

PRACTICAL WIRELESS

APRIL
1977

40p

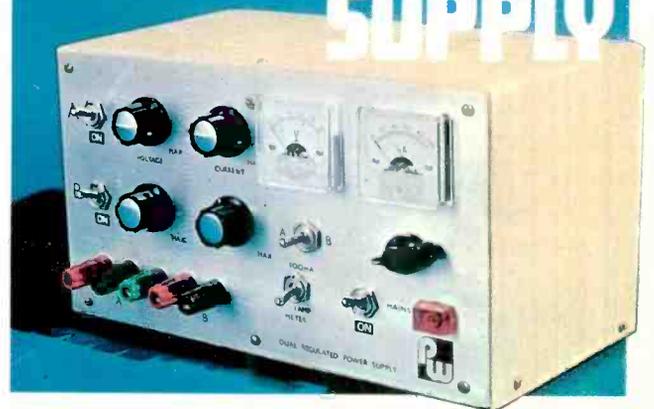
GAS/SMOKE SENSOR ALARM



TUG`O`WAR game



DUAL POWER SUPPLY



Also: FM STEREO TOUCH TUNER (Part 2)

RADIO EXCHANGE LTD.

**ALL PRICES
INCLUDE VAT**

NEW EDU-KIT MAJOR

Completely Solderless Electronic Construction Kit. Build these projects without soldering iron or solder



Total Building Costs **£9.00**

P & P + Ins. 85p.

- ★ 4 Transistor Earpiece Radio
- ★ 7 Transistor Loudspeaker Radio MW/LW
- ★ Batteryless Crystal Radio
- ★ Signal Tracer
- ★ 5 Transistor Short Wave Radio
- ★ One Transistor Radio
- ★ Signal Injector
- ★ Electronic Metronome
- ★ 2 Transistor Regenerative Radio
- ★ Transistor Tester NPN-PNP
- ★ Electronic Noise Generator
- ★ 3 Transistor Regenerative Radio
- ★ 4 Transistor Push Pull Amplifier
- ★ 21 Capacitors
- ★ Audible Continuity Tester
- ★ 5 Transistor Push Pull Amplifier
- ★ 10 Transistors
- ★ Sensitive Pre-Amplifier

Components include: 24 Resistors ★ 21 Capacitors ★ 10 Transistors
 ★ 5" x 3" Loudspeaker ★ Earpiece ★ Mica Baseboard ★ 3 12-way connectors
 ★ 2 Volume controls ★ 2 Slider Switches ★ 1 Tuning Condenser ★ 3 Knobs
 ★ Ready Wound MW/LW/SW Coils ★ Ferrite Rod ★ 6½ yards of wire
 ★ 1 Yard of sleeving, etc. Complete kit of parts including construction plans.

VHF AIR CONVERTER KIT

Build this Converter Kit and receive the Aircraft Band by placing it by the side of a radio tuned to Medium Wave or the Long Wave Band and operating as shown in the instructions supplied free with all parts. Uses a retractable chrome plated telescopic aerial, Gain Control, V.H.F. Tuning Capacitor, Transistor, etc.

All Parts including Case and Plans. **£3.95**
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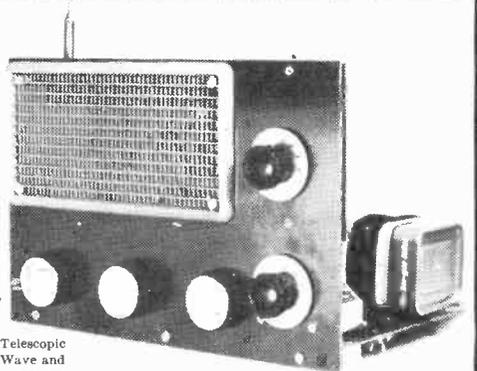


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 13 TRANSISTORS AND FIVE DIODES
 QUALITY 5" x 3" LOUDSPEAKER

WITH Multiband V.H.F. section covering Mobiles, Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc. and Multiband A.M. section with Airspaced Slow Motion Drive Tuning Capacitor for easier and accurate tuning, covering M.W.1, M.W.2, L.W., Three Short Wave Bands, S.W.1, S.W.2, S.W.3, & Trawler Band. Built in Ferrite Rod Aerial for Medium Wave, Long Wave and Trawler Band, etc. Chrome Plated 7 section Telescopic Aerial, single and rotatable for peak Short Wave and V.H.F. reception. Push Pull output using 600mw Transistors. Gain, Wave-Change and Tone Controls. Plus two Slider Switches. Negative Feedback circuit and SPECIAL POWER BOOSTER SOCKET AND RESISTOR, to virtually double gain if required. Powered by P.P.9.9 volt battery. Complete kit of parts including carrying strap. Building instructions and Operating Manuals.

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 3 Tuneable wavebands, M.W., L.W., and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive black and gold case. Size 5½" x 1½" x 3½" approx.

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Total Building Costs

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P & P + Ins. 60p.

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E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3" loudspeaker. Attractive case with red speaker grille. Size 9" x 5½" x 2½" approx. All parts including Case and Plans.

Total Building costs **£4.30** P & P + Ins. 60p.

E.V. 6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. All parts including Case and Plans.

Total Building costs **£4.95** P & P + Ins. 65p.

E.V. 7. Case and looks as above. 7 Transistors and 3 diodes. Six wavebands, MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" Loudspeaker. All parts including Case and Plans.

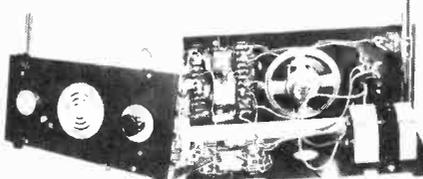
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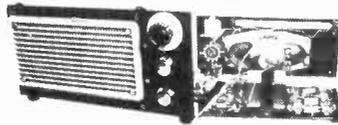
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ECK4

7 Transistors, 6 tuneable wavebands, MW, LW, Trawler Band, 3 Short Wave Bands. Receiver Kit. With 5" x 3" Loudspeaker. Push/Pull output stage, Gain Control, and Rotary Switch. 7 Transistors and 4 Diodes. 6 section chrome-plated telescopic aerial. 8" Sensitive Ready Wound Ferrite Rod Aerial. Tuning Capacitor. Resistors, Capacitors, etc. Operates from a 9 Volt PP7 Battery (not supplied with kit). Complete kit of parts including construction plans.

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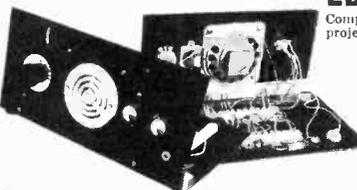


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- ★ 2 Transistor Regenerative Radio
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- ★ 4 Transistor Medium Wave Loudspeaker Radio.
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PRACTICAL WIRELESS

VOL. 52 NO. 12

ISSUE 842

APRIL 1977

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

EDITOR

Lionel E. Howes, G3AYA

ASSISTANT EDITOR

Eric Dowdeswell, G4AR

ART EDITOR

Peter Metall

TECHNICAL EDITOR

Terry Carter

PRODUCTION & NEWS

EDITOR

Bill Tull

TECHNICAL ARTIST

Alan Martin

SECRETARIAL

Linda Walji

ADVERTISING MANAGER

01-634 4612

Roy Smith

CLASSIFIED ADVERTISING

01-261 5762

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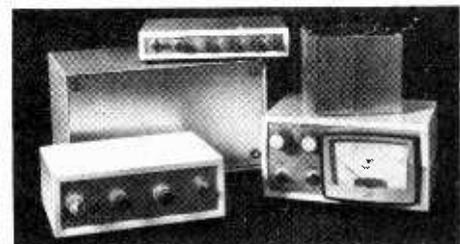
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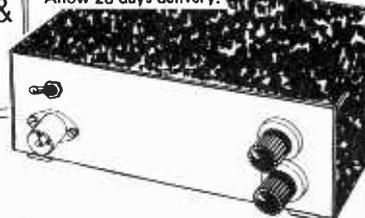
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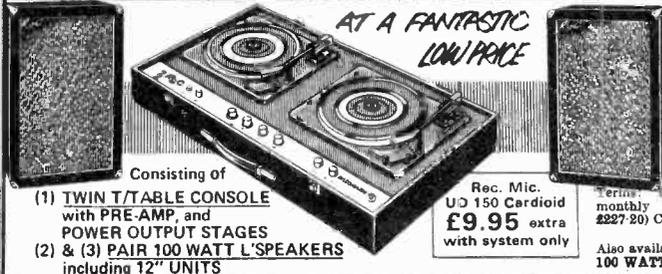
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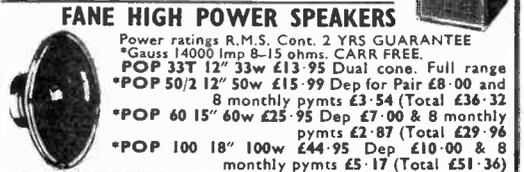
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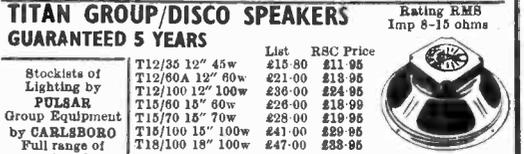
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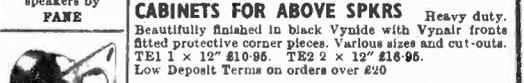
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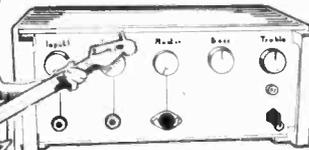
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FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

APPLICATIONS: Hi-Fi—Mixers—Disco—Guitar and Organ—Public address

SPECIFICATIONS:

INPUTS: Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; Input Impedance 4-7k Ω at 1kHz.

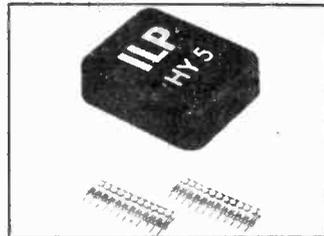
OUTPUTS: Tape 100mV; Main output 500mV R.M.S.

ACTIVE TONE CONTROLS: Treble \pm 12dB at 10kHz; Bass \pm at 100Hz.

DISTORTION: 0-1% at 1kHz; Signal/Noise Ratio 65dB.

OVERLOAD: 38dB on Magnetic Pick-up. **SUPPLY VOLTAGE** \pm 16-50V.

Price £5.22 + 65p VAT P&P free.



HY30 15 Watts into 8 Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

FEATURES: Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.

APPLICATIONS: Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator.

SPECIFICATIONS:

OUTPUT POWER 15W R.M.S. into 8 Ω ; **DISTORTION** 0-1% at 1-5W.

INPUT SENSITIVITY 500mV. **FREQUENCY RESPONSE** 10Hz-16kHz—3dB.

SUPPLY VOLTAGE \pm 18V.

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**Available
June '76**

HY50 25 Watts into 8 Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

FEATURES: Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components

APPLICATIONS: Medium Power Hi-Fi systems—Low power disco—Guitar amplifier

SPECIFICATIONS: **INPUT SENSITIVITY** 500mV

OUTPUT POWER 25W RMS into 8 Ω **LOAD IMPEDANCE** 4-16 Ω **DISTORTION** 0-04% at 25W

at 1kHz

SIGNAL/NOISE RATIO 75dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB.

SUPPLY VOLTAGE \pm 25V **SIZE** 105 50 25mm

Price £6.82 + 85p VAT P&P free.



HY120 60 Watts into 8 Ω

The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components

APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ

SPECIFICATIONS:

INPUT SENSITIVITY 500mV.

OUTPUT POWER 60W RMS into 8 Ω **LOAD IMPEDANCE** 4-16 Ω **DISTORTION** 0-04% at 60W

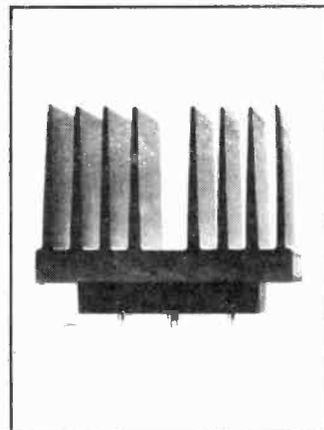
at 1kHz

SIGNAL/NOISE RATIO 90dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB **SUPPLY VOLTAGE**

\pm 35V

SIZE 114 50 85mm

Price £15.84 + £1.27 VAT P&P free.



HY200 120 Watts into 8 Ω

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components

APPLICATIONS: Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address

SPECIFICATIONS:

INPUT SENSITIVITY 500mV

OUTPUT POWER 120W RMS into 8 Ω **LOAD IMPEDANCE** 4-16 Ω **DISTORTION** 0-05% at

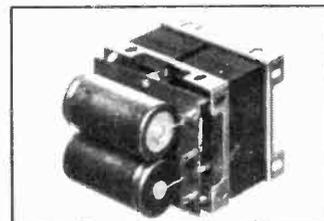
100W at 1kHz.

SIGNAL/NOISE RATIO 96 dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB **SUPPLY VOLTAGE**

\pm 45V

SIZE 114 100 85mm

Price £23.32 + £1.87 VAT P&P free.



HY400 240 Watts into 4 Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4 Ω ! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.

APPLICATIONS: Public address—Disco—Power slave—Industrial

SPECIFICATIONS:

OUTPUT POWER 240W RMS into 4 Ω **LOAD IMPEDANCE** 4-16 Ω **DISTORTION** 0-1% at

240W at 1kHz

SIGNAL NOISE RATIO 94dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB **SUPPLY VOLTAGE**

\pm 45V

INPUT SENSITIVITY 500mV **SIZE** 114 x 100 x 85mm

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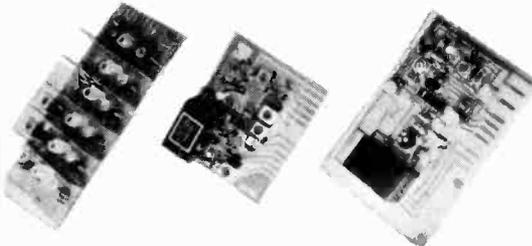
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Our top three FM tunermodules. (EF5800 shown with can off).



From left to right, the EF5800 6 circuit varicap FM tunerhead with the 7030 linear phase IF and the 91196 PLL stereo decoder with integral 55kHz 'birdy' filter. The system provides afc muting, meter drives, agc, auto stereo switch, & a specification that exceeds broadcast requirements. Now available with a new EF5801 tunerhead, with FET buffered oscillator output for synthesiser/frequency readout facilities.

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International Mark 2 Tuner kits:

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Radio module selection: (Prices for kits in our catalogue & PL)

EF5800	Ambit 6 stage varicap 88-108MHz tunerhead	£14.00
EF5600	TOKO 5 stage varicap	£12.95
EC3302	TOKO 3 stage varicap	£7.50
7020	Dual ceramic filter FM IF system module	£6.95
92310	MPX decoder, with stereo filter and preamp	£6.95
93090	MPX decoder with CA3090AQ + filter stage	£7.35
91197	MW/LW varicap AM tuner module	£11.35
771	New 'Off-Air' UHF varicap TV sound tunermodule with mute, AFC, dual conversion, PSU	£27.00
9014	MW/LW/Stereo FM tuner chassis, Mech. tuned	£26.00

Components: ICs, coils, filters, trimmers, diode law pots etc.

