBOARDS

SIMPLE TRANSISTOR DESIGNS 3

By A.R. Winstanley

9V POWER SUPPLY

CONSTRUCTION starts here

WITH one exception, all projects described in this series have been designed to operate from a 9 volt rail. In certain instances, however, it would be considerably more convenient to power the project from the domestic mains supply.

The 9 Volt Power Supply was designed with economy in mind. It was to be built as cheaply as possible, and as such it should eventually pay for itself in terms of the cost of dry batteries. Although the circuit is rather basic (and is not transistorised) the unit has proven quite adequate to operate the projects in this series.

CIRCUIT DESCRIPTION

The circuit diagram is shown in Fig. 1. Transformer T1 is a valve heater transformer with a mains primary and a 6·3V a.c. 300mA secondary. Mains voltage is applied to the primary and stepped down to 6·3V. This low a.c. voltage is presented to D1—D4.

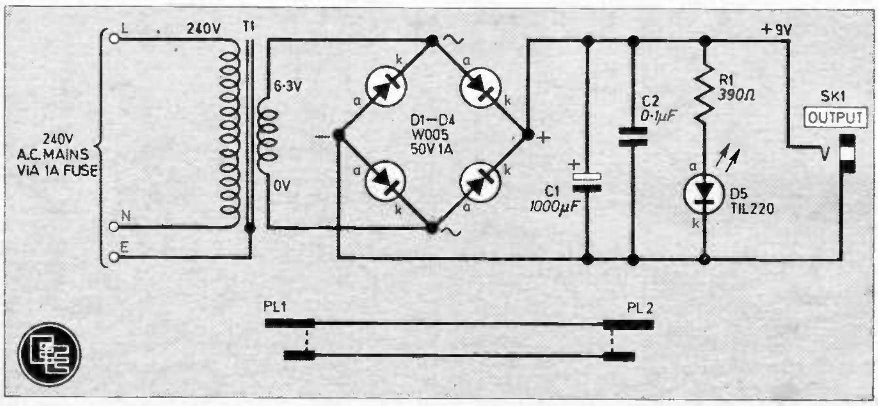
The diagram illustrates four separate rectifiers but in fact a single encapsulated unit, containing four rectifiers, called a "bridge rectifier", is used.

The bridge rectifier converts the a.c. into a pulsating d.c. voltage. Capacitor C1, being a very large value electrolytic capacitor, smoothes out the pulses to give a nominal d.c. voltage of about 9V with a reasonably low ripple content sufficient for our purposes here.

Finally, a light-emitting diode, D5, together with its associated current-limiting resistor R1, forms a "power on" indicator. A further bonus is that if for some reason, the output of the p.s.u. is shorted, the l.e.d. will extinguish, so indicating a fault present.

A 3·5mm jack socket SK1 is used as the outlet for the 9V supply. The tip of the plug inserted in SK1 is connected to +9 volts.

Fig. 1. Circuit diagram for the 9V Power Supply. The output connecting lead is terminated with jack plugs PL1 and PL2. The jack tips carry the positive (+9V) supply.



The prototype unit was housed comfortably in a readily-available PB1 type plastic box, measuring 115 x 75 x 35mm. It is recommended however that the heater transformer is acquired first, and then a plastic box of appropriate dimensions chosen to house it.

The circuit is built on 0·1 inch matrix stripboard measuring 10 strips x 24 holes as shown in Fig. 2. There are no problems with this aspect of construction, but it is extremely important that both the p.c.b. mounting electrolytic capacitor and the bridge rectifier are correctly orientated.

The completed board is mounted on the inside face of the end opposite main cable exit by means of 6BA spacers, nuts and bolts.

The interwiring is as shown. A cable retaining clamp should be fitted to the main cable to prevent it from pulling out. Also, note how the earth input of the mains cable is connected by means of a solder tag to the transformer mounting frame, using one of the mounting bolts.

The l.e.d. can be positioned and secured using the special-purpose plastic clip normally provided. Finally, a 1 amp fuse must be fitted in the mains plug.

VENTILATION

It was found that the transformer itself did tend to get rather warm during normal operation. To counter this a series of ventilation holes have been drilled in the case. If necessary, a piece of aluminium mesh, or perforated zinc, should be glued behind the holes to prevent any objects poking through the holes and possibly touching mains wiring inside.

Jack sockets have been used in the individual projects to facilitate the connection of the 9 Volt Power Supply. A common audio lead, terminated with a 3·5mm jack plug each end, is all that is required to make the connection.

Note that the audio lead must be connected up before the p.s.u. is switched on: if the p.s.u. is switched on first and then plugged into the project, it is possible that the jack plug can temporarily short out the power supply, perhaps having a detrimental effect.

Next Month: Touch Switch

The finished power supply showing the small ventilating holes and the 9V output jack socket.

COMPONENTS

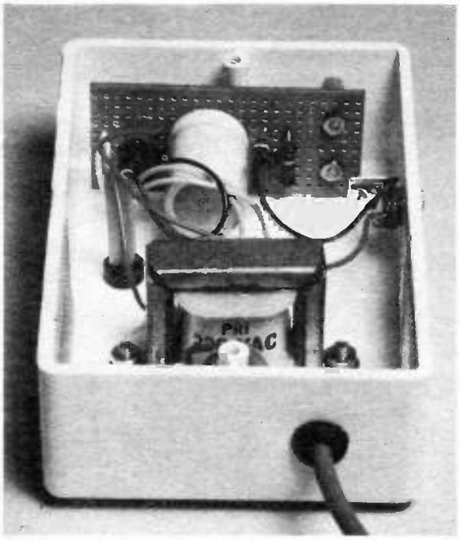
Resistors
R1 390Ω ¼W carbon ±5%

Capacitors
C1 1000μF 25V radial elect.
C2 0·1μF polyester type C280

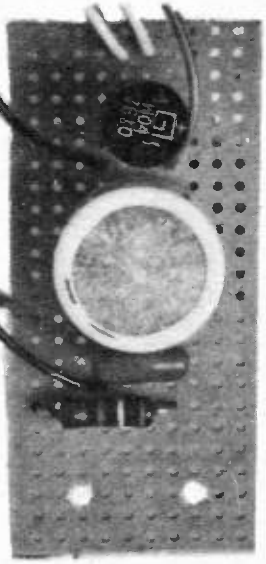
Semiconductors
D1—D4 50V 1A diode bridge type W005 or similar
D5 TIL220 l.e.d. or similar

Miscellaneous
T1 mains primary/6·3V-300mA secondary
SK1 3·5mm jack socket
PL1,2 3·5mm jack plug (2 off)
Stripboard: 0·1 inch matrix size 10 strips × 24 holes; mounting bush for D5; case type PB1, see text; cable retaining clip/grommet; p.v.c. insulated connecting wire; 3-core mains cable; 6BA fixings, nuts bolts, washers, stand-off spacers, solder tag;

Approx. cost Guidance only
£3.25



Layout of components inside the case. The circuit board is mounted on the side of the case using 6BA spacers.



Completed circuit board.

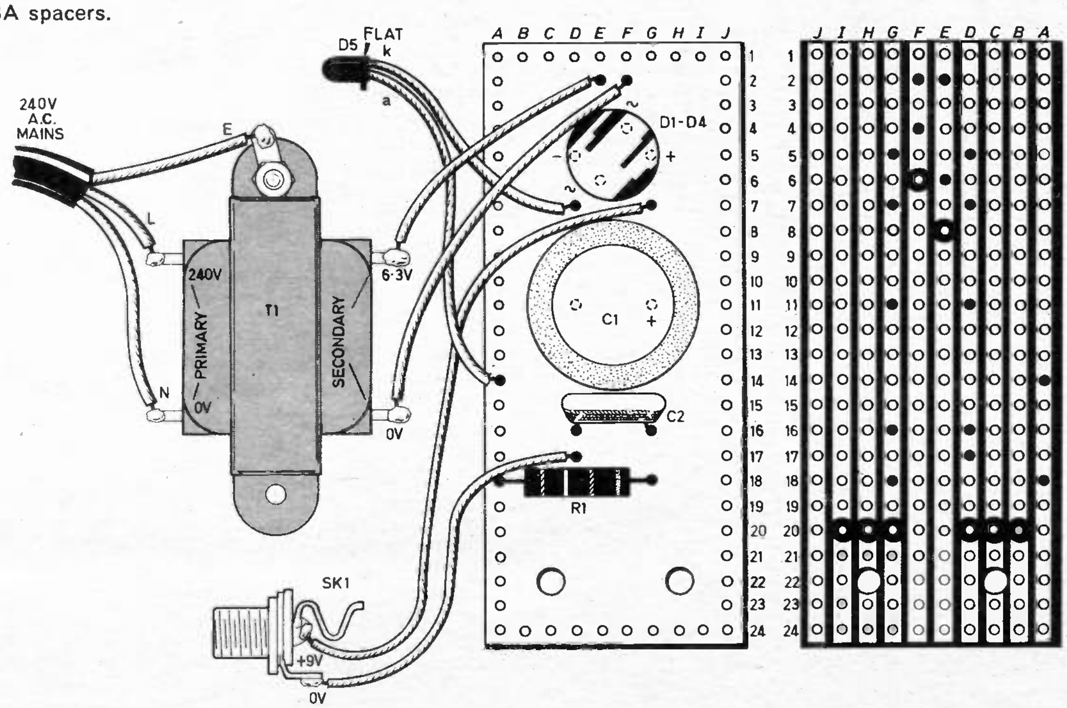
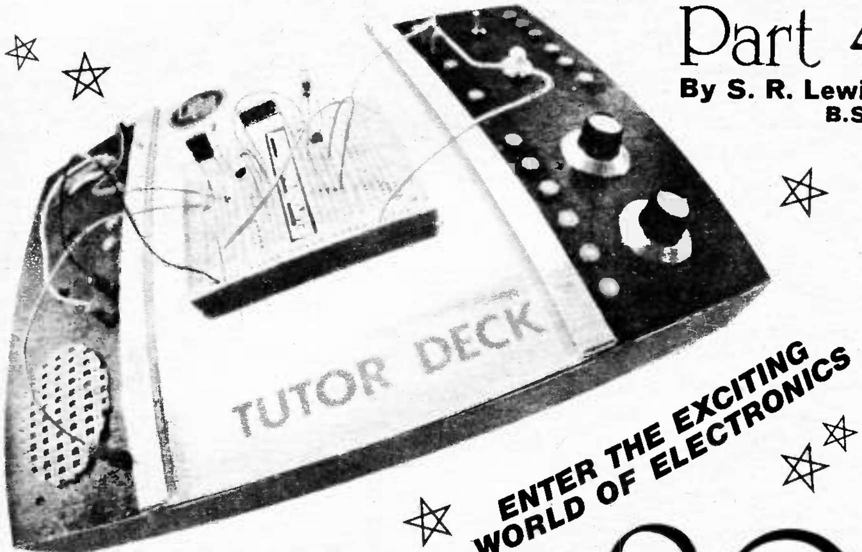


Fig. 2. Layout of components on the topside of the stripboard, breaks to be made on the copper strips on the underside and interwiring details to the mains transformer, light emitting diode (D5) and output jack socket (SK1).



ENTER THE EXCITING WORLD OF ELECTRONICS

TEACH~IN 80

Part 4

By S. R. Lewis, B.Sc.

THE success of electronics as we know it today is based entirely on the growth of the semiconductor industry. Whilst electronics was certainly thriving in the valve era the real potential of electronics could only be realised by producing a small, cheap, low-power alternative to the valve.

Investigation and development just after the last war led to the production of the first **transistor.** It was apparent that the basic components of the transistor—**semiconductor junctions**—could also be used to build a range of devices each with special characteristics.

In this part of the series we will look at the simplest semiconductor junction device—the **diode.** Understanding the operation of this relatively simple two-terminal device will aid the understanding of the more complex three-terminal transistors.

ONE-WAY CURRENT

The major point to understand concerning diodes is that whilst they have two terminals just like a resistor the two ends are not identical. Looking at an actual diode the two ends appear the same with the exception that the body of the diode has a ring at one end, so just what is the difference?

The answer to this is that the diode is a device sensitive to the *direction* of flow of current through it. It does not matter which way round a resistor is put in a circuit, it will still behave in the same way. A diode, on the other hand, appears like two different devices depending on which way round it is connected.

We obviously need to be able to refer to the two ends of a diode using separate names and Fig. 4.1 shows the circuit symbol for a diode next to an actual diode with the terminals marked with their commonly accepted names—**anode** and **cathode** (the latter usually abbreviated to "k"!). The symbol for a diode is an arrow and this gives a clue to its properties.

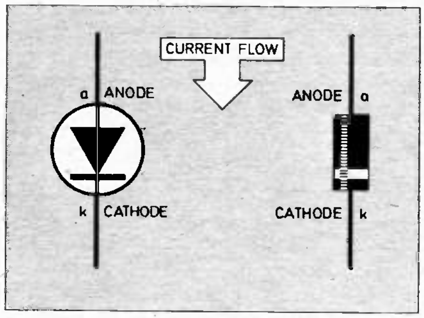
When current flows through the diode from anode to cathode (in the direction of the arrow) the diode presents very little resistance to that current—it is a good conductor. If we try to pass current from the cathode to the anode (against the arrow) we will have great difficulty. In fact, the diode will break down under the voltage before it will pass any appreciable current.

We can liken the diode to an electronic switch which is either open or closed depending on the direction of the current. It behaves very like a valve (mechanical not electronic) in a tyre which allows air in but not out (Fig. 4.2).

When a diode has a voltage across it such that current tends to flow from anode to cathode we say the diode is **forward biased.** If the voltage is in the opposite direction then the diode is **reverse biased.**

RECTIFICATION

The widespread use of diodes has mainly come about because the majority of electronic equipment



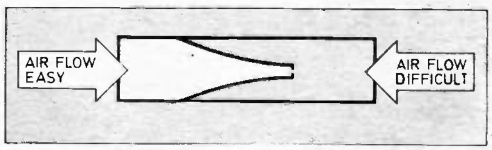


Fig. 4.1 (left). Circuit symbol and names of the two terminals of a diode. Current can only flow in the direction of the arrow.

Fig. 4.2 (above). A tyre valve provides a mechanical analogy of the diode.

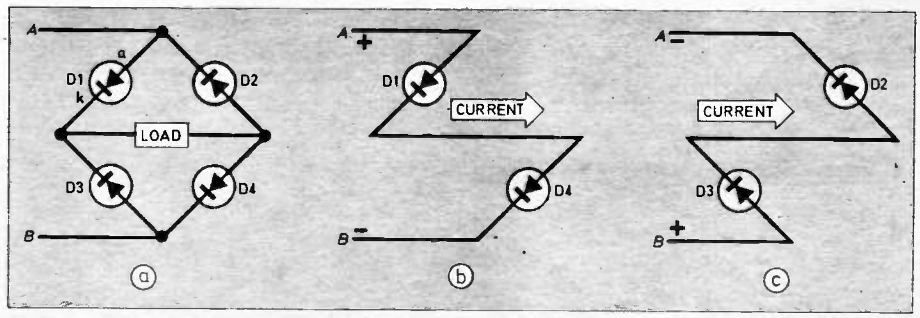


Fig. 4.3. (a) Four diodes connected as a "bridge". The "load" represents either a single component or a whole circuit. (b) shows the path of the current when *A* is positive with respect to *B* and (c) the path when *B* is positive with respect to *A*.

will only operate when supplied with a steady voltage which does not change direction or value with time.

Power as supplied by the electricity generating stations is the opposite to this; it is constantly changing value and direction—in fact doing this 100 times a second.

Diodes are the easiest way (though not the only way) of converting this constantly reversing voltage into one which is in one direction only. In fact four diodes are needed, the arrangement being shown in Fig. 4.3 and usually referred to as a **diode bridge.**

DIODE BRIDGE

When point *A* is positive with respect to point *B*, diodes D2 and D3 are reverse biased; so little current flows through them that they are virtually open circuit. Diodes D1 and D4 on the other hand are forward biased presenting very little resistance to current. The flow of current is thus as shown in Fig. 4.3b.

When the voltage is reversed, that is B positive with respect to A, diodes D1 and D4 are reverse biased while D3 and D2 are forward biased so that the current flows as in Fig. 4.3c. We thus have a circuit where the voltage across the load is the same no matter what the polarity of the power source.

We could use this circuit for protecting a circuit which could be damaged if the battery were connected the wrong way round.

SINUSOIDAL

If the voltage across *A* and *B* is from the mains it will be varying regularly from positive to negative as shown in Fig. 4.4(b). We call this type of waveform **sinusoidal.**

The positive-going half-cycle will be passed by D1 and D4. The negative-going half-cycle will be passed by D2 and D3. After passing through the diode bridge circuit the waveform appears as at (c). Notice that while it is still varying, it is always of the same polarity (the way in which this "pulsating" voltage is converted into a steady d.c. voltage will be described later in this series).

The process of converting an alternating voltage into a single polarity voltage is referred to as **rectification.** Very often the four

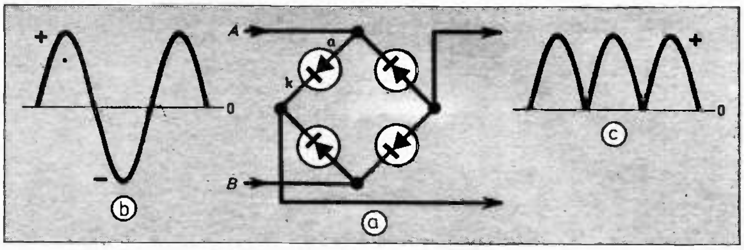


Fig. 4.4. (a) Mains voltage being rectified by a diode bridge. The bidirectional voltage (b) has been converted in to a voltage of a single direction (c)

diodes needed are supplied in a single package with four leads. This is known as a **bridge rectifier.**

NON-LINEARITY

It was stated earlier that a forward-biased diode presents very little resistance to current flow but this statement needs some elaboration.

It is found that, in the forward direction, the diode has a **non-linear** relationship between applied voltage and current. In other words, if the current is 1mA with a forward voltage of 0·5V it is not true that 2mA will flow with an applied voltage of 1V.

A graph of current plotted against voltage for a typical silicon low-current diode is shown in Fig. 4.5. Two points concerning the graph are of particular interest.

The first is that the voltage range of the graph is very small, only going from 0 to 1V. If we look at the graph near the point where 0·7V is applied to the diode we see that a very small change in voltage is needed to produce a large change in current. Alternatively this may be stated as large changes in current produce small changes in diode voltage drop.

It turns out that this voltage is mainly dependent on the materials from which the diode is made. Silicon diodes have a constant voltage characteristic around 0·7V and germanium diodes (now rather uncommon) at 0·2V.

The second point is that at low applied voltages the current is very small, that is the diode has high resistance.

What conclusions can be drawn from the graph? Firstly we can deduce that even when passing a high current the diode will be dropping about 0·7V. In order for the diode to be an efficient rectifier, this voltage should be small with respect to the voltage to be rectified.

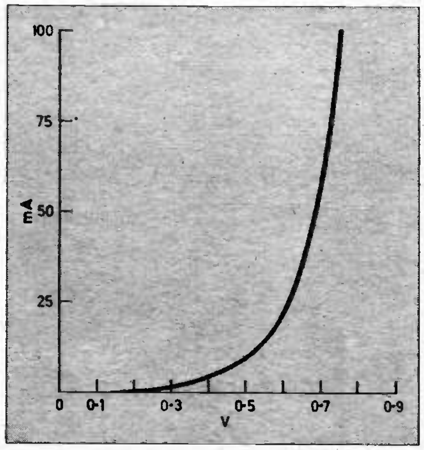


Fig. 4.5. Current plotted against voltage for a typical low-current silicon diode.

The fact that the voltage across the diode is relatively stable and predictable leads to another use of the diode: as a **constant voltage source.** Audio amplifiers often use forward biased diodes to derive stable bias voltages for output stages.

SEMICONDUCTOR JUNCTIONS

Whilst understanding how diodes behave in a circuit is fairly simple, understanding how they are made and how they actually work is far more difficult. One really needs a thorough knowledge of physics to appreciate semiconductor operation but the general principles are as follows.

Diodes nowadays are made from a single piece (or chip) of silicon which is specially treated when in its molten state. The two halves of the diode are exposed to two types of gas which give each half distinct properties.

The process of introducing tiny amounts of impurities into the silicon in this way is known as **doping.**

One half of the diode-to-be is "doped" with a carefully chosen material whose atoms have one more electron than the basic silicon—it is like creating a surfeit of electrons. The other half is doped with a material whose atoms have one less electron than silicon—this is like creating a deficit of electrons.

Where the two forms meet, a field appears which tends to oppose any electrons which try to cross from one side to the other; we call this a **potential barrier.**

A forward bias on the diode tends to reduce the "height" of the barrier allowing more electrons to flow, hence conduction in this direction is easy. Applying a reverse bias however tends to increase the size of the barrier so very little conduction takes place (until the field is so high that the barrier breaks down). See Fig. 4.6.

This description obviously raises a lot of questions but it should give a feel for the sort of processes occurring in a diode.

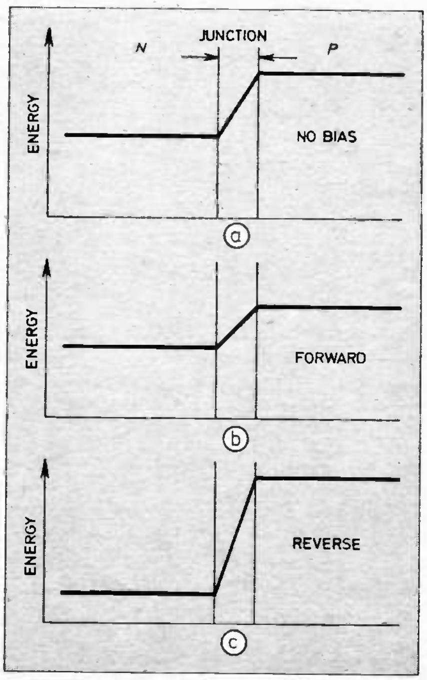


Fig. 4.6. The potential barrier in (a) an unbiased junction (b) a forward-biased junction and (c) a reverse-biased junction.

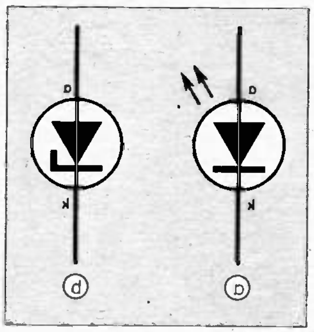


Fig. 4.7. (a) Circuit symbol of a light emitting diode (b) circuit symbol of a Zener diode.

LIGHT EMITTING DIODES

When electrons cross the potential barrier in a forward biased diode they change from a high energy state to a lower energy state. The energy that they lose can appear either as heat or as light.

The materials from which diodes are made determines in which form the energy appears. By making a diode out of gallium, arsenic and phosphorus it is possible to produce a diode which releases a high proportion of the energy change of the electrons as visible light. When these diodes are placed in special translucent packages we have **light emitting diodes (l.e.d.s)** which are becoming so familiar today. The symbol is shown in Fig. 4.7a.

Light emitting diodes usually require a forward current of about 10 to 20mA for efficient light generation. At these sort of currents the voltage drop across the diode is around 1·6V although it may be up to 2V for some types of l.e.d. At the present time the colours available are red, through orange and yellow to green. Blue has proved a very difficult colour to produce although it was recently announced that a blue diode has been manufactured albeit very inefficient.

As well as single light emitting diodes, arrays of diodes can be combined to form **seven-segment l.e.d. displays** so familiar in calculators and digital clocks and watches.

ZENER DIODES

As the reverse voltage across a diode is steadily increased there comes a point where the diode "breaks down" and suddenly becomes a good conductor. If the current is controlled so that the diode does not burn itself out we have a very useful component: the **Zener** or **reference voltage diode.**

By controlling the geometry of their diodes, manufacturers have been able to produce diodes with a huge range of **breakdown** or **Zener voltages.**

The useful thing about the breakdown characteristic is that the current can be varied over a large range with hardly any change in voltage. A typical Zener diode can produce voltages stable to a few tens of millivolts at a voltage of 10V.

Zener diode specifications usually refer to both the Zener voltage and the maximum power dissipation of the diode. The maximum current that must be allowed to pass through the diode is the maximum power dissipation divided by the Zener voltage. Thus a 4·7V 400mW diode must not carry more than 400/4·7 or about 85mA. The symbol for a Zener diode is shown in Fig. 4.7b.

DIODE SPECIFICATIONS

Diodes come in a variety of shapes and sizes. Manufacturers specify two main properties of their diodes: the **maximum forward current** (I_{max}) and the **peak inverse voltage (p.i.v.)**, that is the maximum safe voltage that can be placed across the diode in the reverse direction that will not cause breakdown.

A diode in a transistor radio may have a p.i.v. of 50V and an I_{max} of 100mA. One in a power supply could have a p.i.v. of 600V and an I_{max} of 5A.

When large currents flow through a diode heat is generated so the packages of heavy current diodes are usually designed to bolt onto a piece of metal (a **heatsink**) to help keep the diode cool.

DIODE GATES

We have seen how diodes are similar to switches, having two states one high resistance and the other low resistance, the "switch" being controlled by the direction of the current flow.

The principle can be put to further use in what is known as the diode **gate**.

A "gate" as the name implies can be either open or shut. In real terms this means that a voltage is used to control the flow of current into another part of the circuit.

The circuit of a simple diode gate is shown in Fig. 4.8. The controlling voltage is applied at point *A*, the voltage to be controlled being that at point *B*.

EXPERIMENT 4.1: DIODE BRIDGE RECTIFICATION

Components needed: 1kΩ resistor, 100kΩ resistor, IN4148 diodes (4 off)

The circuit diagram for an experiment to investigate diode bridge rectification is shown in Fig.4.10(a) with the layout of the components on the Tutor-Deck in Fig.4.10(b). Note these additional connections on right hand panel of Tutor Deck: link S1(a) to B1 +9V; link S1(c) to B2−9V.

Switch S1 is used to produce either +9V or −9V at point *A*. Since the meter can only indicate 100μA or so, a resistor R2 is used as the main current path, with the meter (in series with R1) used to indicate the polarity of the voltage across R2.

It will be found that whatever the setting of S1, the polarity of the voltage across R2 will be the same.

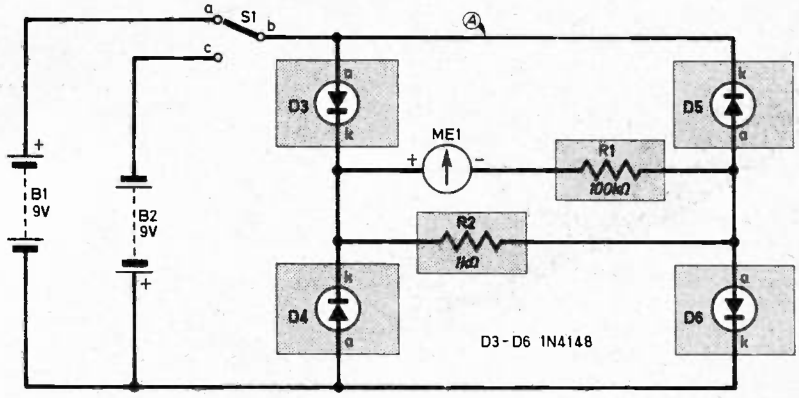


Fig. 4.10 (a) Circuit diagram showing the diode as a rectifier with (b) showing the component layout on the Tutor Deck.

For identification of Tutor Deck components and their associated sockets refer to Fig. 2.8.

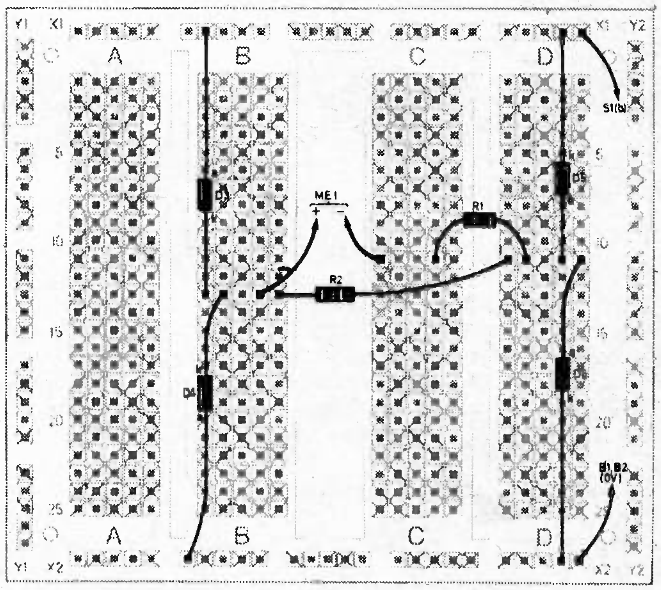


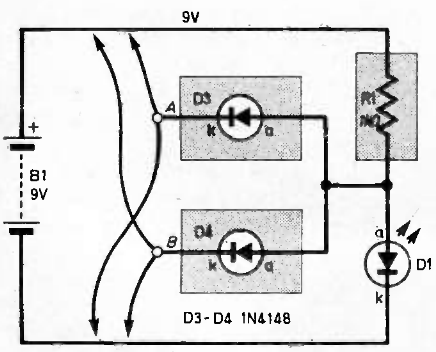
Fig.4.10b

EXPERIMENT 4.2: DIODE "AND" GATE

Components needed: 1kΩ resistor, 1N4148 diodes (2 off)

The circuit diagram for the simple two diode AND gate is shown in Fig.4.11(a) with the layout of the components in Fig.4.11(b).

The l.e.d. D1 serves a dual purpose; it forms both the output diode and the load. When either input *A* or input *B* is taken to 0V the l.e.d. will be off, since all the current through R1 will flow through D3 or D4. Only when both inputs are taken to 9V (or left open-circuit) will the l.e.d. light. We say the input *A* AND input *B* must be at logic "1" before the output is at logic "1".



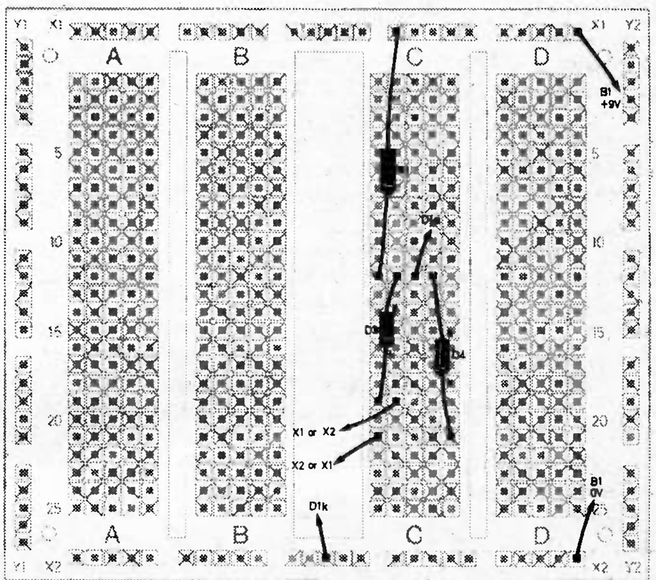


Fig.4.11b

Fig. 4.11 (a) Circuit diagram of a simple two-input diode AND gate. (b) shows the layout on the Tutor Deck.

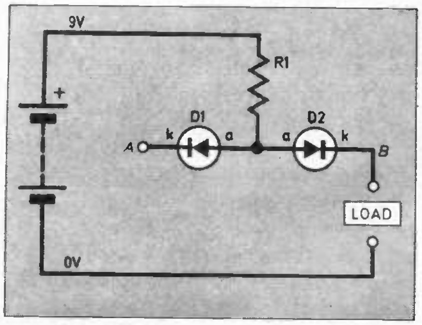


Fig. 4.8. Circuit of a simple diode gate. The voltage at *A* is used to control that at *B*.

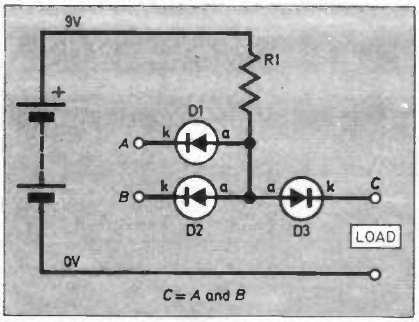


Fig. 4.9. A diode AND gate. All inputs must be at logic "1" (9V) for the output to be high.

PART 4 QUESTIONS

4.1. A diode with its cathode more positive than its anode is said to be
 a) forward biased
 b) reverse biased
 c) neither

4.2. A diode in a circuit is found to have a voltage drop from anode to cathode of 0·2V. Is the diode most likely to be
 a) silicon
 b) germanium
 c) gallium arsenide

4.3. A 10V 1·3 watt Zener diode should not be allowed to pass more than
 a) 1·3A
 b) 130mA
 c) 13mA
 d) 1·3mA

4.4. An AND gate output will only be at logic "1" when
 a) all
 b) none or
 c) some of its input are at logic "1".

4.5. The stripe on an 1N4148 diode indicates
 a) the anode
 b) the cathode
 c) the emitter

PART 3 ANSWERS

3·1. c) 3·2 a) and c) 3·3 b) 3·4 c)

Consider what happens when *A* is taken to 0V. Diode D1 will be forward biased, current flowing through R1. The voltage drop across D1 will be about 0·7V (assuming it is silicon). A load connected from the cathode of D2 to 0V will therefore have no voltage across it.

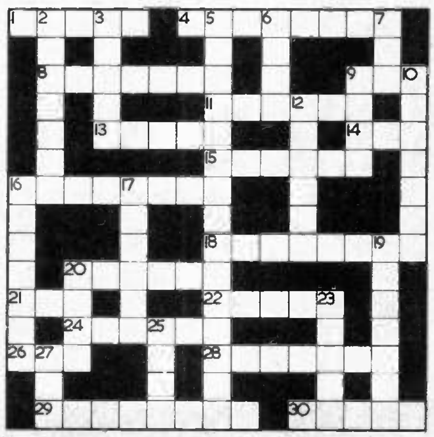
If A is now taken to 9V diode D1 will have zero voltage across it. Now all the current will flow through R1, D2 and into the load.

If the usefulness of this circuit is not apparent, consider the case when, instead of just a single diode, two or more diodes are used in place of D1. Now connecting any input diode to 0V will cause zero voltage to appear across the load. What we have is the basis of a simple **logic gate,** in fact an AND **gate,** see Fig. 4.9.

Logic is a whole subject on its own and we will not go into further detail at this stage. However, from these simple beginnings quite elaborate logic circuits were developed leading to the immensely complicated logic circuits used in today's computers.

Next month we will look at capacitors.

EE CROSSWORD No 23 BY D. P. NEWTON



ACROSS

1 A kind of biscuit found with chips (5).
4 Complete temperature scale (8).
8 Conducts into kidnapping (7).
9 Grille makes sick (3).
11 Metallic ion form expressing the perverse timing of Fate (6).
13 Would another revolution make the i.c. so antique? (5).
14 Short beats give sustaining activity (3).
15 Those heartily felt surges (6).
16 A switch that's a bit shaky (8).
18 Free electricity? (2, 6).
20 Sea with icy connections (6).
21 Phoney part of 25 down (3).
22 Characteristic curves are seldom so perfect (5).
24 Often a cause of an open-circuit but has a capacity to be useful (3, 3).
26 We couldn't solder on with it (3).
28 A stratum characteristic of the i.c. (7).
29 To put down interference (8).
30 Measuring term (5).

DOWN

2 It avoids mis-match at the terminal (7).
3 Aged solder partly but more personal (5).
5 We all must have them to make any start at all (5, 10).
6 Sound tone clipped to place above (4).
7 The fishy part of electricity (3).
9 When 10 down cools off, do we get these? (4).
10 Type of network (7).
12 Nothing like 18 across in part (2, 4).
16 Early galvanometer (7).
17 Bulb coiler tails off to immersion heater (6).
19 One electrode turned cooker (7).
20 All brain but no eye for food (4).
23 Glare makes it big (Anag.) (5).
25 Cog (4).
27 They are common to the electronics of 13 and 28 across (3).

Solution on page 60

next month

SLIDE/TAPE SYNCHRONISER

A compact unit that enables the amateur photographer to give the professional touch to his slide presentation. A simple, cheap and effective design giving fully automatic slide changing with optional manual overide. For use with any slide projector fitted with a remote control socket.

MICRO MUSIC BOX

A touch operated music box using a microprocessor. From a total repertoire of 24 tunes, it plays a selected bank of 8 tunes in rotation by automatic sequencing when operated.

MORSE PRACTICE OSCILLATOR

A very simple project to aid those learning and teaching Morse Code. Contains complete list of Morse alpha-numerics.

SIMPLE SHORT WAVE RECEIVER

This t.r.f. type receiver is designed to combine both simplicity and good performance. Suitable for both Amateur Band and Broadcasting Band listening. Frequency coverage of 1·67 to 31·5MHz in three ranges with c.w. and s.s.b. as well as a.m. resolution.

Special offer
FOR EE READERS
Mini 20 Multimeter

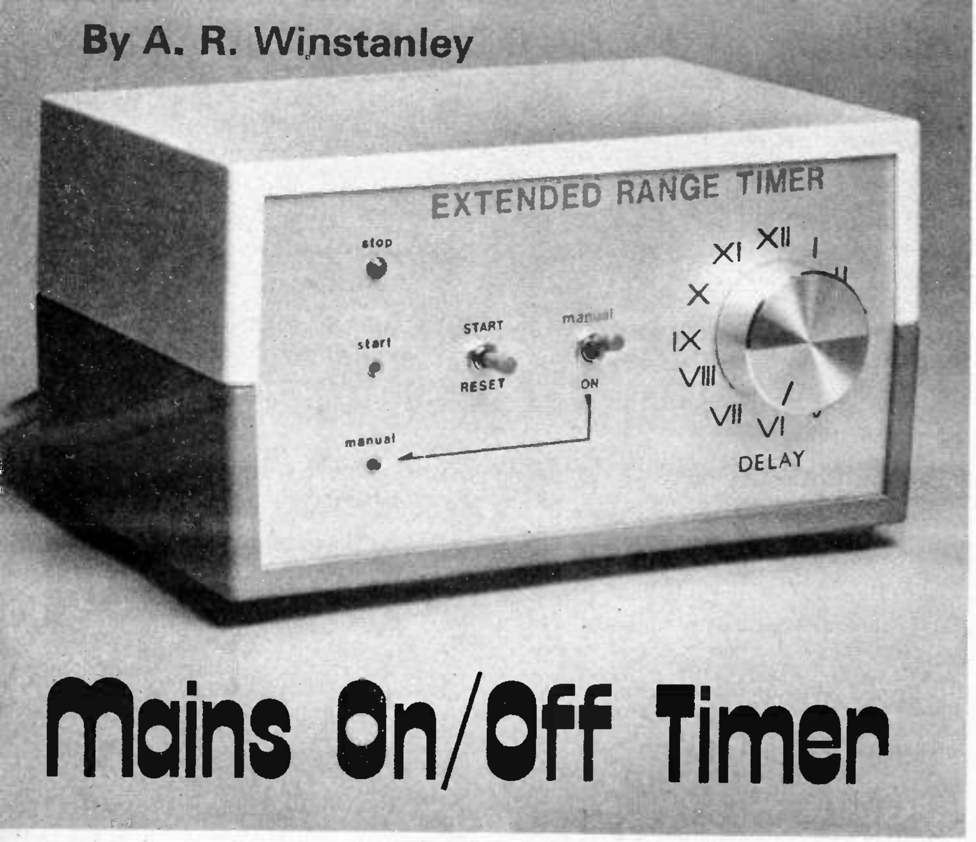
★ A 27-range instrument
★ Ideal for the constructor and experimenter

Full details in February issue

Everyday ELECTRONICS

FEBRUARY 1980
ISSUE ON SALE
FRIDAY, JANUARY 18
Price 50p

By A. R. Winstanley



Mains On/Off Timer

PERHAPS one of the less pleasant ways of starting a day is to be awoken to the nerve-shattering jangling of one very large and very loud alarm clock! There must be better ways of being roused from sleep, and this project would seem to make life a little easier in this respect.

TIMED DELAYS

The Mains On/Off Timer is a versatile unit which will generate timed delays of up to twelve hours in one-hour increments. Once this period is up the Timer will switch on or switch off any mains load connected to its output sockets, and this load can have a power rating of up to 1800 watts; therefore the unit is suitable for driving many appliances.

Thus by connecting a mains radio to the Timer and setting the appropriate delay, one can be awoken to the more acceptable strains of Terry Wogan.

The Timer utilises the Ferranti ZN1034 precision timer i.c. to produce very accurate timing periods using low value timing components when compared with typical component values used with, for example, the NE555 timer.

Also, the ZN1034 is equally at home producing delays of one second or one week—compare this with the maximum one hour delay generated by the 555. Indeed, by using two ZN1034 timers a delay of up to one year is attainable.

THE TIMER I.C.

The internal circuitry of the ZN1034E (the 'E' denotes a 14-pin d.i.l. package) is very simply illustrated in Fig. 1. The i.c. features an on-chip oscillator and twelve-stage divider. The frequency of oscillation is determined by an external *RC* circuit. When the oscillator has cycled 4095 times the control logic switches over the complementary outputs at pins 2 and 3.

The external *RC* circuit therefore determines the delay period which the i.c. will generate. The use of an oscillator and counter in this manner enables an *RC* circuit with a relatively low time constant to be utilised to deliver relatively long delays.

The timing period is given by the formula

$$t = k \times R \times C$$

where t is the delay (seconds)
R is the external timing resistor (ohms)
C is the external timing capacitor (Farads)
and k is a multiplying constant.

The constant, k, is determined by the value of a "calibration resistor." With pins 11 and 12 of the i.c. linked, an internal 100 kilohm resistor is selected, and $k = 2736$.

If pins 11 and 12 are linked by a 50 kilohm resistor then the calibration resistor is increased to 150 kilohms and $k = 4095$. If instead a 300 kilohm resistor is connected between pin 12 and ground then k becomes 7500, and in this mode the i.c. is able to produce its longest delay periods. If the internal resistor is used, this will give the best coefficient of temperature, but whatever method is chosen, the calibration resistor should not exceed 300 kilohms.

When choosing values of R and C, the following limits apply:

$$5k\Omega \leq R \leq 5M\Omega$$
$$C \geq 3300pF$$

The timing period commences when the device is triggered by grounding pin 1. Two complementary outputs are available at pins 2 and 3; pin 2 ($\bar{Q}$) is normally high and goes low during timing; the opposite is true of pin 3 (Q).

COMPONENTS approximate cost £25

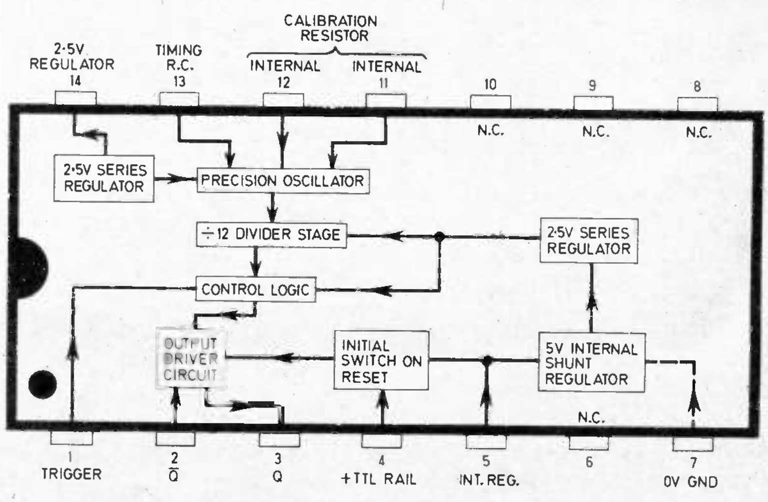


Fig. 1. Block diagram of the internal circuitry of the ZN1034 i.c.

A typical "high" value would be about 3·5V and a "low" would be in the order of 0·3V. When either output is high, it can supply current of up to 25mA to the load connected to it; but when the output is low, if the load is biased correctly then current may sink into the output, and again this current must be limited to 25mA.

POWER REQUIREMENTS

Concerning the power supply rails, the i.c. will operate directly from 5V to 450V d.c. When used with a 5V rail (as with TTL circuits) then pin 4 can be connected straight to +5V. Alternatively when used with a rail exceeding 5V, a series resistor must be connected between pins 4 and 5 and the positive rail. A 5V shunt regulator on pin 5 takes care of the rest.

The value of this series resistance is given by

$$R_s = \frac{(V_s - 5)}{I}$$

where R is the resistor value (ohms)
V_s is the supply rail voltage
and I is the current flowing through the resistor. (amps)

The current is 5mA plus any current drawn at the outputs.

A switch-on reset is incorporated into the chip which resets the time delay if the supply is interrupted.

OSCILLATOR FREQUENCY

The actual precision oscillator can be observed in operation by placing a high-impedance frequency meter or cathode-ray oscilloscope on pin 13. The impedance must be at least ten times that of the timing resistor or the test instrument impedance may alter the *RC* constant.

The actual delay period will be 4095 × period of waveform measured on the 'scope. Measuring the oscillator frequency in this way is often more desirable than having to wait a few hours to check the accuracy of the timer. A provision has been built into the Timer to allow measurement of the oscillator period with an oscilloscope.

CIRCUIT DESCRIPTION

The complete circuit diagram of the Timer is shown in Fig. 2. Mains voltage is stepped down by T1 to 12V a.c. This is rectified by D1-D4, an encapsulated bridge rectifier and smoothed by C1 to produce an unregulated supply of some 17V d.c.; R1 is a series dropping resistor which permits the operation of IC1 from the 17V supply. Capacitors C2, C3 and C4 are used to decouple the supply rails and serve to reduce any spurious noise.

The internal 100 kilohm calibration resistor is brought into circuit by the link between pins 11 and 12. Capacitor C5 is the timing capacitor and switch S3 is a 12-way rotary switch which selects the timing resistor. With S3 at position 1, a 390 kilohm resistor is selected as the timing resistor. The delay t is thus

$$t = k \times R \times C$$
$$= 2736 \times 390\text{k}\Omega \times 3{\cdot}3\mu\text{F}$$
$$= 3521 \text{ seconds or about}$$
one hour (58 minutes)

(Internal 100 kilohm calibration resistor selected, so $k = 2736$.)

With S2 in position 2, two 390 kilohm resistors are in circuit and the delay is about two hours, and so on. No preset has been included in the timing resistor chain which might allow exact trimming of the oscillator period to produce spot-on delays (e.g. exactly one hour). Such a preset would obviously be nearly impossible to set up unless an oscilloscope or frequency meter was available to help. In fact reasonable accuracy is obtained when a tantalum capacitor is used for C5.

Socket SK3 is optional and permits the measurement of the basic oscillator period with test equipment. With a 10 megohm c.r.o. and probe, this socket should be usable with the timer set for a delay of up to three hours. After this the scope impedance might cause false readings to be taken.

The i.c. is triggered by grounding pin 1 via S2. The switch-on reset can be utilised to cut short the time delay if required: this can be done by temporarily interrupting the 17V

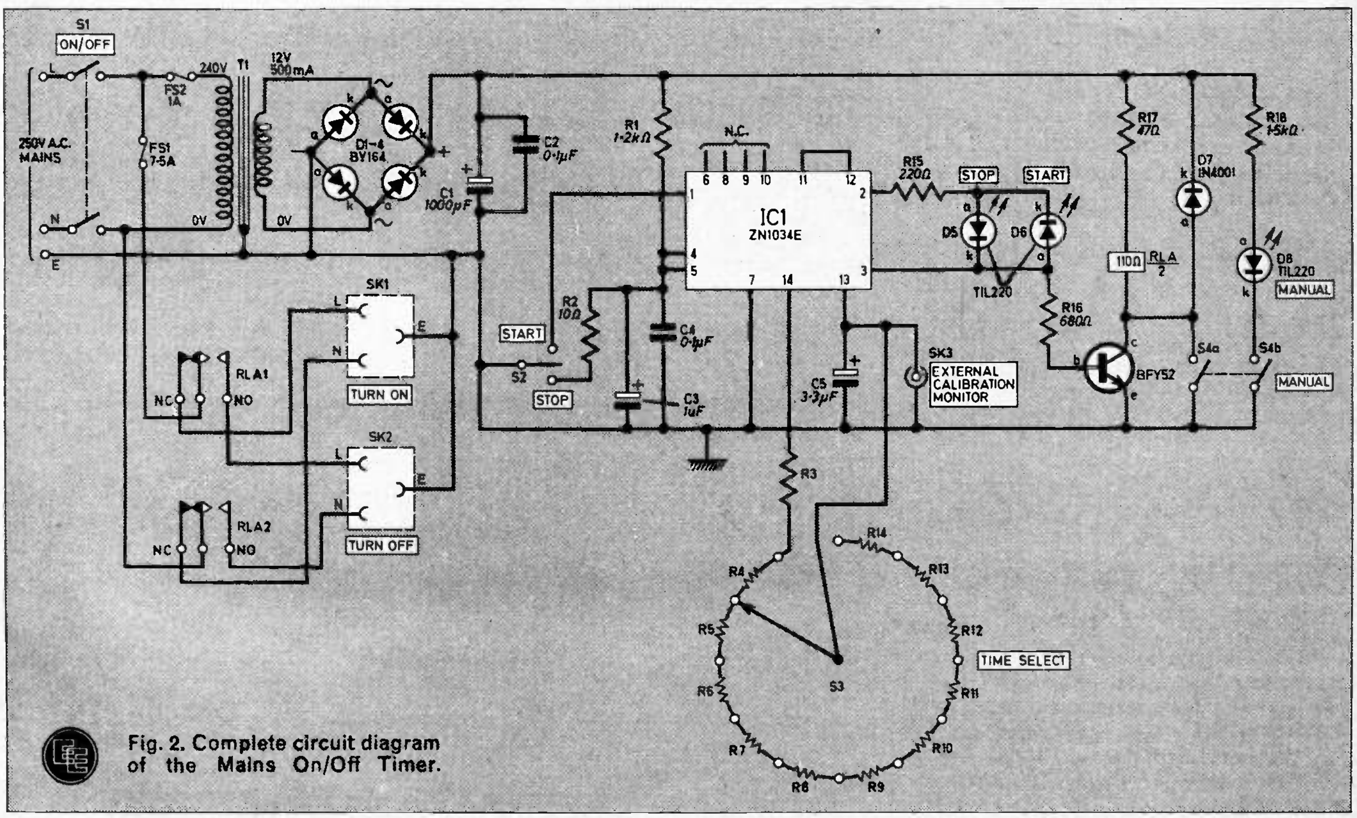
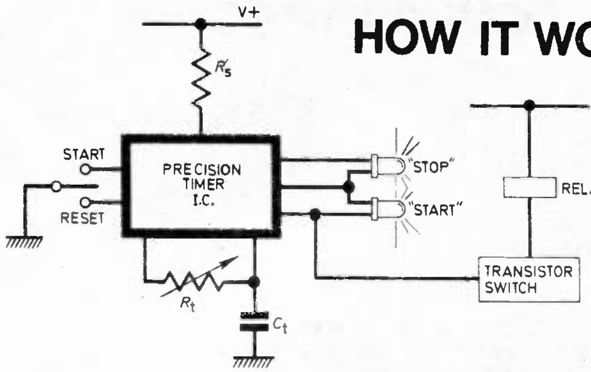


Fig. 2. Complete circuit diagram of the Mains On/Off Timer.

HOW IT WORKS



A precision timer i.c. forms the basis of this design. An external *RC* network (R_t and C_t) alters the frequency of an internal oscillator. When the oscillator has cycled 4095 times, the internal i.c. logic detects this and causes a transistor to switch off, thereby removing power from the relay coil and turning off the mains load.

Two complementary outputs are available on the i.c., and both are utilised to provide a visual indication by means of two l.e.d.s to signal whether the timer has "started" or "stopped."

The i.c. is both triggered and reset with one switch. Timing resistor R_t is varied in steps by means of a rotary switch to allow different delays to be obtained. The Timer generates delays of between 1 and 12 hours, but in theory the i.c. can deliver delays of between about 15 microseconds and about 3 weeks.

The relay contacts switch the mains load off after the delay is up, but in this design by utilising both sets of changeover contacts, the load can be switched on or off after the delay.

supply to the i.c. with a normally-closed switch. Instead, however, a reset function was derived by grounding pins 4 and 5 with S2—this grounds the i.c. and resets it. Resistor R1 ensures that there is no danger of shorting out the supply, and R2 limits the peak current caused by C3 and C4 discharging to 0V.

By resetting the i.c. in this manner it was possible to incorporate the trigger (START) *and* RESET functions into one switch.

I.C. OUTPUIT

Both of the i.c. outputs are used. When the i.c. is not timing, then pin 2 is high and pin 3 low. Therefore output current flows out of pin 2 and sinks into pin 3, illuminating D5 to indicate the timer has stopped. Light emitting diode D6 cannot illuminate because it is reverse-biased by about two volts. Resistor R15 limits the current flowing in the l.e.d. to less than 10mA—generally enough to cause an easily visible glow.

Upon commencement of the timing period (IC1 being triggered by S2), pin 3 goes high and pin 2 low—D5 must therefore extinguish and D6 illuminates to indicate that the timer has started timing. Also, TR1 switches on with pin 3 going high. This completes the circuit to RLA which now operates. Resistor R17 is a series dropping resistor and is necessary to enable the 12V 110 ohm relay to be used with a 17V supply. A transistor is required because the i.c. cannot possibly supply the 110mA or so required by the relay.

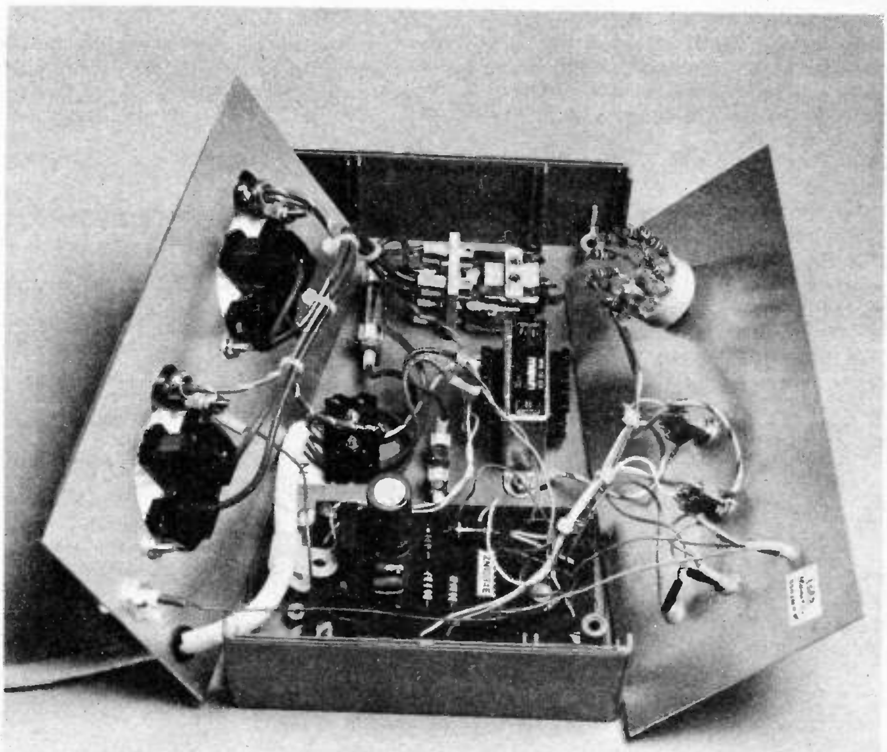
Switch S4 has been incorporated to allow a MANUAL operation of the relay independently of the Timer which switches on the relay itself and illuminates D8 to indicate the manual function.

RELAY

The relay used in the prototype was an R.S. Open Type 348-835 which is equipped with a pair of 10A 250V a.c. changeover contacts. Socket SK1 is connected to the mains through the normally-closed contacts. When the relay operates, these contacts open and switch off the load connected to SK1 which switches on again when the Timer is reset or times out.

The opposite is true of SK2. When the unit is timing, SK2 switches on and switches off when the unit times out. The use of these "complementary" sockets means that any load can be turned on or turned off when the Timer has completed its cycle.

In the final design, the relay contacts have been derated to 7·5A by means of FS1 so that neither the relay contacts or the mains interwiring can be operated at their absolute maximum ratings. Fuse FS2 protects the transformer in case a fault should develop.



Completed Timer with front and rear panels displaced showing interior layout and wiring.

CONSTRUCTION starts here

COMPONENTS

Resistors

R1	1·2kΩ
R2	10Ω
R3-R14	390kΩ (12 off)
R15	220Ω
R16	680Ω
R17	47Ω 1W
R18	1·5kΩ

All ¼W carbon ± 5% carbon except R17 (1W)

Capacitors

C1	1000μF 25V p.c.b. elect.
C2	0·1μF polyester
C3	1μF 35V tantalum
C4	0·1μF polyester
C5	3·3μF 35V tantalum

Semiconductors

D1-D4	BY164 60V 1·4A bridge rectifier
D5, 6, 8	TIL220 or similar l.e.d. with mounting clip (3 off)
D7	1N4001 or similar silicon diode
TR1	BFY52 silicon *npn*
IC1	ZN1034E precision timer i.c. 14 pin d.i.l.

Miscellaneous

T1	Mains primary/12V 500mA secondary transformer
RLA	12V 110 ohm coil with two sets of changeover contacts rated at 250V 10A
S1	d.p.d.t. 10A mains toggle
S2	s.p.d.t. miniature toggle, centre biased
S3	1-pole 12-way rotary switch
S4	d.p.d.t. miniature toggle
SK1, SK2	13A 250V flat pin flush mains socket (2 off)
SK3	See text
FS1	1A 20mm
FS2	7·5A 1¼ inch

Chassis fuse holders for FS1 and FS2; case, Verobox 75-1412-K; glass fibre p.c.b.; 14 pin d.i.l. socket; control knob; 13A cable and plug; p.v.c. insulated interconnecting wire; 10A mains interconnecting wire; 10A connecting block; coloured caps for S2 and S4 (one red and one green); p.c.b. mounting pillars.

See Shop Talk page 19

CIRCUIT BOARD

The circuit is built on a glass fibre printed circuit board for high reliability and strength. The foil layout and component overlay is shown actual size in Fig. 3. The prototype was made using etch-resistant transfers for the tracks and resist ink for the larger areas of copper foil.

There are several points which must be observed when soldering the components to the p.c.b. Firstly make absolutely certain of the polarity of C1. Also ensure the correct orientation of D7. Finally, whilst an i.c. socket was not used on the prototype, it is recommended that one is used to prevent thermal damage to the rather expensive i.c. during soldering. Complete the p.c.b. in accordance with Fig. 3 and then move on to the casework.

CASE DETAILS

The prototype was housed neatly in a plastic Verobox type 75-1412K which has aluminium front and rear panels. The front panel should be drilled to take the three switches and three light-emitting diodes. Take care to ensure that the front panel is not scratched during this operation as this would greatly detract from its final appearance.

Letter the front panel as necessary and give it several light coats of lacquer for protection. A solid machine-turned aluminium knob and two different-coloured end caps for the miniature toggle switches completes the front panel and gives a very professional finish.

REAR PANEL

The rear panel must be punched or cut to take the two main sockets, mains cable inlet, and also SK3 if used. There will not be much room left on the rear fascia after the two mains sockets are in place, and so this stage of the construction needs to be planned with care.

If flush-fitting sockets are used, then two large cut-outs will be required; on the prototype this was very easily accomplished with a tank cutter and hand brace. Other methods include drilling a ring of holes, punching out the centre and then filing till smooth.

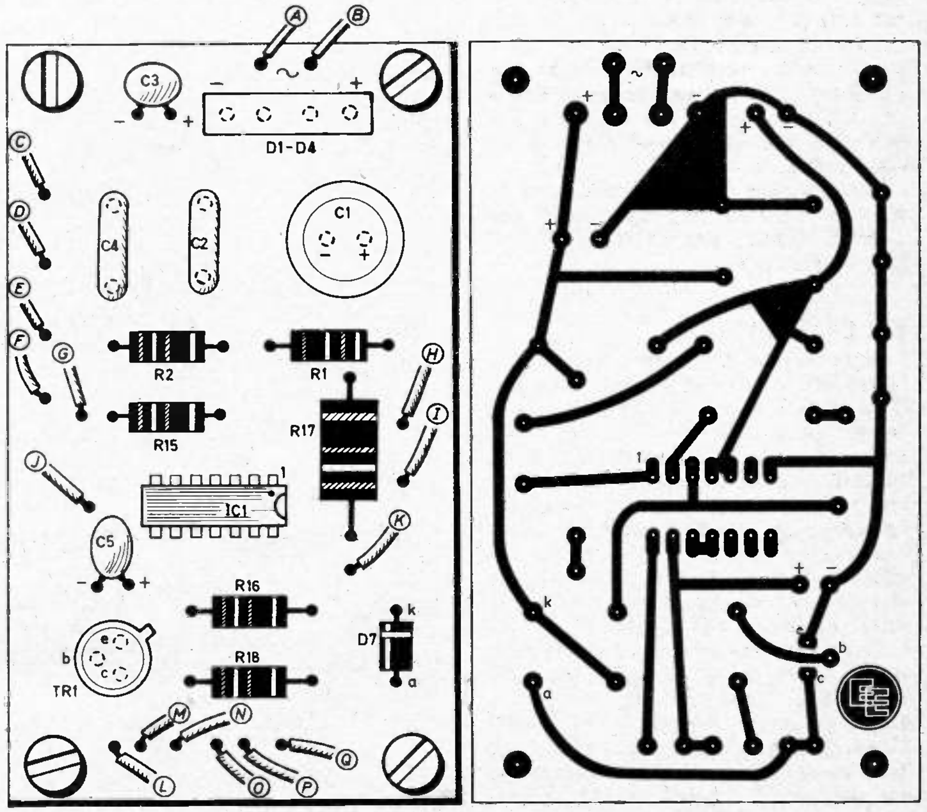
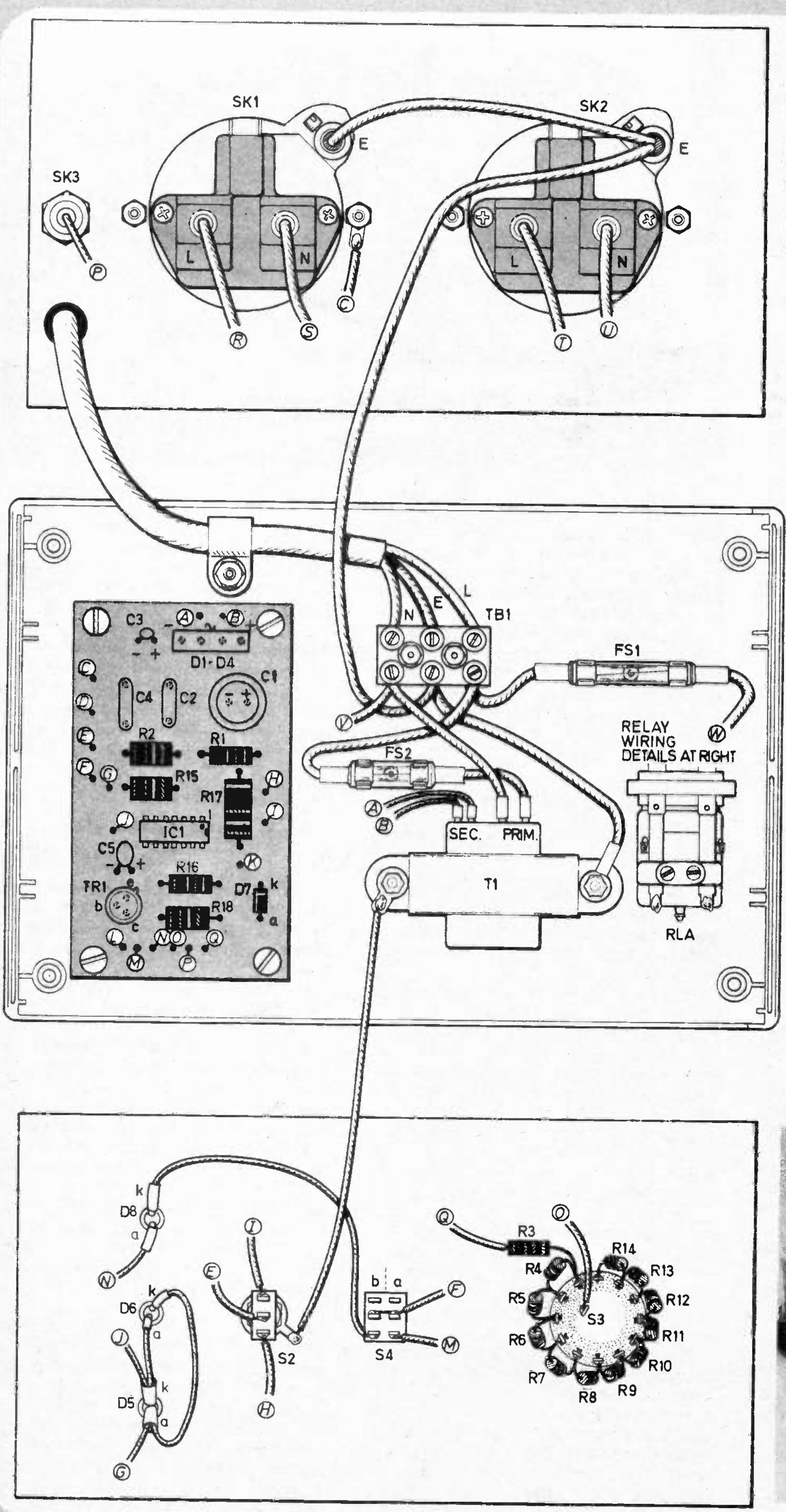
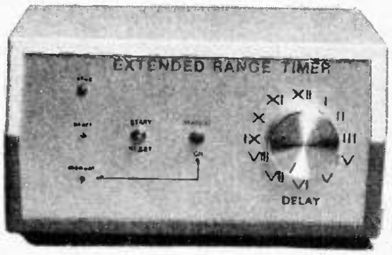


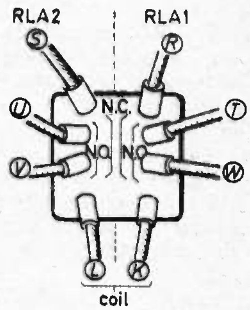
Fig. 3. Printed circuit board component layout and underside foil pattern (actual size).



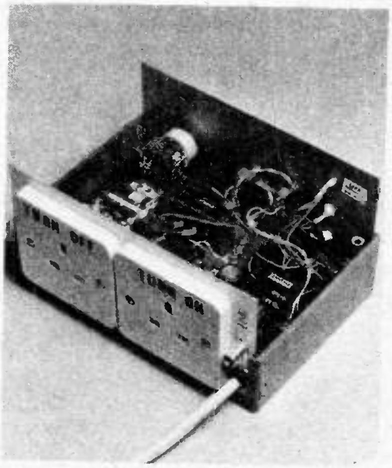


Mains On/Off Timer

Fig. 4. The case opened out to show the position of the internal components and the internal wiring. All cables carrying a.c. mains must be rated at 240V 13A. This includes the wiring to SK1, SK2, RLA, FS1 and T1 primary. The relay connections are shown below. These may differ if the specified relay is not used. Connections to locations on the p.c.b. are made using veropins.



RELAY WIRING RLA



The resulting large holes were then slightly modified with an Abrafile to take the shape of the earth terminals of the mains sockets.

It will be seen that as the mains inlet hole must be very near the right hand edge of the panel, then an adjacent hollow pillar moulded into the base needs to be trimmed right down to allow the mains cable to pass through unhindered. This pillar must be cut with a hacksaw, making quite sure that you don't cut into the edge of the case itself.

A hole (or two holes, depending on the type of socket used) will be required for SK3, if used. If a BNC socket is used, as in the case of the prototype, then one hole only is needed, the 0V connection being made through the earth. If, for example, two 4mm sockets are used then provision has been made on the p.c.b. for a 0V connection to be extended to one of the sockets.

Fit the sockets to the rear panel and fit a grommet to the mains cable inlet hole. Letter SK1 and SK2 "turn on" and "turn off" respectively.

INTERNAL WIRING

The dark grey chassis is drilled to take the p.c.b. mountings, two fuseholders, transformer, terminal block, relay and mains cable clamp. The positioning of these holes should be carefully marked out so that the holes do not foul with the pre-moulded pillars in the base. The mains cable clamp is a nylon "P" clip which prevents the cable from being pulled out.