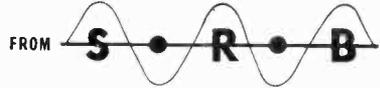
HA1137W/3089E	FM IF	1.94	TOKO AM IF TS:	
TBA120	FM IF and demod. 0.75		455/470kHz types	0.30
MC1350	FM IF preamp	0.97	10.7MHz types	0.33
SN76660N	FM IF and det. 0.75		(10mm square, with int. cap.)	
MC1310/4400	PLL MPX	2.20	455kHz Mechanical filters	
CA3090AQ	PLL MPX	3.75	4 or 7 kHz bandwidths	1.95
HA1196	PLL MPX	4.20	455kHz ceramic IF filters	
uA720	AM radio system	1.40	6 or 8 kHz bandwidth CFT	0.55
TBA651	AM radio system	1.81	SFD455 (Murata)	0.75
HA1197	AM radio system	1.40	455kHz dual ceramic CFX	1.80
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11C90	600MHz decade ctr	14.00	3132A 6 pole lin phase	2.25
LM380N	2 W Audio	1.00	3125N 4 pole lin phase	1.30
LM381N	audio preamp st.	1.81	CFS ceramic filters:	0.50
TDA2020	20W audio amp	2.99	Pilot tone (MPX) filters:	
TCA940	10W audio amp	1.80	BLR3107N stereo	1.90
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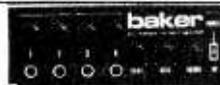
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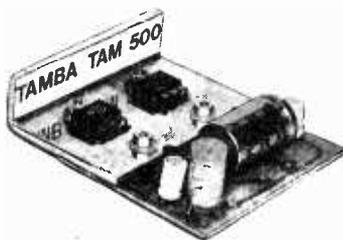
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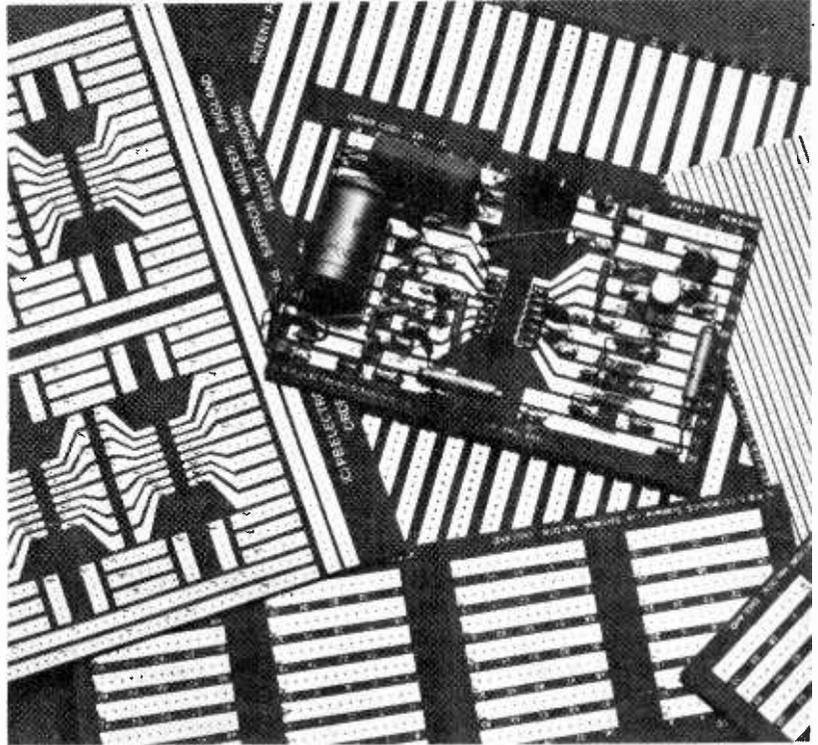
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EC83 0-40	EL95 0-70	PCF805 0-70	AC178 AF178	0-65				1829 0-70	
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AF127	BCY33	GEX66	OC44	2N456A	3N126
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AF239	BF185	OA47	OC78	2N1305	2S303
AFZ12	BFV51	OA70	OC78D	2N1307	T12082
ASV26	BFV52	OA71	OC81	2N1309	40235
ASV27	BSY27	OA73	OC82	2N2062	40250
ASV28	BSY38	OA79	OC82DM	2N2411	40251
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AD161	BY100	OA200	OC83B	2N3053	IN25
AD162	BY216	OA202	OC139	2N3054	IN38A
ADZ11	CRS1/20	OA200	OC140	2N3055	IN43
ADZ12	CRS1/30	OC22	OC170	2N3391	IN70
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ADZ12	CRS3/10	OC25	OC200	2N3819	IN4148
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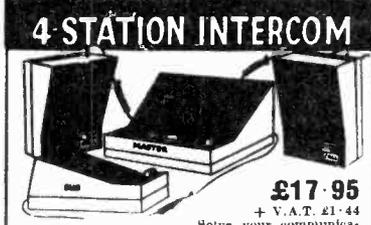
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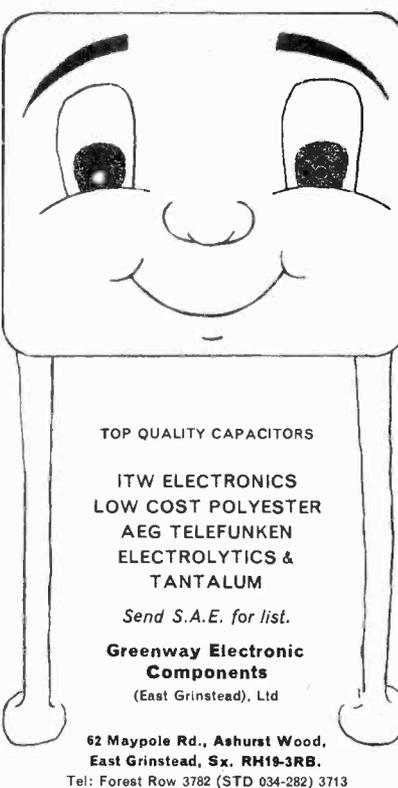
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(No. of Contacts: 70) 1 off £1-98
5 off £1-76

T-DEC (Model PB21)

This Board allows 2 TOS or 1 DIL IC Station to be used and so is primarily intended for discrete work or for linear IC application where considerable numbers of discrete components may be required.

(No. of Contacts: 208) 1 off £3-62
5 off £3-21

μ-DEC 'A' (Model PB31)

The μ-DEC 'A' is specially designed for ease of use with IC's and allows 2 DIL or 4 TOS stations to be used but will accommodate discrete components with equal facility.

(No. of Contacts: 208) 1 off £3-97
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μ-DEC 'B' (Model PB41)

The μ-DEC 'B' is for similar uses as μ-DEC 'A', but has two 16 lead IC sockets as part of the Board.

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16 DIL adaptor (with socket) PB062	£1-92
10 TOS adaptor (with socket) PB072	£1-80
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Capacitive discharge electronic ignition kit

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Sparkrite Mk. 2 is a high performance, high quality capacitive discharge, electronic ignition system in kit form. Tried, tested, proven, reliable and complete. It can be assembled in two or three hours and fitted in 15/30 mins.

Because of the superb design of the Sparkrite circuit it completely 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 to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

THE KIT COMPRISES EVERYTHING NEEDED

Ready drilled pressed steel case coated in matt black epoxy resin, ready drilled base and heat-sink, top quality 5 year guaranteed transformer and components, cables, coil connectors, printed circuit board, nuts, bolts, silicon grease, full instructions to make the kit negative or positive earth, and 10 page installation instructions.

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50V 3A 13p
100V 3A 15p
200V 3A 18p
400V 3A 21p

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100V 1A 28p
200V 1A 30p
400V 1A 32p

RESISTORS 1 1/2p each

WATT E12 (5%)
1 ohm-10m ohm

ZENERS (400mm) BZX 63

3V, 3V3, 5V1, 5V6, 7V5, 8V1, 10V, 12V, 18V, 22V, 30V. All at 12p each.

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Red 29p
Grn 28p
28p 29p
Clips for above 2p.

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60V 1A 20p
600V 1A 60p TAG 1 600
700V 1A 1.20 BT106
400V 4A 58p C106D1
500V 6A 1.25 BT109

RESISTORS 1 1/2p each

WATT E12 (5%)
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28p 29p
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THYRISTORS

60V 1A 20p
600V 1A 60p TAG 1 600
700V 1A 1.20 BT106
400V 4A 58p C106D1
500V 6A 1.25 BT109

RESISTORS 1 1/2p each

WATT E12 (5%)
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Grn 28p
28p 29p
Clips for above 2p.

THYRISTORS

60V 1A 20p
600V 1A 60p TAG 1 600
700V 1A 1.20 BT106
400V 4A 58p C106D1
500V 6A 1.25 BT109

RESISTORS 1 1/2p each

WATT E12 (5%)
1 ohm-10m ohm

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500V 6A 1.25 BT109

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THYRISTORS

60V 1A 20p
600V 1A 60p TAG 1 600
700V 1A 1.20 BT106
400V 4A 58p C106D1
500V 6A 1.25 BT109

RESISTORS 1 1/2p each

WATT E12 (5%)
1 ohm-10m ohm

ZENERS (400mm) BZX 63

3V, 3V3, 5V1, 5V6, 7V5, 8V1, 10V, 12V, 18V, 22V, 30V. All at 12p each.

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THYRISTORS

60V 1A 20p
600V 1A 60p TAG 1 600
700V 1A 1.20 BT106
400V 4A 58p C106D1
500V 6A 1.25 BT109

RESISTORS 1 1/2p each

WATT E12 (5%)
1 ohm-10m ohm

ZENERS (400mm) BZX 63

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THYRISTORS

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600V 1A 60p TAG 1 600
700V 1A 1.20 BT106
400V 4A 58p C106D1
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 Celestion G15C 8 or 15 ohms
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 £28-95 Kef DN13 SP1015 or SP1017
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Ref.	VA	Auto Taps	£
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64	75	"	4-65
4	150	0-115-200-220-240	6-24
66	300	"	8-62
67	500	"	13-10
84	1000	"	19-70
93	1500	"	23-62†
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30 VOLT RANGE

Prim. 220-240V
Sec. 0-12-15-20-24-30V

Ref.	Amps	£
112	0-5	3-15
79	1-0	4-00
3	2-0	5-55
20	3-0	6-87
21	4-0	7-93
51	5-0	9-55
117	6-0	10-69
88	8-0	14-15
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Prim. 220-240V

Sec. 0-24-30-40-48-60V

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126	1-0	5-43
127	2-0	7-65
125	3-0	11-00
123	4-0	13-07
40	5-0	14-20
120	6-0	16-64
121	8-0	19-56†
22	10-0	24-09†
189	12-0	25-16†

SCREENED MINIATURES

Ref.	mA	Volts	£
238	200	3-0-3	2-50
212	1A, 1A	0-6, 0-6	2-97
13	100	9-0-9	2-28
235	330, 330	0-9, 0-9	2-39
207	500, 500	0-8-9, 0-8-9	3-14
208	1A, 1A	0-8-9, 0-8-9	4-51
236	200, 200	0-15, 0-15	2-28
214	300, 300	0-20, 0-20	3-22
221	700 (DC)	20-12-0, 12-20	3-66
206	1A, 1A	0-15-20, 0-15-20	5-37
203	500, 500	0-15-27, 0-15-27	4-77
204	1A, 1A	0-15-27, 0-15-27	6-00
SI12	500	12, 15, 20, 24, 30	3-15

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153	350	17-14
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155	750	27-25†
156	1000	37-97†
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159	3000	78-36†

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350 247 15-23

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213 1-0 0-5 3-01

71 2 1 3-68

68 3 - 5-10

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70 6 3 6-36

108 8 4 7-34

72 10 5 7-86

116 12 6 8-39

17 16 8 10-48

115 20 10 15-42

187 30 15 19-50

226 60 30 21-94†

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Prim. 220-240V

Sec. 0-19-25-33-40-50V

Ref. No. Amps £

102 0-5 4-07

103 1-0 5-27

104 2-0 7-17

105 3-0 8-77

106 4-0 11-26

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EBF80	0-63	EF91	1-35	PCF80	0-34	PY81/800	0-72	30F5/PF818	
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EC882	0-70	EL86	1-40	PCL82	0-84	U191	1-17		0-63
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DCC30	1-85	EF95	0-45	PCC89	0-55	6K8G	0-45
DF91	1-40	EF98	0-80	PC3189	0-85	6K8M	0-70
DF96	0-60	EF184	0-40	PCF80	0-40	6K42	1-00
DK91	0-50	EF182	0-40	PCF82	0-42	6L6G	2-50
DK92	1-00	EL32	0-60	PCF86	0-65	6L6C	0-80
DK96	0-75	EL33	3-40	PCF801	0-60	6Q7G	0-40
DL92	0-50	EL34	0-70	PCF802	0-55	6Q7M	0-60
DL94	0-85	EL36	0-60	PCF805	0-90	6S17GT	0-55
DY96	0-55	EL41	0-90	PCF806	0-90	6S27GT	0-55
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EAF42	0-70	EM80	0-55	PCF82	0-42	6X4	0-45
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EBL31	2-00	EZ80	0-30	PCL83	0-70	7S7	2-25
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EC885	0-45	GZ34	0-75	PCL86	0-50	12A7D	0-45
EC888	0-50	HN309	1-50	PCL85/85		12A7E	0-45
ECH35	1-50	KT61	3-40	PD500	1-50	12A7F	0-45
ECH42	0-85	KT66	3-40	PEN45	0-85	12A7G	0-45
ECH81	0-35	KT81	3-40	PL36	0-63	12A7H	0-45
ECH83	0-50	(7C5)	2-00	PL81	0-55	12A7I	0-45
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ECL82	0-42	KTW61	1-50	PL83	0-50	12A7K	0-45
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EP37A	0-50	OA2	0-45	PL86	0-50	12A7N	0-45
				PCL805/85		12A7O	0-45
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						12A7R	0-45
						12A7S	0-45
						12A7T	0-45
						12A7U	0-45
						12A7V	0-45
						12A7W	0-45
						12A7X	0-45
						12A7Y	0-45
						12A7Z	0-45
						12B6	0-60
						12B6A	0-60
						12B6B	0-60
						12B6C	0-60
						12B6D	0-60
						12B6E	0-60
						12B6F	0-60
						12B6G	0-60
						12B6H	0-60
						12B6I	0-60
						12B6J	0-60
						12B6K	0-60
						12B6L	0-60
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						12B6N	0-60
						12B6O	0-60
						12B6P	0-60
						12B6Q	0-60
						12B6R	0-60
						12B6S	0-60
						12B6T	0-60
						12B6U	0-60
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						12B6AV	0-60
						12B6AW	0-60
						12B6AX	0-60
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						12B6BA	0-60
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						12B6BD	0-60
						12B6BE	0-60
						12B6BF	0-60
						12B6BG	0-60
						12B6BH	0-60
						12B6BI	0-60
						12B6BJ	0-60
						12B6BK	0-60
						12B6BL	0-60
						12B6BM	0-60
						12B6BN	0-60
						12B6BO	0-60
						12B6BP	0-60
						12B6BQ	0-60
						12B6BR	0-60
						12B6BS	0-60
						12B6BT	0-60
						12B6BU	0-60
						12B6BV	0-60
						12B6BW	0-60
						12B6BX	0-60
						12B6BY	0-60
						12B6BZ	0-60
						12B6CA	0-60
						12B6CB	0-60
						12B6CC	0-60
						12B6CD	0-60
						12B6CE	0-60
						12B6CF	0-60
						12B6CG	0-60
						12B6CH	0-60
						12B6CI	0-60
						12B6CJ	0-60
						12B6CK	0-60
						12B6CL	0-60
						12B6CM	0-60
						12B6CN	0-60
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AA213	£0.10	BY105	£0.18	BY213	£0.26	OA182	£0.07
AA217	£0.10	BY114	£0.12	BY216	£0.41	OA200	£0.08
BA100	£0.10	BY124	£0.12	BY217	£0.36	OA202	£0.08
BA102	£0.32	BY126	£0.15	BY218	£0.36	SD10	£0.06
BA148	£0.15	BY127	£0.16	BY219	£0.28	SD19	£0.06
BA154	£0.12	BY128	£0.16	OA10	£0.35	IN34	£0.07
BA155	£0.14	BY130	£0.17	OA47	£0.07	IN34A	£0.07
BA156	£0.14	BY133	£0.21	OA70	£0.07	IN914	£0.06
BA173	£0.15	BY164	£0.51	OA79	£0.07	IN916	£0.06
BB104	£0.15	BY176	£0.75	OA81	£0.07	IN4148	£0.06
BAX13	£0.07	BY206	£0.00	OA85	£0.09	IS44	£0.05
BAX16	£0.08	BY210	£0.36	OA90	£0.07	IS920	£0.06

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IS921	£0.07	IN4004	£0.08	IS021	£0.11	IN5400	£0.13
IS922	£0.08	IN4005	£0.09	IS023	£0.13	IN5401	£0.13
IS923	£0.09	IN4006	£0.10	IS025	£0.14	IN5402	£0.16
IS924	£0.10	IN4007	£0.11	IS027	£0.16	IN5404	£0.17
IN4001	£0.05	IS015	£0.09	IS029	£0.20	IN5406	£0.21
IN4002	£0.06					IN5407	£0.25

TRIACS

2 AMP T05 CASE			10 AMP T048 CASE		
Volts	No.	Price	Volts	No.	Price
100	TR12A/100	£0.31	100	TR110A/100	£0.77
200	TR12A/200	£0.51	200	TR110A/200	£0.92
400	TR12A/400	£0.71	400	TR110A/400	£1.12

6 AMP T066 CASE			10 AMP T048 CASE		
Volts	No.	Price	Volts	No.	Price
100	TR16A/100	£0.51	100	TR110A/100	£0.77
200	TR16A/200	£0.81	200	TR110A/200	£0.92
400	TR16A/400	£0.77	400	TR110A/400	£1.12

THYRISTORS

600mA T018 CASE			7 AMP T048 CASE		
Volts	No.	Price	Volts	No.	Price
10	THY600/10	£0.13	50	THY7A/50	£0.48
20	THY600/20	£0.13	100	THY7A/100	£0.51
30	THY600/30	£0.19	200	THY7A/200	£0.57
50	THY600/50	£0.22	400	THY7A/400	£0.62
100	THY600/100	£0.25	600	THY7A/600	£0.78
200	THY600/200	£0.38	800	THY7A/800	£0.92
400	THY600/400	£0.45			

1 AMP T05 CASE			10 AMP T048 CASE		
Volts	No.	Price	Volts	No.	Price
50	THY1A/50	£0.26	50	THY10A/50	£0.51
100	THY1A/100	£0.27	100	THY10A/100	£0.57
200	THY1A/200	£0.28	200	THY10A/200	£0.62
400	THY1A/400	£0.36	400	THY10A/400	£0.71
600	THY1A/600	£0.45	600	THY10A/600	£0.89
800	THY1A/800	£0.58	800	THY10A/800	£1.22

3 AMP T066 CASE			16 AMP T048 CASE		
Volts	No.	Price	Volts	No.	Price
50	THY3A/50	£0.25	50	THY16A/50	£0.54
100	THY3A/100	£0.27	100	THY16A/100	£0.58
200	THY3A/200	£0.33	200	THY16A/200	£0.62
400	THY3A/400	£0.42	400	THY16A/400	£0.77
600	THY3A/600	£0.50	600	THY16A/600	£0.90
800	THY3A/800	£0.65	800	THY16A/800	£1.39

5 AMP T066 CASE			30 AMP T094 CASE		
Volts	No.	Price	Volts	No.	Price
50	THY5A/50	£0.36	50	THY30A/50	£1.18
100	THY5A/100	£0.48	100	THY30A/100	£1.43
200	THY5A/200	£0.50	200	THY30A/200	£1.63
400	THY5A/400	£0.57	400	THY30A/400	£1.78
600	THY5A/600	£0.69	600	THY30A/600	£3.50
800	THY5A/800	£0.81			

5 AMP T0220 CASE		
Volts	No.	Price
400	THY5A/400P	£0.57
600	THY5A/600P	£0.69
800	THY5A/800P	£0.81

No.	Price
BT101/500R	£0.80
BT102/500R	£0.80
BT106	£1.25
BT107	£0.93
BT108	£0.98
2N3228	£0.70
2N3525	£0.77
BTX30/50L	£0.33
BTX30/40L	£0.46
C106/4	£0.60

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U51	150	Germ. OA70/81 diode	16131	£0.60
U52	100	Silicon diodes 200mA OA200	16132	£0.60
U53	150	Diodes 75mA 1N4148	16133	£0.60
U54	50	Sil rec top hat 750mA	16134	£0.60
U55	20	Sil rec stud type 3 amp	16135	£0.60
U56	50	400mV zeners D07 case	16136	£0.60
U57	30	PNP trans BC107/8 plastic	16137	£0.60
U58	30	PNP trans BC177/178 plastic	16138	£0.60
U59	25	PNP TO59 2N697/2N1711 silicon	16139	£0.60
U60	25	PNP TO59 2N3905 silicon	16140	£0.60
U61	30	PNP TO18 2N706 silicon	16141	£0.60
U62	25	PNP BFY50/51	16142	£0.60
U63	30	PNP plastic 2N3906 silicon	16143	£0.60
U64	30	PNP plastic 2N3905 silicon	16144	£0.60
U65	30	Germ. 0071 PNP	16145	£0.60
U66	15	Plastic power 2N3055 NPN	16146	£1.20
U67	10	TO3 metal 2N3055 NPN	16147	£1.20
U68	20	Unijunction trans IS43	16148	£0.60
U69	10	1 amp SCR TO39	16149	£1.20
U70	15	3 amp SCR TO66 case	16150	£2.50

Code Nos. mentioned above are given as a guide to the type of device in the pak. The device themselves are normally unmarked.

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Pak No.	Qty.	Description	Order No.	Price
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C6	2	Tuning ganks. MW/LW VHF	16169	£0.60
C7	1	Pack wire 50 meters assorted colours single strand	16170	£0.60
C8	10	Reed switches	16171	£0.60
C9	3	Micro switches	16172	£0.60
C10	15	Assorted pots	16173	£0.60
C11	5	Metal jack sockets 3 x 3.5mm 2 x standard switch types	16174	£0.60
C12	30	Paper condensers preferred types mixed values	16175	£0.60
C13	20	Electrolytic trans. types	16176	£0.60
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S3	6	Slider potentiometers, all 10k Ω lin	16192	£0.60
S4	6	Slider potentiometers, all 2k Ω lin	16193	£0.60
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S6	6	Slider potentiometers, all 47k Ω log	16195	£0.60

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R5—60 mixed ½W 100-820Ω.
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R6—60 mixed ½W 1-8-2kΩ.
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R7—60 mixed ½W 10-82kΩ.
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R8—60 mixed ½W 100-820kΩ.
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Size 60 × 24 × 90mm
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1000
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1000
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Resistance 0-150kΩ

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AC127	£0.14	BC115	£0.09	BC461	£0.28	BFX85	£0.24	TIP30A	£0.50	2N2907	£0.19
AC128	£0.12	BC148	£0.09	BC477	£0.20	BFX86	£0.25	TIP30B	£0.60	2N2907A	£0.22
AC128K	£0.26	BC149	£0.09	BC478	£0.19	BFX87	£0.22	TIP30C	£0.70	2N2926G	£0.22
AC132	£0.15	BC157	£0.12	BC479	£0.20	BFX88	£0.22	TIP31A	£0.54	2N2926Y	£0.09
AC134	£0.15	BC158	£0.12	BC547	£0.12	BFX90	£0.25	TIP31B	£0.66	2N2926Y	£0.09
AC137	£0.15	BC159	£0.12	BC548	£0.12	BFY50	£0.14	TIP32A	£0.64	2N2926Y	£0.09
AC141	£0.18	BC167	£0.12	BC549	£0.12	BFY51	£0.14	TIP32B	£0.76	2N2926Y	£0.09
AC141K	£0.30	BC168	£0.12	BC550	£0.14	BFY52	£0.14	TIP32C	£0.80	2N2926Y	£0.09
AC142	£0.18	BC169	£0.12	BC556	£0.14	BI19	£0.38	TIP41A	£0.66	2N2926Y	£0.09
AC176	£0.12	BC169C	£0.12	BC557	£0.13	BI20	£0.38	TIP41B	£0.70	2N2926Y	£0.09
AC176K	£0.26			BC558	£0.12	BI19/20MP	£0.80	TIP41C	£0.80	2N2926Y	£0.09
AC178	£0.25	BC170	£0.10	BC559	£0.14	BRY39	£0.45	TIP42A	£0.72	2N2926Y	£0.09
AC179	£0.25	BC171	£0.10	BD115	£0.50	BU05	£1.90	TIP42B	£0.78	2N2926Y	£0.09
AC180	£0.20	BC172	£0.10	BD116	£0.80	BU105/02		TIP42C	£0.95	2N2926Y	£0.09
AC180K	£0.30	BC173	£0.12	BD121	£0.65			TIP2955	£0.95	2N2926Y	£0.09
AC181	£0.20	BC177	£0.16	BD123	£0.65			TIP3055	£0.75	2N2926Y	£0.09
AC181K	£0.30	BC178	£0.16	BD124	£0.70	BU204	£1.70	TIP3055	£0.75	2N2926Y	£0.09
AC187	£0.16	BC179	£0.16	BD131	£0.35	BU205	£1.70	TIS90	£0.18	2N2926Y	£0.09
AC187K	£0.26	BC180	£0.25	BD132	£0.38	BU208/02		UT46	£0.20	2N2926Y	£0.09
AC188	£0.16	BC181	£0.25	BD131/132MP	£0.80			ZTX107	£0.10	2N2926Y	£0.09
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AD142	£0.85	BC183L	£0.10	BD136	£0.36	MJE3055	£0.60	ZTX300	£0.12	2N2926Y	£0.09
AD143	£0.75			BD137	£0.38	MJE3440	£0.45	ZTX500	£0.14	2N2926Y	£0.09
AD149	£0.60	BC184	£0.10	BD138	£0.40	MP8113	£0.45	MPF102	£0.35	2N2926Y	£0.09
AD181	£0.36	BC184L	£0.10	BD139	£0.54	MPF104	£0.38	MPF105	£0.38	2N2926Y	£0.09
AD162	£0.20			BD140	£0.60	MPSA05	£0.20	MPSA05	£0.20	2N2926Y	£0.09
AD161/162MP	£0.10			BD139/140MP	£1.20	MPSA06	£0.20	MPSA55	£0.20	2N2926Y	£0.09
AF114	£0.75	BC207	£0.11			MPSA56	£0.20	OC22	£1.50	2N2926Y	£0.09
AF115	£0.20	BC208	£0.11	BD155	£0.80	OC23	£1.50	OC24	£1.50	2N2926Y	£0.09
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AF117	£0.20	BC212	£0.11	BD177	£0.68	OC27	£0.60	OC28	£0.90	2N2926Y	£0.09
AF118	£0.40	BC212L	£0.11	BD178	£0.68	OC29	£1.00	OC30	£0.90	2N2926Y	£0.09
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AF126	£0.30			BD203	£0.80	OC35	£0.90	OC36	£0.90	2N2926Y	£0.09
AF127	£0.32	BC214	£0.12	BD204	£0.80	OC37	£0.15	OC38	£0.90	2N2926Y	£0.09
AF139	£0.58	BC214L	£0.12	BD203/204MP	£1.70	OC39	£0.15	OC40	£0.90	2N2926Y	£0.09
AF140	£0.58			BD207	£0.80	OC41	£0.15	OC42	£0.90	2N2926Y	£0.09
AF181	£0.58	BC237	£0.16	BD208	£0.80	OC43	£0.15	OC44	£0.90	2N2926Y	£0.09
AF186	£0.58	BC238	£0.16	BD209	£0.80	OC45	£0.15	OC46	£0.90	2N2926Y	£0.09
AF239	£0.38	BC251	£0.15	BD210	£0.80	OC47	£0.15	OC48	£0.90	2N2926Y	£0.09
AL102	£0.95	BC251A	£0.15	BD211	£0.80	OC49	£0.15	OC50	£0.90	2N2926Y	£0.09
AL103	£0.95			BD212	£0.80	OC51	£0.15	OC52	£0.90	2N2926Y	£0.09
AL104	£1.00	BC301	£0.20	BD213	£0.80	OC53	£0.15	OC54	£0.90	2N2926Y	£0.09
AL110	£1.00	BC302	£0.28	BD214	£0.80	OC55	£0.15	OC56	£0.90	2N2926Y	£0.09
AL113	£1.00	BC303	£0.32	BD215	£0.80	OC57	£0.15	OC58	£0.90	2N2926Y	£0.09
BC107A	£0.08	BC304	£0.38	BD216	£0.80	OC59	£0.15	OC60	£0.90	2N2926Y	£0.09
BC107B	£0.08	BC305	£0.38	BD217	£0.80	OC61	£0.15	OC62	£0.90	2N2926Y	£0.09
BC107C	£0.08	BC306	£0.38	BD218	£0.80	OC63	£0.15	OC64	£0.90	2N2926Y	£0.09
BC108	£0.08	BC307	£0.15	BD219	£0.80	OC65	£0.15	OC66	£0.90	2N2926Y	£0.09
BC108B	£0.08	BC308	£0.15	BD220	£0.80	OC67	£0.15	OC68	£0.90	2N2926Y	£0.09
BC108C	£0.08	BC309	£0.15	BD221	£0.80	OC69	£0.15	OC70	£0.90	2N2926Y	£0.09
BC109B	£0.08	BC310	£0.15	BD222	£0.80	OC71	£0.15	OC72	£0.90	2N2926Y	£0.09
		BC311	£0.15	BD223	£0.80	OC73	£0.15	OC74	£0.90	2N2926Y	£0.09
		BC312	£0.15	BD224	£0.80	OC75	£0.15	OC76	£0.90	2N2926Y	£0.09
		BC313	£0.15	BD225	£0.80	OC77	£0.15	OC78	£0.90	2N2926Y	£0.09
		BC314	£0.15	BD226	£0.80	OC79	£0.15	OC80	£0.90	2N2926Y	£0.09
		BC315	£0.15	BD227	£0.80	OC81	£0.15	OC82	£0.90	2N2926Y	£0.09
		BC316	£0.15	BD228	£0.80	OC83	£0.15	OC84	£0.90	2N2926Y	£0.09
		BC317	£0.15	BD229	£0.80	OC85	£0.15	OC86	£0.90	2N2926Y	£0.09
		BC318	£0.15	BD230	£0.80	OC87	£0.15	OC88	£0.90	2N2926Y	£0.09
		BC319	£0.15	BD231	£0.80	OC89	£0.15	OC90	£0.90	2N2926Y	£0.09
		BC320	£0.15	BD232	£0.80	OC91	£0.15	OC92	£0.90	2N2926Y	£0.09
		BC321	£0.15	BD233	£0.80	OC93	£0.15	OC94	£0.90	2N2926Y	£0.09
		BC322	£0.15	BD234	£0.80	OC95	£0.15	OC96	£0.90	2N2926Y	£0.09
		BC323	£0.15	BD235	£0.80	OC97	£0.15	OC98	£0.90	2N2926Y	£0.09
		BC324	£0.15	BD236	£0.80	OC99	£0.15	OC100	£0.90	2N2926Y	£0.09
		BC325	£0.15	BD237	£0.80	OC101	£0.15	OC102	£0.90	2N2926Y	£0.09
		BC326	£0.15	BD238	£0.80	OC103	£0.15	OC104	£0.90	2N2926Y	£0.09
		BC327	£0.15	BD239	£0.80	OC105	£0.15	OC106	£0.90	2N2926Y	£0.09
		BC328	£0.15	BD240	£0.80	OC107	£0.15	OC108	£0.90	2N2926Y	£0.09
		BC329	£0.15	BD241	£0.80	OC109	£0.15	OC110	£0.90	2N2926Y	£0.09
		BC330	£0.15	BD242	£0.80	OC111	£0.15	OC112	£0.90	2N2926Y	£0.09
		BC331	£0.15	BD243	£0.80	OC113	£0.15	OC114	£0.90	2N2926Y	£0.09
		BC332	£0.15	BD244	£0.80	OC115	£0.15	OC116	£0.90	2N2926Y	£0.09
		BC333	£0.15	BD245	£0.80	OC117	£0.15	OC1			

AMONG our constructional projects this month is a Gas/Smoke Sensor Alarm that is designed to give a visual and audio warning when the gas or smoke content of the atmosphere rises above a predetermined level. In view of the apparent spate of explosions around the country in recent times, frequently due to the leakage of natural gas, it might be thought that we are trying to 'cash-in' on other people's misfortunes.