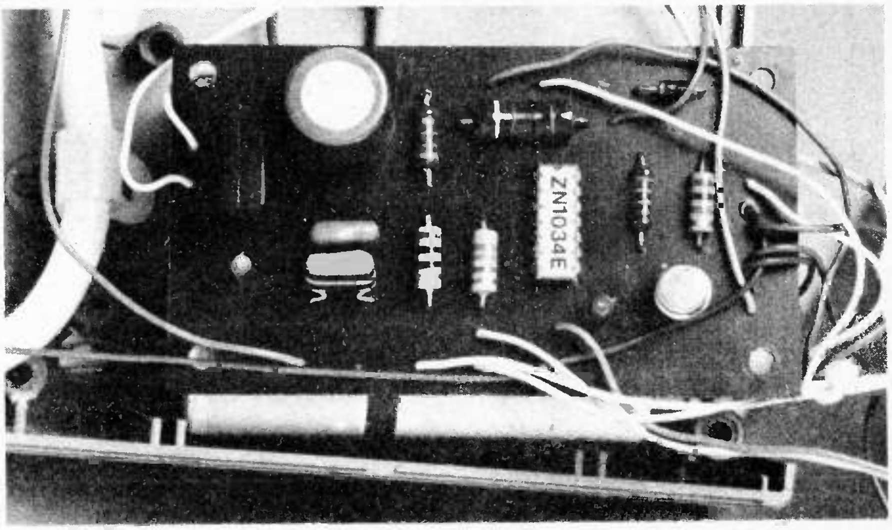
There is quite a lot of interwiring to be carried out but if Fig. 4 is followed carefully then no problems should arise.

All mains-voltage joints must be neatly soldered and insulated with p.v.c. sleeving, and all of this wiring is carried out with 10A (or greater) mains cable coloured blue, brown or green/yellow to coincide with the standard mains colour code. The transformer and FS2 can, however, be wired with normal 6A mains cable. The mains inlet must be rated at 13A. All other wiring can be carried out with lightweight hook-up wire, preferably stranded.

The relay connections shown in the diagram are for the specified relay only, and may differ if other makes of open relay are used.

EARTHING

Concerning the earthing arrangements, the front panel must be earthed using a very large earthing tag placed under one of the miniature toggle switches. An alternative here would be to solder the earth wire directly to the metal body of one of the switches. The rear panel is earthed



Close up view of the top of the p.c.b. showing component positioning and wiring.

with a 4BA solder tag under one of the mains socket mounting bolts. The 0V line of the p.c.b., and the transformer mounting bracket, are earthed in a similar fashion.

The wiring can be tidied up using nylon ties. The wires are arranged into looms, the tie is threaded around the loom and pulled tight. The excess is then snipped off. When forming the looms, keep mains cables away from low voltage wiring.

CHECKING AND SETTING UP

With all of the wiring completed, check carefully all aspects of your work. Check the p.c.b. for errors like reversed components or dry joints, etc. Recheck the mains wiring for quality and make sure that this is in order. Check the polarities of the l.e.d.s are correct.

If a multimeter is available, select a low ohms range and test for a low resistance between the earth pin of the mains plug and the front and rear panels. Test for infinite resistances between the earth pin and live and neutral pins of the plug.

If you are satisfied, fix down the top cover of the case, plug in and switch on. The STOP l.e.d. should be alight. Move S1 to START and allow it to return to centre off. The STOP indicator should extinguish and the START l.e.d. glow. The relay should also be heard switching in. Reset the timer at S1 and the relay should click out and the l.e.d.s switch over again.

Check now that the manual switch operates the relay and MANUAL l.e.d. when moved down. Set the knob for a one hour delay and start the timer; check that roughly a one hour delay is achieved. This last test will give a good indication of the accuracy to be expected with other delay settings. The prototype gave exactly 58 minutes delay on a one hour setting—this is exactly the period calculated with the formula given earlier.

If a c.r.o. is available, then the basic oscillator period can be measured (up to a maximum three hour delay) and the expected time delay computed with the formula given previously.

If everything seems in order then try the timer on a very long delay setting to confirm its accuracy. Here again the prototype was less than ten minutes out on an eleven-hour setting.

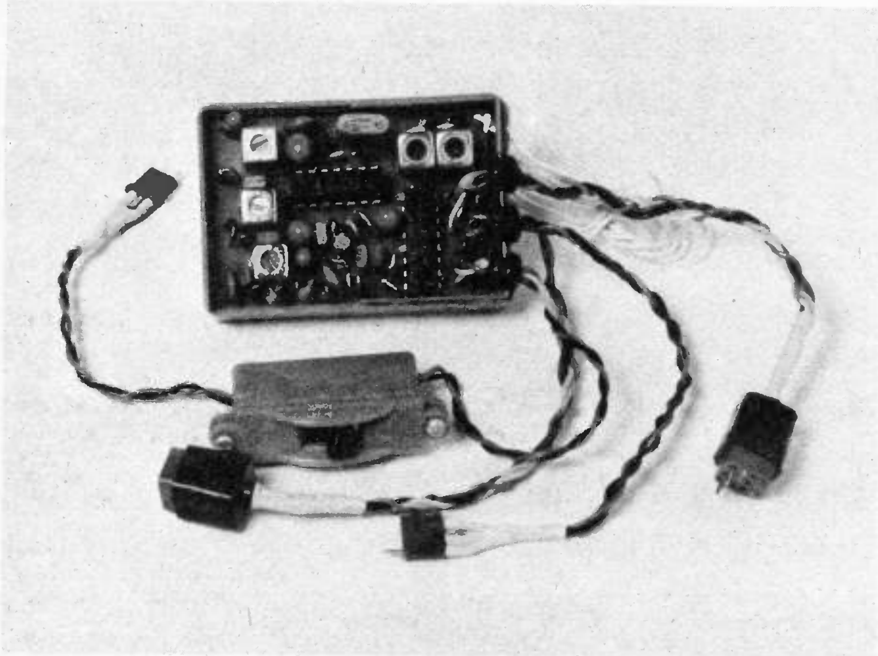
USING THE TIMER

Someone will possibly want to use a cassette recorder with the device. This is in order provided that the cassette recorder is not allowed somehow to remain for long periods in the "play" position **with the power removed.** Otherwise the rubber pinchwheel may possibly become physically distorted if it is kept "pinching" the tape against the capstan spindle for too long.

The timer can quite successfully be used with "auto stop" recorders to turn the power off altogether after the tape mechanism has stopped automatically at the end of a tape.

Finally it was discovered that in spite of the decoupling incorporated in the circuit, spurious noise generated by other appliances sharing the same socket being switched on and off sometimes reset the Timer. The Timer will not however *start* timing when a transient appears on the line.

The only way round this it seems is to use the timer and nothing else off one mains outlet, or plug into a suitable mains "suppression unit". It can be noted that the timer is not susceptible to transients generated by appliances in other parts of the building, and it is in order to share a mains wall socket with loads that are always on all of the time, like digital clocks, for example.



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

PART THREE

EE RADIO CONTROL SYSTEM

RECEIVER DESCRIPTION AND CONSTRUCTION

THIS third part of the series deals with the receiver, its construction and the tuning-up procedure.

This receiver is as sensitive as most commercial receivers and is capable of working in the 25kHz spaced split frequencies provided reasonable care is taken to ensure that the adjacent channel transmitter is not nearer to the model than the control transmitter.

The receiver is housed in a small plastics case. External connections to the servos and the battery are made either by floating connectors attached to the ends of flexible leads, or via a connector block mounted directly on the p.c.b.

FLEXIBILITY

Any number of channels from one to seven may be used, the only difference being in the number of leads brought out. Individual sockets may be used for each channel if so required, or a mixture of single sockets and blocks as shown in the diagrams.

Any servo may be plugged into any receiver output channel provided that particular channel has a control stick on the transmitter. It is not necessary to use the control channels in any set order and the servos should be plugged into the channels required.

Once again i.c.s are used where advantageous, such as in the r.f. amplifier / oscillator stages and the decoder. This also helps to reduce constructional errors in these areas.

RECEIVER IN OUTLINE

A typical 27MHz receiver is shown in block diagram form in Fig. 3.1.

The transmitter signal is received by the aerial and passed on to a tuned circuit which has a high impedance to 27MHz signals but has a low impedance to signals of other frequencies. This ensures that a maximum 27MHz signal is passed to the radio frequency (r.f.) stage for amplification.

The crystal oscillator, which is usually of the third overtone type, runs at a frequency of 455kHz less than that of the transmitted signal.

When the oscillator signal and the output of the r.f. stage are fed into the mixer stage, the sum and difference frequencies of the two input signals are available at the output of the mixer. The output of the mixer is fed into a tuned amplifier which is tuned to 455kHz thus ensuring that only the signals spaced 455kHz away from the crystal oscillator frequency are amplified. This stage is called the intermediate frequency amplifier (i.f.).

The i.f. amplifier output is then fed into a detector stage which effectively removes the 455kHz signal and leaves only the modulation, the modulation in this case being the pulses necessary to drive the decoder circuitry which in turn drives the servos.

It can be seen that the first three stages of the block diagram Fig. 3.1 are contained in one integrated circuit IC1. This i.c. gives a reliable mixer stage which is necessary if repeatability of performance is to be obtained amongst receivers built by different constructors.

A conventional i.f. amplifier using transistors and transformers is used, this then feeds a transistor detector. It was considered whether to use ceramic filters to obtain a better selectivity, but suitable filters cost a few pounds and were not generally available, hence the choice of standard circuitry.

The rest of the receiver consists of the pulse amplifier, sync pulse detector stage and the decade counter decoder IC2 which decodes the pulses suitably for driving the servos.

CIRCUIT DESCRIPTION

In the full circuit diagram (Fig. 3.2) it can be seen that the aerial is connected to the primary of a double-

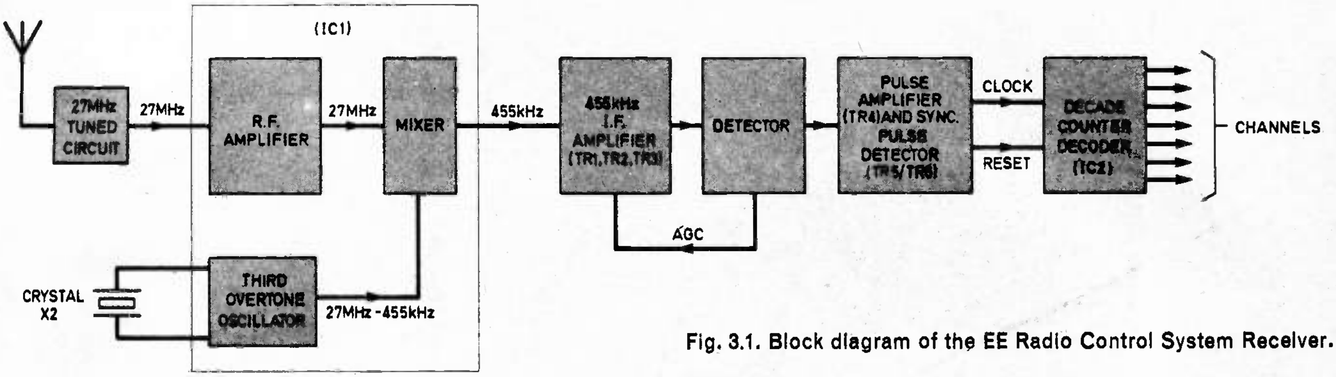


Fig. 3.1. Block diagram of the EE Radio Control System Receiver.

tuned r.f. circuit comprising inductance L1 and capacitor C2. A small capacitor C3 couples the primary tuned circuit to the resonant secondary circuit L2, C4. These two tuned circuits form a highly selective tuned input stage.

Impedance matching into the r.f. stage of IC1 is achieved by using the secondary of L2.

The crystal oscillator discrete components are the crystal X2 and three capacitors, C7, C8, C9; the remainder of the oscillator circuit being in IC1 itself.

MIXER STAGE

The r.f. stage output and the oscillator output are mixed internally, the output of the mixer stage (pin 2) being fed into the primary of the first i.f. transformer T1 which is tuned to the difference frequency of 455kHz by its internal capacitor and adjustable ferrite potcore. The output of the untuned secondary drives the first i.f. amplifier TR1, the collector currents of TR1 and TR2 being determined by the emitter resistors and the base voltages.

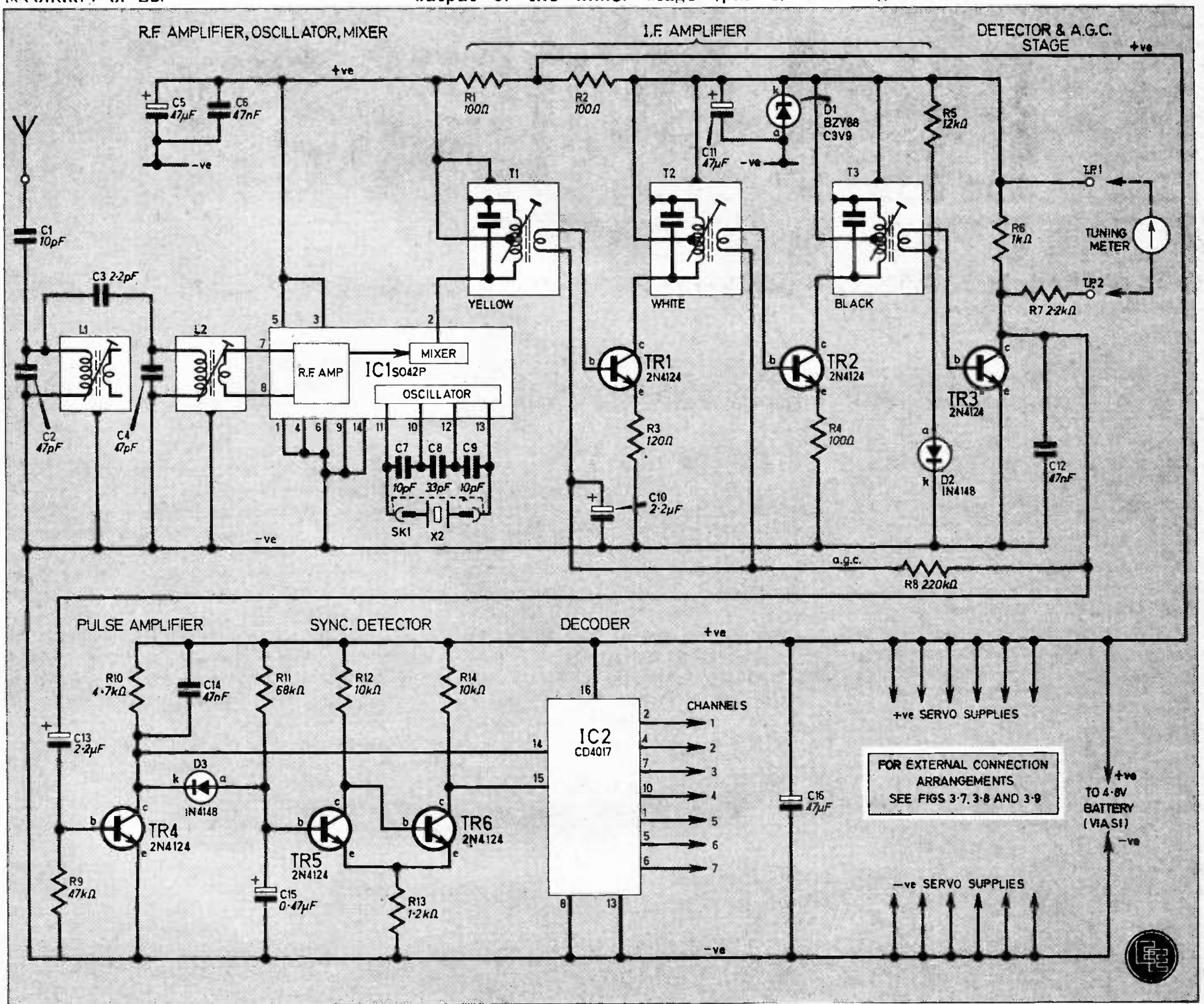


Fig. 3.2. Circuit of the EE Radio Control System Receiver.

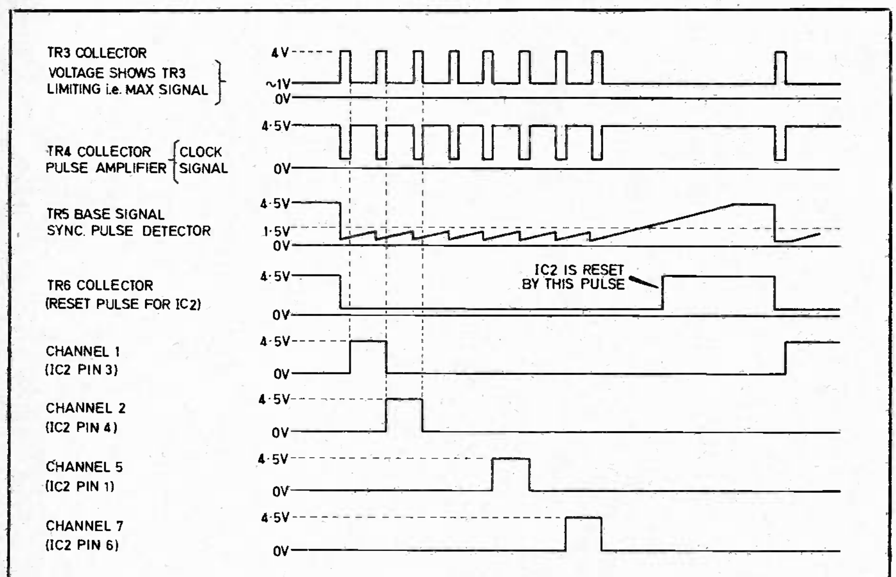


Fig. 3.3. Waveforms at various points in the receiver.

The second i.f. transformer T2 couples the signal into the second i.f. amplifier TR2 which in turn feeds i.f. transformer T3.

The secondary of T3 is connected between a forward biased diode D2 and the base of detector transistor TR3. The forward voltage of 0·5V across D2 is insufficient to turn on TR3 which needs approximately 0·65V base voltage for this purpose. It can be seen therefore if the secondary of T3 supplies a 300mV peak-to-peak i.f. signal, the positive peaks will add to the 0·5V thus supplying the base voltage needed and so turn on TR3.

The larger the signal, the larger the voltage swing at TR3 collector until the maximum swing of (supply voltage—0·4V) is reached. Smoothing capacitor C12 has the effect of changing the 455kHz peaks into a mean d.c. voltage whose d.c. level varies with signal strength, the larger the signal the lower the d.c. voltage at TR3 collector.

When a 200μsec "interruption" in signal occurs (which constitutes a channel gap from the transmitter), TR3 has insufficient base voltage and turns off, capacitor C12 charging swiftly up to positive rail via R6. When the signal resumes, TR3 turns on again discharging C12 and the "interruption" becomes a "pulse". In this way the transmitted pulses are reconstituted at TR3 collector.

AUTOMATIC GAIN CONTROL

Since the d.c. level at TR3 collector is dependent upon signal strength, it is fed via R8 to the bases of the two i.f. amplifier transistors TR1, TR2, the pulse interruptions in signal being "smoothed out" by capacitor C10. In this way the gain of the i.f. amplifier is controlled by the incoming signal strength, since the mean d.c. voltage at TR3 collector drops with large signals thus decreasing the base voltages of TR1, TR2, hence their gain.

The signal from TR3 collector is fed via C13 to the pulse amplifier TR4 which has no bias and hence requires 0·6V pulse to trigger it thus giving a measure of noise immunity. The output at TR4 collector is approximately a 4·5V peak-to-peak signal and is used to "clock" the decoder IC2.

DETECTION OF SYNC PULSE

In order that "Channel 1" always appears at the same output pin of IC2 it is necessary to detect the end of a block of pulses and reset the counter IC2. It is for this purpose that the sync pulse was inserted into the pulse train and this is now detected by D3, R11, C15.

Under no-signal conditions the collector of TR4 is high and hence C15 charges up via R11. When the pulses appear, C15 is discharged to approximately 0·7V via D3, TR4.

The time constant of C15, R11 is such that C15 cannot recharge between channel pulses, but only in the sync pulse period which is relatively long. The voltage across C15 is therefore fed into a level detector TR5, TR6 which has a high output when C15 is charged up and vice versa. Hence under no-signal conditions, or during sync pulse, C15 is charged up and TR6 collector is high thus resetting the decoder IC2 ready for the next pulse train.

DECADE COUNTER AND DECODER

The decoder IC2 is a CMOS five-stage Johnson decade counter with built-in code converter. The ten decoded outputs, of which only seven are used, are normally low and only go high at their appropriate decimal time period. The output changes occur on the positive-going edge of the clock pulse and the outputs appear in rotation as shown in the waveform diagram, Fig. 3.3.

The sequence of events is therefore as follows:

Assuming sync pulse time, TR6 collector is high thus resetting IC2. The negative-going edge of the first clock pulse takes TR6 collector low thus removing the reset from IC2.

When the positive edge of the first pulse occurs, output 1 of IC2 goes high and remains high until the positive edge of the second block pulse, whereupon output 1 returns to the low state and output 2 goes high. This remains high until the positive edge of the third clock pulse when output 2 returns low and output 3 goes high.

This sequence carries on for each clock pulse up to 7 when the sync pulse occurs and resets IC2. All the outputs are set low again ready for the next pulse train.

Hence it can be seen each output goes high for the period between two adjacent clock pulses thus reconstituting the original pulse from the transmitter for that particular channel.

CONSTRUCTION starts here

The receiver is built on a small printed circuit board, Fig. 3.4. Location of components is given in Fig. 3.5.

As with the transmitter, the importance of using a good soldering iron with a small bit must be stressed.

Good joints are *most* essential here as it is the receiver that will be taking all the knocks and bumps in your model, so any dry and loose joints will be a hazard to its survival. A skilled and practised hand in soldering miniature components is demanded. This is *NOT* a task for a novice to undertake.

CIRCUIT BOARD

Construction is started with the insertion on to the p.c.b. (plain side) of wire links.

"Link "A" goes from IC2 pin 6 to "Channel 7" pad.

Link "B" goes from IC2 pin 12 to position shown. This is for an optional "fail-safe" facility, to be described later.

The r.f. tuned circuits can now be inserted, then the i.f. cans making sure in the case of the latter that

EE RADIO CONTROL RECEIVER

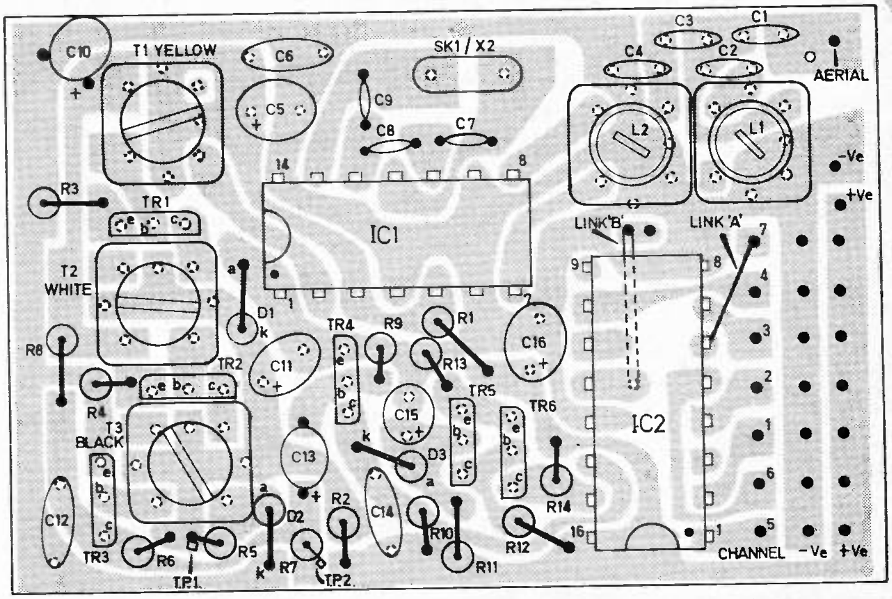


Fig. 3.5. Top view of the printed circuit board with all components in situ. The pattern on the other side of the board is shown in grey to assist when fitting components. Note the two links "A" and "B" which must be fitted before any components are mounted. T.P.1 and T.P.2 are "tuning points"—for connection of multimeter.

COMPONENTS

RECEIVER

See Shop Talk page 19

Resistors
- R1 100Ω
- R2 100Ω
- R3 120Ω
- R4 100Ω
- R5 12kΩ
- R6 1kΩ
- R7 2·2kΩ
- R8 220kΩ
- R9 47kΩ
- R10 4·7kΩ
- R11 68kΩ
- R12 10kΩ
- R13 1·2kΩ
- R14 10kΩ

All ⅓W carbon ± 5%

Capacitors
- C1 10pF ceramic plate
- C2 47pF ceramic plate
- C3 2·2pF ceramic plate
- C4 47pF ceramic plate
- C5 47μF tantalum bead 6·3V
- C6 47nF ceramic disc 12V
- C7 10pF ceramic plate
- C8 33pF ceramic plate
- C9 10pF ceramic plate
- C10 2·2μF tantalum bead 35V
- C11 47μF tantalum bead 6·3V
- C12 47nF ceramic disc 12V
- C13 2·2μF tantalum bead 35V
- C14 47nF ceramic disc 12V
- C15 0·47μF tantalum bead 35V
- C16 47μF tantalum bead 6·3V

Semiconductors
- TR1-6 2N4124 *npn* silicon (6 off)
- D1 BZY88C3V9 Zener diode 3·9V
- D2, 3 1N4148 silicon diode (2 off)
- IC1 SO42P R.F. amplifier, tuner & oscillator (Siemens)
- IC2 CD4017 CMOS decade counter

Inductors
- L1, 2 Tuned r.f. coil Toko 113CN-2K159 (2 off)
- T1 i.f. transformer, yellow Toko 4827
- T2 i.f. transformer, white Toko L238
- T3 i.f. transformer, black Toko 4828

Miscellaneous
- Receiver case (SLM)
- ½ inch grommets (3 off)
- Printed circuit board.
- Connectors—as required, see text (SLM)
- Connecting wire (10 strand), various colours. Heat shrinkable plastic tubing.
- Nicad battery box, 4 × HP7, (SLM)
- S1 Noble slide switch d.p.d.t., with box (SLM)
- SK1 crystal socket, low profile (SLM)
- X2 Crystal (see Part 2)

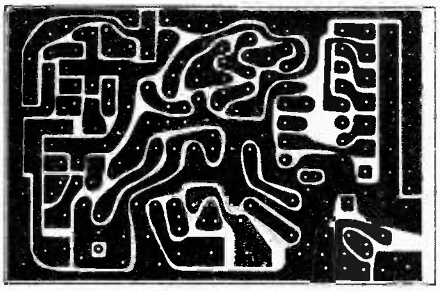


Fig. 3.4. Printed circuit board for the EE Radio Control Receiver, actual size.

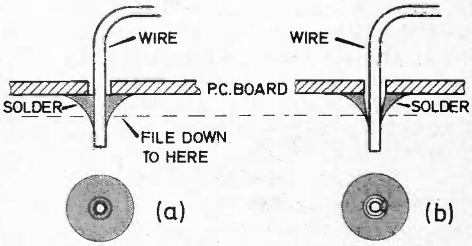
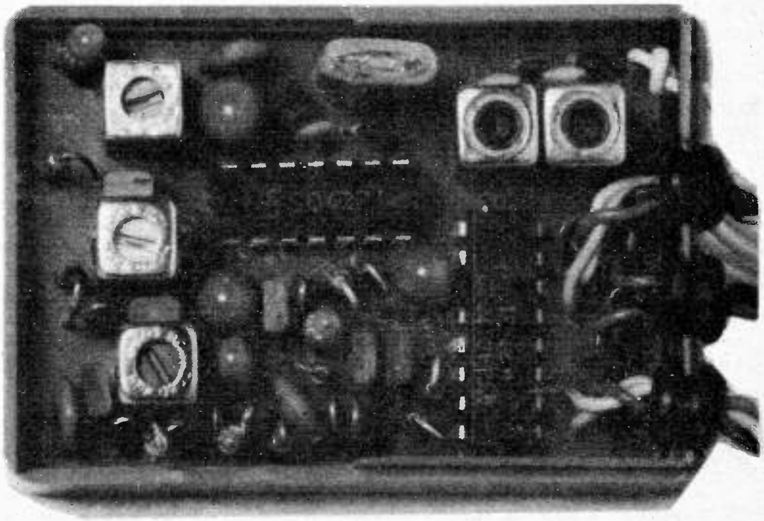


Fig. 3.6. (a) Good joint, any filing shows just solder and wire; (b) Bad joint; filing reveals wire with ring of solder and air gap between the two.



they are inserted in the correct place (identified by their coloured tuning core).

The integrated circuits IC1 and IC2 are inserted next. Take care with IC2 as this is one of those CMOS devices. If in doubt follow the precautions suggested in the transmitter construction section.

The order of placement for the remaining components is not critical, however a suggestion is to insert the physically smaller components first. Make sure that the diodes, tantalum capacitors and the transistors are all inserted the correct way round.

The uppermost leads of R5 and R7 should be bent to form tuning points.

When mounting the crystal socket take care no solder gets down the leads as this will ruin it.

PLUGS AND SOCKETS

The choice of plugs and sockets for connecting between the receiver and servos is left entirely to the constructor as it is dependent upon whether it is to be compatible with parts of an existing system. In the case of the "first time" constructor then Figs. 3·7 and 3·8 show how to connect to the connector block, in this case the SLM 7-way 3-pin type.

This block can be used either as a floating connector on the end of flexible leads, or mounted directly on to the p.c.b.

The writer's preference is to use floating connectors rather than a p.c.b.-mounted block connector, since as the receiver is invariably wrapped in sponge rubber the servos may be plugged or changed in at will without disturbing it. Hence a suggested wiring scheme if more than four channels are required could be as follows:

A single 3-pin socket on a flying lead is used for the first channel since this is invariably the aerilon channel and the servo is mounted in the wing of the plane. The remaining channels are wired to the connector block as shown, the battery supply feeding into the plug on the block. When ordering the connector block specify 7-way block and cover (6 sockets plus 1 plug).

The power pins on the blocks are wired in parallel as shown. Two or three strands from the hook-up wire are twisted together and tinned. The wire is then wound round the pins and soldered.

After all the leads are connected, check them *very carefully*. Then cover the back of the block and the joints with 5-minute epoxy and slip the cover on to the back of the block. The epoxy when set fixes the pins and wires into a solid block and prevents any single connector from pulling out of the block.

AERIAL

The aerial should be a 30-inch length of light flexible cable similar to that used for the leads.

FINAL EXAMINATION

When all the wiring is completed (including the servo leads), the bottom of the board should be cleaned to remove any flux. The board should be scrutinised for any solder bridges between tracks and these removed.

Another trick is to file the heads off all the joints and then clean the board again. This usually shows up any dry joints since these *cannot* be tolerated. Think of the model and your time mending it!! See Fig. 3.6.

CHECKING AND TUNING-UP

Measure the resistance between the battery supply leads with a multimeter on the ohms range. It should read approximately 1kohm with the leads one way round and 100ohm the other way round. If much less check for shorts on the back of the p.c.b. and check parts placement.

If the measurements prove correct then connect the correct way round to a 4·8V supply and the following measurements should be checked with reference to the "O" volts (−ve) rail. Measurements should be done under no-signal conditions, that is with the transmitter switched off.

1. Pin 2 IC1	approx. +4·5V
2. Emitter voltages of TR1, TR2 measured at top of R3 and R4	approx. +0·25V
3. Can of i.f. transformer T3	approx. +3·9V
4. Collectors of TR1, TR2	approx. +3·9V
5. A.G.C. supply voltage (top of R8/collector of TR3)	4·5V
6. Base of TR3	0·6V
7. Collector TR4	4·8V
8. Collector TR5	1·3V
9. Collector TR6	4·8V

Should any of the above measurements be incorrect then check the placement of the components associated with them.

If the measurements are correct, then plug in the matching crystal into the socket SK1. Place the transmitter, less aerial, very close to the receiver.

Connect a multimeter (of 5kohm/volt a.c. minimum) on the lowest a.c. voltage range nearest 1V between the tops of resistors R7 and R5 (T.P.1 and T.P.2).

Switch on transmitter. If the receiver is anywhere near in tune the meter will start to indicate. Make sure the receiver aerial is clear of any metal work, etc.

Adjust the i.f. transformers T1, T2 and T3 for maximum voltage deflection then L1 and L2, gradually moving the transmitter further away to keep the meter reading below 0·5V (as this is the maximum deflection obtainable).

Each time the reading approaches 0·5V, progressively move the transmitter further and further away adjusting L1, L2 and T1, T2 and T3 to peak the reading. The meter may well be 10 to 15 feet away at this stage.

The receiver should now be in tune.

If a servo is available, plug it into channel 1 lead, which should be the aileron, and move the transmitter stick to get a servo movement. Typical range with one servo and with no aerial on the transmitter should be about 15 to 20 feet. If no servos are available then this test will have to await next month's issue when the servos will be described.

ALTERNATIVE TUNING METHODS

Two other tuning techniques are available, the first being to connect a crystal earphone between T.P.1 and T.P.2 where the tone of the pulse train can be heard. The same tuning sequence is used to peak the tone to its maximum loudness and clarity.

The other technique is to connect an oscilloscope to the test point T.P.1 and T.P.2 and tune-up watching the waveform. R7 should be increased to 10kohm in this case. The waveforms are as in Fig. 3.3.

FITTING IN CASE

Depending on whether a p.c. block or flying leads are used, the appropriate holes should be cut in the lid of the receiver case with a modeller's knife or file.

The receiver aerial exits from the case via a small hole and the aerial wire should be knotted on the inside so that no strain is applied to the connection on the p.c.b. if the aerial is tugged.

The p.c.b. assembly should be fitted into the box base and a piece of sponge rubber (about ¼ inch thick) cut such that when put on top of the receiver, the crystal socket SK1 is uncovered (as is the connector block, if used). This sponge rubber prevents the receiver rattling about in the case and also stops the board lifting when the crystal is removed. The receiver case top should then be fitted and the whole sealed with tape. The receiver is now completed.

BATTERY ASSEMBLY

Fit four Nicad cells into that half of the Nicad holder with the hole in the end. See Fig. 3.11.