Nothing could be further from the truth. The project was scheduled for publication in this issue several months ago. Observant readers may have noticed that issues with major projects in them are being interspersed with issues containing a number of smaller constructional designs. The Gas/Smoke Alarm is just one of those designs, among a number that we shall be presenting to our readers in the forthcoming months.

Should any of our readers make up this Alarm gadget then we sincerely hope that it never goes off! It's like an insurance policy, really. One pays and pays but hopes that the need to collect will never arise! On the other hand, the Dual Power Supply also presented in this issue is something that ought to be seen to be working all the time.

There is nothing more annoying than to finish an interesting and enjoyable project only to find that there are not enough batteries in the shack to get your pride and joy working. Our design comprises two completely independent supplies, each fully monitored for voltage and current output, which should prove to be just about the most useful bit of gear to have around.

On a slightly different tack, the generally forecast shortage of components, and the inevitable increase in prices for those that are available, should tend to favour the smaller electronic project in the future. Every constructor, if he is wise, soon begins to collect bits and pieces, in the way of capacitors, resistors etc and every nut and washer should be preserved. There are those among us who can remember stripping down government surplus radio and radar equipment after the last war and getting jars full of lovely cadmium plated bolts, washers, nuts and so on, plus many hundreds of various components, not to mention untold numbers of that elegant and ubiquitous valve, the EF50! They must have been produced by the million!

'Ah!' I hear you saying 'but we can't get that sort of stuff today'. No, maybe not, but is there a home, house, shed or attic in the land that does not have a discarded TV in some dark corner? But whatever you do, be careful when handling the tube, especially when removing it from the chassis. If tube is sound and you intend to use it again, all well and good, but if you are going to dispose of it to the dustman then place it face downwards in a substantial cardboard box and mark it accordingly. **DO NOT** try to break it yourself or the resulting implosion could cause injury to the eyes or face.

From then on it is an enjoyable few hours work, pulling the set to pieces and sorting the 'swag' into types of components as you go along. Later, every component ought to be checked for actual value before being used again. This is where a lack of test equipment begins to show up. One of the more instructive and rewarding of pastimes is the building and using of test gear because when there is something wrong with a component or circuit it needs a little brain work to find the fault and that is where the learning begins.

ERIC DOWDESWELL *Assistant Editor*

SILENT KEY

Readers will be sorry to learn of the death of Austin Forsyth, OBE, G6FO, in his 70th year. He had been Editor of *Short Wave Magazine* since 1938

Fair enough

FOLLOWING on from the story in the February issue concerning the cancellation of the 1976 Audio Fair, we are now pleased to see the return of this major event in 1977. Due to take place at Olympia from September 12th to the 18th, this latest show promises to be an even greater success than those in past years.

The organisers, Iliffe Promotions Ltd., say that "although the show will retain its appeal to the specialist audio and Hi-Fi enthusiasts, the 1977 Audio Fair will take account of the greatly increased family demand for sound and visual home entertainment".

Provisional bookings have already been taken up by such firms as BSR, Shure, National Panasonic, Eagle, Hitachi and JVC. It would appear that this is just the beginning of the list of exhibitors and that 'on the day' all the old firms, together with many new ones, will again be under the one Olympia roof.

Audio Fair, Iliffe Promotions Ltd., Dorset House, Stamford Street, London SE1 9LU.

No free plugs for this product

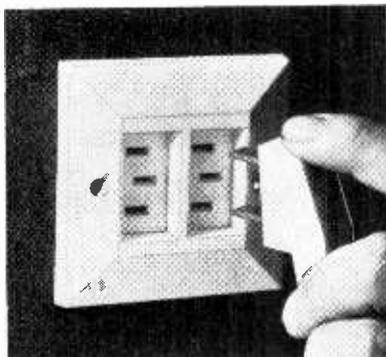
WHY is it that we British always seem to knuckle under to ideas and technical innovations, when all and sundry KNOW that our standards in the field of electrical safety are second to none? The point that we're getting at, is the recent revelation from those Barons of the EEC, that there will shortly be a new "World Plug", designed specifically to be compatible in any corner of the world. Fine ideas indeed you may say, but no amount of persuasion will convince these EEC commissioners and their bevy of technical advisers to incorporate a fuse within the plug. You see the plug is a 16A moulded de-

NEWS...

NEWS...

NEWS...

vice with three in-line flat pins, permanently fixed to the lead and totally fuseless. This of course would mean that all equipment purchased would have to be fused in the unit itself, and



should you decide that you would like to keep your "antiquated" 13A system, recently installed at the expense of next year's holidays, you will be delighted to know that any new equipment would have to have its plug physically cut off and a new—sorry old—plug put on.

Another controversial, and in our opinion downright dangerous idea, is that generally, the sockets for these plugs will be without shutters, although the commissioners do state that "provision MAY be made in the UK for the use of shuttered socket outlets"—how thoughtful of them! Maybe if they do, we won't have a spate of dead children—the result of poking knitting needles and the like into the open holes. It's a pity we can't say the same thing for those unsuspecting French or German children. Still we suppose that the Commissioners have thought all about this—or have they?

This sort of situation epitomises the depths that our negotiators in Brussels have sunk to, and it's up to the general public and the electrically orientated press in this country to say STOP—ENOUGH—we know what's right, and we refuse to be browbeaten into accepting an expensive second-rate article.

Tiny Tele!

FOR the past four or five years, rumours have been flying around thick and fast concerning the imminent appearance of a pocket sized TV. It's true to say that a couple were produced and shown to the Press, but were never marketed due to some fundamental design fault. There were also more, we are led to believe, that were never revealed to the Press, but were sent back to the "Drawing board" for a further re-think. However, Sinclair—possibly one of the leading exponents of the miniature electronics industry in this country, are now producing a truly tiny TV, which really is "Pocket" size—well large pocket size anyway!—and are claiming a World first.

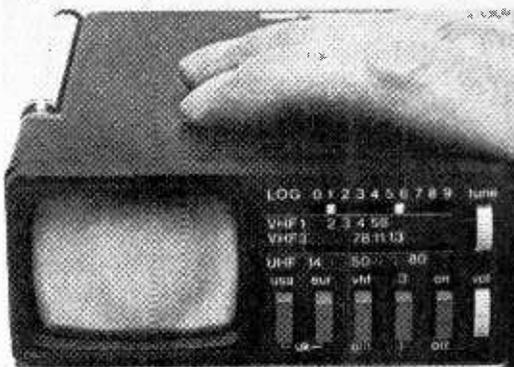
Called the Microvision, it's just $6 \times 4 \times 1\frac{1}{2}$ in with a 2in screen, and is claimed to work just about anywhere in the Western World. It can tune in to any UHF or

VHF channel in bands 1, 3, 4 or 5 and consume less power than a large pen torch bulb—to be exact 750mW from 4 AA nickel cadmium rechargeable batteries. When fully charged, life is about 4 hours, with a 14-hour recharging cycle. Audio output is 50mW, while EHT to the tiny tube is 2kV.

The Microvision is the result, say Sinclair, of 12 years research and some £500,000 spent in development work alone. Readers may also remember that the NEB granted a large sum of money to Sinclair, which really does prove that some Civil Servants know a good thing when they see it!

Manufactured at Sinclair's Headquarters at St Ives, the Microvision is priced at \$300 in the USA or £175.00 plus VAT in the UK.

Sinclair Radionics Ltd., London Road, St Ives, Huntingdon, Cambs PE17 4HJ. Tel: (St Ives) 0480 64646.



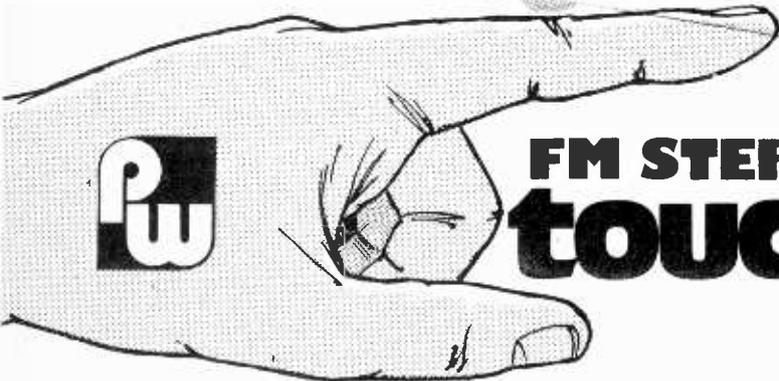
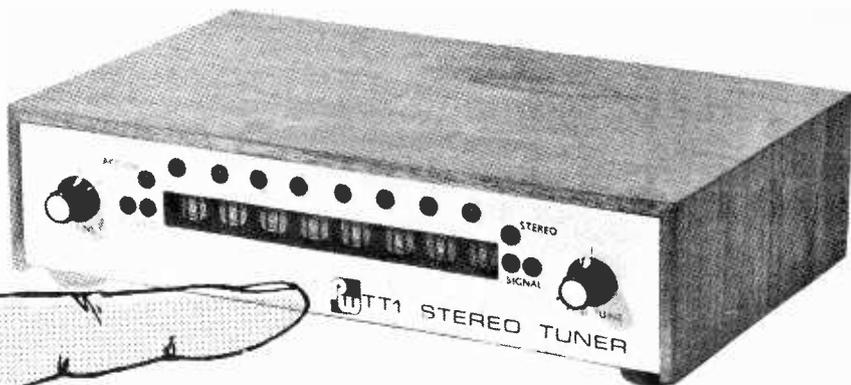
Alex Marshall

IT IS with regret that we have to announce the death of Alex Marshall, founder of A. Marshall (London) Ltd. of Cricklewood Broadway, London, after a short illness. Mrs. Marshall is continuing the business with the same management staff.

Sutton & Cheam RS

THE ANNUAL Dinner Dance, will take place on Saturday 19 March at the Woodstock Hotel, Morden when the guest of honour will be the President of the RSGB, the Lord Wallace of Coslany. Details from Bob Tillin G3MES, 11 Great Ellshams, Banstead, Surrey or telephone Burgh Heath 56095.

Part 2



FM STEREO touch tuner

FRANCIS HOW (B.A. Cantab)

CONSTRUCTION

You may wish to construct the whole unit at one go and then test it, but you can run the risk of being faced with a totally baffling case of absolute silence at the end! The method to be described is a "build and test as-you-go" procedure which to some extent avoids this. Construction cannot be described as elementary, but neither is it particularly difficult. Be methodical in your approach and do not try to rush. First to be assembled is PCB1 according to the plan given in Fig. 5b. If you have not attempted PCB construction before, do not be afraid of making a start now. Follow the usual rules when mounting components; semiconductor connections are given in the drawings. With the board drilled as shown, the LP1186 and BLR3107 modules will only fit in one way round, as will L2. CF1 and CF2 may be mounted either way round. The relay may present a slight problem.

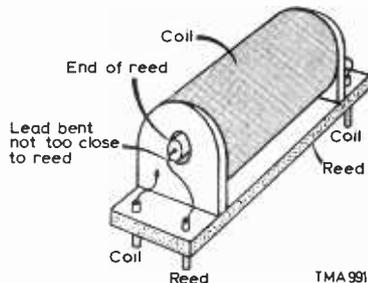


Fig. 6. Diagram of the reed relay assembly as used by the author.

Fig. 6 shows how the reed was mounted in the coil in the prototype, when a fairly standard type was used. If the relay used has different base connections, either it or the board will have to be suitably altered. Fig. 7 shows the heatsink for Tr1, which is mounted vertically as indicated. Note that

to avoid the tuner current passing through the fixing screws of the heatsink a separate lead is soldered between the heatsink and the PCB. Apart from the power input, aerial and output leads, and the tuning voltage lead to the tunerhead, leave all flying connections off at this stage, which makes initial testing considerably easier. Finally, check all wiring thoroughly against the diagrams.

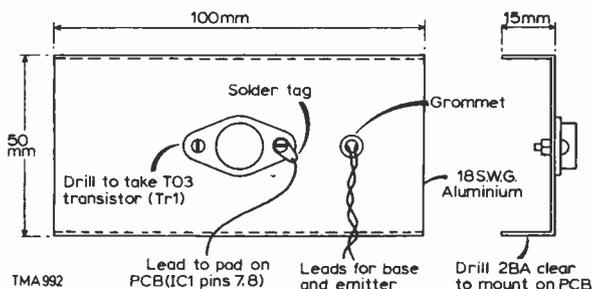


Fig. 7. Details of the heatsink for transistor Tr1, which is bolted on direct without any insulating kit. Avoid shorting the heatsink, which is at +25V, to earth.

Figs. 8 and 9 show the layouts for PCB2 and PCB3. Notice that PCB3 is not drawn full length; to each end of what is shown in the diagram should be added another 1 $\frac{3}{4}$ in of unetched board, making a total board length of 11in. On these unetched portions holes should be drilled to take the mains switch and fine tune control (both of which are bolted to PCB3). Brackets may be bolted on for fixing the completed assembly of PCB2 and PCB3 to the chassis bottom. The positions for these holes can be calculated from Fig. 10.

When mounting the LEDs observe that they lie on the copper side of PCB3, with their leads taken in a loop and back through the second set of holes provided on the board, for soldering. C45 to C52 must be bent flat on the board in order to leave clearance for mounting PCB2.

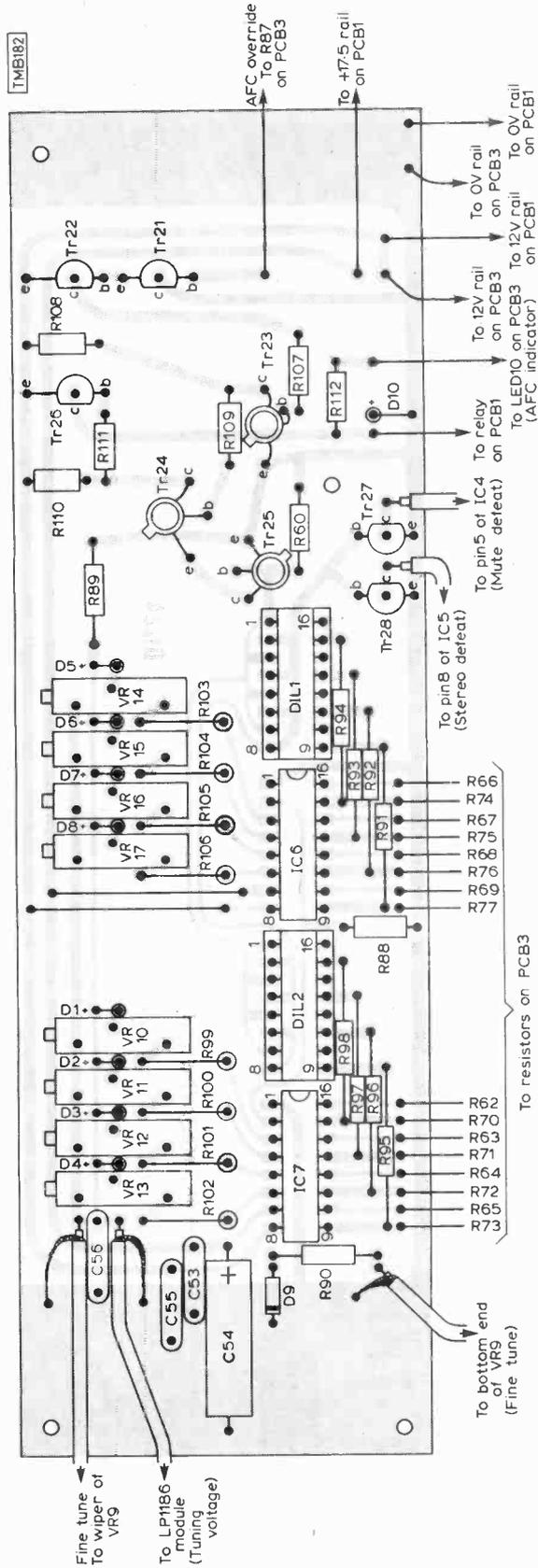
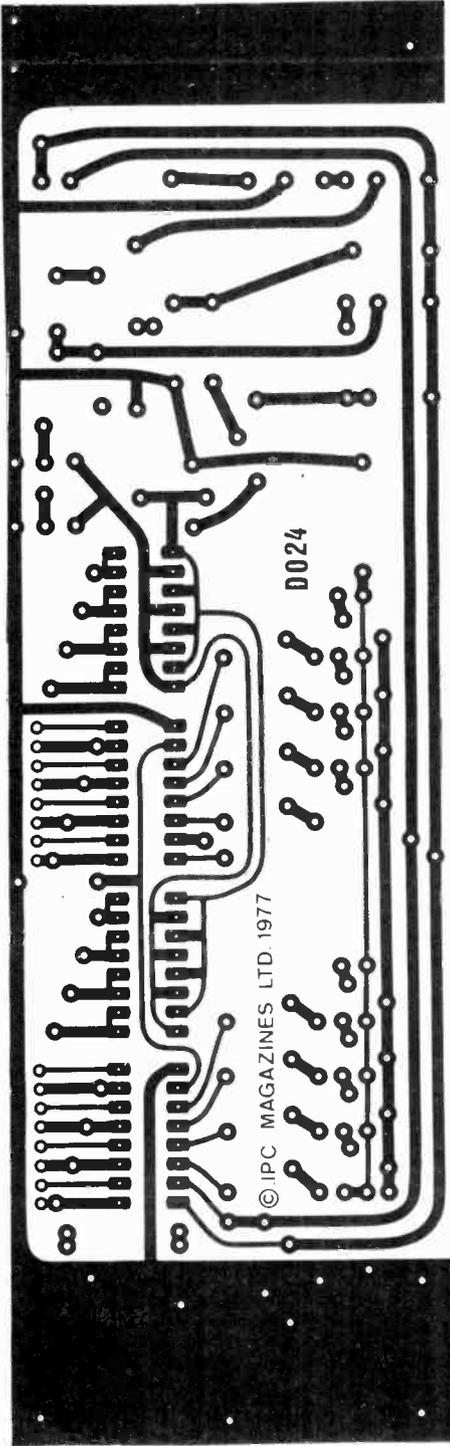
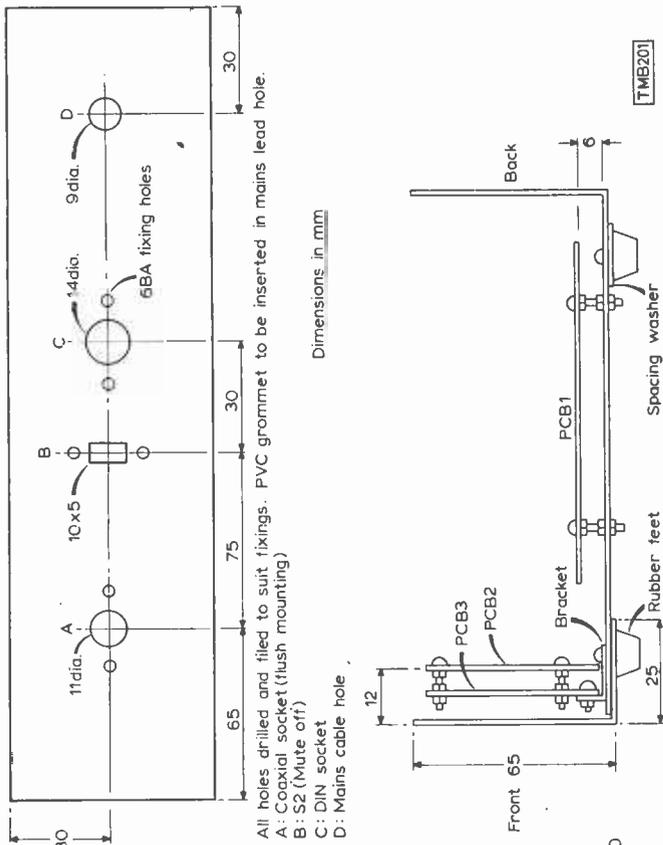
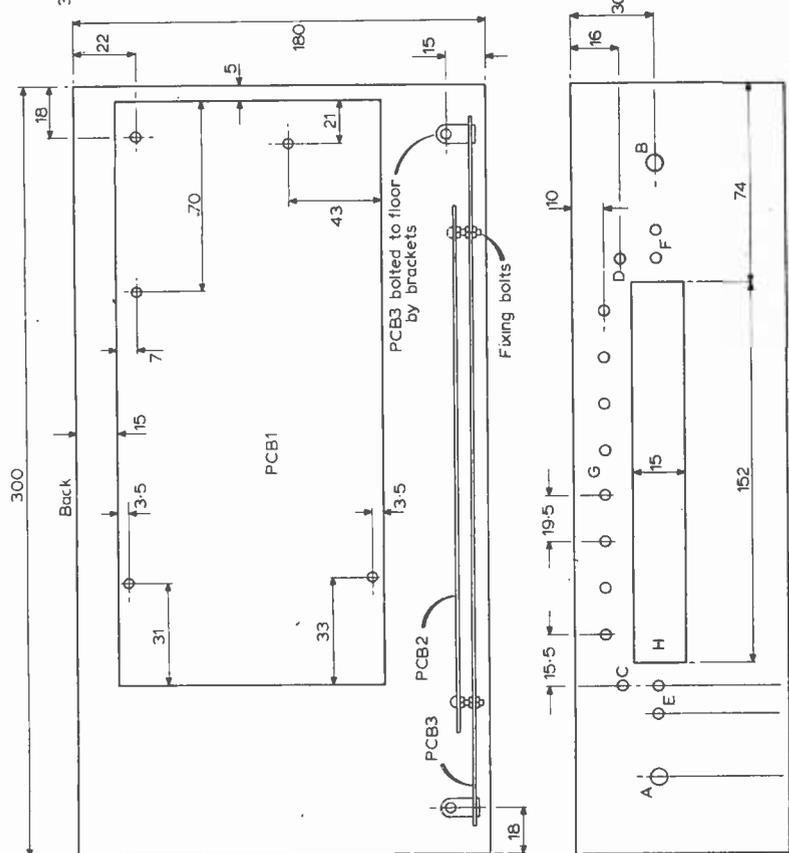
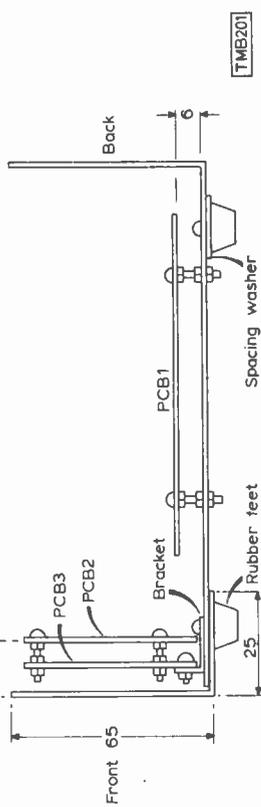


Fig. 8. PCB2 containing the touch and selection and AFC circuitry. The foil side, above, is shown full size with the component layout below. Before mounting any components on this board or on PCB3 it is a good idea to ensure that the mounting holes on the boards are coincident.



Dimensions in mm

A: Coaxial socket (flush mounting)
 B: S2 (Mute off)
 C: DIN socket
 D: Mains cable hole



Dimensions in mm

A: Hole for spindle of mains switch } 3.8 dia.
 B: Hole for spindle of fine tune control }
 C: AFC beacon
 D: Stereo beacon
 E: Tuning indicators
 F: Signal strength indicators
 G: Station indicators
 H: Slot to give access to touch buttons on PCB3

Fig. 11. Drilling details for the rear panel are given at the top, with an end view of the arrangement of the PCBs in the chassis. Note the two-piece construction of the chassis.

NOTE: Material for main chassis is 300 x 245mm and not as indicated in Components List.

Photograph of the front panel of the Touch Tuner to show the way in which the foil side of PCB3 is painted to leave the touch 'buttons'.



Fig. 10. Details of the layout of the three PCBs on the metal chassis are shown at the top. The drilling and cutting information for the front panel is given below. Check hole sizes required from components actually used.

PCB2 itself is relatively straightforward to construct and assemble; use screened lead where indicated; this is important as wires carrying the tuning voltage are particularly likely to introduce hum into the system, which then appears at the output.

Next construct the first part of the chassis. It will be seen from Fig. 11 that the metalwork is made of 18SWG aluminium in two L-shaped pieces. One forms the back and bottom, the other the front panel with a 25mm (1in) flange for attaching it to the bottom. It is the first-mentioned piece which must be made now; cut, bend and drill as appropriate, making any alterations as necessary for the components actually used. For accurate drilling it is probably best to locate the positions of the holes for PCB1 by using the board as a template. Any treatment intended for the back panel such as labelling should be done now. The prototype was sprayed white, the lettering put on and then a very thin protective coat of polyurethane varnish sprayed on top. Allow adequate time for the paint to thoroughly harden off.

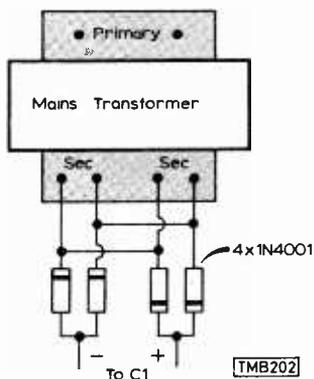


Fig. 12: Method of connecting the four 1N4001 diodes to the secondary tags of the mains transformer to form the bridge rectifier.

Now mount the switch S2, the sockets, the mains transformer and capacitor C1. If the recommended transformer is used, its windings should be wired in parallel and in phase Fig 12, and the four secondary tags may conveniently be used for soldering the diodes D11 to D14 into the circuit. Temporarily connect a mains supply direct to the transformer, connect C1 in circuit, and ensure that this unregulated supply gives about 35V. If all is well, PCB1 may be mounted on the chassis floor and the aerial, output, and power supply connections wired up.

PRELIMINARY TESTING

Note that C57 and C58 are mounted directly on the DIN socket, not on PCB1. Wire in S2 but during testing leave it switched off (open circuit) until testing the mute circuitry. Leave the C1 end of the wire link on PCB1 between C1 and the rest of the board circuitry unconnected at this stage. Switch on and if all is well, Tr1, IC1 and IC2 should all remain cold; VR1 and VR2 are adjusted to give 12V at the output of the main supply regulator, and 17.5V from the tuning voltage regulator. Then connect a milli-ammeter across the broken link mentioned above, thus delivering power to the board. About 70mA should flow and the supply rail remain at 12V. See that none of the ICs or transistors are hot; all the ICs and Tr1 will be warm under normal

conditions. When satisfied, the link may be soldered in place.

Plug in an aerial and amplifier, and feed a tuning voltage to the tunerhead using the 17.5V supply and a 100kΩ potentiometer. With L2 adjusted so that the top of the core is one or two turns below the top of the screening can it should be possible to tune in a station. Adjust the core for maximum audio level (corresponding to maximum inter-station noise). Find a stereo transmission and adjust VR8 so that the decoder separates the two channels: if necessary an LED may be connected in place of LED9 between R55 and the 12V rail which will then illuminate when a station is being received in stereo. Check the voltages provided in Table 1. If at any stage it is suspected that something may be wrong, switch off immediately and check the circuitry.

TABLE 1

Test	Volts
Unregulated supply when loaded	22 to 26
Main supply	12
Tuning supply	17.5
Decoder supply (top of C40)	10.5
Detector supply (top of C23)	10
IF amp supply (top of C19)	9.5
Tunerhead supply (top of C18)	7.8
IC4 reference volts (pin 10, IC4)	5.6

(All measurements made with a 20kΩ/V voltmeter on 5 or 25V range as applicable).

Now attach all the leads to PCB1 not previously soldered in place, and connect all the wires leading between PCB2 and PCB3, and those between these two boards and PCB1 (the 100kΩ potentiometer used earlier is not now needed). Bolt PCB2 and PCB3 together and mount the assembly on the bottom of the chassis using two small brackets as indicated in Fig. 11. The four rubber feet should also be attached, and the mains switch S1 wired into circuit. The copper side of PCB3 is painted matt black all round the touch buttons (the positions of which are indicated in Fig. 10) so that above, below, and at the ends of the row of buttons a ¼in border of black exists. The copper-less lines in between the electrodes on each button should also be painted.

The stations should be labelled, from left to right, 2, 3, 4, L, L, L, L, L, (three BBC national stations and five local). This may be done either on the central electrodes (in which case a small covering of varnish should be placed over the letters if 'magic letters' are used, but not so as to cover the whole electrode which would then insulate it), or on the front panel underneath the buttons.