EE RADIO CONTROL RECEIVER

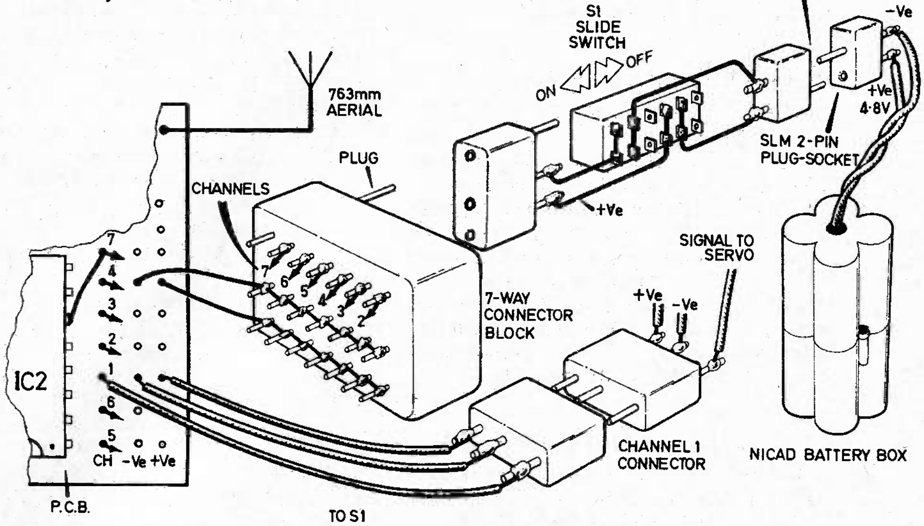


Fig. 3.7. The receiver wired for seven channels, using floating connectors. The slide switch S1 and the Nicad battery box are also shown.

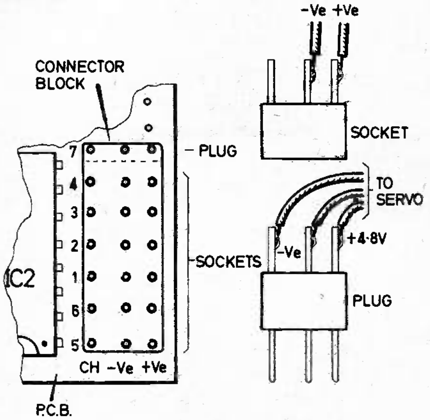


Fig. 3.8. The receiver wired for seven channels using 7-way connector block mounted directly on p.c.b. External connections are via one socket and six plugs.

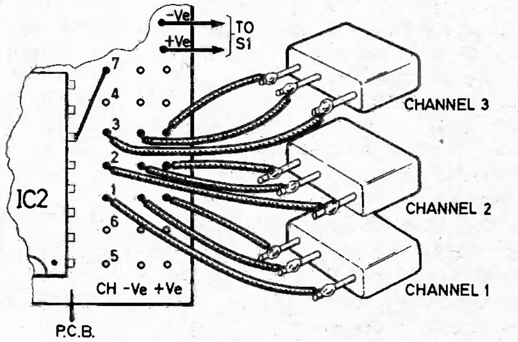


Fig. 3.9. The receiver wired for three channels using single sockets.

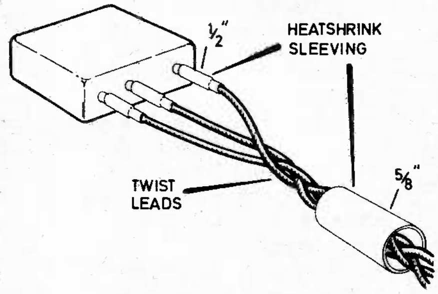


Fig. 3.10 (left). Wiring of single plugs and sockets and fitting of shrinkable plastic sleeves. Apply heat (e.g. from hair drier) and sleeves will shrink to half original diameter, thus securing the lead connections.

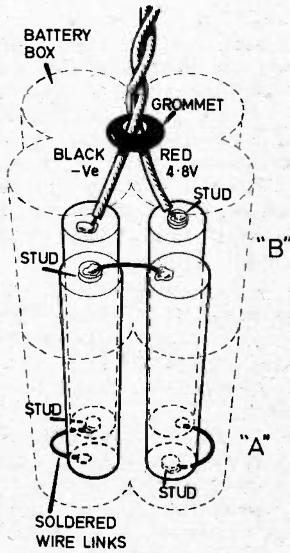


Fig. 3.11. Wiring of the four Nicad cells and their installation within the battery box.

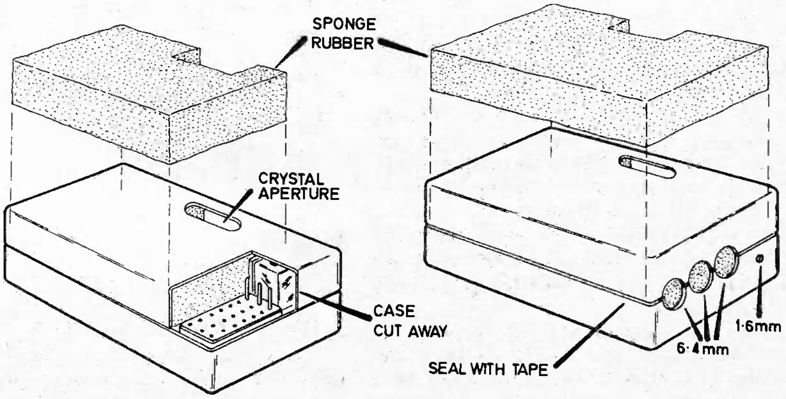


Fig. 3.12. Receiver case showing cut-outs required and sponge rubber pad.

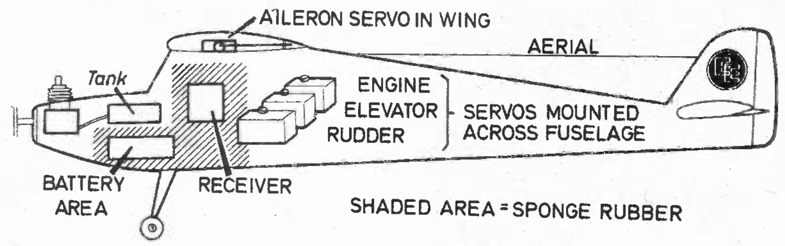


Fig. 3.13. A typical installation of equipment in a model aircraft.

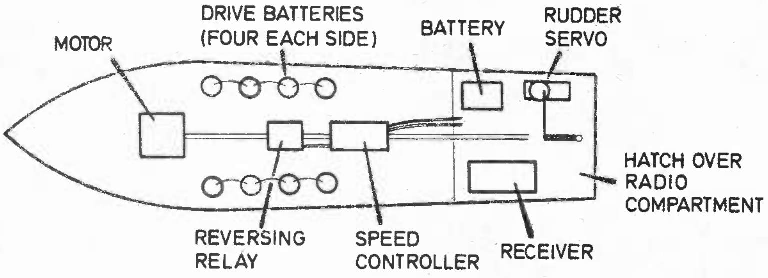


Fig. 3.14. A typical installation of equipment in a model boat.

Wire the exposed ends of the cells as shown at "*A*". Fit other end of holder over this wired end, invert box and remove top cap. Wire this end now as "*B*" taking care to fit the battery supply wires through the grommet and the top before connecting to the cells. Finally screw the two halves of the Nicad box together.

INSTALLATION IN A MODEL

Arrangement of the equipment in a model is usually shown on the model plans. If such information is not available, it is suggested that a book on the particular line of modelling in question should be purchased. These specialist publications give a lot of useful advice based on experience. In a plane for instance, a typical installation is as shown in Fig. 3.13.

Note the battery is installed at the *front* so that in the event of a crash the battery does not rush forward and batter the receiver to certain death.

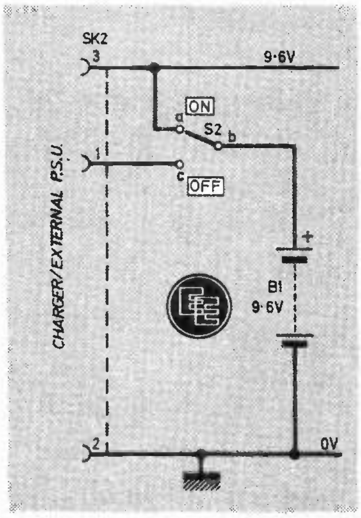
The battery and receiver should be well packed in foam rubber. The servos can either be mounted on commercially available servo trays (which even hold the on/off switch), mounted on bearers via woodscrews and the mounting grommets supplied with each servo, or just fixed inside the model using double-sided adhesive tape.

TRANSMITTER

The transmitter circuit diagram Fig. 1·3 should be amended as follows:

(i) To conform with Fig. 2.6 and conventional numbering of DIN sockets, renumber SK2 pins as shown below

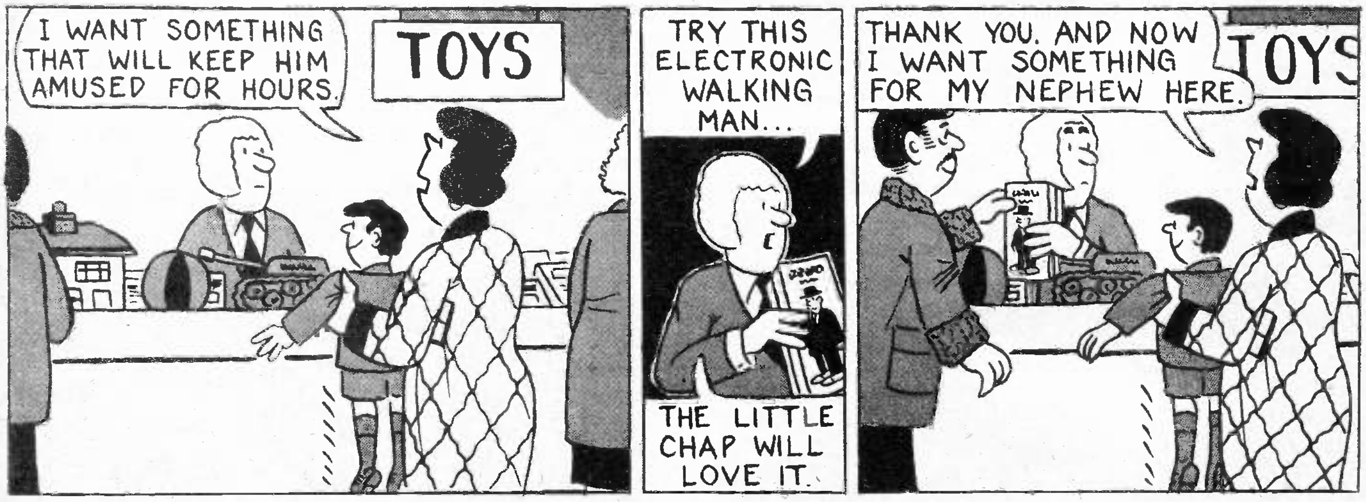
(ii) Add letter code to S2 contacts. (Second pole is not used, but slider contact (e) provides anchor point—as in Fig. 2.6.)

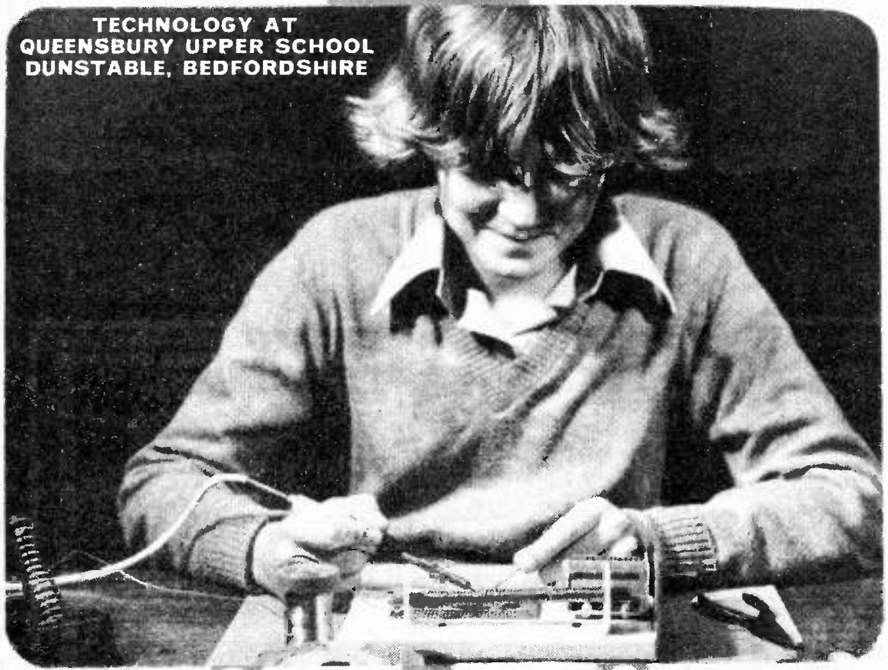


In the case of a boat it is best to waterproof all the equipment where possible. This can be easily achieved by putting the receiver battery, receiver and servos inside a plastic sandwich box. It is advisable to mount the speed controller and changeover relay near to the motor in order to cut down any voltage loss which can occur with today's powerful electric motors.

Next Month: Servos and speed controller.

JACK PLUG & FAMILY... BY DOUG BAKER





TECHNOLOGY AT QUEENSBURY UPPER SCHOOL DUNSTABLE, BEDFORDSHIRE

School Report

By M. H. S. Higley

Electronics was introduced into Queensbury School curriculum in September 1974 and then, shortly afterwards, the subject of Design Technology. Both of these subjects are taught within the Craft, Design and Technology department, under the title of Design Technology, and satisfy the School's desire to provide a link between Mathematics/Science and Craft.

Pupils who study Design Technology find they are able to build the AND, NOT and OR gates which they encounter in Computer Studies. Likewise, the very elementary electronics knowledge the pupils obtain in Physics is extended both in theory and practice during Design Technology lessons.

Exams

The public examinations taken by pupils, having completed the two year Technology course, are C.S.E. Electronics and, either C.S.E. or 'O' level Technology. Within the next two years it is hoped to have sixth formers studying at 'A' level.

Electronic components are, of course, expensive and the constructional projects undertaken by the pupils, in the main, employ discrete components as many of the integrated circuits available are far too expensive for school use. However, the 741 op. amp and T.T. Logic (TTL), in the 7400 series, are used extensively because these are extremely useful and also inexpensive.

Projects

Recently, they have been experimenting with the ZN414 integrated circuit radio "chip" and this may become the basis of a standard receiver for the pupils. Several simple circuits are used as an introduction to the world of electronics such as, a single transistor radio receiver, a moisture detector, a light operated switch and an elementary metal detector. These are projects which ideally suit the inexperienced constructor. The more advanced pupils have in the past constructed a manual telephone exchange, a digital clock, a logic tutor box and a differential amplifier which is used to demonstrate electrocardiograph techniques.

Work now in progress includes a full-adder demonstration unit using TTL and a model high-speed commuter train driven by an air-screw. This particular project will have circuitry to start, stop and reverse the vehicle at pre-determined points along the track.

Identi-light

One pupil is investigating the possibility of identifying people using a light detector which could be employed in police work or in hospitals. His theory is that different features reflect varying amounts of light and by scanning the face with a light measuring device an electrical output can be obtained which can be stored in many ways.

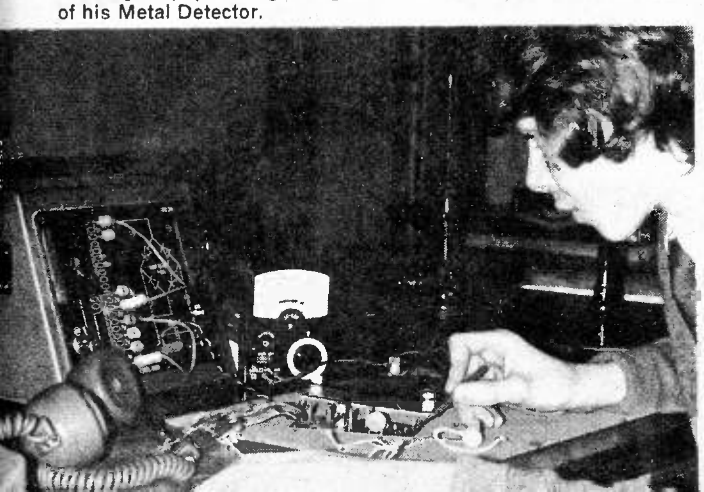
With the assistance of the Computer Studies department, he will write a BASIC program to store his data in the computer and also carry out a comparison check against previously stored data.

Careers

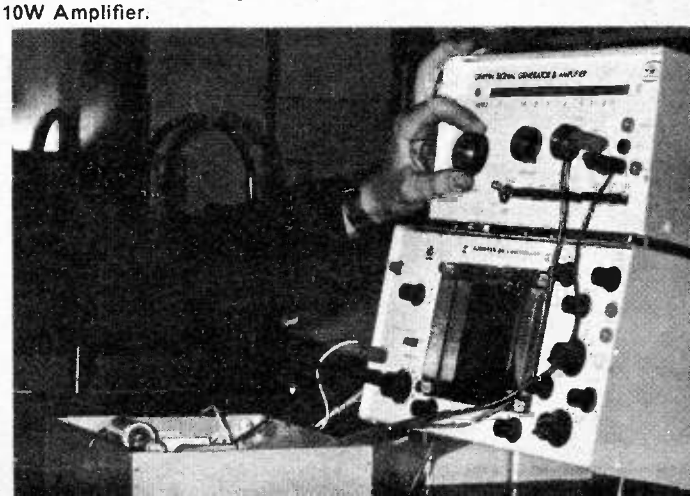
The projects vary in their complexity but it is hoped that all the pupils gain some insight into the ever-expanding fields of electronics. Having experienced the various courses offered through the School curriculum they are better able to choose the career that is suited to their ability.

It is not the intention to produce complete electronic engineers within the school system but to enable the pupils to make the correct choice of career and thence go on to higher education. Should they find in later years they require to cross over into another field then with a good background of Mathematics, Science, English and an appreciation of Technology the transition would be that much easier.

A fifth year pupil taking voltage measurements on the circuit board of his Metal Detector.



A sixth former checking the frequency response of his Mullard 10W Amplifier.



Memory Lane

This being the festive season my indulgent Editor kindly allows me to wander down memory lane and rattle a few old skeletons. In the past I have related incidents in my life that I thought were interesting or amusing without any particular regard to chronological order. This year I thought I would go back in time to my earliest recollections, to see at what point I became entangled in electronics.

It all began when I was about five and was given for my birthday one of those lovely old torches. Perhaps you know the ones. They have a huge bulbous lens and take the Ever Ready 1289 battery. Perhaps they are still around, the batteries are still on sale.

Its amazing after all these years, I think Lawrence of Arabia said the streets of Mecca were lit by electricity while we were still wearing woad. I expect the Arabs used 1289 batteries!

Shock Treatment

Where was I? Oh yes the large torch. Like all small boys I soon reduced it to its component parts and found I could do things with the battery and bulb on their own. I put the bulb in a small aspirin bottle hung it over my bed and wired it up to the battery under by pillow.

So far so good, but I quickly learned that small batteries are soon exhausted, and that led to my next experiment, a more disastrous one. Having decided the battery was dead because there was no electricity in it, where should I get some more? Why of course in the light socket. I promptly removed the bulb and placed the battery contacts on the studs. The result was a violent flash and new fuses required all round.

Moving on a year or two I made the interesting discovery that if two pieces of wire were connected to a battery and joined by a short length of very thin wire it would soon get red hot. The thin wire was placed in the hole in the end of a cotton reel while the hole was filled with gunpowder.

The idea was undoubtedly to explode it from a safe distance. Unfortunately while I was busy stuffing the gunpowder into the hole the two wires some-how contrived to make contact with the battery and caused the loss of my eyebrows, the first of many times it was to happen in my chequered career.

Crystal Clear

It was shortly after that, that crystal sets began claiming my attention. My father brought home a most exquisitely made Marconi set. Rather like a small black attache case with two plated knobs at either side which slid in and out for tuning.

Inside the lid was a panel with switching arrangements for different lengths of aerial and for changing from galena crystal to carborundum. The wiring inside was fantastic, all 16 gauge square sections and every bend an exact right angle. Alas it was several years before they discovered that r.f. currents dislike going round sharp corners and tend to fly off at a tangent. My father was delighted with it and told my brother and I that "Gamages are selling them off for ten bob (50p) and they originally cost fourteen pounds". Even so, we found a simple set using a variometer worked much better.

We then made the amazing discovery that the higher the aerial the louder the sound. Each week we would buy a length of bamboo pole and push it up another ten feet. The trouble was that each extension had to be thinner than the last until ultimately they were so thin and bent so much that the height advantage was lost.

We made another useful discovery at this time. We found we could run three pairs of earphones from the same set. My father had one pair in the living room and my brother and I each had one by the bed.

We found that to communicate with our parents, we could take off the earphones and talk into them instead of bawling at the top of our voices. This did have its drawbacks. According to my father, I cannot guarantee the veracity of the story, he said he was listening to the news which went as follows "Last night Queen Mary was seen going out with *Dad*!" The last word being supplied by one of his erring children probably wanting a glass of water. Mind you I have always regarded this story as highly suspect!

Enter the Valve

I had now reached the ripe old age of eleven and was staying in the house of a gentleman who owned a valve set. These had to be seen to be believed. Each valve was turned on slowly by a rheostat, to-day we would call it a variable resistor, and you really could read a newspaper from the light they gave out.

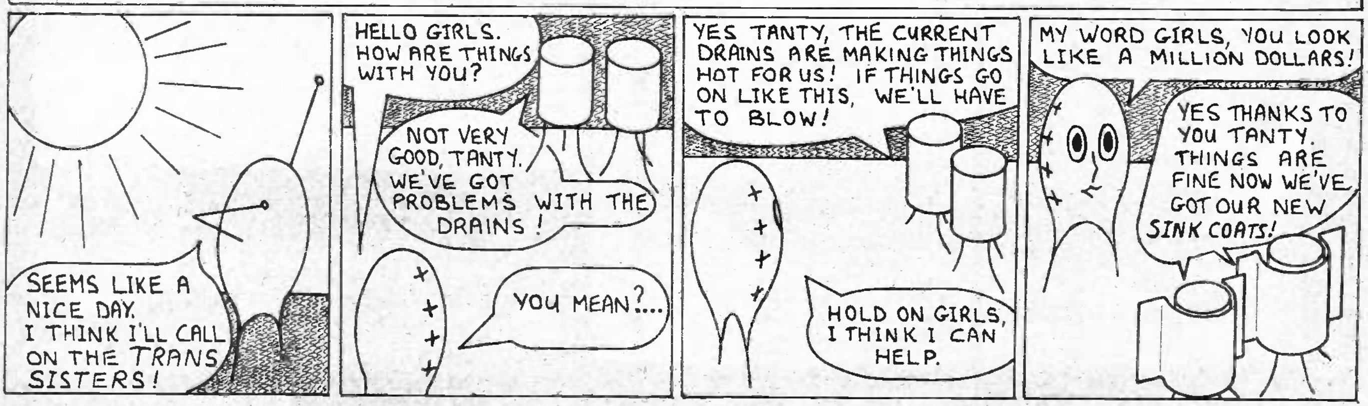
Masses of wires led to an h.t. battery that weighed half a hundredweight, an accumulator fit for a car, and a grid bias battery about a yard long. An enormous coil and slider at the top of the set and two swinging coils on the side, plus a fearsome array of dials and knobs completed the receiver, and crowning all this mammouth out-fit a tiny little horn speaker made by someone called "Brown".

We would all gather round it expectantly and after sundry howls and noises reminiscent of a cat having its tail trodden on, with any luck a squeaky voice would come out of the horn. "This is 2LO London calling in the British Isles, tonight ladies and gentlemen we have for your entertainment that well known comedian Leonard Henry". I wonder how many of my readers remember this or similar announcements.

Say what you will, it was great fun. We were all enthusiastic because we felt we were in at the beginning of a great achievement, and I am delighted to say, those of us in Electronics, to-day, are experiencing the same feelings all over again.

The Adventures of Tanty Bead

By Matthew Reed



STEVENSON
Electronic Components

CMOS

		4020	50p	4050	25p
		4022	50p	4060	80p
		4023	13p	4066	30p
		4024	40p	4068	13p
4001	13p	4025	13p	4069	13p
4002	13p	4026	90p	4070	13p
4007	13p	4027	28p	4071	13p
4009	30p	4028	45p	4072	13p
4011	13p	4029	50p	4081	13p
4012	13p	4040	55p	4093	36p
4013	28p	4041	55p	4510	60p
4015	50p	4042	55p	4511	60p
4016	28p	4043	50p	4518	65p
4017	47p	4046	90p	4520	60p
4018	55p	4049	25p	4528	60p

FULL DETAILS IN CATALOGUE!

TTL

		7473	20p	74141	55p
		7474	22p	74145	55p
7400	10p	7475	25p	74148	90p
7401	10p	7476	20p	74150	55p
7402	10p	7485	55p	74151	40p
7404	12p	7486	20p	74154	65p
7406	22p	7489	135p	74157	40p
7408	12p	7490	25p	74164	55p
7410	10p	7492	30p	74165	55p
7413	22p	7493	25p	74170	100p
7414	39p	7494	45p	74174	55p
7420	12p	7495	35p	74177	50p
7427	20p	7496	45p	74190	50p
7430	12p	74121	25p	74191	50p
7432	18p	74122	35p	74192	50p
7442	38p	74123	38p	74193	50p
7447	45p	74125	35p	74196	50p
7448	50p	74126	35p	74197	50p
7454	12p	74132	45p	74199	90p

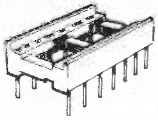
OPTO

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 T018 or T05 socket. 10p each
Soldercon pins: 100:50p 1000:370p

PCBS

VEROBOARD

Size in.	0.1in.	0.15in.	
25 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 Megohm (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	3.5p	3.2p

WE WISH ALL OUR CUSTOMERS A MERRY CHRISTMAS AND A HAPPY NEW YEAR

LINEAR

THIS IS ONLY A SELECTION!

		LF356	80p	NE531	98p
		LM301AN	26p	NE555	23p
		LM308	60p	NE556	60p
		LM318N	75p	NE567	100p
		LM324	45p	RC4136	100p
709	35p	LM339	45p	SN76477	230p
741	16p	LM378	230p	TBA800	70p
747	45p	LM379S	410p	TBA810S	100p
748	30p	LM380	75p	TDA1022	620p
7106	850p	LM3900	50p	TL081	45p
7107	900p	LM3909	65p	TL084	125p
CA3046	55p	LM3911	100p	ZN414	80p
CA3080	70p	MC1458	32p	ZN425E	390p
CA3130	90p	MM57160	590p	ZN1034E	200p

TRANSISTORS

				ZTX500	16p
				2N697	12p
		BCY72	14p	2N3053	18p
AC127	17p	BD131	35p	2N3054	50p
AC128	16p	BD132	35p	2N3055	50p
AC176	18p	BD139	35p	2N3442	135p
AD161	38p	BD140	35p	2N3702	8p
AD162	38p	BFY50	15p	2N3703	8p
BC107	8p	BFY51	15p	2N3704	8p
BC108	8p	BFY52	15p	2N3705	9p
BC108C	10p	MJ2955	98p	2N3706	9p
BC109	8p	MPSA06	20p	2N3707	9p
BC109C	10p	MPSA56	20p	2N3708	8p
BC147	7p	TIP29C	60p	2N3819	15p
BC148	7p	TIP30C	70p	2N3820	44p
BC177	14p	TIP31C	65p	2N3904	8p
BC178	14p	TIP32C	80p	2N3905	8p
BC179	14p	TIP2955	65p	2N3906	8p
BC182	10p	TIP3055	55p	2N4058	12p
BC182L	10p	ZTX107	14p	2N5457	32p
BC184	10p	ZTX108	14p	2N5459	32p
BC184L	10p	ZTX300	16p	2N5777	50p
BC212	10p				
BC212L	10p				
BC214	10p				
BC214L	10p				
BC477	19p				
BC478	19p				
BC548	10p				
BCY70	14p				
BCY71	14p				

DIODES

1N914	3p	1N4006	6p
1N4001	4p	1N5401	13p
1N4002	4p	8ZY88 ser.	8p

ITT Full spec. product.
1N4148 – £1.40/100.

CAPACITORS

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

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

	screened	unscreened	socket
2.5mm	9p	13p	7p
3.5mm	9p	14p	8p
Standard	16p	30p	15p
Stereo	23p	36p	18p

DIN PLUGS AND SOCKETS

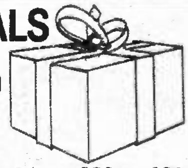
	plug	chassis socket	line socket
2pin	7p	7p	7p
3pin	11p	9p	14p
5pin 180°	11p	10p	14p
5pin 240°	13p	10p	16p

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

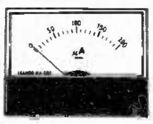
CHRISTMAS SPECIALS



A range of special offer items valid during December. All orders placed for these items **must** be received during December.

Murata Ultrasonic Transducers, per pair	~~350p~~	280p
PCB etch kit. Contents: 5 assorted sheets Alfac. Pound of Ferric Chloride. Dalo pen. Fibre glass PCB.	~~375p~~	325p
Resistor Development Pack. 10 off, each ¼W value from 4.7Ω to 1M	~~570p~~	470p
Polyester Development Pack. 5 off, each value from 0.01uF to 2u2.	~~620p~~	480p
Texas sockets. Must be in multiples of 100.		
8 pin, per 100		750p
14 pin, per 100		900p
16 pin, per 100		1000p
Pack of 10 x NE555	~~230p~~	200p
Pack of 10 x PP3 clips	~~60p~~	45p
Pack of 10 crocodile leads (20 clips)	~~115p~~	90p
Pack of 6 x C106D thyristors	~~270p~~	220p
Pack of 70 x 1N4148	~~140p~~	100p
Expo Reliant drill	~~665p~~	550p
Expo Titan drill	~~1030p~~	890p
LEDs, Pack of 10 x 0.2 Red, 10 x 0.2 Green, 10 x 0.2 Yellow	~~350p~~	290p
AY51013P UART	~~360p~~	325p
2114 Low Power 300nS	~~535p~~	450p
2708 EPROM	~~750p~~	590p
SS-2 Breadboards	~~1085p~~	990p

PANEL METERS



High quality 2" wide view meters. Zero adjustment. Back illumination wiring.
Available in 50 uA, 100 uA, 500 uA, 1 mA, 100 mA, 500 mA, 1A. £4.75 ea.
VU meter similar style. £1.40 ea.

SLIDE POTENTIOMETERS

Good quality 60mm travel slider with 80mm fixing centres.
Available from 5k – 500K in log and linear. 55p each.
Suitable black knobs 6p ea. Coloured knobs 10p ea.

We now offer one of the widest ranges of components at the most competitive prices in the U.K. See catalogue for full details. We welcome callers at our shop in College Rd, Bromley, from Mon–Sat, 9am–6pm (8pm on Weds and Fridays). Special offers always available.
We also provide an express telephone order service. Orders received before 5pm are shipped same day. Contact our sales office now with your requirements.
TELEPHONE: 01-464 2951/5770.

Quantity discounts on any mix TTL, CMOS, 74LS and Linear circuits: 100+ 10%, 1000+ 15%. Prices VAT inclusive. Please add 30p for carriage. All prices valid to April 1980. Official orders welcome.

ORDERS DESPATCHED BY RETURN POST

BARCLAYCARD & ACCESS WELCOME.

Mail orders to: STEVENSON (Dept EE)

76 College Road, Bromley, Kent BR1 1DE.

A MICRO LASHING FOR INDUSTRY

Judging from the many stories published in these pages over the last year, we find it hard to believe a statement and report from the Minister of State for Industry that less than a third of Britain's top 1,000 companies are applying microelectronics in their business.

This is the finding of a MORI survey conducted for the Department of Industry and revealed recently by Lord Trenchard, Minister of State for Industry.

Brief extracts of a speech he made at a recent London seminar on "Technology and Organised Labour" are given below:

"The lack of British microelectronic applications is reinforcing the huge productivity gap between the UK and our major competitors and provides an explanation as to why UK unit labour costs are so high while our wage levels remains so low."

"In 1978-79 unit labour costs were increasing at a rate of 10 per cent in the UK, twice as fast as in the USA and almost five times as fast as in Germany. Japanese unit labour costs were actually declining at over 3 per cent."

"I have just returned from Japan whose post-War performance is outstanding. I believe that there are two secrets in the Japanese miracle. First, they really accept that the foundation for a high standard and quality of life must be industrial success and expansion. Secondly, within their companies, they all work together for efficiency and profit. Negotiation of entirely dependable agreements with one union only, in no way conflicts with the drive of all employees towards constant change and greater efficiency."

"With regard to the absolute dependability of agreements and the freedom, indeed requirement, for management to introduce constant change and improvement in Japan, it is not generally realised that even with well ordered industrial relations, it is quite difficult for a factory manager to 'spare up' more than 20 per cent of his time for the introduction of new methods and new systems to move his company forward. Eighty per cent of his time is already mortgaged in carrying out essential routine duties. If he has to spend up to 50 per cent of his time in constant negotiation at many levels the show moves backwards and not forwards."

"The challenge before us today is whether we can, by combining will with technology right across our industrial and commercial operations, lift ourselves off the lower rungs of the productivity ladder in order to generate the wealth we all need to improve the quality of life for all our people."

"Microelectronics provides us with a means to meet this challenge."

"Why then is it that less than a third of Britain's top 1,000 companies are already applying microelectronics to their production processes, purchasing, design, quality control, and products? This was a finding in a MORI survey commissioned by the Department of Industry to monitor our national microelectronics awareness campaign."

"The answer is that effective application of microelectronics requires a radical change in work habits and attitudes from the boardroom to the factory floor. The whole company has to learn a new way of operating."

"The MORI survey disclosed that some 5 per cent of the top 1,000 British companies reckon that they have already lost market share because of failure to apply microelectronics and another 9 per cent expect to suffer losses for the same reason."

"In the United States, over 750,000 new jobs have been created during the last three years in California, the home of 'Silicon Valley', while over 5 million new jobs have been generated over the last four years in the USA as a whole. Of even greater significance was the finding of the Birch Report that small firms in the USA employing 20 or fewer people generated 66 per cent of all new jobs. Many of these small firms have come forward on the wave of microelectronic inventions and applications that have been sweeping through the USA."

"There is no reason why we in the UK should not seize our share of these new opportunities, if we turn our attention as a nation away from the sterile internal debates between 'we' and 'they' on whichever side of the fence we are and focus all our energies on acquiring the skills necessary to exploit the new technology whatever our current status or job functions."

The finance may be there, but the millions of pounds investment needed at the new interest rate could make the final unit cost too high for the purchaser?

No doubt readers will have their own views?

Viewdata Boost

A promise to build thousands a month of viewdata TVs during 1980 has been made by ITT and they will be able to receive the Post Office Prestel Service.

This will go a long way towards remedying Post Office complaints that Britain's TV industry has been producing too few sets, therefore retarding wider useage of Prestel. ITT forecast that by 1985 there will be over a million business users of Prestel and 600,000 domestic users.

GOLDEN AGE

This year's President of the Institution of Electrical and Radio Engineers, Professor William Gosling, called his inaugural address "Electronics—a profession in its golden age".

He pointed out that for the first time in human history we can create artefacts of more than biological complexity and from materials that are as common as dirt.