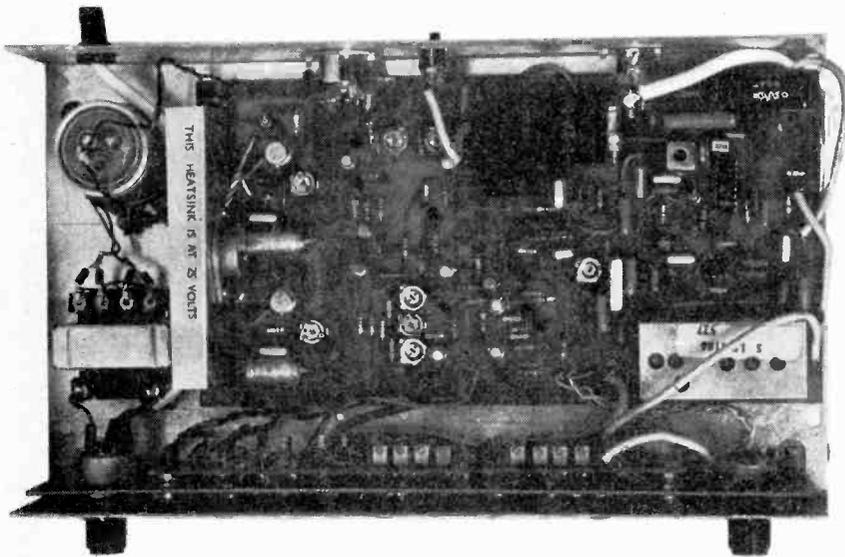
SELECTOR TESTING

Now comes the station selector testing. Switch on once more and ensure that the two supply rails remain at their correct voltages (an indication that the circuitry is not taking too high a current). One of the station LEDs should be on, and touching other buttons should select the corresponding stations; try adjusting the tuning presets to see that they all tune the receiver satisfactorily. When a stereo broadcast is being received the stereo beacon should be illuminated.

To set up the switching levels of the signal strength and tuning indicator LEDs it is necessary to peak up the tuning of L2. Detune the receiver so that a station is just distorted, and connect a link across the reed contacts of relay, RLA. If the AFC is working, the station should return to tune. Connect a voltmeter across the reed contacts; set the fine tune control to its midway position and adjust a tuning preset so that a station is in tune (when no voltage should be read). Detuning the receiver with the fine tune control should give equal but opposite voltage variations when the control is moved to equal positions either side of the midway position. If not, adjust L2 and re-tune the receiver such that this is so. It should be possible to do this with variations up to about 3V, which will mean that the system is sufficiently well adjusted for use.

AFC ADJUSTMENTS

Lastly the AFC override circuitry and the DIL socket defeat functions must be tested. During the above work, it will be found that when the tuning LEDs go off, the output is muted. Now insert a diode across pins 2 and 15 of DIL1, in the orientation shown in Fig. 4. The mute function should now be inoperative on Radio 2; that is, instead of the output being quiet when the tuning lights are extinguished, the station will gradually fade into a loud background hiss as the receiver is detuned. The station should also be permanently in mono. The same applies to diodes inserted across corresponding pairs of pins for other stations. Now similarly insert a diode between pins 1 and 16 on DIL1. Again select Radio 2, where the AFC should now be operative,



View down on to the Touch Tuner with mains transformer and smoothing capacitor to the left, both bolted direct to the chassis. The Tr1 heatsink is at extreme left of main PCB while PCBs 2 and 3 are fitted behind the front panel. The longer of these two boards carries the fine tuning control and mains switch. The shorter board carries the eight station tuning potentiometers which can be clearly seen.

Now place the voltmeter across R8. Turn VR5 fully anticlockwise and adjust VR3 and VR4 so that LED14 and LED13 switch on and off at voltages about 0.4V below and above the in-tune voltage respectively. Leaving the receiver exactly in tune, place the voltmeter on pin 13 of IC4, and adjust VR5, VR6 and VR7 so that LEDs 13 and 14 switch on at 2V, LED12 at 3V, and LED11 at 4.5V. Alteration of the voltage on pin 13 for this purpose may be done by de-tuning the receiver, but the best method is to remove the aerial and then slowly bring it up to the centre pin on the socket. When the receiver is tuned to a strong signal and the presets correctly adjusted the LEDs should progressively switch on as the signal strength is increased by the method outlined.

It is emphasised that all the LED adjustment should be done when the tuner is warmed up as the level indicator circuits are rather temperature-sensitive. Under normal operating circumstances the room temperature should not vary too much, but if it were to do so the voltages at which the LEDs switch on would vary considerably. With the signal level indicators set to the above values, when LED 12 is on the signal is strong enough for reasonable mono reception, and when both LED11 and LED12 are on then noise-free stereo reception should be possible.

signified by the fact that the sound remains clear and undistorted and the tuning indicators permanently on, over a considerable frequency range. At the extremes of this range the AFC will suddenly cease to operate and the station will be lost, denoted by the extinguishing of the tuning and signal strength LEDs. Try holding your finger on the Radio 2 button; it will need a firmer touch than when selecting a station, but the AFC should be rendered inoperative by this action, and the AFC beacon will go out. This permits accurate tuning of the station.

The same can be done for all the other stations by inserting a diode across the appropriate pins. Switching S2 to the off position will permanently defeat the mute function. This completes the electronics of the tuner and you can now insert diodes as required, and tune in the stations. The in-tune position is, of course, indicated by both tuning LEDs being illuminated. Although a simple piece of wire will suffice as an aerial in many cases, the benefits of a better arrangement are considerable when trying to receive high quality stereo broadcasts or signals from distant transmitters.

The last part of the work is to construct the front panel Fig. 10. As stated before, this is an L-shaped piece of aluminium (Fig. 11). Drill holes on the flange so that it may be fixed to the chassis bottom with the same bolts as are used to keep PCB2, PCB3

and the front rubber feet in place. Great care must be taken when cutting and drilling the front itself; there is considerable use of straight lines and symmetrical patterns which, if not strictly adhered to will mean that the panel will not coincide with the components on PCB3, and the appearance will be disastrous! Although positions are given in Fig. 10 for drilling the holes and cutting the slot it is strongly recommended that each hole is positioned with reference to the reader's version of PCB3. This means placing the panel in position against the LEDs (it may be necessary to remove the mains switch and fine tune control) and marking where the holes should be drilled on the inside of the panel.

Now drill each LED hole, one at a time; drill them only to 0.2in diameter and file out the hole to take the black clip. This way ensures that straight lines of LEDs are obtained. Similarly drill the holes for the spindles of the controls, and cut out the slot. Any painting and lettering intended should be done at this stage, removing the LED clips to do so, of course.

The prototype was treated in the same way on the front and back panels, as has already been described. When the paint has hardened, glue to the inside of the front panel, all round the slot, some 1/4in square balsawood rod, painted matt black. This will hide undesirable parts of the printed circuit from view and prevent reflections from the LEDs on the buttons.

A three-sided wooden sleeve was made for the tuner from teak veneered plywood. Simple tack and glue joints were used, with wooden fillets for strengthening the corners. Small 90° brackets were bolted to the inside of the sides so that when the sleeve was fitted on the chassis these brackets lay on the floor of the chassis. Self-tapping screws, put through holes in the floor from the underside, then held the brackets rigidly to the chassis.

NOTES

Clearly there are faults that could be encountered during construction; the most likely cause is a wiring error. If the receiver has a background hum on some or all stations check the decoupling on the tuning voltage lines, both into IC6 and IC7, and from the presets which tune the stations. Also try reducing the main supply voltage a little; the system will work with as little as 9V.

It may be that some of the stations cannot be selected, or that the receiver sticks on one position and pushing other buttons has no effect. Moisture on the electrodes could cause the latter fault, although the former is more likely to be a wiring error. It should never be possible to simultaneously have two stations selected (unless you hold fingers on two buttons). When first switching on it may be that although a station light is illuminated, no sound is heard. This is normal for these ICs and touching that button will immediately bring the station into tune. PW

Please note the following amendments to Fig. 4 in Part 1.

1. The common line at the bottom of R78 to R85 and C45 to C52 should be shown as going to +12V.
2. LED20, in the collector line of Tr26, should be marked LED10.
3. Capacitor C53 is not polarised and should not be shown as an electrolytic.

next month in Television

● THE DECCA 80 CHASSIS

The Decca 80 chassis, released in early 1976, is representative of the latest approach to colour set design, featuring an in-line gun c.r.t. and extensive use of new i.c.s. Barry Pamplin describes basic circuit operation, fault diagnosis procedures and common faults. The first of two articles.

● CRT BOOSTER

A c.r.t. booster can save money and do wonders for a set displaying a dull picture. This design, by Andy Denham, can be used with both colour and monochrome tubes and can be built up using components from the spares box. Boosting should give a tube at least six months' extra life.

● HAVE YOU NOTICED ... ?

What's Les up to this time? His latest discourse on servicing experiences describes various failure patterns he has encountered time and time again.

● SCOPE TUBES

Oscilloscope tubes are constructed to meet quite different requirements from the normal receiver display tube. This can be confusing to anyone selecting a tube to build an oscilloscope around. 'Phosphor' describes basic scope tubes and the features they offer.

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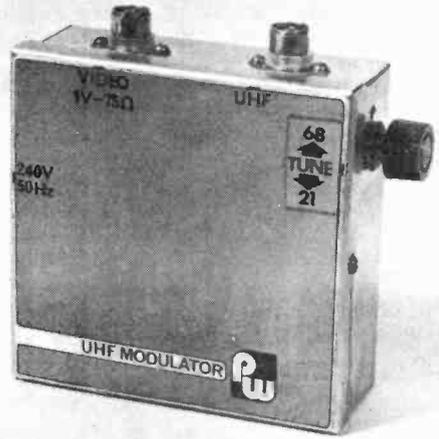
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Pw UHF Modulator

E. TRUNDLE



THE modulator to be described is based on the standard Mullard varicap tuner type ELC1043 or ELC1043/05. These are currently being advertised in this and other magazines.

The basic idea is to isolate the RF amplifier and self-oscillating mixer sections after which the oscillator is tuned down so that it comes into line with the RF amplifier. The oscillator output is then applied to the redundant RF input so that the RF stage amplifies the oscillator's signal. The video input is applied to the AGC line to vary the gain of the RF amplifier, the net result being a negatively-modulated RF signal at UHF, whose frequency may

Replace R2 by R32, 47 Ω .

Position of R2 in ELC1043/05

Position of R2 in ELC1043

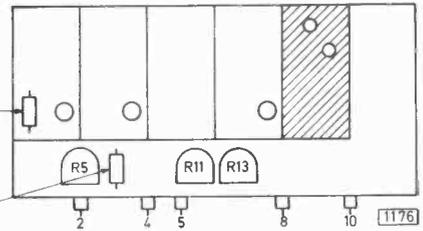


Fig. 2. The location of R2 and the three tuning presets, R5, R11 and R13.

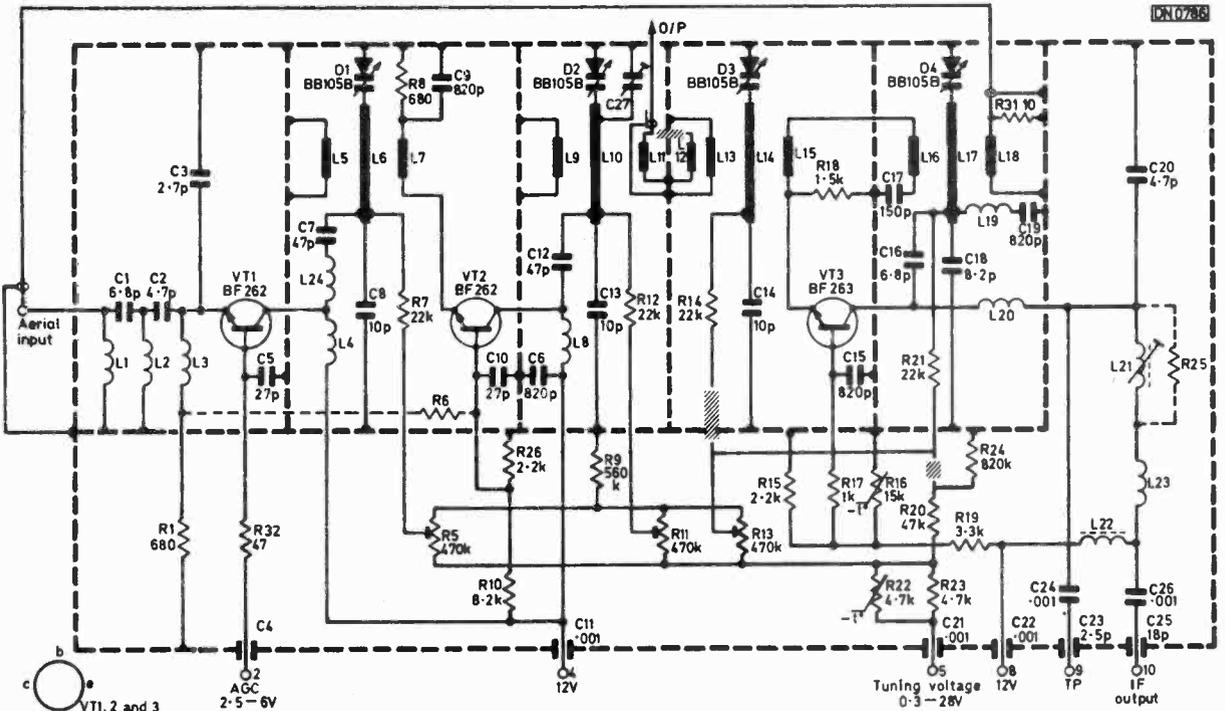


Fig. 1. Circuit of the ELC1043 after modification. The ELC1043/05 is similar apart from transistor types. The shaded areas indicate breaks in the P.C. tracks. R31 is added in series with L18 to provide the oscillator output tapping point.

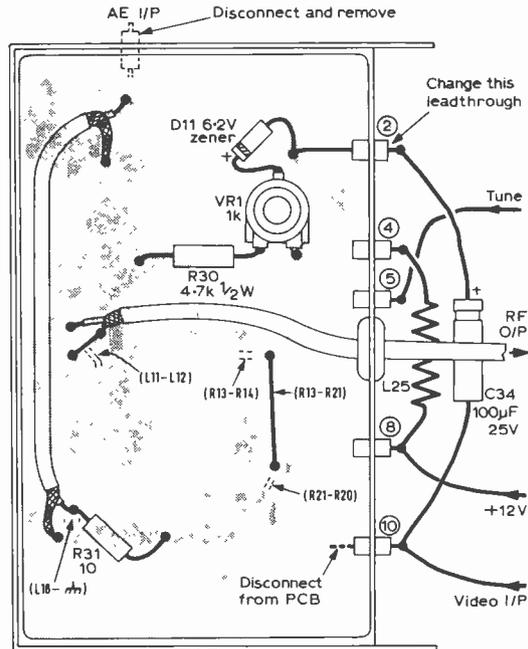
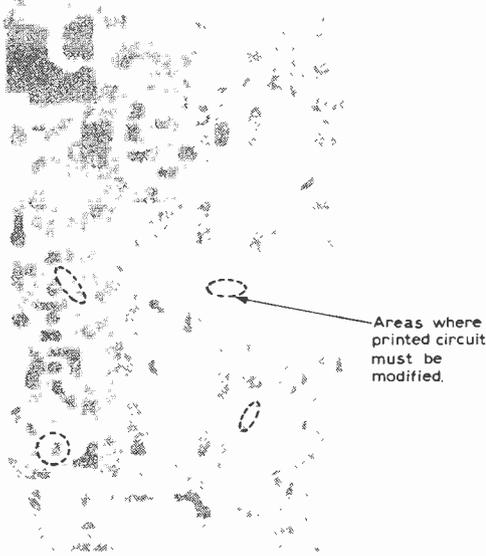
be set in the usual way by adjusting the bias on the tuning diodes from an external source. The RF output is several millivolts, sufficient to drive several sets if required, and may require attenuation if a signal set is used.

Unlike some commercial types, few spurious outputs are generated and such problems as microphony and drift are virtually eliminated.

TUNER MODIFICATIONS

The tuner circuit, after modification, is shown in Fig. 1. The bandwidth of the AGC line is first increased by replacing the ceramic feedthrough capacitor C4 by one of lower capacity, eg a ferrite bead or sleeved wire, and the original R2 (470Ω) by R32 (47Ω), see Fig. 2 for location.

DN 0787



DN 0788

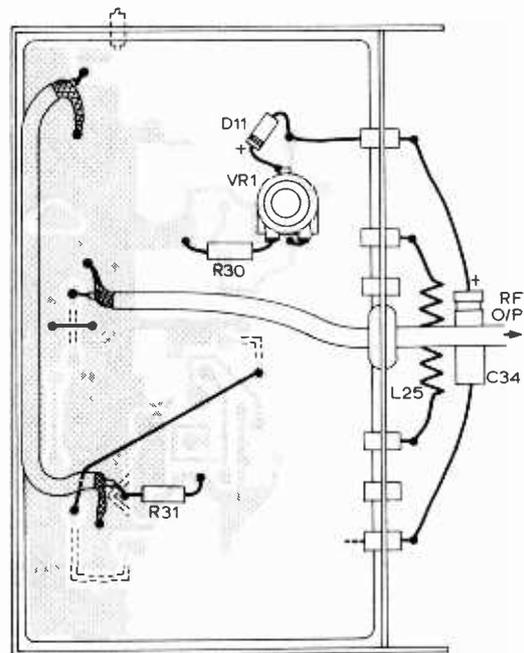
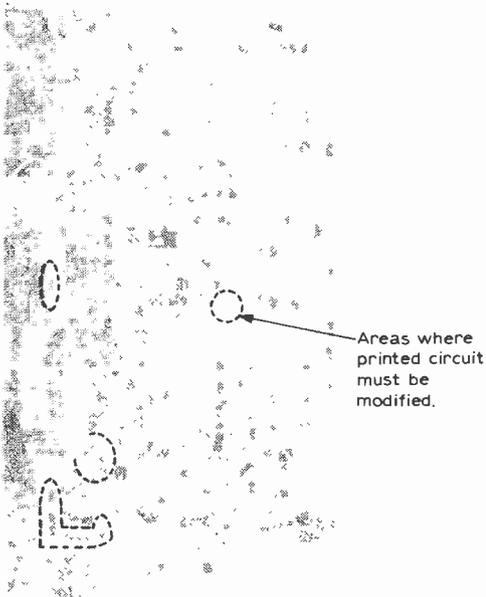


Fig. 3. Layout of the printed boards and modification details for the ELC1043/05 (top) and ELC1043 (bottom). In each case the left-hand drawing shows the print pattern before modification. The right-hand drawing shows track and components to be removed in broken lines, links and components to be added in full lines. Links should be made in 16 or 18 swg tinned copper wire, formed to stand clear of the board. External connections are identical for both versions.

The rest of the modifications are to the print pattern inside the tuner and are illustrated in Fig. 3 for each type. The link between L11 and L12 is severed, and an earth bridge soldered across the gap. The RF output is taken out by a thin screened lead from the "top" end of L11 through the vacant hole adjacent to pin 5.

One end of L18 is isolated from earth and a 10Ω carbon resistor, R31, fitted across the break. From the same point a screened lead is routed to L1, the original aerial input. The existing aerial input tag should be removed.

The lecher line, L14, is not required for our purpose, and the control potential from R13 is diverted to D4 by disconnecting the lower end of R21 from the junction of R20/R24 and linking it to R13 slider, which must be isolated from R14.

Finally, D11, VR1 and R30 are fitted inside the tuner on the print side, being suspended in the wiring, as shown in Fig. 3. The now redundant IF output pin (no. 10) is cut inside the tuner and used to anchor C34, the video coupler, which is mounted externally.

POWER SUPPLIES

The modulator requires a 12V line, positive of chassis, which must be capable of supplying 14mA with a peak-to-peak ripple not exceeding 50mV. A suitable circuit is given in Fig. 4, using a subminiature mains transformer. L25 is a UHF choke mounted on the tuner between pins 4 & 8, and consisting of a few turns of ordinary plastic insulated wire. F1 is important from the safety angle and should not be omitted.

A further supply line is necessary for tuning purposes. If a fixed-frequency UHF output is required, the arrangement of Fig. 5 may be adopted, VR2 taking the form of a slider or rotary potentiometer.

GT9

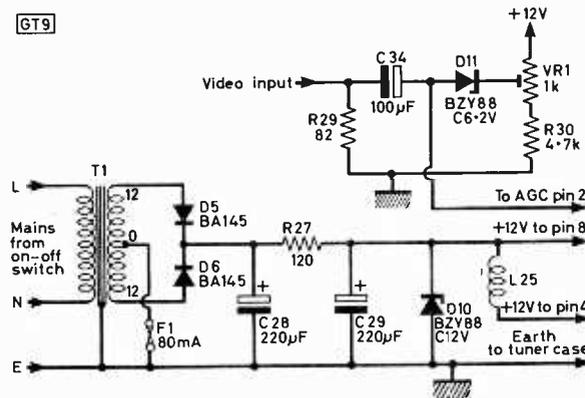


Fig. 4. The Power Supply and Input Bias circuits.

GT10

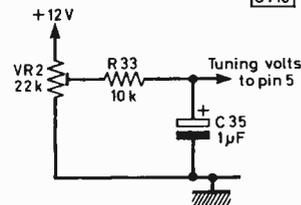


Fig. 5. The tuning circuit for a preset spot frequency output.

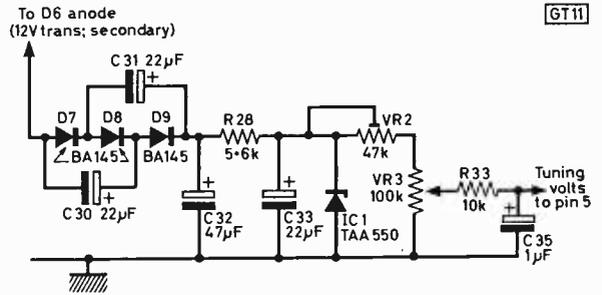


Fig. 6. The circuit for continuous coverage of Band IV and V.

meter mounted on the tuner body. This will give pre-set coverage up to about channel 44. The more elaborate circuit of Fig. 6 utilises a voltage tripler and an IC to give a stabilised 32V line derived from one-half of the transformer secondary. This offers coverage of the UHF band up to channel 68 but at greater expense.

A suitable arrangement of the components required for the power supply and the variable, total coverage, tuning circuit of Fig. 6 is shown as Fig. 7. This drawing also shows the arrangement of the tuner and the extra board in the box.

★ components list

General

Varicap tuner type ELC1043 or ELC1043/05. Aluminium box, 102 × 102 × 38mm (4 × 4 × 1½ins) with lid. 2 surface mounting coaxial sockets. Knob for VR3 (when used).

Power supply and input bias cct.

- R27 120Ω 5%, ½W
- R29 82Ω 5%, ½W
- R30 4.7kΩ 5%, ½W
- VR1 1kΩ, min. skel. horz.
- C28 220µF, 25V
- C29 220µF, 25V
- C34 100µF, 25V
- D5 } BA145 or BA148
- D6 } or BY206
- D10 BZY88C12V
- D11 BZY88C6V2

T1, 12-012V at 50mA or 100mA subminiature mains transformer. F1, 80mA, antisurge fuse (20mm) and holder. L25, home made inductor (see text). Mounting board.

Tuning circuit (Fig. 5)

- R33 20kΩ 5%, ½W
- VR2 22kΩ min. skel. horz.
- C35 1µF, 35V, tant.

Tuning circuit (Fig. 6)

- R28 5.6kΩ 5%, ½W
- VR2 47kΩ, min. skel. horz.
- VR3 100kΩ, carbon, linear
- C30 22µF, 35V
- C31 22µF, 35V
- C32 47µF, 63V
- C33 22µF, 63V
- D7 } BA 145 or
- D8 } BA148 or
- D9 } BY206
- IC1 TAA550 or ZTK33B or SN76550

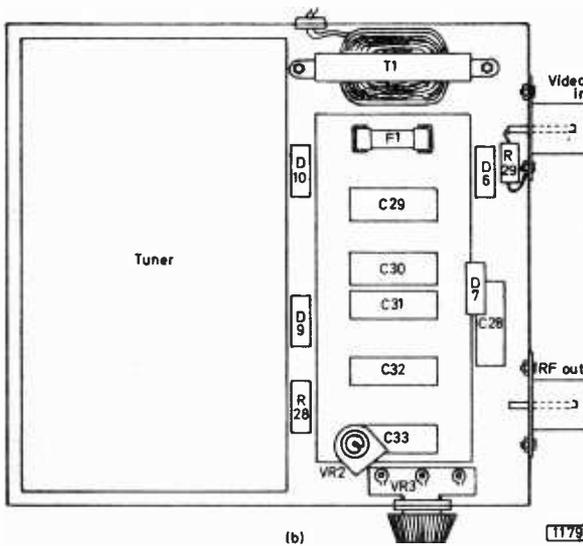
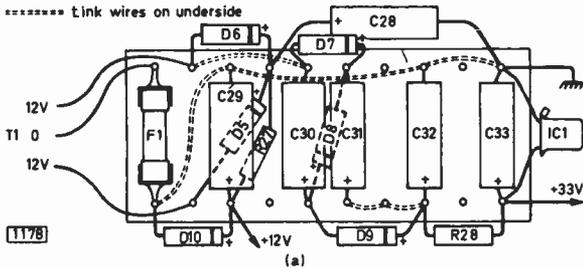
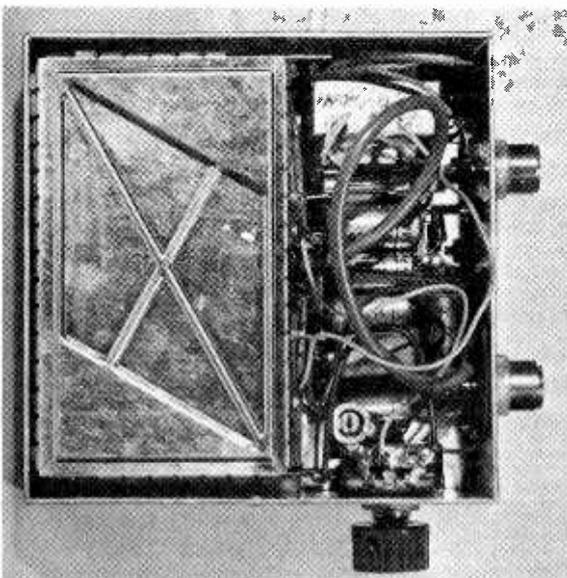


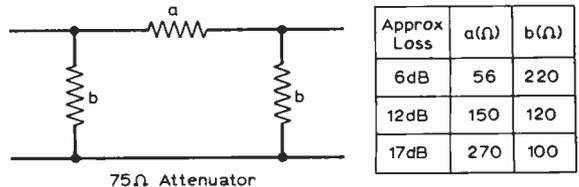
Fig. 7. A diagrammatic representation (above) of the extra board, with wiring for the components of the power supply and continuous coverage tuning circuit shown. A photograph of the inside of the prototype (below) shows that although the extra components are not too cramped there is not much surplus space available.



SETTING-UP

Ensure that the input to the modulator is not in excess of 1.2V p-p. Connect the RF output to a TV receiver tuned to about channel 35. Adjust the output tuning (VR2 or VR3) for best results.

Set VR1 to mid-point and adjust R13 for the strongest RF signal, indicated by minimum "snow" on the TV receiver. It will be necessary to attenuate the signal for this test. If a standard attenuator is not available a temporary circuit can be constructed to Fig. 8 using the values in the table. Try 6dB first.



GT20

Fig. 8. The arrangement and values of the resistors for a 75 Ω attenuator. This unit is not exactly 75 Ω impedance nor does it give exactly 6, 12 and 17dB. So, although it is quite adequate for this purpose, it should be used with caution in other applications.

Alternatively, a UHF field strength meter may be used by adjusting R13 for maximum deflection, again via attenuation if necessary.

VR1 sets the initial bias on Tr1 and should be adjusted as follows: With the modulated signal displayed rotate the control to one end, whereupon line pulling and frame roll will occur. Back off the control until sync returns to normal and mark this position of the wiper. Now fully rotate the control to the opposite end, the white characters will become grey and crushed. Again, back off until full white level is restored and mark the wiper mid-way between the two marks.

If the circuit of Fig 6 is used, VR2 should be adjusted to position the output on channel 68 with the main output tuning control VR3 set at maximum. The other two pre-sets within the tuner, R5 and R11 should not need any adjustment provided the tuner alignment was originally correct.

MOUNTING

The positioning of this unit inside another piece of equipment is not critical. The tuning-voltage lead to pin 5 should be screened if it is more than 150mm long and, in any case, should be routed as far from mains transformers, PCBs and other wiring as practical.

In the unlikely event of microphony, mount the tuner on foam rubber pads and secure it by sticking or by rubber bands rather than by screws.

POSSIBLE APPLICATION

This unit is particularly suited to the Video-Writer project in this magazine and, in fact, the second Video-Writer, used for demonstration purposes, uses the prototype modulator on which this article is based.

The design of this tuner was first published in April 1975 by our sister magazine "Television". PW

Unique full-function 8-digit wrist calculator... available only as a kit.

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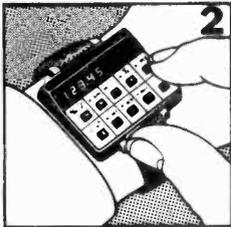
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1. The switch in its normal, central position. With the switch centred, numbers – which make up the vast majority of key-strokes – are tapped in the normal way



2. Hold the switch to the left to use the functions to the left above the keys...

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PW/4

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P.W. MARCH '77

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PIV	8A	1A	3A	4A	6A	8A	10A	15A
(TO92)	(TO5)	(C106)	(TO220)	(TO220)	(TO220)	(TO220)	(TO220)	(TO64)
50	0.20*	0.25	0.35	0.32	0.41	0.42	0.47	0.96
100	0.25*	0.25	0.40	0.37	0.47	0.48	0.54	1.02
200	0.27*	0.35	0.45	0.40	0.58	0.60	0.68	1.14
400	0.30*	0.40	0.50	0.45	0.87	0.88	0.98	1.40
600	—	0.65	0.70	—	1.09	1.19	1.26	1.80

TRIACS (PLASTIC TO-220 PKG ISOLATED TAB)

	4A	6-5A	8-5A	10A	15A
(a)	(b)	(a)	(b)	(a)	(b)
100V	0.60	0.60	0.70	0.70	0.78
200V	0.64	0.64	0.75	0.75	0.87
400V	0.77	0.78	0.80	0.83	0.97
600V	0.96	0.99	0.87	1.01	1.21

N.B. Triacs without internal trigger diac are priced under column (a). Triacs with internal trigger diac are priced under column (b). When ordering please indicate clearly the type required.