A big future for video discs for home entertainment is expected by RCA following a signing with Paramount and Rank for the supply of feature films.

By 1990, RCA estimate that video disc players will have captured as much as 50 per cent penetration of all homes with colour TV with possibly 40 million units in service.

SAFETY IN THE HOME

Originally published to give guide-lines for safety in domestic radios, successive editions of the British Standards Institution safety requirements has had to take in more and more household electronic equipment.

The latest edition, now entitled "BS 415 Safety requirements for mains-operated electronic and related apparatus for household and similar general use", specifies safety requirements for a whole range of mains electronic equipment now available for use in the home. It includes monochrome and colour television receivers, radio receivers, clock radios; stereo amplifiers, tuners and turntables; record players, music centres, tape recorders, video cassette recorders, and electronic musical instruments.

Auxiliary equipment provided for use with this apparatus is also covered, e.g. microphones, loudspeakers, cable connected remote control devices and battery eliminators.

. . . from the World of Electronics

—ANALYSIS

THE MIRACLE INGREDIENT

System X sounds as if it ought to be one of those new-formula consumer products promising better action with less effort at lower cost. But System X is no soap substitute. It is the new generation of digital electronic telephone exchanges which are now being constructed and will be installed in ever-increasing numbers in the 1980s. The first large System X exchanges being installed in 1980 and operational in 1981.

If all goes well it certainly promises better action with less effort for the consumer though whether at lower cost remains problematical. And System X also has a miracle ingredient.

The advantage of going all-digital is that a digital network can handle any type of information without discrimination. The system sees no difference between digitized speech or data or facsimile or telephone answering machines or automatic diallers or teleconferencing or wake-you-up calls or radiopaging or Prestel terminals. Once you change everything into digits you get a complete communications and information system on one network.

A digital system also has a big money-saving spin-off in management statistical information, automatic billing to the customer, automatic self-testing and fault diagnosis, and overload control which at busy periods will hopefully solve queuing and rerouting problems.

A small miracle had to happen in the first place to make this mammoth project feasible. This was to get the equipment manufacturers talking to each other and to the British Post Office with everyone, so to speak, on the same wavelength instead of competing with each other as in the past. GEC, STC and Plessey needed to reveal their engineering secrets to each other as well as to the Post Office. And it actually happened, although not without difficulty.

A central theme of System X is that it is not only good for the UK but for the rest of the world as well. The world telephone network of 400 million lines today is expected to grow to a staggering 1,400 million lines by the end of the century and System X could capture 10 per cent of the world market.

It raised a lot of interest at the recent international *Telecom* '79 show at Geneva where it was the only large scale digital system shown in actual operation as distinct from wall diagrams and glossy pamphlets from other countries.

The first-ever public demonstration was a triumph but it raises the spectre, ever-present with high technology, of being before its time, of already being obsolescent before getting into service.

But have we not forgotten the miracle ingredient? The modular architecture of System X in both hardware and software is such that it can always be up-dated to take advantage of new components and technology. Moreover, it can be tailored to interface with any existing equipment anywhere in the world and can be expanded at will to accommodate more or different services as they become demanded by the user.

Brian G. Peck

THE ELECTRONIC OFFICE

The electronic office was a big feature of the International Business Show at Birmingham where 430 exhibitors reported a good attendance. But, as one observer reported, the huge display of electronic equipment for the office of the 80s was not matched by the mass of new office furniture, very little of which was designed to accommodate the electronics.

The beginning of a Japanese low-cost invasion was spearheaded by the first UK showing of the Sharp desk-top personal computer priced at from £520 plus VAT.

Britain's Airborne Early Warning (AEW) system is running to schedule. The tactical communications system comprising 120 different electronic units has been ground-tested and is now being air-tested in a special trials aircraft. Main contractor for both the airborne radar and communications is Marconi Avionics Ltd.

The Rank Organisation expects to sell 5,000 colour TVs a year in Israel following the recent introduction of colour TV. The Rank sets will be distributed through Electra of Israel.

VIDEO AWARD

The Sony Corporation has been awarded its third Emmy by the National Academy of Television Arts and Sciences for its role in developing the one-inch Videotape recorder for broadcast production.

Sony developed its one-inch BVH series of recorders in 1976. Since then, one-inch VTRs have been rapidly replacing the two-inch format equipment in television stations around the world.

PERSON-to-PERSON

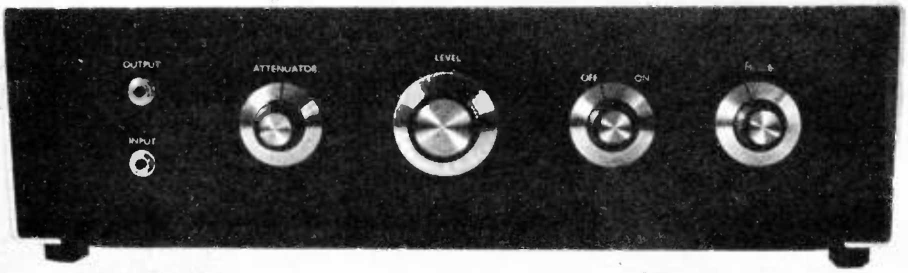
The chance to speak person-to-person to Post Office telephone subscribers anywhere in the country from the privacy of their own vehicle is now possible through the Network radiophone service.

Believed to be the first time an independent message-handling contractor has been granted a licence to break the Post Office's monopoly on telephone communications, the new service is now operational throughout the Greater Manchester area.

Through the Network service's transmitter at Salford, the motoring businessmen can now be "plugged" directly into the Post Office telephone system making it possible to make and receive calls to and from anywhere in Britain or abroad.

Subscribers to the system are charged £60 a month for the rental of the equipment and service, and allowed up to 40 free local telephone calls a month made or received over the Post Office telephone lines. They are only charged for incoming calls if they agree to accept them from the operator.

Perhaps, when radiophones become standard fitments in new vehicles the sight of vandalised public call boxes and long queues will be a thing of the past.—A commercial venture here for the "new" Post Office?



SPRING-LINE REVERB UNIT

BY R. A. PENFOLD

REVERBERATION is caused by sounds bouncing around the floor, ceiling and walls of a room, and tends, to a certain extent, to sustain sounds and merge them into one another.

Many types of music benefit from a suitable amount of reverberation and sound rather "flat" if it is absent. This can be something of a problem for the home-recording enthusiast because the carpets, curtains and furniture of most homes tend to have good sound absorbing properties, giving very little reverberation.

Fortunately it is possible to artificially add reverberation to a signal using a unit such as the one described in this article, and very realistic results can be obtained in this way. There are several ways of producing the reverberation artificially, but using a spring-line unit is probably the best low-cost method, and is the one employed here.

The unit can also be used with an electric guitar or an electronic organ or other electronic instrument as an effects unit, and can produce very interesting results.

BLOCK DIAGRAM

The block diagram seen in Fig. 1 shows the basic stages in the circuit of the reverberation unit. The input signal is taken to a buffer stage which gives a reasonably high input impedance of about 100 kilohm. Some of the output from this stage is taken to a mixer, and then to the output by way of an output level control.

The rest of the output from the buffer stage is coupled to an audio power amplifier via a volume control type attenuator. The output from the power amplifier is used to drive the spring-line unit.

A spring-line basically consists of a long coiled wire spring having a transducer at each end. One transducer is fed with the output from the power amplifier, and it converts this signal into sound waves which travel down the spring comparatively slowly due to its inertia. The transducer at the other end of the spring picks up these sound waves after a short delay, and converts them back into electrical signals.

The sound waves are not totally absorbed, however, and are reflected backwards and forwards along the spring numerous times before they die away to an insignificant level. These reflected waves are picked up by the output transducer each time they reach the appropriate end of the spring, and this gives the required reverberation signal.

The reverberation signal is mixed with the main signal, and the attenuator at the input of the power amplifier controls the level of reverberation signal that is added to the ordinary signal. A switch is used to disconnect the ordinary signal from the mixer when only the reverberation signal is required.

The reverberation time, i.e. the time taken for the reverberation to decay to an insignificant level (−60dB), depends upon the type of spring-line utilised in the project, but is approximately 2·5 to 3 seconds if the specified unit is used. This is ideal for most applications.

THE CIRCUIT

The circuit diagram of the reverberation unit is shown in Fig. 2. TR1 and its associated components form the input buffer amplifier connected in the emitter follower mode so that it provides the necessary fairly high input impedance, and a low output impedance to drive the following circuit with little loss of signal level due to loading.

Capacitor C3 couples some of the output from the buffer stage to the reverberation level control, VR1. From here the signal is coupled direct into the non-inverting input of the audio power amplifier which uses a LM380N device (IC1). The inverting input of IC1 (pin 6) is earthed to the negative rail in order to prevent stray pick up here. Capacitor C5 decouples the supply to the input stages of IC1, and this helps to improve the low-frequency stability of the circuit.

The output from IC1 is coupled to the input transducer of the spring-line unit by way of d.c. blocking

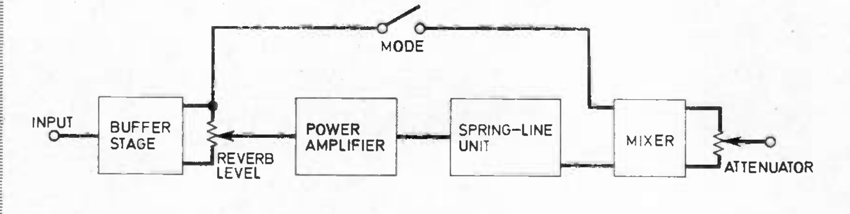


Fig. 1. Block diagram showing the basic arrangement of the Spring-Line Reverb Unit.

capacitor C6. The input transducer is a low impedance (16 ohm) magnetic type, and this is why it is necessary to use a power amplifier to drive it.

The output transducer of the spring-line is a medium impedance (10 kilohm) magnetic type, and its output is coupled by C7 to the mixer stage. This consists of TR2 connected in common emitter mode with input resistors R5 and R6.

The full gain of TR2 is not required and so emitter resistor R9 is used to introduce negative feedback which reduces the voltage gain of TR2 to about 20. There are some losses incurred through R6, but the output from the spring-line still receives a significant amount of amplification. This is necessary due to the quite high signal loss through the unit.

REVERBERATION LEVEL

The second input of the mixer stage is fed with the ordinary input signal from TR1 emitter unless S2 is switched to break this signal path and give only the reverberation signal.

The signal from TR1 emitter will normally be considerably stronger than that from the spring-line, even with the reverberation level control well advanced, and so R5 is given a much higher value than R6. This enables a reverberation level equal to the main signal level to be obtained, as the higher losses through R5 permits the two signals to be roughly balanced. The output from the mixer stage is fed to the output socket via d.c. blocking capacitor C9 and output attenuator VR2.

The voltage gain of the circuit is a little in excess of unity with this control set for maximum output, but the addition of a high level of reverberation can increase the effective voltage gain to about ×2.

On/off switching is provided by S1, and power is obtained from a 9 volt battery. The quiescent current consumption is only about 9mA, but will usually increase somewhat at high volume levels as the L380N has a class B output stage. In fact on high level inputs when a high reverberation level is required, IC1 may have to give an output of a few hundred milliwatts r.m.s. into the spring-line in order to give sufficient reverberation, producing a current consumption of as much as 100mA on volume peaks. It is therefore advisable to power the unit from a large battery such as a PP7 or PP9 size.

COMPONENTS

Resistors

R1	220kΩ
R2	270kΩ
R3	3·9kΩ
R4	560Ω
R5	220kΩ
R6	39kΩ
R7	1·5MΩ
R8	4·7kΩ
R9	220Ω

All ¼W carbon ± 5%

See Shop Talk page 19

Potentiometers

VR1	5kΩ carbon log.
VR2	10kΩ carbon lin.

Capacitors

C1	100µF 10V elect.
C2	100nF polyester
C3	10µF 10V elect.
C4	100µF 10V elect.
C5	10µF 10V elect.
C6	470µF 10V elect.
C7	1µF 10V elect.
C8	100nF polyester
C9	10µF 10V elect.

Semiconductors

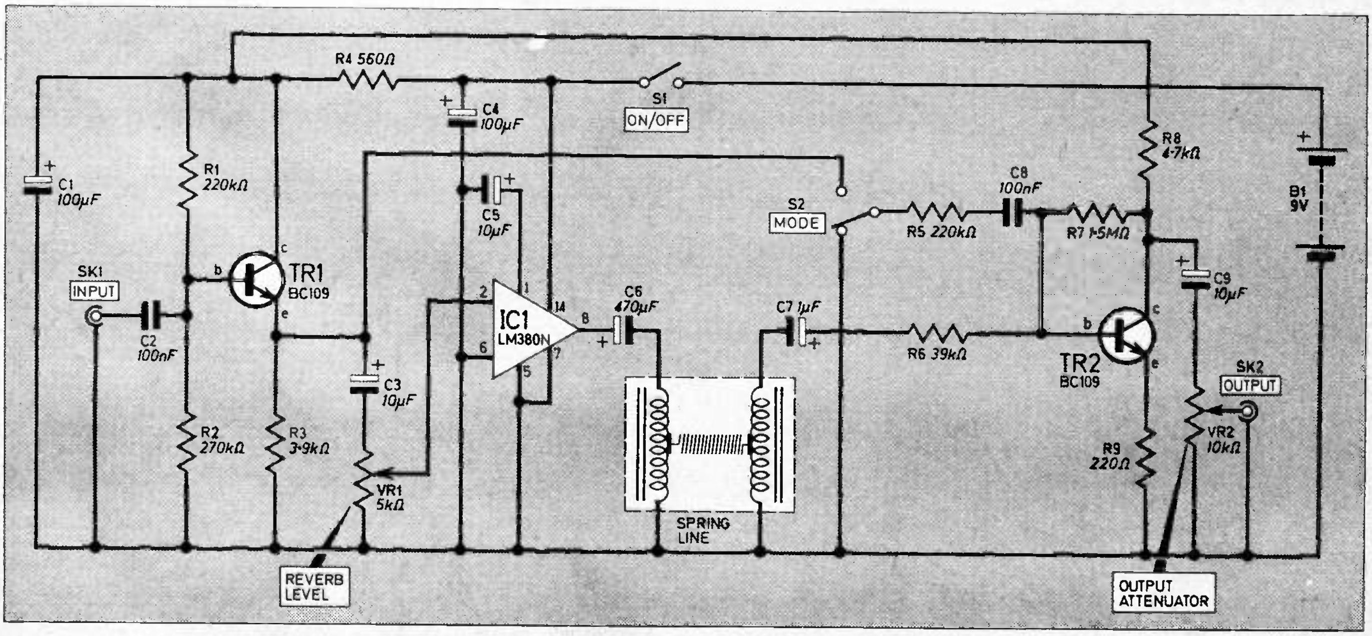
IC1	LM380N 2W audio amplifier i.c.
TR1	BC109 silicon *npn*
TR2	BC109 silicon *npn*

Miscellaneous

S1 s.p.s.t. toggle or rotary switch
S2 s.p.d.t. toggle or rotary switch
SK1, SK2 3·5mm jacks (2 off)
Large metal case (Vero "G Range" case type 91-2674B, 304 × 210 × 84mm or any similar case); 0·1 inch matrix stripboard panel 36 holes × 17 strips; Short spring-line unit (Maplin Electronic Supplies); control knobs; PP9 battery and connectors to suit; connecting wire.

COMPONENTS approximate cost £12.50 excluding case

Fig. 2. Complete circuit diagram for the Spring-Line Reverb Unit.



SPRING-LINE REVERB UNIT

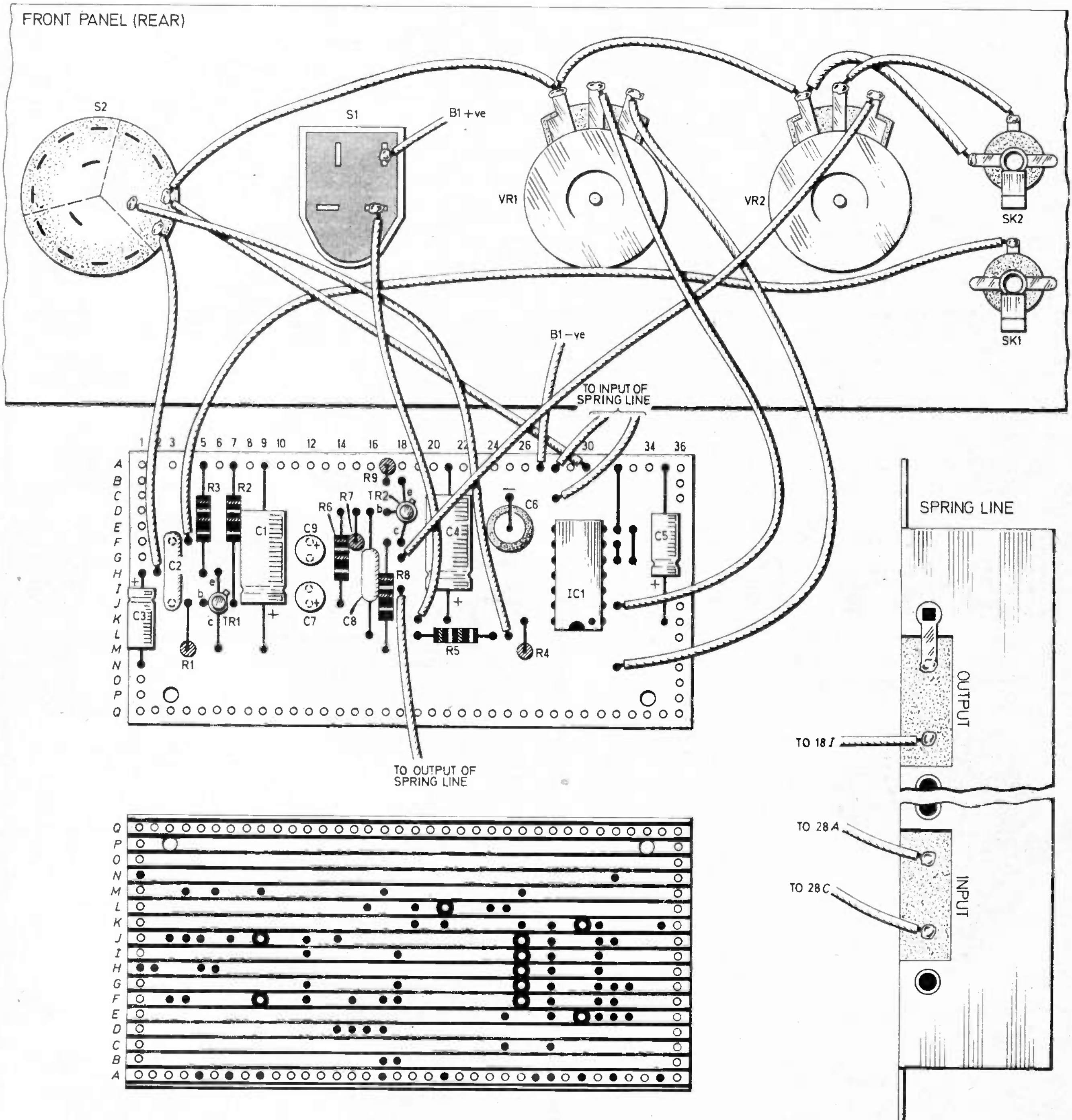


Fig. 3. Complete interwiring details, component layout on the circuit board and underside of stripboard showing breaks to be made in the copper strips.

CONSTRUCTION starts here

THE CASE

A suitable component layout for the unit using a stripboard having 36 holes by 17 strips is shown in Fig. 3. Drill the two 6BA or M3 clearance mounting holes and make the 10 breaks in the copper strips before soldering in the components and three link wires. The semiconductor devices should be the last components to be soldered into circuit.

The case needs to be a fairly large type in order to accommodate all the components, and in particular the spring-line unit which is a little over 200mm in length. The largest size Vero "G range" case makes a very attractive housing for the project and is used as the cabinet for the prototype unit, but any case of about the same size should also be perfectly suitable.

The layout of the unit is not critical, and the arrangement used for the prototype can be seen from the illustrations.

INTERIOR WIRING

All the point-to-point wiring of the unit is illustrated in Fig. 3. S1 and S2 are rotary types on the prototype (S2 being one pole of a 4-way 3-pole type having an adjustable end stop set for 2-way operation), but toggle or slider types can be used if preferred.

The input and output terminals of the spring-line unit are clearly marked, and the leads to the input transducer can be connected with either polarity. One of the output terminals is connected to the metal casing of the spring-line by a solder-tag which is ready wired into place by the spring-line manufacturer.

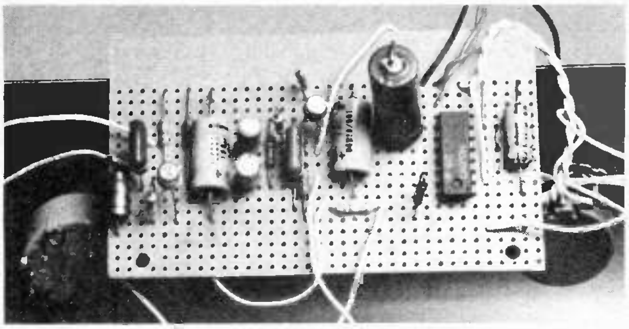
Assuming a metal case is used there is no need to make a connection to this terminal since it will be earthed to the negative supply rail through the cabinet, which is in turn earthed by the negative supply connection to SK2. Using a separate connecting wire would probably produce an earth loop with consequent instability. Socket SK1 also receives its earth connection via the metal case. However, an earth wire to each socket will be required if insulated case jack sockets are used.

USING THE UNIT

The unit is intended to be used in a high-level signal path, with an input level of about 50 to 1000mV r.m.s. It is unlikely that really good results will be obtained operating the unit from a low-level source such as a dynamic microphone, since the signal to noise ratio will inevitably be effectively reduced. Far better results would be obtained by interposing a suitable pre-amplifier between the source and the reverberation unit.

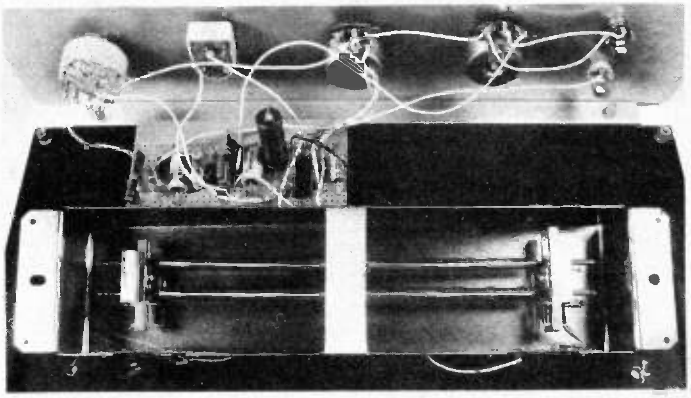
Except with input levels of about 50mV r.m.s. or less, full reverberation will be reached before VR1 is advanced to its fully clockwise setting. Taking it beyond the point at which full reverberation is achieved would simply cause the signal at the output of IC1 to clip, producing severe distortion on the output signal.

With S2 switched to the position where the ordinary signal is muted and only the reverberation signal is obtained the unit will act as an interesting effects unit for an electronic instrument. It is particularly effective with instruments that provide a glissando signal, as it then gives a weird but not unmusical wailing sound. ⌑

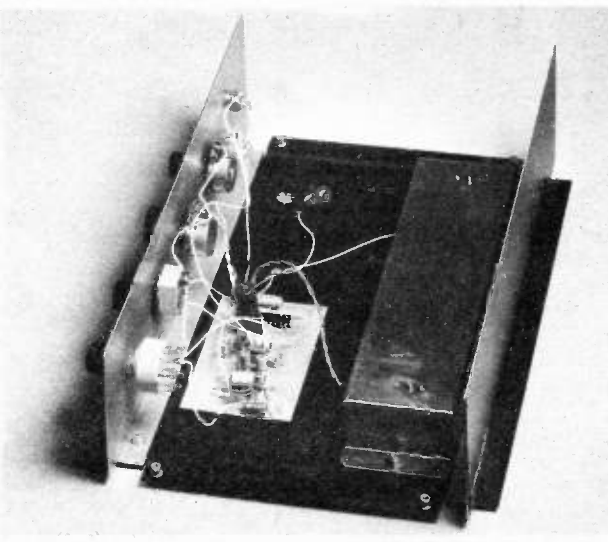


The finished circuit board removed from the chassis.

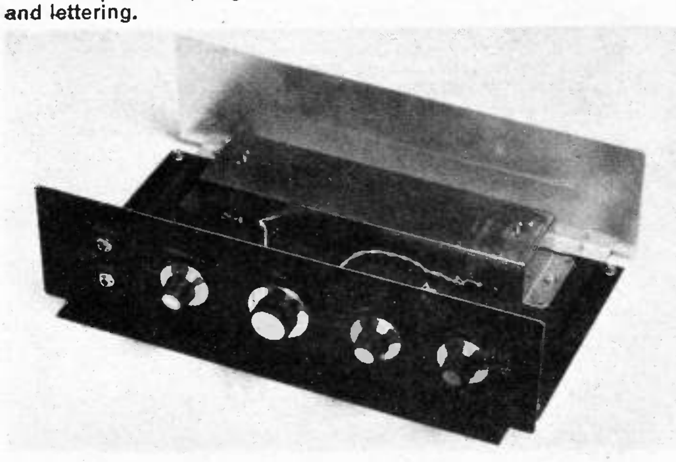
The case "surround" removed showing positioning of circuit board and Spring-Line module.



Interwiring to the front panel controls and detail of the Spring-Line module.

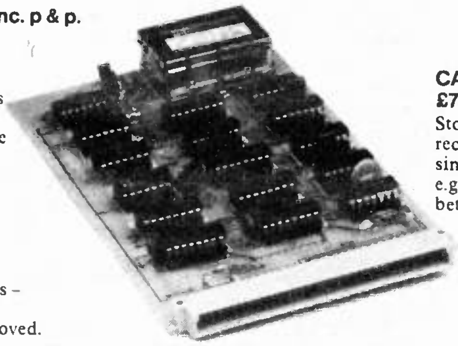


The completed Spring-Line Reverb showing front panel controls and lettering.

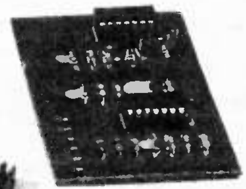


Now, the complete MK 14 micro-computer system from Science of Cambridge

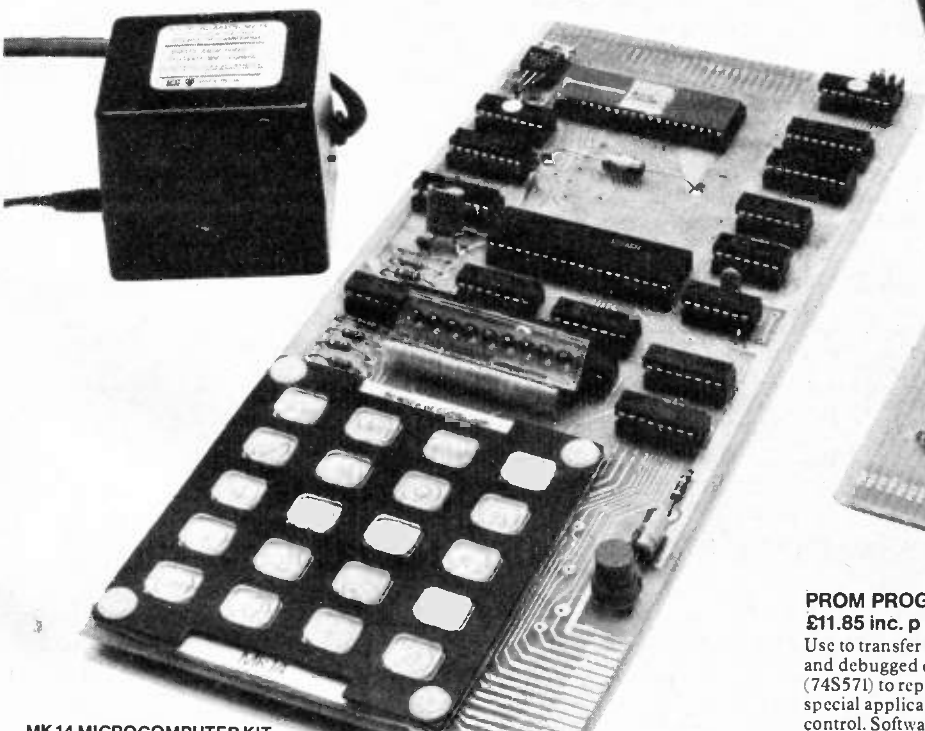
VDU MODULE. £33.75
(£26.85 without character generator) inc. p & p.
Display up to ½K memory (32 lines x 16 chars, with character generator; or 4096 spot positions in graphics mode) on UHF domestic TV. Eurocard-sized module includes UHF modulator, runs on single 5 V supply. Complete ascii upper-case character set can be mixed with graphics.

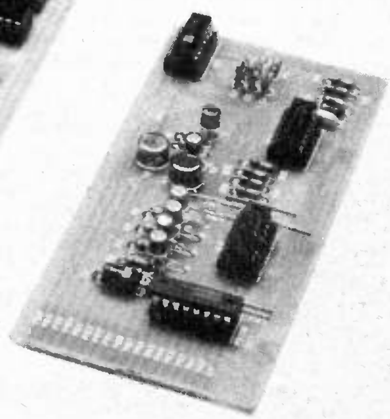


CASSETTE INTERFACE MODULE.
£7.25, inc. p & p.
Store and retrieve programs on any cassette recorder. Use for serial transmission down single line at up to 110 baud (teletype speed), e.g. over telephone line, and to communicate between two or more MK 14s.



POWER SUPPLY. £6.10 inc. p & p.
Delivers 8 V at 600 mA from 220/240 V mains – sufficient to drive all modules shown here simultaneously. Sealed plastic case, BS-approved.





PROM PROGRAMMER.
£11.85 inc. p & p.
Use to transfer your own program developed and debugged on the MK 14 RAM to PROM (74S571) to replace SC10S monitor for special applications, e.g. model railway control. Software allows editing and verifying.

MK 14 MICROCOMPUTER KIT
£46.55 inc. p & p.
Widely-reviewed microcomputer kit with hexadecimal keyboard, display, 8 x 512-byte PROM, 256-byte RAM, and optional 16-lines I/O plus further 128 bytes of RAM.

Supplied with free manual to cover operations of all types – from games to basic maths to electronics design. Manual contains programs plus instructions for creating valuable personal programs. Also a superb education and training aid – an ideal introduction to computer technology.

Designed for fast, easy assembly; supplied with step-by-step instructions.

Science of Cambridge Ltd

6 Kings Parade, Cambridge, CAMBS., CB2 1SN.
Tel: 0223 311488.

To order, complete coupon and post to Science of Cambridge
Return as received within 14 days for full money refund if not completely satisfied.

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.

Please send me:
- ☐ MK 14 standard kit @ £46.55.
- ☐ Extra RAM @ £4.14 per pair.
- ☐ RAM I/O device @ £8.97.
- ☐ VDU module including character generator @ £33.75.
- ☐ VDU module without character generator @ £26.85.
- ☐ Cassette interface module @ £7.25.
- ☐ PROM programmer @ £11.85.
- ☐ Power supply @ £6.10.
- ☐ Full technical details of the MK 14 System, with order form.

All prices include p+p and VAT.

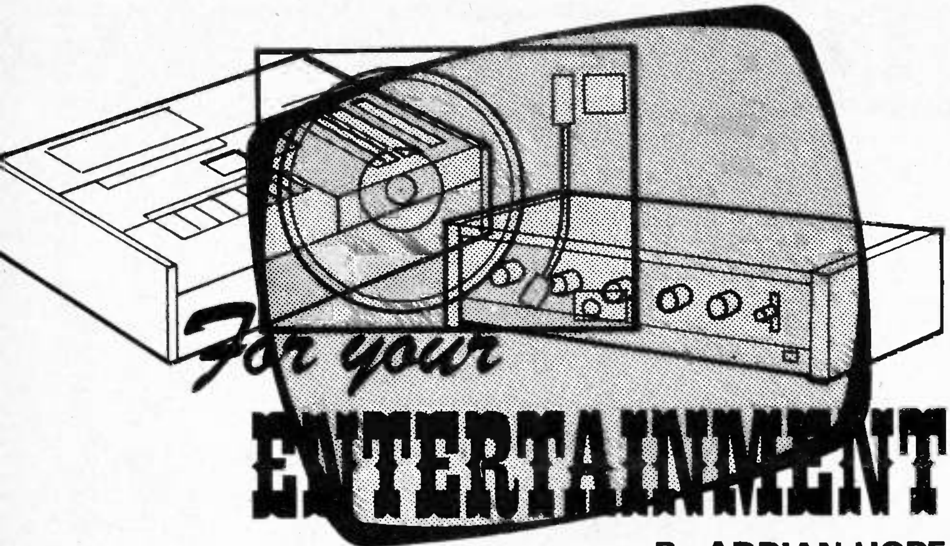
I enclose cheque/MO/PO for £__________(total).

Name____________________

Address (please print)____________________

EE/1/80

For your ENTERTAINMENT



By ADRIAN HOPE

Singing Lights

Have you ever noticed how electric light bulbs, especially of high wattage "sing" when run off a thyristor dimmer switch? The singing is usually most pronounced when the switch is set at a half-way position.

The reason for this seems pretty clear. The thyristor dimmer works by biting chunks out of the 50Hz mains sine waveform and they are taken out so sharply that the waveform ends up with squared edges. These square edges generate high frequency harmonics which cause interference on medium and long wave radio sets.

It also seems reasonable to deduce that some of the lower frequency harmonics fall in the audible range. By electro-magnetic induction these set the coils of the lamp filament vibrating at an audible pitch. In other words the coils of the lamps behave just like the coils and laminations, which can emit mechanical buzzes and hums of an infuriating level.

Given the fact that the use of a dimmer will vibrate the coiled filament mechanically, an interesting thought now arises. Surely this continual mechanical vibration of the lamp filament can't exactly lengthen the lamp's life.

It has become a factoid (Norman Mailer's delightful term for an unsubstantiated fact that finds its way into the folklore) that the use of a dimmer prolongs lamp life because it cuts down on cold current surge and consistently under-runs the lamp. But over the years I have been led to the reluctant conclusion that lamps run on dimmers need replacing at least as often as lamps run on simple on/off switches.

Could it be that the disadvantage of mechanical vibration outweighs the advantage of limited current surge, so that the use of a dimmer actually shortens, rather than lengthens, lamp life?

Frozen picture

A low dosage X-ray machine produced by EMI Pantak and International Aeradio is being installed at Gatwick and Heathrow airports for airline security baggage inspections. The new Rapidex X100 machines will not fog film and development of X100 represents an interesting change in policy by EMI Pantak.

The company had previously supplied Heathrow with Rapidex high dose machines which fog passenger's film, even when shielded by protective lead bags. The original machines generated an X-ray dose of at least 17 milliroentgens per second and as the inspection process takes up to ten or twelve seconds (for instance if the operator looks closely at a suspicious object) the baggage under inspection may receive a total of up to 200 milliroentgens.

The advantage of the old machines is a very clear picture which reveals the presence of any metallic weapon, however carefully concealed. The disadvantage is a very unhappy passenger who has forgotten to remove all cameras and film beforehand, or relied on shielding by a protective lead bag.

Low dose X-ray systems, as already used by many airports around the world, expose the baggage only briefly to low level radiation. The resultant X-ray picture is then frozen on a fluorescent screen and artificially brightened by an image intensifier.

Low dose systems do not fog film and will not penetrate the lead shield. If the operator sees the opaque outline of a lead bag the passenger is asked to open it for visual inspection. Public pressure has now forced the London airports to follow the rest of the world and install low dose systems.

The new Rapidex X100 uses a similar strength of radiation to the original machine but for just one hundredth of a second. The picture is then frozen on a memory tube.

There is certainly no noticeable effect on photographic film. Pictures taken on even very fast colour stock, rated at 400ASA, and exposed thirty times to the X100 radiation dose, show barely noticeable fogging.

Airline passengers passing through London will thus no longer need to remember to remove all unexposed film from their baggage for pre-flight security checks.

Queen's English

The Texas Instruments Speak and Spell toy (previously mentioned in this column) is now available in a version which speaks something approaching the Queen's English. The basic three-chip synthesiser circuitry includes a ROM which can be programmed to speak any words in any language.

But the original Speak and Spell was modelled on an American voice, with American pronunciation and the visual display shows American spelling. So anomalies like "color" for "colour" and "skedule" for "schedule" are buried in the ROM to confuse British-speaking users.

Although it is an expensive business to completely reprogramme the ROM, and change the speech accent, Texas has now altered the programme sufficiently to eradicate the most obvious "Americanese" anomalies. Unfortunately, both original and re-programmed models are on sale virtually side by side and it is very hard to distinguish one from the other.

The circuitry synthesizes words from the ROM in purely random fashion and a potential customer might have to test the toy for hours before hitting by chance on a tell-tale word like "honor". Fortunately, there is a very simple way to distinguish the two models.

The Z key on the British version has been re-programmed to say "zed" whereas the American version still says "zee". So anyone buying a Speak and Spell to help their childrens' education would be well advised to press the "Z" key before parting with their money.

Speak and Spells are already available for under £40 and the price, especially of now obsolete Americanese versions, will probably drop further. Texas is using the basic 3-chip circuitry for a whole range of new applications, for instance a language translator which speaks in a foreign language.

Without doubt there will be all kinds of new speaking gadgetry on the market from Texas and other firms over the next year or so and their prices will fall just as calculator prices have plummeted over recent years. So think twice before buying at current prices.

Is it a Mental Breakdown?

That said, I have to admit to finding Speak and Spell a fascinating gadget, and while playing with one on loan for a week discovered a delightful trick which you can play on it.

In order to expand the Speak and Spell's vocabulary, there is provision for an extra ROM in the form of a plug-in module. A "module" key on the keyboard makes the content of the new memory accessible to the synthesizer circuit.

If you press the "module" key, but fail to insert the module, the synthesizer circuitry makes its usual random search for instructions and will sooner or later try to delve into the non-existent ROM. When this happens the synthesizer goes haywire, asking the operator to spell non-existent words, phrases and sounds. So pathetic is the garbled sound that only the hardest heart can fail to feel sorry for the confused electronics burbling as if in final, demented death throes.

By B. H. Baily

synthesisers EXPLAINED PART 2

IN PART 1 we dealt with the basic principles of tone generation and envelope shaping in both electronic organs and synthesisers. We saw how the organ uses a set of oscillators and dividers to produce all the required notes or pitches for the entire organ, and the keyboard selects these when keys are pressed, but that in the monophonic synthesiser only one, two or three oscillators are normally used, and these are made such that each can produce a wide range of pitch, and can thus be called upon to produce any note over the whole keyboard, by applying a suitable voltage to its voltage control input.

We also saw how easy it is to memorise any such pitch by arranging for the voltage applied to be "stored" in a special sample/hold circuit, using a simple capacitor.

Already, the principle of voltage control has shown to be very valuable. But it does not stop at that. Just think of the numerous effects pedals you can now buy for guitars alone. Each of these contains a circuit which can be varied by mechanical means to give such effects as waa-waa, phase, etc. The circuits are designed such that the effect is modified by the rotation of a potentiometer, which changes the resistance in a certain part of the circuit to give the change in effect. The rotation of the potentiometer is produced by movement up and down of the foot-operated pedal, and is what is termed manually operated.

Manual operation is all very well, and essential in some cases, but in a synthesiser it is often convenient that such changes in effect be done automatically, usuall at a preset frequency of repetition. Of course, little motors could be devised to drive the shafts of potentiometers, but this has obvious disadvantages.

VOLTAGE VARIATION

Instead, the circuits which require a variable resistance to work them are modified so that they will produce the effect by a variation of voltage on a special voltage control input as with the voltage controlled oscillator mentioned earlier. The actual pattern of voltage applied to control such circuits can be generated internally in the synthesiser by other special circuits, or, where required, manually, by either the keyboard, as in tone generation using the v.c.o.s, or even by a special two-function voltage source potentiometer known as a joystick. This device uses two potentiometers arranged such that the movement of a control stick in one direction produces a variable voltage output from one output terminal, whilst movement in a direction at 90 degrees to this, varies a second voltage output. In this way, two separate voltage controlled circuits may be varied using only one hand.

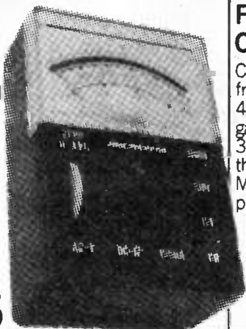
Another source of manually-operated voltage control is the ribbon controller which is rather like a long potentiometer operated by a finger pressed on to a foil strip which is pressed to make contact on a strip of resistive element underneath it. The output is taken from the foil, and a voltage is connected across the ends of the resistive element, so that the foil picks off whatever voltage is present at its point of contact with the element.

AUTOMATIC SOURCES OF V/C VOLTAGES

A repetitively-changing voltage is relatively simple to produce. After all, this is what we have coming from our v.c.o.s, except that the repetition rate is too fast for most of our purposes. So, a slower oscillator is required, whose frequency can be

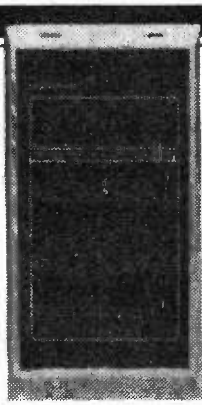
MORE BIG VALUE FROM YOUR TANDY STORE

1000 OHMS/VOLTS AC/DC 8 RANGES



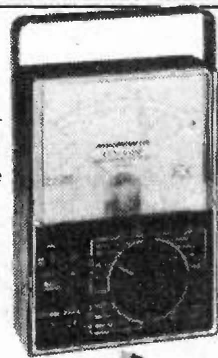
Handy multitester for home and work-shop. Easy-to-read two colour 5cm meter, pin jacks for all 8 ranges. Reads AC and DC volts: 0-15-150-1000 DC current: 0-150 mA. Resistance: 0-100,000 ohms. Accuracy: ± 3% full scale on DC ranges, ± 4% on AC ranges. Complete battery. **22-027.** REG. PRICE **£6.95**

6-DIGIT FREQUENCY COUNTER



Counts frequencies from 100 Hz to over 45 MHz with 100 mS gate time. Accuracy is 3 ppm at 25°C or less then ± 30 Mkz on 10 MHz! Overload-protected 1-meg input. Sensitivity, 30 mV up to 30 MHz. Req. 9V battery. **22-351.** REG. PRICE **£79.95**

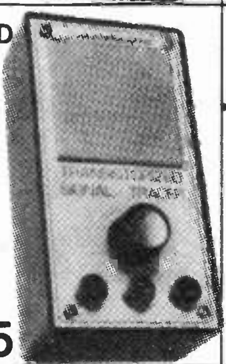
MULTITESTER



Dual FET imput for accuracy and minimum loading. 11.5cm mirrored scale. DC volts, 0-1-3-10-30-100-300-1000. DC current 0-100 a. 0-3-30-300 milliamp. Resistance 0-30-300-3k-30 1C-1 megaohm. 0-100-1k-10 1C-100K-3 megaohms. Req. 9V battery. **22-209.**

REG. PRICE **£29.95**

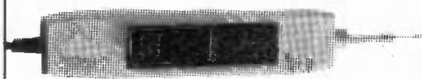
TRANSISTORIZED SIGNAL TRACER



Spot circuit troubles and check RF, IF and audio signals from aerial to speaker on all audio equipment. With 9V battery, instructions. **22-010.**

REG. PRICE **£9.95**

DIGITAL IC LOGIC PROBE



Unique circuitry makes it a combined level detector, pulse detector and pulse stretcher. Hi-LED indicates logic "1". Lo-LED is logic "0". Pulse LED displays pulse transitions to 300 nanoseconds, blinks at 3 Hz for high frequency signals (up to 1.5 MHz). Input impedence: 300K ohms. With 36" power cables. **22-300.**

REG. PRICE **£19.95**

SIGNAL INJECTOR

For RF, IF, AF circuits. Maximum accuracy. Easy pushbutton operation. Needs two "AA" batteries. **22-4033.**

REG. PRICE **£2.79**

AC/DC CIRCUIT TESTER

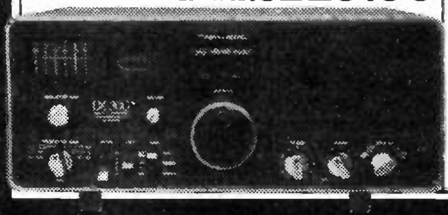
Accuracy in 1-300 volts ranges. Safe in live/dead circuits. Needs two "AA" batteries. **22-4034.**

REG. PRICE **£1.99**

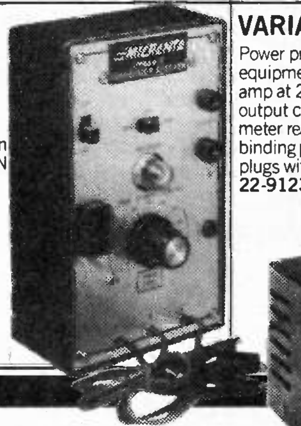
REALISTIC DX 300

General coverage receiver. Quartz-synthesised tuning, digital frequency readout. 3-step RF Attenuator. 6-range preselector with LED indicators. SSb and CW demodulation. Speaker. Code oscillator. Batteries (not included) or 12V DC. **20-204.**

REG. PRICE **£229.95**



DYNAMIC TRANSISTOR CHECKER



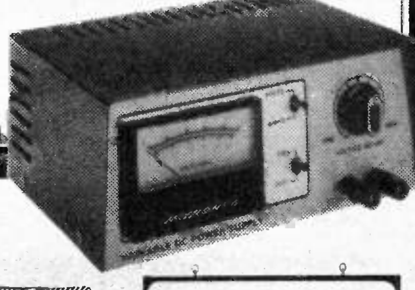
Shows current gain and electrode open and short circuit. Tests low, medium or high power PNP or NPN types. Go/no-Go test from 5-50mA on power types. **22-024.**

REG. PRICE **£9.95**

VARIABLE POWER SUPPLY

Power project boards. IC's, other low-voltage DC equipment. Load regulation: less than 450mV at 1 amp at 24V DC. Ripple: less then 25mV. Maximum output current: 1.25 amps. Switchable colour-coded meter reads 0-25V. DC and 0-1.25 amps. Three-way binding posts take wires, banana plugs or dual-banana plugs with 0.75" centres. For 220/240V AC. **22-9123**

REG. PRICE **£35.95**



You save because we design, manufacture, sell and service. Tandy have over 7,000 stores and dealerships worldwide. Over 2,500 products are made specifically for or by Tandy at 16 factories around the world. The quality of our products has been achieved by over 60 years of continuous technological advancement.

KNOWN AS RADIO SHACK IN THE U.S.A. MAKERS OF THE WORLD'S BIGGEST SELLING MICROCOMPUTER TRS80.

TANDY

The largest electronics retailer in the world.

Offers subject to availability. Instant credit available in most cases.

OVER 170 STORES AND DEALERSHIPS NATIONWIDE.

TANDY DEALER

Most items also available at Tandy Dealers. Look for this sign in your area.

Access, Barclaycard and Trustcard welcome.

Prices may vary at individual stores.

The NEW Marshall's 79/80 catalogue is just full of components

and that's not all . . .

. . . our new catalogue is bigger and better than ever. Within its 60 pages are details and prices of the complete range of components and accessories available from Marshall's.

These include Audio Amps, Connectors, Boxes, Cases, Bridge Rectifiers, Cables, Capacitors, Crystals, Diacs, Diodes, Displays, Heatsinks, I.Cs, Knobs, LEDs, Multimeters, Plugs, Sockets, Pots, Publications, Relays, Resistors, Soldering Equipment, Thyristors, Transistors, Transformers, Voltage Regulators, etc., etc.

Plus details of the NEW Marshall's 'budget' Credit Card. We are the first UK component retailer to offer our customers our own credit card facility.

Plus — Twin postage paid order forms to facilitate speedy ordering.

Plus — Many new products and data.

Plus 100s of prices cut on our popular lines including I.Cs, Transistors, Resistors and many more.

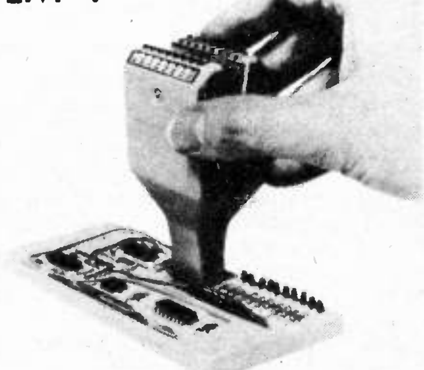
If you need components you need the new Marshall's Catalogue.

Available by post 65p post paid from **Marshall's, Kingsgate House, Kingsgate Place, London NW6 4TA.** Also available from any branch to callers 50p.

Retail Sales: London: 40 Cricklewood Broadway, NW2 3ET. Tel: 01-452 0161/2. Also 325 Edgware Road, W2. Tel: 01-723 4242. Glasgow: 85 West Regent Street, G2 2QD. Tel: 041-332 4133. And Bristol: 108A Stokes Croft, Bristol. Tel: 0272 426801/2.

FASTER THAN A SCOPE — SAFER THAN A VOLTMETER

LOGIC MONITOR LM-1



ONLY £28·70

plus 15% VAT, plus post and packing Total £34.44 including box and instruction manual.

CONTINENTAL SPECIALTIES CORPORATION
CSC

Europe, Africa, Mid-East: CSC UK LTD. Dept. 4S.
Unit 1, Shire Hill Industrial Estate,
Saffron Walden, Essex CB11 3AQ.
Telephone: SAFFRON WALDEN 21682.
Telex: 817477.

Instant – simultaneous monitoring of the logic state of all IC nodes

Just clip it over your IC.

LM-1 Instantly and accurately shows both static and dynamic logic states on a bright 16 LED display.
LM-1 finds its own power.
LM-1 cuts out guesswork, saves time, and eliminates the risk of short circuits.
LM-1 is suitable for all dual-in-line logic ICs.
LED on = logic state 1 (high), LED off = logic state 0 (low), and each LED is clearly numbered 1 to 16 in the conventional IC pattern.

CONTINENTAL SPECIALTIES CORPORATION
CSC

CONTINENTAL SPECIALTIES CORPORATION. DEPT. 4S.
Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex.

Name . . . .

Address. . . . .

	QUANTITY REQUIRED
LM1. £34.44 inc. p & p and VAT	

FREE catalogue Tick box ☐
I enclose cheque/PO for
£ . . . .

Phone your order with Access, Barclaycard or American Express
Card No. . . . . Expiry date. . . . . .

varied at will to suit the type of music being played, and whose effect or intensity can also be varied.

A suitable frequency range would be from 1Hz (i.e. one cycle per second) to about 7Hz. Such an oscillator is termed a low-frequency oscillator (l.f.o.) to distinguish it from the v.c.o. used to produce the tones. Whilst the l.f.o. is used to vary voltage-controlled circuits, it is not normally itself voltage controlled, but is varied manually.

Similarly, its output is manually variable, by means of a potentiometer, which results in the change of intensity of the effect being controlled by the l.f.o.

VIBRATO

The vibrato effect is popular in organs and synthesisers. In both cases it is created by modifying the pitch of the tone generators slightly by applying a low-amplitude sinewave of about 6Hz to the tone generator(s) so that the pitch is varied about six times a second upwards and downwards around the natural frequency of the note(s) being sounded.

In the synthesiser there is no need to apply the l.f.o. signal to each v.c.o. separately, since each oscillator is controlled by the same source, i.e. the resistor ladder of the keyboard and the subsequent sample/hold circuit. So the l.f.o. signal may be applied to either of these.

If it was applied to the keyboard resistor ladder, however, it would be effective only while the keyboard was in actual use. Once a key was released, i.e. during the sustain period, the sample/hold circuit would be disconnected from the ladder, and, of course, the sample/hold could not memorise the changing voltage from the l.f.o.

The effect of vibrato during the held portion of a note, and not during the decay period of the sustain has its uses, but it is more common for the vibrato to be present throughout the entire length of a note. This can be done by applying the l.f.o. signal to the sample/hold circuit, where the stored voltage on its capacitor could be modified at the frequency of the l.f.o., 6Hz.

The variation that the l.f.o. produces in pitch of the v.c.o. is of the order of a quarter-tone in each direction for normal vibrato supplied on organs, but in the synthesiser we can vary our intensity control so that the l.f.o. sweeps the frequency over many full tones, or even a full octave! Such an effect is in great demand in space-type musical effects.

PRODUCING CHORDS

Before we drift too far away from the v.c.o. it is relevant to cover the use of more than one v.c.o.

As stated already, the monophonic synthesiser allows one key of the keyboard to be played at a time. So far, it is easy to understand how a single pitch can be created, as a single v.c.o. is scaled by the voltage control selection on its input. Imagine a second oscillator connected the same as the first. If this were identical, the two v.c.o.s would both produce the same pitch, e.g. middle *C*, when the keyboard key of middle *C* is pressed. But if we equip one oscillator with an independent pitch-modifying control, and turn this control on the second oscillator such that it changes the pitch of the second oscillator to, say, *G* below middle *C*, we find we have a chord of two notes.

The *G* is, in fact, five semitones below *C*. When the oscillator is so adjusted for *G*, and the key pressed is, say, *D*, the second oscillator sounds a note still five semitones below *D*, i.e. the note of *A* below middle *C*. So, although the secondary pitch control of the second v.c.o. has been changed, the change is constant, so that we can depend upon the fact that if we offset the second v.c.o. to produce a certain difference in pitch as measured on the musical scale, then that same difference in pitch will be maintained for whatever key is pressed on the keyboard. Where more than two v.c.o.s are used, the number of notes sounded in a single-key chord can be increased proportionally.

MULTIPLE-STRING EFFECT

It is not always to produce chords, however, that more than one v.c.o. may be used. You will remember that it was mentioned in Part 1 that a piano hammer strikes more than one string when a key is pressed. There is more than one reason for the use of multiple-strings, and increased volume of sound is only one.

In a piano, it is practically impossible to set two strings such that their frequencies are exactly identical, and certainly quite out of the question to rely on them staying in perfect tune with one another for any length of time afterwards. No, an integral part of the quality of a piano note is actually the very slight difference in pitch produced by the strings of any note played. In fact, the strings are sometimes deliberately offset by a noticeable degree to enhance the "honky-tonk" sound of a piano in a bar-room.

Similarly, in synthesisers, we can use more than one v.c.o., each set basically to the same pitch, yet not quite. The effect is a curious phasing quality as the pitches come together to reinforce one another and gradually drift out of phase so that one tends toward cancelling another out. The change may be very slow, taking a second or two to repeat, or it may be faster, depending on the discrepancy of tuning between the v.c.o.s.

PHASING

The previous paragraphs have introduced an effect which can be produced by two oscillators slightly off-tune to one another; known as phasing. However, there is another way of producing this effect without resorting to two oscillators.

The reader will probably be familiar with the small units available for guitar use, which give a continuously varying phasing sound. The effect is created by selecting a narrow band of frequencies in the audio spectrum and suppressing these frequencies. The band selected is then slowly moved up and down the spectrum, so that it covers and re-covers the whole range of its ability. The result is the familiar effect known as phasing. It operates by suppressing the harmonics of the notes played.

So far, we have dealt with individual notes only, but now we shall look closer at such notes and see exactly what they consist of.

Many books have been written on this sort of study alone, so it must be understood that the look we take at it can only be very brief and basic, sufficient to understand the operation of the phaser and filters, to be described later.

HARMONIC CONTENT

In Fig. 1.2 there are three output waveforms available from the v.c.o. One is a truly wavelike form, smooth and flowing, with no sharp corners or points on it, shaped like the ripples on a pond when a stone is thrown into the water. The waveform is known as a sinewave. It is technically pure, i.e. it consists of one frequency, its natural frequency, or *fundamental*.

If we look at a sinewave of a note of say, middle *C*, on an oscilloscope, we are looking at the actual shape of the pure signal of middle *C* frequency. The straight portions and the rounded portions are all part of the pure and fundamental frequency. This means that any shape slightly different from the sine shape is impure, and contains an element of another frequency.

Difficult to understand? Well, consider the following.

If we take the sinewave of middle *C*, and modify its shape slightly, such that although its peaks are the same distance apart, the "bend" is made sharper instead of being so smooth. The bent portion will then be narrower, and the sharper law of bend will therefore correspond to the law of bend of a frequency whose peaks are closer together, i.e. a higher frequency. So our modified waveform

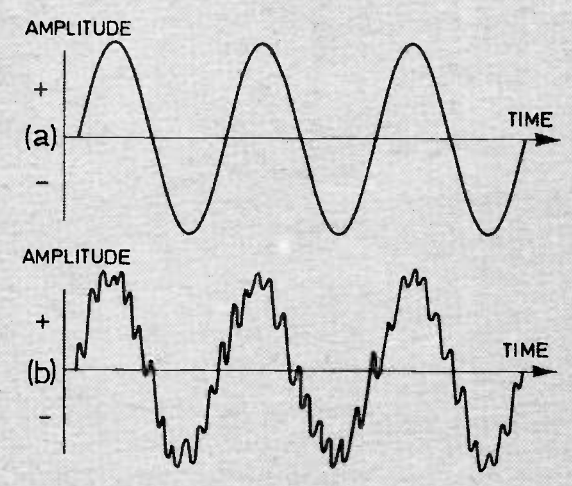


Fig. 2.1. (a) Sinewave (b) Same fundamental frequency, with added harmonics.

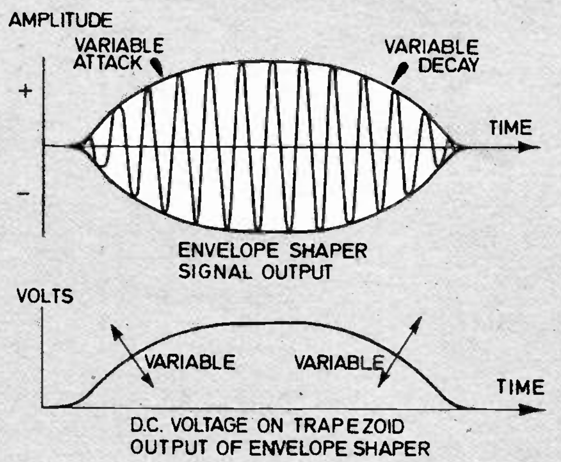


Fig. 2.2. Trapezoid output from envelope shaper for use in controlling voltage controlled circuits.

will still have the same fundamental, i.e. number of peaks per second, but will also contain a characteristic of another higher, frequency within it!

This second frequency content is termed a *harmonic*. The more a signal departs from the pure shape of a sinewave, the more harmonics it contains. In fact, the squarewave contains many harmonics, chiefly because its vertical edges are so sharp, but it has a clear-cut fundamental, i.e. repetition rate. Violin music is also rich in harmonics, and a single violin note has a host of harmonics (overtones) contained within it.

WHITE NOISE

A pure sinewave is shown in Fig. 2.1a, to be compared to Fig. 2.1b, a waveform very rich in harmonics, but having the same fundamental frequency as that in Fig. 2.1a.

It is these harmonics which the phaser and later-to-be-described filter operate upon. For this reason, the application of these circuits to pure sinewave signals is largely ineffective, and the more harmonics a signal has the more effective the phaser or filter is found to be.

Sometimes, a deliberate quantity of *white noise* is added to a signal to enrichen it and make use of a filter or phaser more noticeable. White noise sounds like the rush of steam from a locomotive, or similar to waves breaking on a sea shore. It contains a vast number of harmonics, with no regular or constant fundamental to bias the sound. So, it is analogous to white light, and contains all the colours of the spectrum of sound within it. It is easy to see now why a signal containing white noise is so effectively phased.

FILTERS

Filters take three main forms, bandpass, highpass and lowpass. Like the phaser, filters in synthesisers are made voltage controlled for full flexibility.

The bandpass filter is basically opposite in function to the phaser. Instead of suppressing a narrow band of frequencies or harmonics it is designed to suppress all but this narrow band. The effect is as if it were amplifying the narrow band over all other frequencies.

As in the phaser, the narrow band is moveable, up and down the audio spectrum by means of a voltage control frequency. On some filters, the actual band is adjustable by means of a panel control, so that the band may be narrowed or broadened at will.

The effect of a simple bandpass filter is that of the familiar waa-waa circuit which is really a simple form of bandpass filter.

The highpass filter suppresses frequencies below a certain threshold and this threshold is adjustable by voltage control. The lowpass filter works in reverse, by suppressing frequencies above a threshold, which again can be moved up and down the spectrum by voltage control.

The effects differ in practice between the three types of filter, but their basic operation is that of filtering certain harmonic contents in composite waveforms. The actual effect of filters on specific waveforms is not easily shown in diagramatic form, so no attempt is made here to illustrate filtered and unfiltered waveforms, mainly because filtering is not a present/absent effect, but is more a gradual onset as the threshold level is met, and changes as the voltage control is varied, and two dimensions would prove inadequate to illustrate the whole overall picture. However, it is hoped the above description will give the reader a good idea as to the principles involved.

VOLTAGE CONTROL FROM ENVELOPE

A useful source of voltage control signal is derived from the envelope shaper circuit. Unlike the signal output, which contains the signal shaped into an envelope of variable attack and variable decay, this second output is simply a d.c. voltage, which varies in direct proportion to the form of the actual envelope at any given time. This output is known as the trapezoid output, and it can be used to control other circuits by changing the voltage on their voltage control inputs, see Fig 2.2.

If it were applied to a bandpass filter (giving waa-waa sound), through which the final synthesiser signal is passed, the sound produced would be, perhaps, "oowwhaah". The "oow" portion being produced as the attack portion was covered, and the "whaah" part during the decay period. This effect is particularly useful when it is required to give waa-waa effects which are synchronised with the playing of the tunes.

If the waa-waa was produced by driving the filter from a l.f.o., it would be self-repetitive at the frequency of the l.f.o., and the player would have to set this frequency to synchronise with the music beat, whereas with envelope control, the envelope automatically follows the music beat, as it follows the playing of the keys themselves.

To be continued


MAPLIN
ELECTRONIC SUPPLIES
SOLDER
A high quality standard solder by Ersin Multicore. Ideal for miniature components 22swg. ½kg reel, about 163 metres.
Order as FY70M
Price £7.87
MINIATURE TRANSFORMERS
Good quality mains transformers to BS415.
6V type: secondaries 0-6V at 500mA + 0-6V at 500mA.
Order as WB06G Price £2.19
9V type: secondaries 0-9V at 500mA + 0-9V at 500mA. Order as WB11M Price £2.58
12V type: secondaries 0-12V at 250mA + 0-12V at 250mA. Order as WB10L Price £2.19
15V type: secondaries 0-15V at 200mA + 0-15V at 200mA. Order as WB15R Price £2.19.
AMP KITS
Complete kits of parts with full instructions to make hi-fi amplifiers with excellent specifications.
8W amp kit: Order as LW36P
Price £3.83
50W amp kit: Order as LW35D
Price £13.73
150W amp kit: Order as LW32K Price £14.89
LIQUID CRYSTAL DISPLAY
High quality 3½ digit 12.7mm (½in) high figures. Display has centre colon for use in 12 hour clocks and decimal points, plus and minus signs and overflow indicator for use in panel meters.
Order as FY89W Price £8.89
SIREN
A small, but penetrating siren operating on 12V DC (1.2A) Dia. 75mm.
Order as YB25C
Price £9.11
McKENZIE POWER SPEAKERS
High quality, high power speakers.
12in. 50W 8Ω Order as XQ79L
Price £18.79
12in. 50W 16Ω Order as XQ80B
Price £18.79
12in. 80W 8Ω Order as XQ81C
Price £26.92
12in. 80W 16Ω Order as XQ82D
Price £26.92
15in. 150W 8Ω Order as XQ83E
Price £57.80
15in. 150W 16Ω Order as XQ84F
Price £57.80
PIEZO HORN TWEETER
Very simply added to any speaker system up to 100W rms. No crossover required. Distortion <1%.
Order as WF09K
Price £5.27
20,000 OHM/VOLT MULTIMETER
A 20,000 ohms per volt multimeter at an incredibly low price. DC volts 5, 25, 125, 500, 2,500; AC volts 10, 50, 250, 1,000; DC amps 0 to 0.05mA, 0 to 250mA; Resistance 0 to 50k, 0 to 5M ohms; Decibels −20 to +22dB. Complete with test leads, battery and instruction leaflet.
Order as YB83E
Price £13.70
MIC STAND
Quality microphone stand extends to 1.5m. Boom arm 1m long adjustable.
Stand: Order as XB45Y
Price £12.71
Boom: Order as XB46A
Price £11.25
SOLDERING IRONS & KITS
Antex CX iron. 17W miniature.
Order as FY62S Price £4.85
Antex X25 iron. 25W.
Order as FR12N Price £4.85
CX iron with stand in presentation pack.
Order as FY68Y Price £6.85
X25 iron with stand in presentation pack.
Order as FY69A Price £6.85
CLOCK MODULE
Module requires only transformer and two push switches to operate 4-digit, 0.7in red LED display. Alarm and radio outputs. Battery back-up when mains fail. Sleep and snooze timer. Seconds display. Just add speaker for alarm tone. Full details on page 267 of our catalogue.
Order as XL14Q Price £8.41
QUICK CHARGE RECHARGEABLE CELL
1.2V. Size AA(HP7). Fully recharged in 5 hours with 150mA. Capacity: 450mAh. Will last for at least 500 full charge/discharge cycles.
Change to quick charge cells now!
Order as LR74R Price £1.49
POCKET MULTIMETER
Amazing value 4,000 ohms per volt DC jewelled moving coil meter. Ranges: DC volts 5, 25, 250, 500; AC volts 10, 50, 500, 1,000; DC amps 0 to 0.25mA, 0 to 250mA; Resistance 0 to 600k ohms; Decibels −10 to +22dB. Size only 3¾ x 2¼ x 1¼ inches. Complete with test leads, battery and instructions.
Order as FL60Q Price £6.75
REVERBERATION SYSTEM
The 'concert hall' sound in your living room.
Driver module: Order as XB85G Price £6.14
Requires + and − 15V 20mA power supply (ready built) suitable for Driver Module.
Order as YL17T Price £4.73
Spring line with 3 sec. reverb time:
Order as XL08J Price £4.93
Spring line with 7 sec. reverb time:
Order as XB84F Price £11.13
KEYBOARDS
High quality keyboards with hard wearing sloping fronted plastic keys. With keys mounted on nylon bushed steel levers 49 note C to C.
Order as XB15R Price £23.99
61-note C to C. Order as XB16S Price £29.90
With keys pivoted on a hard wearing moulded fulcrum.
49-note C to C. Order as XB17T Price £19.93
MULTIMETER & TRANSISTOR TESTER
Superb high sensitivity multimeter and transistor tester in one. Sensitivity 100,000 ohms per volt DC. Ranges DC volts 0.5, 2.5, 10, 50, 250, 1,000; AC volts 5, 10, 50, 250, 1,000; DC current 0.01, 0.025, 0.5, 5, 50, 500mA, 10A; AC current 10A; Resistance 5k, 50k, 5M, 50M ohms; Decibels −10dB to +62dB. Complete with test leads, three leads for transistor tester batteries and instruction leaflet.
Order as YB87U Price £39.30
TURNTABLES
Autochanger complete with stereo ceramic cartridge and circuit to make a complete low cost record player ideal for the young pop fan.
Order as XQ00A Price £16.30
Single-play rim drive turntable with stereo ceramic cartridge.
Order as XB23A Price £24.79
Single-play belt-drive turntable 'S'-shaped tone arm.
Order as XB25C Price £30.63
LASER TUBE
A helium-neon 0.5mW laser tube. Full details on page 262 of our catalogue.
Order as XL11M Price £104.35
ADJUSTABLE LAMP
Adjustable to get a bright light on miniature components. With bracket for clamping or bolting to bench or wall. Shade and position fully adjustable and stable. Finished in white.
Order as XY25C
Price £10.90
All prices include VAT and postage and packing, but if total under £4 please add 30p handling charge. Prices guaranteed until February 8th 1980. Export customers deduct 13% and export postage will be charged extra at cost.
Please use order code.
All items in stock at time of going to press.
FOR FULL CATALOGUE DETAILS SEE BACK COVER
MAPLIN ELECTRONIC SUPPLIES LIMITED
All mail to PO Box 3, Rayleigh, Essex SS6 8LR. Telephone: Southend (0702) 554155.
Shop: 284 London Road, Westcliff-on-Sea, Essex (closed on Monday). Telephone: Southend (0702) 554000.

LETTERS

No Entry

May I endorse what Pat Hawker had to say concerning the delay in the Radio Amateurs Examination, see *Radio World* November 1979 issue.

Having studied for a year I applied to the R.S.G.B. last August to sit the exam in December. I received no entry form from them and on checking in October found I was too late for the December exam and would have to wait until May 1980, with no results until September. I am considering giving it up especially as I am no youngster but an elderly gent.

G. J. Abrahams
Birchington,
Kent.

Fading Display

I am writing to correct a statement that appeared in *For Your Entertainment* October 1979 issue. Mr. Adrian Hope quotes that liquid crystal displays fade after about five years. In fact this is only true of the cholesteric type, the fading being caused by ultraviolet light. The cyano-biphenyl type of display is immune to this fading.

It is possible to tell the difference between the cholesteric and cyano-biphenyl types of display. Look at the display, while it is running, with your eye almost on a level with it. A cholesteric display will show a greenish tint to the characters.

A more general criterion is that cholesteric displays are fitted mainly to Casio calculators. Sharp calculators, and most modern l.c.d. watches, have cyano-biphenyl displays.

I hope this will prove helpful to readers.

C. G. Bulman
Worcester.

Light Resistance

Recently, I was in need of a photo transistor OCP71 for a simple alarm circuit. I solved this problem by converting an old OC71 transistor to an OCP71 by scraping off some of the black paint on the outside of the case, Fig. 1.

To test, set a multimeter to the resistance range, connect the common or black test lead to the emitter and the red (+) lead to the collector. By covering the clear area with your fingers the resistance should increase substantially. Connect the other way round and this will not be effected by light. You can use the OCP71 as a light dependent resistor (l.d.r.) as long as the collector is supplied with a positive voltage and emitter a negative voltage, disregarding the base.

David Elwin (age 13),
Kings Lynn,
Norfolk

Ideas Wanted

As I have just arrived in England to work, I am a keen electronics enthusiast, I feel I have no friends to talk about electronics or to exchange ideas and get help in constructing circuits etc.

I am from Mauritius, and speak the English, and the French language. I would be very glad if you would kindly insert my address in your *Letters* page—about me wishing to write and exchange ideas with other electronics enthusiasts.

Sam Hosenbocus,
11 Claremont Grove,
Leeds LS3 1AX

Crossword No. 23—Solution

SQUARE one FOR BEGINNERS

THE COMPONENT LIST

Each constructional article featured in EVERYDAY ELECTRONICS contains a comprehensive and detailed component list. This lists all the electronic components and various pieces of hardware, sometimes to the last nut and bolt to complete the project. A typical list is seen on page 31.

Each component is specified in detail and this stringent specification can cause headaches for some constructors, especially the newcomers to electronics.

For convenience (yours and ours) the list has several headings under which like components are grouped in numerical order as per the circuit diagram.

RESISTORS

All fixed-value resistors will be found under the heading of **resistors**. In the majority of cases they will be collectively specified as "¼ watt carbon ±5 or 10 per cent". Any special types will be indicated appropriately after the value. Many newcomers can be excused for thinking that this particular type is vital for successful operation of the circuit. It is not!

A metal film, metal oxide and in some cases wirewound types may be readily substituted for just as good, if not better overall performance. Wirewound types however should be substituted with caution, their relatively high inductance could interfere with the operation of some circuits.

Carbon types are chosen for their availability and low relative cost.

WATTAGE

Now a few words on wattage. As previously said most resistors in these pages are specified as ¼ watt types. This does not exclude the use of ⅓, ½, ¾, 1 watt and even higher, except where available "board space" is limited, or on a p.c.b. design where component hole spacings have been decided with a particular component in mind.

The ¼ watt resistor is probably chosen by designers for its small, but still easy to handle size, availability and cheapness. They are more than adequate for low-voltage, low-power battery circuits, as many of our projects are.

If someone took the time and trouble to calculate the required wattages in a circuit, it would be found that in many cases 1/10, 1/20 watt and less are all that are necessary. (Divide the square of the maximum possible voltage across the resistor by the resistance value. $W=V^2/R$.)

But for those not sufficiently experienced, the specified rating should be regarded as the minimum required for the circuit, allowing higher wattages to be used if at hand.

TOLERANCE

The "±5 or 10 per cent" seen in component lists refers to the resistor tolerance, its maximum deviation from its nominal value. For ¼ watt carbon types the constructor these days has little choice. It appears that only 5 per cent types are available. A closer tolerance type can be employed if that is all you can obtain at the time with no adverse effects on operation. Also a 10 per cent can replace a 5 per cent and in a lot of cases an even looser tolerance. Some parts of circuits will still operate in a fashion even if the value is widely different.

CAPACITORS

Both fixed-value and variable capacitors (including preset-types usually called trimmers) are found under the heading **capacitors**.

With variable types, their *maximum* value is given. For example, a variable capacitor specified as 365pF is continuously variable from 0pF to 365pF. A lower value than specified, e.g. 208pF if at hand could be used to initially test the circuit operation but would give reduced coverage or range. A higher value variable capacitor (e.g. 500pF) can also be used for testing purposes. The range or coverage would be increased, but the intended coverage would be cramped at one end. Similarly with trimmers.

Fixed value capacitors fall into two categories — polarised (electrolytic) and non-polarised. The latter can be connected in circuit either way round but the former can only be connected one way.

Non-polarised capacitors are specified as value and dielectric. In many cases the latter reads "ceramic or plastic". The constructor then has a free choice from what is available to him since plastic includes polycarbonate, polyester, polystyrene and polypropylene. Polyester is the most common and cheapest.

If a particular dielectric is specified it is wise to obtain this type, as it may have been chosen for its particular properties and optimum performance. For example, a silvered mica capacitor would be chosen for its close tolerance and high stability. A particular dielectric may also be specified if it is to be mounted on a p.c.b. where the lead fixing holes have been accurately dimensioned to suit the specified type.

WORKING VOLTAGE

Working voltages of non-polarised capacitors tend to be high, certainly higher in nearly all cases than 9V which is the most popular supply voltage in our battery operated projects. If the working voltage requires mention, when it is used, say, for example, in a mains filter, it is clearly specified after the value—0·01μF 400V a.c. The capacitor can have a higher working voltage but should never, in any circumstances, be less.

This is true also for electrolytic capacitors where the working voltage is always specified. With such capacitors, the physical size for a given value increases with working voltage.

In particular applications, a higher working voltage type than required may be called up. In timing circuits, where capacitors are being charged with minute currents, the leakage through the capacitors may become significant.

The leakage effect is reduced by using a higher working voltage type of the same value.

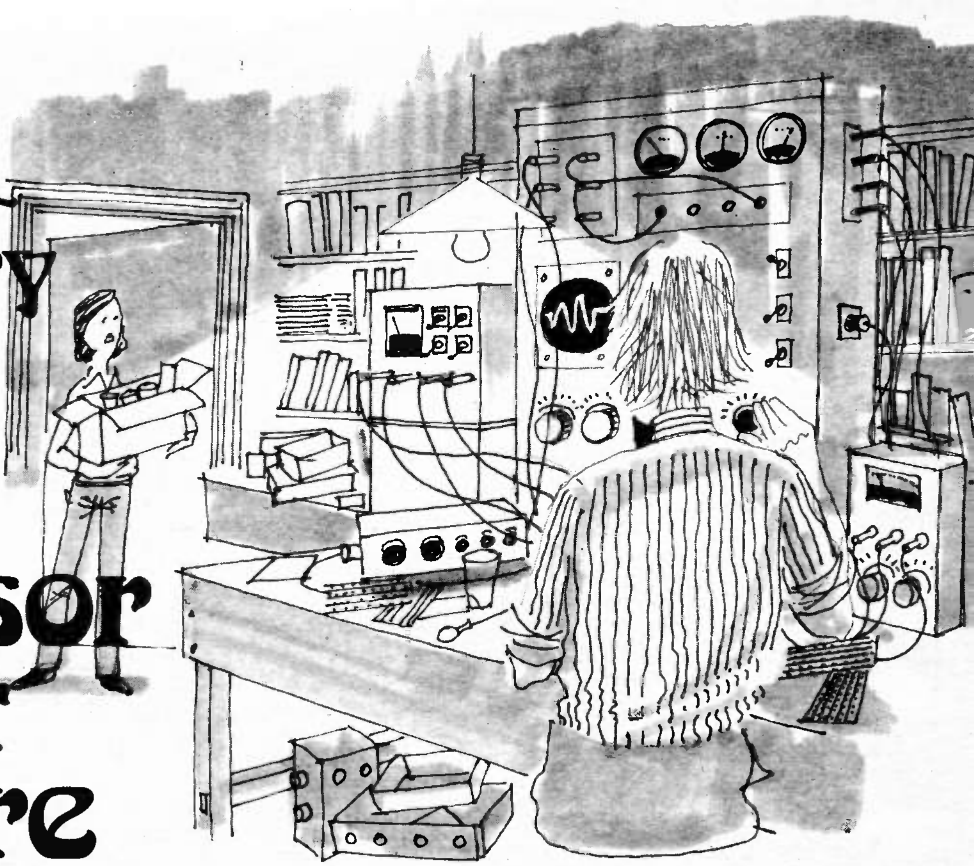
The working voltage specified for electrolytic capacitors is usually that used in the prototype and may considerably exceed the maximum requirement.

This may be due to the fact that this is the lowest working voltage available to meet the voltage requirement.

SHOP TALK

A reference to our *Shop Talk* feature appears alongside most components lists and is often overlooked by constructors. If you are building a project, it is wise to read this page. Here, among other items, any components thought likely to be difficult to get, special components, substitutions etc. are discussed, and where appropriate sources of supply and cost are given.

The Extra-ordinary Experiments of Professor Ernest Eversure



by Anthony John Bassett

BOB, Tom and Maurice watched as the Prof. fed a few instructions into a computer which promptly printed out a large bundle of fuzz box circuits, which were simultaneously displayed on one of his large computer viewscreens. "I know you will want to take these and study them." He handed the bundle to Bob.

"Thanks, Prof. These look really interesting. I know that fuzz boxes produce their effects by various changes in the musical waveform of the instrument and it will be interesting to study a few of the different circuits and their effects. I am amazed that there are so many!"

"Yes—but although the large number of circuits may seem bewildering, they can mostly be fitted into a number of small groups according to the various principles of operation."

As the Prof. spoke his young friends saw the diagrams rearrange themselves into groups on the large computer viewscreen.

"In this group (Figs. 1-6) the fuzz is produced by operating transistors as non-linear amplifiers, which adds harmonic distortion, and intermodulation effects. An extra bonus of fuzz effects is also produced by overloading the circuit.

"Notice how in this early design fuzz circuit (Fig. 1) using germanium *pnp* transistors, the input transistor TR1 is not forward biased at all and relies upon a combination of transistor leakage together with the guitar signal itself, to bias it into conduction. This results in a highly-distorted signal at the collector, which is fed through a 0·1μF capacitor (sometimes 0·047μF or smaller) to the other two transistors where further distortion and amplification occurs. The effect is modified by adjusting VR1 'Fuzz Filter' control.

"Here is a very similar circuit using silicon transistors (Fig. 2). Because these transistors do not 'leak' as much as the older germanium types and the guitar signal itself cannot be relied upon to bias the input transistor to conduction, a bias circuit (R1, R2, R3) is used and this is decoupled by a 10μF capacitor to prevent negative feedback from correcting distortion introduced by the transistor.

"I will not comment on every circuit. You can learn a lot for yourself by studying them all and by doing a few experiments. In Fig. 4 the fuzz effect is varied by changing the bias on a transistor, whilst this circuit, Fig. 5, uses a transistor, TR3, which has been deliberately reverse-biased. This technique can be useful in reducing low-level noise and interference which is a problem with many other fuzz box designs.

"The 'overdriver' (Fig. 6) is basically a fuzz circuit which incorporates tone-controls."

DIODES IN FUZZ BOXES

"Here are some more fuzz-box circuits which use diodes to distort the waveform and produce fuzz effects, but these circuits, unlike earlier ones which used heavy duty power diodes connected to the speaker outlet of the amplifier, use miniature diodes to distort the signal before it reaches the input of the guitar amplifier.

"Either silicon or germanium diodes may be used to produce the fuzz effects, and although the principles are the same, the effects produced are not identical and may sound different. In the first of these diode fuzz circuits (Fig. 7) an integrated-circuit pre-amplifier is used to raise the voltage level of the input signal to a value which will cause the diodes to conduct, alternately clipping away the upper parts of the signal waveform, when the fuzz control is at minimum resistance.

"As the fuzz control is adjusted to higher resistance, the clipping is reduced to give less harsh effects."

"What happens if you use germanium diodes instead of silicon ones in this circuit, Prof?" Bob enquired.

"Due to the lower forward voltage drop of the germanium diodes, they would clip at a lower voltage level, giving a lower output level which would be especially noticeable when the fuzz depth control was set to low resistance. This lower amplitude can easily be compensated by means of extra amplification. So the circuit will work equally effectively with either germanium or silicon diodes!"

To be continued

FUZZ CIRCUITS

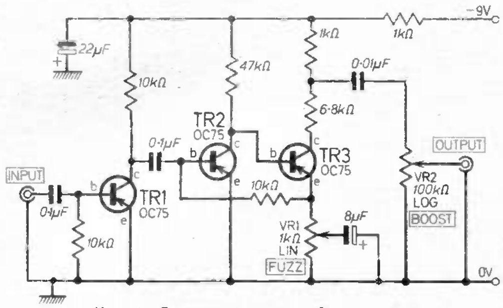


Fig. 1. Germanium *pnp* fuzz circuit.

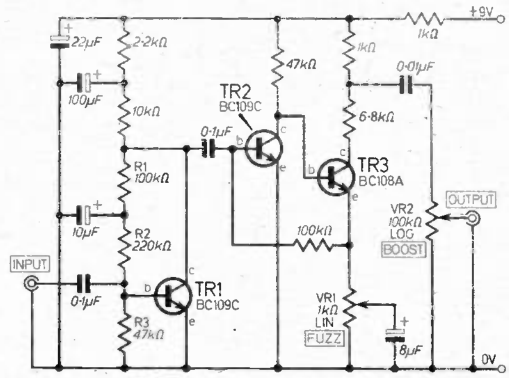


Fig. 2. Silicon *npn* fuzz circuit.

DISTORTION BOOSTER

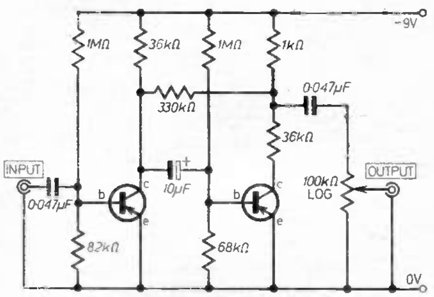


Fig. 3. Distortion Booster circuit diagram. Note that any high gain *pnp* transistor can be used here.

FUZZ CIRCUIT

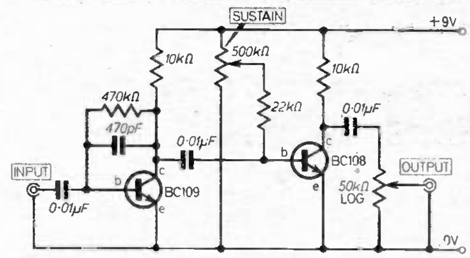


Fig. 4. Another simple fuzz circuit.

FUZZ & TREBLE BOOSTER

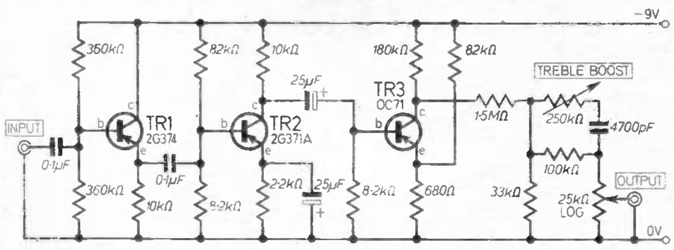


Fig. 5. Circuit diagram for the fuzz box with treble boost.

DIODE FUZZ

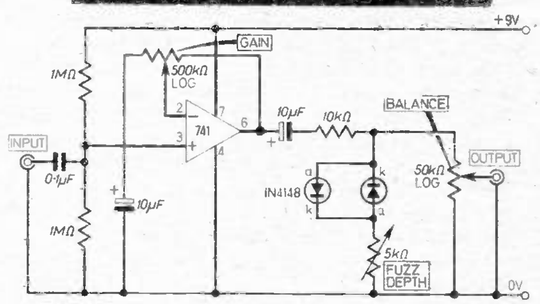


Fig. 7. Simple i.c. fuzz box circuit diagram. Note the use of diodes to produce distortion by clipping the output waveform.

OVERDRIVER CIRCUIT

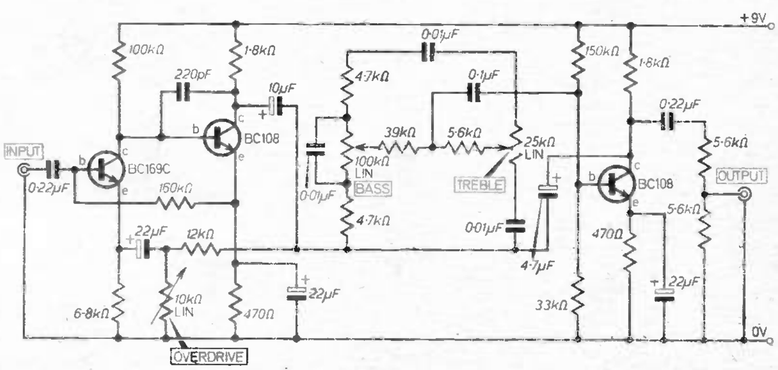


Fig. 6. "Overdriver" effect circuit diagram.

RADIO WORLD

By Pat Hawker, G3VA

Down to earth?

In announcing the engineering plans for the fourth British TV programme channel, Lady Plowden, chairman of the IBA, pointed out recently that many people think that transmitter networks on the ground are about to be overtaken by direct broadcasting to the home from space, adding: "If we were starting all over again, and there were no u.h.f. networks in the country, there might be reason to do this—always assuming that we were not working to a fixed launch date." This confirms, once again, the view that the question of broadcasting from spacecraft is now increasingly one of need, desire or choice rather than technological feasibility (which indeed is now virtually proven).

In practice, for the Fourth Channel, there could be no question of using direct broadcasting satellites, with the u.h.f. networks now firmly established and with so many viewers already having receivers and aerials and just waiting to touch or push the channel-selection button. For 12GHz transmissions from space they would need at least a new "electronic aerial" comprising a parabolic dish aerial of up to one-metre in diameter together with the circuitry of a receiver or adaptor capable of dealing with 12GHz frequency-modulated signals. Because of the electrical power limitations on spacecraft (the idea of putting a nuclear generator into space is now virtually ruled out) it is necessary for direct-broadcast satellites to use f.m. for vision as well as sound.

I would estimate that it would be some considerable time, if ever, before the extra cost to a viewer for watching programmes coming directly from a space satellite would fall below about £100–£200. This might be well worth paying for say five additional programme channels (the UK allocation) or if you are located in one of the "impossible" places for u.h.f. reception, but otherwise would not appeal to many viewers.

While France, West Germany and Luxembourg all seem anxious to push ahead with direct-broadcast satellites (the first two with an eye on industrial opportunities in those countries where the advantages of satellite systems are more real than in Europe) the major need at present would seem to be for "distribution satellites" akin to those which are already proving useful and profitable for so many American cable "subscription TV" services, for the Canadian CBC and American PBS broadcast networks.

The intention in this case is to provide a low-cost "programme feed" for transmitters spread over large areas or for small, medium and large cable networks. Currently over 1500 TV receiving terminals (mostly working on about 4GHz) are in use or being planned in North America, and all the major American sound radio networks now distribute their programmes to affiliated transmitters by means of satellite distribution circuits (which allow improved audio up to 15kHz compared with the 5kHz of most long-haul terrestrial links).

Europe at present has only the *OTS* experimental satellite, apart from the high-cost *Intelsat* global system. But at least this has enabled the IBA to make some interesting use of their transportable up-link terminal, including the first space relays from the Channel Islands and Eire (for the Pope's visit).

Since most European countries operate a telecommunications monopoly, one suspects that there will be less rapid progress towards low-cost satellite distribution circuits in Europe than in the fiercely competitive situation in the USA where RCA, Western Union and now AT & T are all in the business of providing circuits in space.

What a novice needs to know

At a time when there is renewed discussion about the possibility of "novice" amateur licences in the UK, based on an appreciably simpler technical examination and a Morse test of only 5 or 6 words per minute, Graeme Scott, an Australian amateur with the callsign VK3ZR has formulated what appear to be some guidelines on the minimum technical/operating knowledge suitable for a novice examination. He considers that the candidate should be expected to show knowledge of the legal conditions imposed by the amateur licence he is seeking (i.e. how to operate legally); how to tune a transmitter; how to carry on a contact in Morse; how to put together a simple station; show an understanding of common problems (including the causes of television interference, key clicks etc); and have some basic familiarity with the terminology and equipment commonly used in radio.

These guidelines differ from the standard Radio Amateur's Examination in placing much less emphasis on the design of equipment and would limit the mathematics to such basic formulae as Ohm's Law; resistance—capacitance—inductance—frequency—wavelength relationships; value of parallel/series resistors, watts input and so on. The emphasis would be on the information needed in practice to ensure the radiation of satisfactory signals.

Interference

Recently, I was speaking to someone concerned with interference complaints in South Africa (where this is primarily the responsibility of the broadcasters rather than the Post Office). He reported that there had been a very significant increase in complaints of television interference since the start of Citizens Band radio there a couple of years ago.

Tests showed that often the CB rig when correctly tuned and operated gave no problem, even when placed on a bench beside the TV receiver. However, when used over a period of time by people with very little technical knowledge, the same rig tended to drift out of adjustment and to cause severe interference.

The most recent figures from the USA also underline the problem of the inexperienced operator: in the first quarter of 1979, the FCC received 16,401 complaints of alleged radio-frequency interference to TV reception: 13,894 related to CB stations; only 519 to amateur radio stations.

Young Ladies

A very marked change has come over the electronics trade and technical press during the past decade: today one finds that the industry's press conferences are very far from being the all-male affairs they tended to be not so many years ago. A large number of talented young ladies are now writing regularly on electronics.

Does this mean, one wonders, whether the readership is similarly changing? Mr Editor may correct me, but I would hazard the guess that the overwhelming majority of readers are still male.

This certainly applies to the field of amateur radio, where at a guess not more than about 0·25 per cent of British amateurs are "YLs" (young ladies) or "XYLs" (wives)—the former expression "OW" comparable to "OM" (old man) is never used today. Of course, even 0·25 per cent represents several hundred and this is a vast increase since the early days of amateur radio.

I was reminded of this by learning of the death a few months ago of Miss Barbara Dunn, G6YL who for five years (1927–1932) had the distinction of being Britain's first and only YL operator. Altogether she held her amateur licence for more than 50 years and, particularly in the 1930s was an extremely active and able operator.

She taught herself 20 words-per-minute operating by listening on a crystal set to the old FL time signals on 2600 metres from Paris and by listening to ships working on 600 metres and (as they did in the early days) around 2100 metres. She also had to cope with the problem, common to many of the early amateurs, of having no a.c. mains supply and having to depend on a rotary converter running from accumulators charged from 100-volt d.c. mains. Even now, it is well within memory of many of us when quite large areas of London had nothing but d.c. mains.

In 1932 Barbara Dunn was joined by another YL colleague, the late Miss Nell Corry, G2YL who also achieved great distinction in the amateur world by her work on 28MHz—on which band she became the first British amateur to work all continents in October 1935.

In fact, although the number of YLs has always been small in the UK they have contributed much to the hobby. These days I find quite a few American amateurs and also the operators on the Russian club stations turn out to be "YLs".

With my name I also encounter the problem that a number of the people I work on c.w. imagine that I am a "YL" operator and insist on sending me "88" (love and kisses)!

Simply ahead . .

ILP'S NEW GENERATION OF HIGH

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

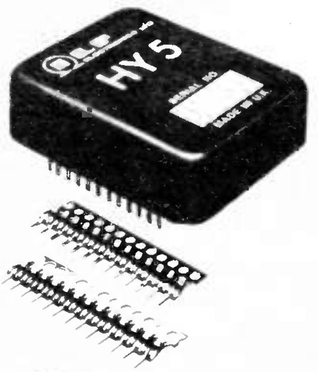
With I.L.P. performance standards and quality already so well established, any advances in I.L.P. design are bound to be of outstanding importance – and this is exactly what we have achieved in our new generation of modular units. I.L.P. professional design principles remain – the completely adequate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

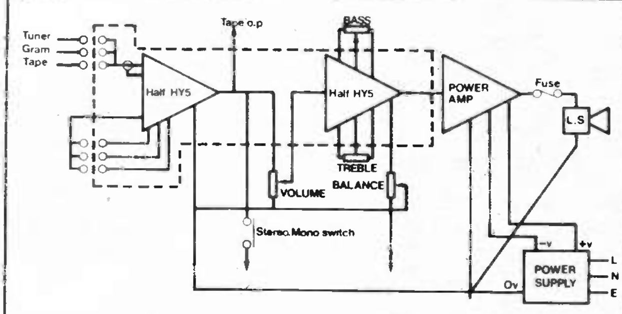
PRODUCTS OF THE WORLD'S FOREMOST SPECIALISTS IN ELECTRONIC MODULAR DESIGN

and staying there

PERFORMANCE MODULAR UNITS

HY5 PRE-AMPLIFIER



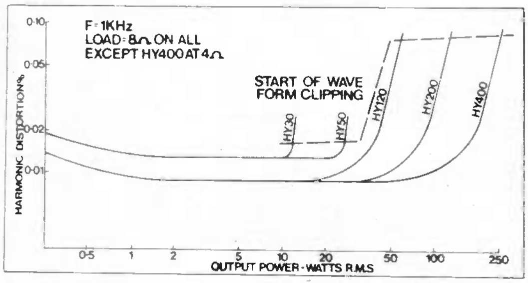


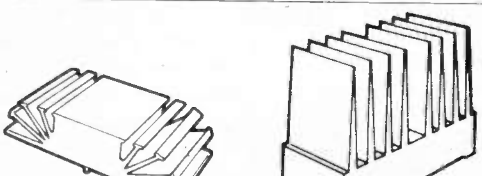
VALUES OF COMPONENTS FOR CONNECTING TO HY5
Volume — 10K Ω log.
Bass/Treble — 100K Ω linear.   Balance — 5K Ω linear.

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

£4.64 + 74p VAT

THE POWER AMPLIFIERS

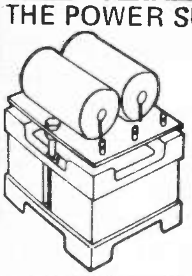




Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105x50x25	155	**£6.34** + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0- +25	105x50x25	155	**£7.24** + £1.09
HY120	60 W into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

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

THE POWER SUPPLY UNITS



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

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

NO QUIBBLE
5 YEAR GUARANTEE

7-DAY DESPATCH ON ALL ORDERS

INTEGRAL HEATSINKS

BRITISH DESIGN AND MANUFACTURE

FREEPOST SERVICE
—see below

★ *ALL U.K. ORDERS DESPATCHED POST PAID*

HOW TO ORDER, USING FREEPOST SYSTEM

Simply fill in order coupon with payment or credit card instructions. *Post to address as below but do not stamp envelope — we pay postage on all letters sent to us by readers of this journal.*

ILP ELECTRONICS LTD.

FREEPOST 3 Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP.
Telephone (0227) 54778   Telex 965780

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

ELECTROVALUE CATALOGUE 10

Ready early December

Our computer has already selected thousands of our customers to whom our new catalogue has automatically been sent. If you would like a copy too, simply send us your name and address. It's

FREE

(You don't even have to pay postage)

IT'S A GOOD DEAL BETTER FROM ELECTROVALUE

- **We give discounts**

on C.W.O. orders, except for a few items market Net or N in our price lists.

5% on orders, list value £10 or more

10% on orders list value £25 or more.

Not applicable on Access or Barclaycard purchase orders.

- **We pay postage**

in U.K. on orders list value £5 or over. If under, add 30p handling charge.

- **We stabilise prices.**

by keeping to our printed price lists which appear but three or four times a year.

- **We guarantee**

all products brand new, clean and maker's spec. No seconds, no surplus.

- Appointed distributors for SIEMENS, VERO, ISKRA, NASCOM and many others.

OUR NEW CATALOGUE No 10

Over 120 pages. Thousands of items. Improved classification for easier selection. Valuable working information. Illustrations. Separate quick-ref price list.

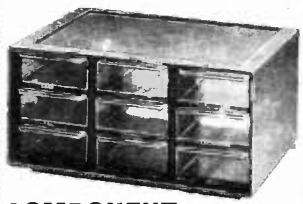
ELECTROVALUE LTD

HEAD OFFICE (Mail Orders)
28(A) St. Judes Road, Englefield Green, Egham, Surrey TW20 0HB. Phone: 33603 (London prefix 87. STD 0784) Telex 264475.

NORTHERN BRANCH (Personal Shoppers Only)
680 Burnage Lane, Burnage, Manchester M19 1NA
Phone: (061) 432 4945.

GREENWELD

443D MILLBROOK ROAD, SOUTHAMPTON SO1 0HX
All prices include VAT–just add 30p post. Tel (0703) 772501



COMPONENT CABINET IDEAL FOR THE NEWCOMER TO ELECTRONICS

Contains hundreds of brand new resistors, capacitors, transistors diodes and I.C.'s. All useful values, carefully chosen to help the new constructor pursue his hobby without finding himself short of some vital parts!

All parts contained in clearly marked bags in a plastic storage cabinet 232 × 121 × 165mm with 9 drawers into which all parts can be neatly located.

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.

CONTENTS:

200	½ watt resistors
20	Wire wound resistors
70	Ceramic Capacitors
70	Mylar Capacitors
50	Polyester Capacitors
56	Electrolytic Capacitors
61	Transistors
12	I.C.'s
20	L.E.D.'s
55	Diodes and rectifiers

Altogether 614 components.

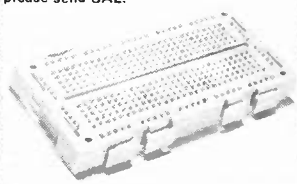
Price includes current catalogue and Greenweld pen for reordering supplies. Plus **FREE** surprise gift.

PC ETCHING KIT MK III

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

V002 Twin type. 2 meters 40 × 40mm and driver board, supplied with circuit and connexion data, **£3·50.**
V003 New type, just in. Twin type moulded in one piece. 80 × 40mm (no driver board but suitable circuit supplied). **£2·50.**

THE NEW 1980 GREENWELD *CATALOGUE*

FEATURES INCLUDE:

- 60p Discount Vouchers
- Quantity prices for bulk buyers
- Bargain List Supplement
- Reply Paid Envelope
- Priority Order Form
- VAT inclusive prices

PRICE 40p + 20p POST

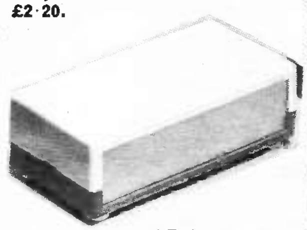
WIRE & FLEX

Solid core—ideal for breadboards etc. 50 × 2m lengths many assorted colours, total 100m for **£1·30.**
Flex packs—5 × 5m lengths of multi-strand thin flex, ideal for wiring up circuits. Only **35p**

3W Amp Module

Ready built and tested, this handy amplifier will prove very useful around the workshop. Just requires 17V ac source (and 8R spkr) as bridge rect and smoothing cap are mounted on the PCB. The 4 transistor circuit provides enough sensitivity for most applications. Supplied complete with circuit diagram and wiring details.

Only £1·75. Suitable transformer £2·20.



VEROCASE SALE!!

3 popular sizes of Verocase at drastically reduced prices—these were part of their standard range (75-1411 etc.) but are in GREEN and have been discontinued by Vero. We have purchased their entire stock and offer them as below:

Type No	Size	Price
21050	205×140×75mm	£2·70
21052	154×85×60mm	£1·70
21053	125×65×40mm	£1·40

1A 400V RECTIFIERS

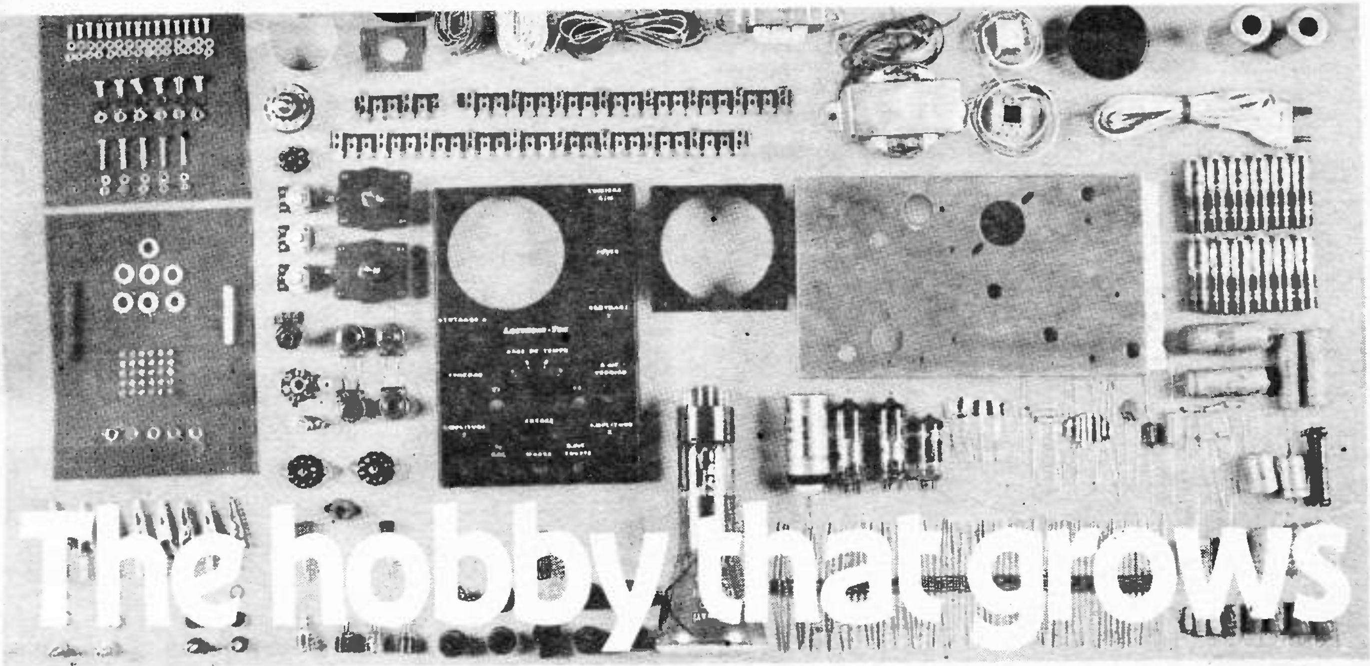
Plastic, like 1N4004, type 388F these diodes have preformed leads for horizontal mntg (15mm FC). Supersaver price—100 for **£2·30; 500/£10 1000/£18**

BUZZERS & MOTORS & RELAYS

Z401 Powerful 6V DC Buzzer all metal construction 50mm dia × 20mm **70p.**
Z402 Miniature type Buzzer 3-9V, only 22 × 15×16mm. Very neat **65p.**
Z450 Miniature 6V DC motor, high quality type 32mm dia × 25mm high, with 12mm spindle. **Only £1.**
Z451 12V high torque motor 30mm dia × 40mm high, with 10mm spindle. **65p.**
W892 Heavy duty 12V relay, ideal for car use—single 15A make contact. Coil 25R.
W890 DIL reed relay—SPCO 2·4V-10V 200R coil. Only **£2·20.**

TEACH IN 80

We are again supplying all parts required for this major series which started in 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.** All prices include VAT and Postage. Reprints of Oct & Nov parts **30p** ea.



What you see above is a kit of parts that builds into a fully working oscilloscope.

No toy, this vital piece of functional equipment can be found in any professional electronics workshop. It is a valuable instrument of true professional quality.

By building the oscilloscope you will be taking the first steps to a rewarding hobby that knows no bounds.

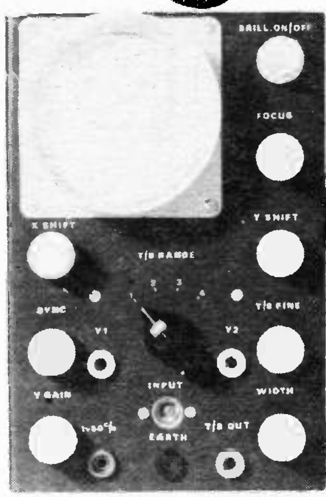
Each constructional stage is a complete lesson in the basics of electronics practice and carefully designed to be understood by those with no previous knowledge. Once built, this instrument can be used to complete a course of practical study and experimentation that will reveal the secrets of printed circuitry, testing and servicing of T.V. and radio and the vast majority of electronic equipment.

Invaluable knowledge that pays big dividends. Send today for the free colour brochure and start growing a new hobby.

and grows.

1. Build an oscilloscope.

As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property and represents a very large saving over buying a similar piece of essential equipment.



2. Read, draw and understand circuit diagrams.

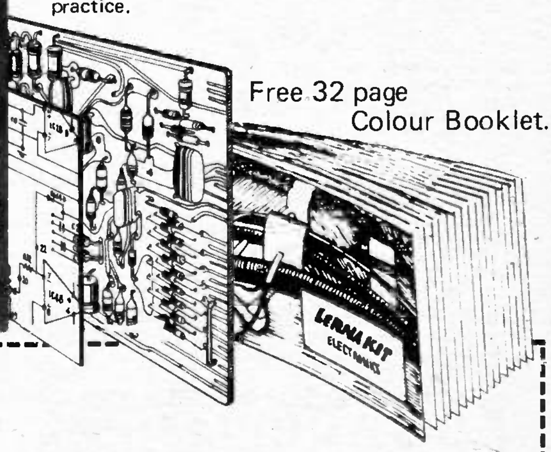
In a short time you will be able to read and draw circuit diagrams, understand the very fundamentals of television, radio, computers and countless other electronic devices and their servicing procedures.

3. Carry out over 40 experiments on basic circuits.

We show you how to conduct experiments on a wide variety of different circuits and turn the information gained into a working knowledge of testing, servicing and maintaining all types of electronic equipment, radio, t.v. etc.

4. Free Gift.

All students enrolling in our courses receive a free circuit board originating from a computer and containing many different components that can be used in experiments and provide an excellent example of current electronic practice.



Free 32 page Colour Booklet.

EEH/1/80

NAME ....

ADDRESS ....

.... Block Caps Please

Post now, without obligation, to:-

BRITISH NATIONAL RADIO and ELECTRONICS SCHOOL P.O. Box 156, Jersey, Channel Islands.

A new book for the home electronics constructor

Microprocessors for Hobbyists

Ray Coles

- An introduction to microprocessors based on two popular series in *Practical Electronics*
- Covers the architecture of microprocessor chips and systems, programming memory and input-output components
- Describes home computers together with a comparison of different models and the appropriate software
- Includes a comprehensive glossary of terms to explain the 'buzz-words' of the microprocessor scene

1980 96 pages £2.95 US $ 6.75

Newnes Technical Books

Borough Green, Sevenoaks, Kent TN15 8PH. Tel: (0732) 884567

Butterworths have companies in Australia, Canada, New Zealand, South Africa and the USA, where local prices apply

---

VHF/UHF FETS BF 256C @ 4 for 75p, E304 @ 4 for **£1.**

MINIATURE 12 WAY CERAMIC TAG STRIPS @ 15p.

CERAMIC DISC CERAMICS 50v.w. 22pf, 33pf, 270pf, 330pf, 2,200pf, ·01uf. **All** at 25p doz.

TRANSMITTING VARIABLE CAPACITORS 30×30pf @ **£2·20.**

CLOSE TOLERANCE CAPACITORS 1288pf, 1670pf, 5979pf, 19669pf. **All 1%** 125v.w. @ 5p each, ·01uf 2%, ·11uf 2%. Both **8p** each, 100,000pf (·1uf) 1% @ **12p** each.

MINIATURE WIRE ENDED R.F. CHOKES 3uH, 5uH, 10uH, 22uH, 27uH, 68uH, All at 7p each.

THYRISTORS (S.C.R.s) 10 amp Type 100PIV @ **28p**, 400 PIV @ **55p, 800 PIV @ 65p,** 700 PIV 5 amp @ **50p.**

WIRE WOUND POTENTIOMETERS 2 Watt type 2K, 10K @ **30p**, 100K 4 Watt @ **30p**.

3/16" COIL FORMERS with core @ 6 for **25p.**

10 ASSORTED PUSH BUTTON BANKS LESS KNOBS for **£1·30.**

50. OC 71 TRANSISTORS untested for **75p.**

50. BC 107-8-9 TRANSISTORS assorted untested @ **60p.**

20. 10 amp STUD MOUNTING DIODES untested @ **60p.**

50. 1 amp S.C.R's T05. Case untested @ **£1.**

NON POLARISED CAPACITORS 63v.w., 1uf @ **5p, 4·7uf @ 10p,** 10uf @ **15p.**

SMALL GLASS 1 POLE MAKE REEO RELAYS with magnet @ **15p** pair.

TANTALUM CAPACITORS ·1uf 35v.w., 2·2uf 35v.w., ·33uf 35v.w., ·47uf 35v.w., 1uf 35v.w., 2·2uf 35v.w., 3·3uf 16v.w., 4·7uf 16v.w., 4·7uf 35v.w., 6·8uf 35v.w., 10uf 25v.w., 22uf 16v.w., 33uf 10v.w., 33uf 25v.w. **All at 9p** each. 100uf 10v.w., 150uf 10v.w. Both **25p** each.

VERNITRON FM4 10·7MHz FILTERS at **50p.** 3 for **£1.**

MAINS TRANSFORMERS 250 volt input. Tyoe 1. 24 volt tapped at 14 volt 1 amp @ **£1·30** (P&P 25o). Type 2. 30-0-30volt 500mA @ **£1·30** (P&P 25p). Type 3. 45 volt 6 amp @ **£4·50** (P&P 95p). Type 4. 20volt 1 amo Twice, 10volt 1 amp twice @ **£4·50 (P&P 95p).** Tyoe 5. 45 volt 2 amo, 45 volt 500mA @ **£3·50** (P&P 85p). Type 6. 16 volt 2 amp @ **£1·60** (P&P 25p). Type 8. 30 volt 1·75 amp @ **£1·60** (P&P 25p). Type 9. Small output Transformer @ **50p.**

VHF STRIPLINE TRANSISTORS BF 362, BF 679. Both **25p.**

50. ASSORTED SILVER MICA CAPACITORS for **75p.**

DAU SEMI-AIRSPACED TRIMMERS 2 To 9pF, 7 To 35pf, 6 To 45pf, 8 To 125pf, 8 To 140pf. **All** at **15p** each.

SILICON BRIDGE RECTIFIERS 100 PIV **1** amp @ **20p.** 200 PIV **4** amp @ **60p.**

20 ASSORTED PHOTO TRANSISTORS, DARLINGTONS untested for **£1.**

VARIABLE CAPACITORS 5pf @ **75p,** 10pf @ **75p,** 125+125pf @ **60p,** 100+200pf @ **60p,** 200+300pf @ **60p,** 250+250+20+20+20pf @ **75p,** 25+25+25pf @ **75p.**

SOLDER-IN FEED THRU CAPACITORS 6·8pf, 300pf, 1000pf. **All 20p** doz.

PAPER 10uf 370 volt A.C. CAPACITORS $5\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{1}{2}$ @ **£1·50** each.

PRECISION METAL FILM RESISTORS 0·5% Tol. 32, 39, 68, 82, 82·5, 100, 121, 150, 270, 330, 332, 360, 365, 470, 562, 619, 620, 680, 681, 700, 750, 820, 909, 910, IK, 2·15K, 2·2K, 3·01K, 3·9K, 5·1K, 6·2K, 10K, 18K, 75K, 150K, 200K, 392K, 597K, 600K, 1·21M. **All** at **6p** each.

Please add 20p for post and packing, unless otherwise stated, on U.K. orders under £2. Overseas postage charged at cost.

J. BIRKETT

RADIO COMPONENT SUPPLIERS

25 The Strait, Lincoln LN2 1JF Tel. 20767

CHROMASONIC electronics

your soundest connection in the world of components

Dept EE1, 56 Fortis Green Road, Muswell Hill, London N10 3HN. Tel: 01-883 3705

The items shown in this advert are just a small selection taken from our new 78/79 Catalogue which is now available. It contains everything from Resistors to the latest in Microprocessors. Don't delay order your copy today.
The price is only **40p** (inc. **45p** vouchers).

Just a small selection from our vast stock. Ring to check current stock levels.

TRANSISTORS

AC 126	22p
127	22p
128	22p
176	22p
187	22p
187K	37p
188	22p
188K	37p
AD 140	79p
149	61p
161	48p
162	48p
AF 116	35p
117	35p
124	63p
139	40p
172	37p
239	48p
BC 107	10p
108	10p
109	10p
147	8p
148	8p
149	9p
157	12p
158	13p
169C	12p
BF 178	29p
179	35p
180	23p
181	32p
184	24p
185	24p
194	13p
195	13p
196	13p
197	13p

AMPLIFIER KIT

75B (7 watts)	3·67
75X (10 watts)	4·60

VEROBOARD

Size ins.	0·1 dc
25 × 1	12p
2·5 × 3·75	45p
2·5 × 5	52p
3·75 × 3·75	52p
3·75 × 5·00	60p
17 × 2·50	1·55
17 × 3·75	2·01
17·9 × 4·7	2·68
Pin Insertion tool	98p
Spot Face Cutter	84p
Vero Pins	42p per 100

POTENTIOMETERS

Log or Lin L/S	31p
Dual Log or Lin L/S	90p
Dual Log W/S	1·28
Log or Lin W/S	72p

VERO BOXES

Type No. 2523E	8·78
1798K	5·09
G. Range 2672A	5·88
2673G	9·17
2674B	12·49
Plastic 2514F	1·99
2516G	2·27
2518H	2·53
2520J	2·87
2522K	3·85
Series 2 Casebox	
2037C	3·93
2068B	5·21
2073K	7·08

INTEGRATED CIRCUITS

741	23p
748	38p
LM301AN	31p
LM307	51p
LM308	75p
LM324	65p
LM380	99p
LM381	1·77
LM3900	67p
MC1310	1·26
NE555	30p
TBA810AS	99p
TCA940	1·79
TDA2020	3·58
ZN414	92p

TOGGLE SWITCHES

S.P.S.T.	32p
D.P.D.T.	43p
Sub Min	
S.P.S.T.	58p
S.P.D.T.	63p
D.P.D.T.	72p

PUSH SWITCHES

Push to Make	16p
Push to Brake	22p

SLIDE

Standard D.P.D.T.	17p
Min D.P.D.T.	17p

ROCKER

Miniature	22p

DIN

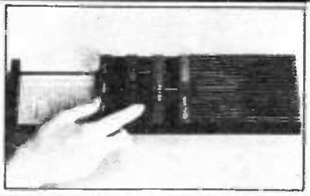
Pins	Plug	Socket
2	15	10
3	15	10
4	15	10
5 (180°)	15	10
5 (240°)	15	10

V.A.T. inclusive prices. Export Customers deduct 2%. Postage and Packing 25p. Trade and Export Inquiries most Welcome. Hours 9.00am–5.00pm. Now available our ORDER-RING line, just phone your order through with your Access or Barclaycard number and providing the order is received by 3.00pm the components will be despatched the same day (min tel order £5·00).

24 TUNE DOOR CHIMES

DOOR TUNES £17·13 + VAT.

Waddington's Videomaster announce a doorbell that doesn't go Brrringgg, Ding-Dong or Bzzzzz. Instead it plays 24 different classical and popular tunes. It will play the tune you select for your mood, the season or the visitor you are expecting to call. Door tunes is not only great fun and a wonderful ice breaker, but is also very functionally and beautifully designed to enhance your home. There is something for Christmas, something for your continental visitors or your relations from the states, and even something for the Queen. Door tunes is easy to install and has separate controls for volume, tone and tempo.



T.V. GAMES

PROGRAMMABLE £29·50 + VAT.
COLOUR CARTRIDGE T.V. GAME.

The TV game can be compared to an audio cassette deck and is programmed to play a multitude of different games in COLOUR, using various plug in cartridges. At long last a TV game is available which will keep pace with improving technology by allowing you to extend your library of games with the purchase of additional cartridges as new games are developed. Each cartridge contains up to ten different action games and the first cartridge containing ten sports games is included free with the console. Other cartridges are currently available to enable you to play such games as Grand Prix Motor Racing, Super Wipeout and Stunt Rider. Further cartridges are to be released later this year, including Tank Battle, Hunt the Sub and Target. The console comes complete with two removable joystick player controls to enable you to move in all four directions (up/down/right/left) and built into these joystick controls are ball serve and target fire buttons. Other features include several difficulty option switches, automatic on screen digital scoring and colour coding on scores and balls. Lifelike sounds are transmitted through the TV's speaker, simulating the actual game being played.
Manufactured by Waddington's Videomaster and guaranteed for one year.

EXTRA CARTRIDGES:

ROAD RACE – £8.87 + VAT.
Grand Prix motor racing with gear changes, crash noises

SUPER WIPEOUT – £9.17 + VAT.
10 different games of blasting obstacles off the screen

STUNT RIDER – £12.16 + VAT.
Motorcycle speed trials, jumping obstacles, leaping various rows of up to 24 buses etc.

NON-PROGRAMMABLE TV GAMES

6 Game – COLOURSCORE II – £13.50 + VAT.

10 Game COLOUR SPORTSWORLD £22.50 + VAT.

CHESS COMPUTERS

STAR CHESS – £55·09 + VAT.
PLAY CHESS AGAINST YOUR PARTNER.

using your own TV to display the board and pieces. Star Chess is a new absorbing game for two players, which will interest and excite all ages. The unit plugs into the aerial socket of your TV set and displays the board and pieces in full colour (or black and white) on your TV screen. Based on the moves of chess. It adds even more excitement and interest to the game. For those who have never played, Star Chess is a novel introduction to the classic game of chess. For the experienced chess player, there are whole new dimensions of unpredictability and chance added to the strategy of the game. Not only can pieces be taken in conventional chess type moves, but each piece can also exchange rocket fire with its opponents. The unit comes complete with a free 18V mains adaptor, full instructions and twelve months guarantee.

CHESS CHALLENGER 7 – £85·65 + VAT.
PLAY CHESS AGAINST THE COMPUTER.

The stylish, compact, portable console can be set to play at seven different levels of ability from beginner to expert including "Mate in two" and "Chess by mail". The computer will only make responses which obey international chess rules. Castling, en passant, and promoting a pawn are all included as part of the computer's programme. It is possible to enter any given problem from magazines or newspapers or alternatively establish your own board position and watch the computer react. The positions of all pieces can be verified by using the computor memory recall button.
Price includes unit with wood grained housing, and Staunton design chess pieces. Computer plays black or white and against itself and comes complete with a mains adaptor and 12 months guarantee.

ELECTRONIC CHESS BOARD TUTOR £17·17 + VAT.

A special bulk purchase of these amazing chess teaching machines enables us to offer them at only £17·17 less than half recommended retail price. The electronic chess tutor is a simple battery operated machine that can actually teach anyone to play chess and improve their game right up to championship level. This machine is not only for total beginners, but also for established players wanting to play better chess. Unit contains the electronic chessboard with 32 chess pieces, a 64 page explanatory booklet and a set of 32 progressive programme cards including 6 beginners cards, 16 check mate positions, 9 miniature games, 5 openings, 3 end games, 28 chess problems and 2 master games.

OTHER CHESS COMPUTERS IN OUR RANGE INCLUDE:

CHESS CHAMPION–6 LEVELS £47·39 + VAT.
CHESS CHALLENGER – 10 LEVELS £138·70 + VAT.
BORIS – MULTI-LEVEL TALKING DISPLAY £163·04 + VAT.

DRAUGHTS COMPUTERS

CHECKER CHALLENGER 2 LEVELS £43·00 + VAT.
CHECKER CHALLENGER 4 LEVELS £70.00 + VAT.

The draughts computer enables you to sharpen your skills, improve your game, and play whenever you want. The computer incorporates a sophisticated, reliable, decision making microprocessor as its brain. Its high level of thinking ability enables it to respond with its best counter moves like a skilled human opponent. You can select offence or defence and change playing difficulty levels at any time. Positions can be verified by computer memory recall. Machine does not permit illegal moves and can solve set problems. Computer comes complete with instructions, mains adapator and twelve months guarantee.

PLAY DRAUGHTS/CHECKERS AGAINST THE COMPUTER

FOR FREE BROCHURES – SEND S.A.E

For FREE illustrated brochures and reviews on TV and chess games please send a stamped addressed envelope, and state which particular games you require information on.
Callers welcome at our shop in Welling – demonstrations daily – open from 9am-5.30pm Mon-Sat (9am-1pm Wed).
To order by telephone please quote your name, address and Access/Barclaycard number.
Postage and Packing FREE.

AJD DIRECT SUPPLIES LIMITED, Dept. EE1 102 Bellegrove Road, Welling, Kent DA16 3QD. Tel: 01-303 9145 (Day) 01-850 8652 (Evenings)

All these advantages...

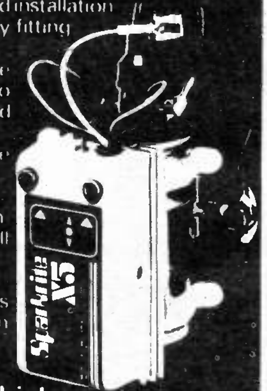
- Instant all-weather starting
- Smoother running
- Continual peak performance
- Longer battery & plug life
- Improved fuel consumption
- Improved acceleration/top speed
- Extended energy storage

..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.

The superb technical design of the Sparkrite circuit eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R P M. Contact breaker burn is eliminated by reducing the current by 95% of the norm.

There is also a unique extended dwell circuit which allows the coil a longer period of time to store its energy before discharging to the plugs. The unit includes built in static timing light, systems function light, and security changeover switch. Will work all rev counters.



Fits all 12 v negative-earth vehicles with coil/distributor ignition up to 8 cylinders.

THE KIT COMPRISES EVERYTHING NEEDED
Die pressed case. Ready drilled, aluminium extruded base and heat sink, coil mounting clips and accessories. All kit components are guaranteed for a period of 2 years from date of purchase. Fully illustrated assembly and installation instructions are included.

Roger Clark the world famous rally driver says "Sparkrite electronic ignition systems are the best you can buy."

Sparkrite

HIGH PERFORMANCE ELECTRONIC IGNITION
Electronics Design Assoc.
82 Bath Street, Walsall WS1 3DE

Electronics Design Associates, Dept. EE180
82 Bath Street, Walsall, WS1 3DE. Phone: (0922) 614791

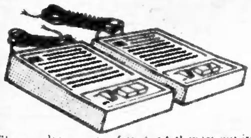
Name ______________________
Address ______________________

Phone your order with Access or Barclaycard

Inc V.A.T. and P.P	QUANTITY REQ'D.
X5 KIT £16·95	
ACCESS OR BARCLAY CARD No.	

I enclose cheque/PO's for
£ ______
Cheque No. ______
Send SAE if brochure only required

MAINS INTERCOM



NO BATTERIES NO WIRES

ONLY **£32·99** PER PAIR + VAT £4·95

The modern way of instant 2-way communications. Just plug into power socket. Ready to use. Crystal clear communications from room to room. Range ½-mile on the same mains phase. On/off switch. Volume control. Useful as inter-office intercom, between office and warehouse, in surgery and in homes. P. & P. £1·25.

4-STATION INTERCOM

£27·95 + VAT £4·19

Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs) in robust plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospitals and Office. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. A Battery and other accessories. P. & P. £1·25.

NEW! AMERICAN TYPE CRADLE

TELEPHONE AMPLIFIER

£17·95 +VAT £2·70 +P & P 99p

Latest transistorised Telephone Amplifier with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/off switch, volume control, conversation recording model at £19·95 + VAT £3·00. P. & P. 99p.

DOOR ENTRY SYSTEM

No house/business/surgery should be without a DOOR ENTRY SYSTEM in this day and age. The modern way to answer the door in safety to unwanted callers. Talk to the caller and admit him only if satisfied by pressing a remote control button which will open the door electronically. A boon for the invalid, the aged and busy housewife. Supplied complete d.i.y. kit with one internal Telephone, outside Speaker panel, electric door lock release (for surface mortise reversible latch locks) mains power unit, cable (8-way) 50 ft and wiring diagram. Price £49·95 + VAT £7·50 + P. & P. £1·50. Kit with two Telephones £59·95 + VAT £9·00 + P. & P. £1·75.

10-day price refund guarantee on all items.

WEST LONDON DIRECT SUPPLIES (EE12)
169 KENSINGTON HIGH STREET, LONDON W8

★

Please mention *Everyday Electronics* when replying to advertisements

★

FROM CASIO — THE NEXT STEP FORWARD IN TIME

New Lithium battery lasting up to 5 years, totally eclipses most SOLAR watches

FOR THE EXECUTIVE WHO DOESN'T WANT HANDS ON HIS TIME

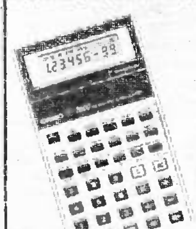
THIS YEAR'S STAR BUY

THE NEW 83QS—27B ALARM CHRONOGRAPH

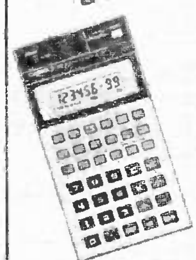
Optional display of hours, minutes, seconds, date, am/pm; or alternatively: Hours, minutes, alpha day, date, am/pm. The automatic calendar is set for 28 days in February. Casio's new Lithium battery lasts up to 4 YEARS or more. The chronograph times in 1/10 second units up to 12 hours, measuring net, lap and first and second place times. An indicator shows the chronograph is running when normal time is displayed. The 24 hour alarm can be set very easily to 1 minute intervals with an indicator to show the alarm is set.
In addition the watch can be set to chime every hour, on the hour, with a separate indicator to show this function is on.
A micro light illuminates the display at night time.
This superb watch is stainless steel encased, has a mineral glass face and is guaranteed water resistant to 66 feet (2 at).

RRP £31.95 **£27.95**

NEW SCIENTIFICS With non-volatile memory



CASIO FX-2600 Ultra slim— 5/32 inch
6 + 2 digits L C Display. 43 sci functions. Auto power off with memory retention. 6 level ( ). SD, R to P, P to R, Eng., FIX, SCI, RND and Random number keys. 5/32 × 2¾ × 4⅞in.
£19·95



CASIO FX-3200
10 digit version.
£21·95

CASIO FX-310
Similar to FX-2600 but 50 sci funct. ¼ × 2⅞ × 5¼
£17·95

CASIO FX-510
10 digit version.
£19·95

Others: FX-48 £12·75, FX-58 £25·95, FX-68 £19·95, FX-80 £15·95, FX-8000 £31·95.

CASIO CALCULATORS
NEW! Musical calculators ML-831 £11·95
ML-720 Credit card size, kiss keys £14·95

CLOCK CALCULATORS

HQ-21	£10·95	AQ-2000	£24·95
MQ-11	£26·95	CQ-82	£19·95

GET THE MIDAS TOUCH BEFORE YOUR FRIENDS DO
SUPERSWITCH Midas Touch Dimmer
The softest touch on the brushed aluminium panel of this beautifully styles control is all that is required to switch lights on and off and to vary lighting brilliance.
Touch Midas with the fingertips and the light is on. Touch again and it's off. Allow the finger to rest on the panel and the light intensity changes smoothly through a cycle from bright to dim and back again. Removing the touch during the cycle sets the lighting at the level required. Once set, this brightness level will be maintained during normal on/off operations.
Meets latest BS for RF interference. **£14.95**

WE ARE NEVER KNOWINGLY UNDERSOLD AND WILL TRY AND MATCH OR BEAT ANY OTHER ADVERTISED PRICE PROVIDING THE ADVERTISER HAS STOCKS

IF YOU WANT A WATCH WITH
Chrome plating that may wear off after a few months.
A plastic glass that will scratch and scuff and you may not be able to replace.
A module with around 25% failure rate, that may take weeks to repair.
A dubious or non-existent spares service.
If you want a watch that the manufacturer doesn't put his name on.
THEN DON'T BUY A CASIO

F-200 SPORTS CHRONO

Hours, minutes, seconds, am/pm. Day, date, month. 1/100 sec. chrono to 1 hr. Net. lap and 1st and 2nd place times. Backlight. Resin case/strap. Mineral glass. WR to 66 feet. Silver oxide battery. (£17·95)
£15·95

F-8C Time/date
3 YEAR BATTERY
Hours, minutes, seconds, date, day, am/pm. Auto 28, 30, 31 day calendar Backlight. Resin case/strap. Mineral glass WR to 66ft (£12·95)
£10·95

CASIO CHRONOGRAPHS
Normal time and dual time, 12/24 hour systems. Calendar pre-programmed to 2029. 1/100 second chronograph to 7 hours.

95CS-31B	Stainless steel	£29·95
95QS-31B	Stainless jacket	£23·95
95QS-32B	Chrome plated	£23·95

CASIO ALARM CHRONOGRAPHS
As above but with alarm and hourly chimes and without dual time.

81CS-36B	Stainless steel	£35·95
81QS-33B	Chrome plated	£27·95

CASIO ALARM WATCH
4 digit ultra-slim dress watch with four year calendar and alarm.

59CS-33B	Stainless steel	£44·95

Send 25p for illustrated brochures, prices.

Prices includes VAT, P & P. Send your cheque, P.O. or phone your ACCESS or B'CARD number to:

TEMPUS

Dept. EE, Beaumont Centre, 164-167 East Rd., Cambridge CB1 1DB. Tel. 0223 312866

SMALL ADS

The prepaid rate for classified advertisements is 20 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £5·00 per single column centimetre (minimum 2·5cm). All cheques, postal orders, etc., to be made payable to Everyday Electronics and crossed "Lloyds Bank Ltd." Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Everyday Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London SE1 9LS. (Telephone 01-261 5942).

NOTICE TO READERS

Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser both prices and availability of goods before ordering from non-current issues of the magazine.

For Sale

Receivers and Components

Miscellaneous

Educational

Record Accessories

Service Sheets

PLEASE MENTION EVERYDAY ELECTRONICS WHEN REPLYING TO ADVERTISEMENTS

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Everyday Electronics for ....

insertions. I enclose Cheque/P.O. for £...........................

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Everyday Electronics)

NAME ....

ADDRESS ....

....

Send to: Classified Advertisement Manager

EVERYDAY ELECTRONICS
GMG, Classified Advertisements Dept., Room 2337, King's Reach Tower, Stamford Street, London SE1 9LS. Telephone 01-261 5942

Rate:
18p per word, minimum 12 words. Box No. 60p extra.

Company registered in England. Registered No. 53626. Registered Office: King's Reach Tower, Stamford Street, London SE1 9LS.

INDEX TO ADVERTISERS

Published approximately the third Friday of each month by IPC Magazines Ltd., Kings Reach Tower, Stamford St., London SE1 9LS. Printed in England by Index Printers Ltd., Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Subscriptions: Inland £9.00, Overseas £10.00 per annum payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex. Everyday Electronics is sold subject to the following conditions namely that it shall not, without the written consent of thePublishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on cover, excluding Eire where the selling price is subject to V.A.T., and that it shall not be lent, resold, or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

£69 + VAT

GRANDSTAND
VIDEO ENTERTAINMENT COMPUTER

SIMPLY PLUGS INTO YOUR TV

Beautifully simple to link to any 625-line UHF Television. Connects to the mains and just plugs into the TV aerial socket and ... you're off! Plays in colour on colour TVs and gives a sparkling black and white picture with B & W televisions, and broadcasts realistic sound effects to add to the excitement.

Space-age computer technology brings an amazing variety of games which you play in the comfort of your own armchair stadium at home. Get in with the action without getting out! Fun for all the family, it plays the generation game with live TV action to suit all ages. Once you've been in control of the TV, normal service might never be resumed again! It's so excitingly different ... great for parties and to make the evening when visitors call.

CARTRIDGES AVAILABLE AT **£11.99**

Videocart-1: 1-player games—"Noughts and Crosses," "Shooting Gallery," "Doodle" and "Quadradoodle"
Videocart-2: 2-player "Desert Fox" and 1-player "Shooting Gallery"
Videocart-3: 1 and 2-player "Video Blackjack"
Videocart-4: 1 and 2-player "Spitfire"
Videocart-5: 2-player "Space War"
Videocart-6: 1-player "Math Quiz 1" (addition-subtraction)
Videocart-8: 1-player "Mind Reader"
Videocart-9: 2-player "Drag Strip"
Videocart-10: 1 and 2-player "Maze" and "Cat & Mouse"
Videocart-11: 2-player "Backgammon" and "Acey-Ducey"
Videocart-12: 2-player "Baseball"
Videocart-13: 1 and 2-player "Torpedo Alley" and "Robot War"
Videocart-14: 1 and 2-player "Sonar Search"
Videocart-15: 1 and 2-player "Memory Match"
Videocart-16: 1 and 2-player "Dodge It"
Videocart-17: 1 and 2-player "Pinball Challenge"
Videocart-18: 1 and 2-player "Hangman"
Videocart-20: 1 and 2-player "Video Whizball"
Videocart-21: 1 and 2-player "Bowling"

HITACHI PROFESSIONAL MONITORS
9" — £129 / 12" — £199 + VAT

● **Reliability** Solid state circuitry using an IC and silicon transistors ensures high reliability. ● **500 lines horizontal resolution** Horizontal resolution in excess of 500 lines is achieved at picture center. ● **Stable picture** Even played back pictures of VTR can be displayed without jittering. ● **Looping video input** Video input can be looped through with built-in termination switch. ● **External sync operation** (available as option for U and C types) ● **Compact construction** Two monitors are mountable side by side in a standard 19-inch rack.

Break the language barrier ONLY £138 + VAT

At a price equivalent to learning one language, LEXICON offers you, English, Spanish, French, German, Italian and Greek. The LK3000 comes to you with the person to person module which contains 6 languages, de-luxe carrying case and a charger adaptor using its own power source which will give you 4 - 5 hours continuous use, and can easily be re-charged from the mains supply, wherever you may be in the world. Every additional module carries a concise and understandable instruction book. Your deluxe carrying case has room for two additional modules.

UNIVERSAL POWER SUPPLY

Suitable for Nascom I, Nascom II, Superboard and all computers requiring these specifications.
+5V @ 3 amps +12V @ 1 amp —5V @ 500 mills —12v @ 500 mills
Easy to construct — complete with transformer. Our price £24.90

ETI TV PINBALL
FEATURING BREAKOUT
CHIP & PCB £14.90
ALL OTHER PARTS ALSO EX-STOCK

THE ATARI VIDEO COMPUTER SYSTEM £138 + VAT

Atari's Video Computer System now offers more than 1300 different game variations and options in twenty great Game Program™ cartridges!

Have fun while you sharpen your mental and physical coordination. You can play rousing, challenging, sophisticated video games, the games that made Atari famous. You'll have thrill ater thrill, whether you're in the thick of a dogfight, screeching around a racetrack, or dodging asteroids in an alien galaxy. With crisp bright colour (on color TV) and incredible, true-to-life sound effects. With special circuits to protect your TV.

Cartridges now available All at £13.90 each + VAT
Basic Maths, Airsea Battle, Black Jack, Breakout, Surround, Spacewar, Video Olympics, Outlaw, Basketball, Hunt & Score*, Space War, Sky Diver, Air Sea Battle Codebreaker*, Miniature Golf

Extra Paddle Controllers—£14.90 + VAT
*Keyboard Controllers—£16.90 + VAT

SPECIAL OFFER WHILE STOCKS LAST:
Free extra cartridge of your choice, please state 1st, 2nd and 3rd preference.

MODULATORS UHF Channel 36
Standard 6 meg band width £2.25
High Quality 8 meg band width £4.90 EX-STOCK

SHORT C12 CASSETTES FOR COMPUTER PROGRAMMES 10 for £4.00

video 100
12" BLACK & WHITE LOW COST VIDEO MONITOR

- Ideal for home, personal and business computer systems
- 12" diagonal video monitor
- Composite video input
- Compatible with many computer systems
- Solid-state circuitry for a stable & sharp picture
- Video bandwidth - 12MHz + 3DB
- Input impedance - 75 Ohms
- Resolution - 650 lines Minimum In Central 80% of CRT; 550 Lines Minimum beyond central 80%.

Only **£79** + VAT

COMP SHOP LTD

Please add VAT to all prices — Delivery at cost, will be advised at time of purchase. Please make cheques and postal orders payable to COMPSHOP LTD., or phone your order quoting BARCLAYCARD, ACCESS, DINERS CARD or AMERICAN EXPRESS number.
CREDIT FACILITIES ARRANGED — send S.A.E. for application form.
14 Station Road, New Barnet, Hertfordshire, EN5 1QW Telex: 298755 TELCOM G
Telephone: 01-441 2922 (Sales) 01-449 6596
OPEN - 10 am - 7 pm — Monday to Saturday
✱NOW OPEN ALL DAY SUNDAY — For Shop Sales Only✱
Close to New Barnet BR Station — Moorgate Line.

COMP COMPUTER COMPONENTS
(Part of the Compshop Ltd. Group)