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Displays	Discretes	
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707	0.95	0.20
727	1.95	0.14
728	1.95	0.90
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7400	0.16
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7402	0.18
7403	0.18
7404	0.18
7405	0.18
7406	0.18
7407	0.18
7408	0.18
7409	0.18
7410	0.18
7412	0.25
7413	0.25
7414	0.72
7418	0.43
7417	0.43
7420	0.18
7422	0.38
7423	0.40
7425	0.30
7427	0.48
7428	0.53
7430	0.18
7432	0.37
7433	0.49
7437	0.35
7438	0.35
7440	0.18
7441	0.78
7442	0.85
7445	0.50
7446	2.56
7447	0.81
7448	0.81
7450	0.85
7451	0.18
7453	0.18
7454	0.18
7460	0.18
7470	0.32
7472	0.26
7473	0.30
7474	0.32
7475	0.47
7478	0.36
7480	0.55
7481	1.26
7482	0.75
7483	1.12
7484	0.85
7485	1.25
7486	0.32
7489	2.92
7490	0.45
7491	0.68
7492	0.57
7493	0.45
7494	0.85
7495	0.67

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LINEAR	ICS		
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7414	0.72	585	14 Pin DII 2.00*
7418	0.43	566	8 Pin DII 1.50*
7417	0.43	567	8 Pin DII 2.00*
7420	0.18	709	8/14 Pin DII 0.35
7422	0.38	741	8/14 Pin DII 0.28
7423	0.40	748	8 Pin DII 0.35
7425	0.30	3900	14 Pin DII 0.70*
7427	0.48	CA3045	0.85*
7428	0.53	CA3046	0.50*
7430	0.18	CA3130	1.69
7432	0.37	MC1307P	1.56
7433	0.49	MC1458P	0.77
7437	0.35	MC1496L	1.10*
7438	0.35	SN75324	2.55
7440	0.18	SN75451	0.89*
7441	0.78	SN75452	0.89*
7442	0.85	TA A300	1.61
7445	0.50	TA A310A	1.38
7446	2.56	TA A350	0.45*
7447	0.81	TA A611B12	1.25*
7448	0.81	TBA530	1.85*
7450	0.85		
7451	0.18		
7453	0.18		
7454	0.18		
7460	0.18		
7470	0.32		
7472	0.26		
7473	0.30		
7474	0.32		
7475	0.47		
7478	0.36		
7480	0.55		
7481	1.26		
7482	0.75		
7483	1.12		
7484	0.85		
7485	1.25		
7486	0.32		
7489	2.92		
7490	0.45		
7491	0.68		
7492	0.57		
7493	0.45		
7494	0.85		
7495	0.67		

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7475	0.47	E24SER	0.015
7478	0.36	E24SER	0.02
7480	0.55		
7481	1.26		
7482	0.75		
7483	1.12		
7484	0.85		
7485	1.25		
7486	0.32		
7489	2.92		
7490	0.45		
7491	0.68		
7492	0.57		
7493	0.45		
7494	0.85		
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AC141	0.18	BD233	0.48*	OC44	0.12
AC141K	0.28	BD237	0.55*	OC45	0.10
AC142	0.18	BD238	0.60*	OC70	0.10
AC142K	0.28	BD184	1.20	OC71	0.10
AC176	0.18	BDY57	0.80	OC72	0.22
AC176K	0.28	BDY38	0.80	OC84	0.14
AC187	0.18	BDY60	0.80	SC40A	0.73
AC187K	0.25	BDY61	0.85	SC40B	0.81
AC188	0.18	BDY62	0.55	SC40D	0.98
AC188K	0.25	BF78	0.28	SC40F	0.65
AD140	0.50	BF79	0.30	SC41A	0.65
AD142	0.50	BF194	1.0*	SC41B	0.70
AD143	0.48	BF195	0.10*	SC41D	0.85
AD149	0.45	BF196	0.12*	SC41F	0.60
AD161	0.35	BF197	0.12*	ST2	0.20
AD182	0.35	BF224J	0.18*	TIP29A	0.44
AL102	0.95	BF244	0.17	TIP30A	0.82
AL103	0.93	BF251	0.30	TIP31A	0.54
AF114	0.20	BF258	0.35	TIP32A	0.64
AF115	0.20	BF337	0.32	TIP34	1.05
AF116	0.20	BFW60	0.17*	TIP41A	0.68
AF117	0.20	BFX29	0.26*	TIP42A	0.72
AF118	0.50	BFX30	0.30	IN2069	0.14
AF139	0.33	BFX84	0.23	IN2070	0.18
AF239	0.37	BFY00	0.65	IN4001	0.04*
BC107	0.09	BFY88	0.20	IN4002	0.05*
BC107B	0.09	BFY50	0.20	IN4003	0.06*
BC108	0.09	BFY61	0.18	IN4004	0.07*
BC109	0.09	BFY32	0.19	IN4005	0.08*
BC109C	0.12	BFY64	0.35	IN4006	0.09*
BC117	0.18*	BFY90	0.65	IN4007	0.10*
BC125	0.18*	BR100	0.20	2N696	0.14
BC126	0.20*	BFY39	0.40	2N897	0.12
BC141	0.28*	BSX19	0.18	2N708	0.10
BC142	0.23	BSX20	0.18	2N929	0.14
BC143	0.23	BSX21	0.20	2N930	0.14
BC144	0.30	BSY95A	1.02	2N1131	0.15
BC147	0.09*	BT106	1.00	2N1132	0.16
BC148	0.09*	BT107	1.60	2N1304	0.45
BC149	0.09*	BT108	1.60	2N1305	0.45
BC182	0.25*	BT109	1.00	2N1711	0.18
BC153	0.18*	BT116	1.00	2N1202	0.44
BC157	0.09*	BU105	1.80*	2N2369	0.14
BC158	0.09*	BU108/021	0.90*	2N2369A	0.14
BC159	0.09*	BU126	1.60*	2N2484	0.16
BC160	0.32	BU204	0.60*	2N2646	0.30
BC161	0.38	BU208	2.60*	2N2905	0.18
BC168B	0.09*	BY206	1.15	2N2905A	0.22
BC182	0.11*	BY207	0.20*	2N2926R	0.10*
BC182L	0.11*	BYX36	—	2N29280	0.09*
BC183	0.10*	300	0.12*	2N2928Y	0.09*
BC183L	0.10*	600	0.15*	2N2928G	0.10*
BC184	0.11*	900	0.18*	2N3053	0.15
BC184L	0.11*	1200	0.21*	2N3054	0.40
BC207B	0.12*	BYX38	—	2N3055	0.50
BC212	0.11*	300	0.50	2N3440	0.56
BC212L	0.11*	600	0.55	2N3442	1.20
BC213	0.12*	900	0.60	2N3525	0.50
BC213L	0.12*	1200	0.65	2N3570	0.80
BC214	0.14*	BZX61 Series	—	2N3702	0.10*
BC214L	0.14*	Zeners	0.20	2N3703	0.10*
BC237	0.16*	BZX83 or	—	2N3704	0.10*
BC238	0.16*	BZX88	—	2N3705	0.10*
BC300	0.34	Series	—	2N3706	0.10*
BC301	0.32	Zeners	0.11	2N3707	0.10*
BC323	0.60	CO16A	0.40	2N3714	1.05
BC327	0.18*	CO16B	0.45	2N3715	1.15
BC328	0.18*	CO16D	0.50	2N3716	1.25
BC337	0.17*	CO16F	0.35	2N3771	1.60
BC338	0.17*	CRS1/05	0.25	2N3772	1.80
BCY30	0.55	CRS1/10	0.25	2N3773	2.10
BCY31	0.55	CRS1/20	0.35	2N3819	0.28*
BCY32	0.60	CRS1/40	0.40	2N3904	0.18*
BCY33	0.55	CRS1/60	0.65	2N3906	0.11*
BCY34	0.55	CRS3-05	0.34	2N4124	0.14
BCY38	0.61	CRS3-10	0.45	2N4290	0.12
BCY39	1.15	CRS3-20	0.50	2N4348	1.20
BCY70	0.12	CRS3-40	0.60	2N4870	0.35*
BCY71	0.18	CRS3-80	0.85	2N4871	0.35*
BCY72	0.12	MJ480	0.80	2N4919	0.40*
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BD132	0.40	MJ491	1.15	2N4923	0.64*
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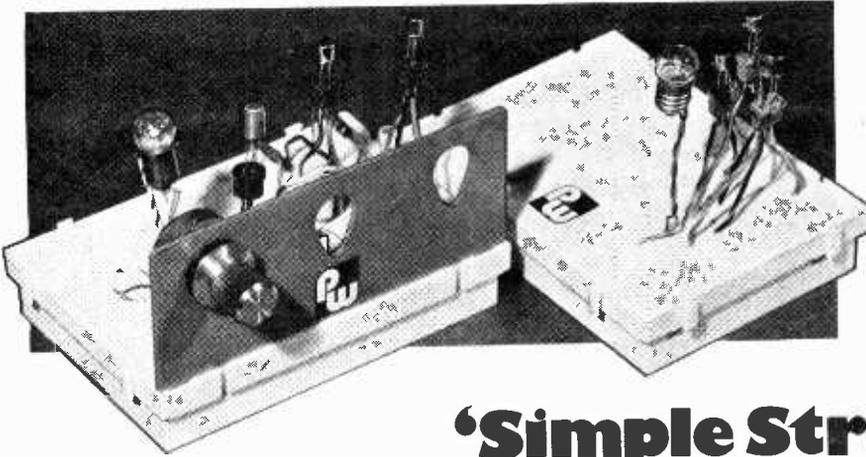


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S-DeCnology

DAVID GIBSON



THIS MONTH

'Simple Stroboscope'

THE majority of "lamp flashing" circuits seen in the popular constructional journals seem to employ a two-transistor multivibrator circuit with a bulb as one of the collector loads. In this month's S-Dec circuit I've tried to reproduce similar results, but with different circuitry.

The final arrangement is shown in Fig. 1. Readers who have built the previous projects in this series will see most of the components used again in this circuit.

Circuit details

Note that Tr1 is a BC109, a NPN type transistor, whereas Tr2 is a AC126, a PNP type. These two semiconductor components are connected in a complementary arrangement and are DC coupled, i.e. the connection

from the collector of Tr1 to the base of Tr2 is direct and not through any capacitor which, of course, would block the DC. Transistor Tr2 derives its base bias from a resistive divider chain formed by R4 and Tr1. The load for Tr2 is the lamp LP1 connected in its collector lead. The circuitry around Tr1 seems quite conventional, too. A base bias from the resistor chain (R3, VR1, R1, R2) and R4 as a collector load.

Then there's the capacitor C1. This is a feedback component which applies the output signal back to the input or base of Tr1 and this is why the whole circuit oscillates.

The oscillator is of the "RC" type, meaning that its frequency of operation (or the rate at which the bulb flashes on and off) is determined and controlled by resistance and capacitance values. Since there is only one capacitor in the circuit then this takes care of the "C". The resistance variation is afforded by the potentiometer VR1 allowing the flashing rate to be varied over a set range. The other resistance in series with VR1 also have an effect on the flashing rate.

Construction

To build the circuit, simply plug the components (via their own leads) into the S-DeC holes indicated on the diagram of Fig. 1. The lamp, for example, is

you will need

R1	5-6k Ω	Tr1	BC109 or 2N1613
R2	5-6k Ω	Tr2	AC126
R3	39k Ω	B1	12V battery
R4	1k Ω	L1	6V 100mA bulb
VR1	50k Ω pot		solid core wire for wiring
C1	4-7 μ F 12V		One S-DeC

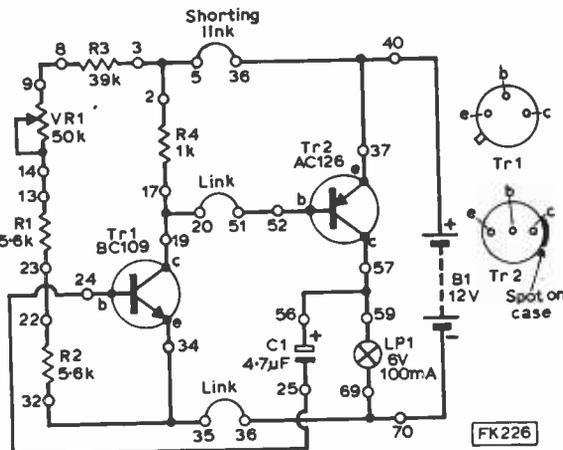


Fig. 1: Circuit diagram of the Simple Stroboscope. Varying the rate of flash can be achieved by experimenting with the values of C1 and R3. The lower link should be connected between 35 and 66.

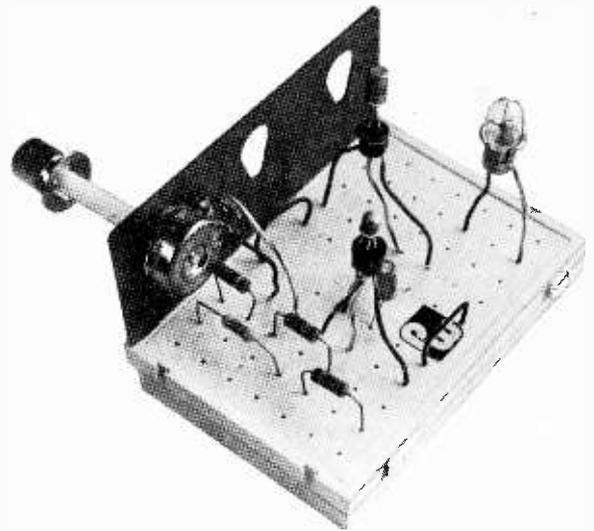
plugged into holes 59 and 69 while R2 is plugged into S-DeC holes 22 and 32. The three lines marked "links" in Fig. 1 are simply short lengths of wire which have their ends plugged into the S-DeC holes as marked. Figure 2 shows a full size drawing of an actual S-DeC and the holes and component locations can be clearly seen. Be careful when you plug in Tr2, remember that it is a PNP device unlike the BC109, and has a small spot or mark on its case signifying that the lead nearest to it is the collector.

Component trials

One of the great advantages of using an S-DeC is the ease and simplicity in experimenting with different devices and alternative values for components. Constructors might like to conduct their own experiments to see if they agree with my own findings.

For example: why is R3 39k Ω ? Why not 47k Ω or 10k Ω ? When the circuit was first "plugged in" on the S-DeC, R3 was omitted. After all, if one can vary VR4 one could obtain a variable resistance.

The first attempt to get the circuit to oscillate used a 10k Ω potentiometer for VR1. The result was that the BC109 got very hot very quickly! Look at Fig. 1 and you'll see why. If VR1 is at zero resistance, then the base of Tr1 is connected via R1 to the positive 12V rail (I didn't have R3 in circuit) so the transistor was biased very hard "on". But even with 10k Ω in circuit (i.e. maximum setting of VR1) the BC109 was still hot and the flashing rate was not very good although the circuit did work. Substituting a 50k Ω pot gave some improvement but again, if the pot was set to minimum resistance, the base of Tr1 would be connected via R1 to the 12V positive rail. Clearly a "safety" resistor was needed in series with the pot to ensure that there was always some sensible resistance value between Tr1 base and the 12V rail.



Rearview photograph of the S-DeC showing the simple nature of the circuit. It's advisable to use holders for the transistors, as their leads tend to be on the short side.

Various values were tried for R3 but the optimum value was found to be 39k Ω .

Changing the value of the capacitor in this circuit did not prove a good move. Using a 10 μ F component reduced the flashing rate, and swinging VR1 from maximum to minimum gave far less variation in the rate than with a 4.7 μ F capacitor for C1.

All values given in Fig. 1 were found to be optimum although there is no reason why readers should not experiment for themselves with other values. The 2N1613 used in earlier S-DeC projects in this series can be substituted for the BC109 with very little effect on the overall performance. (Lead connections the same.)

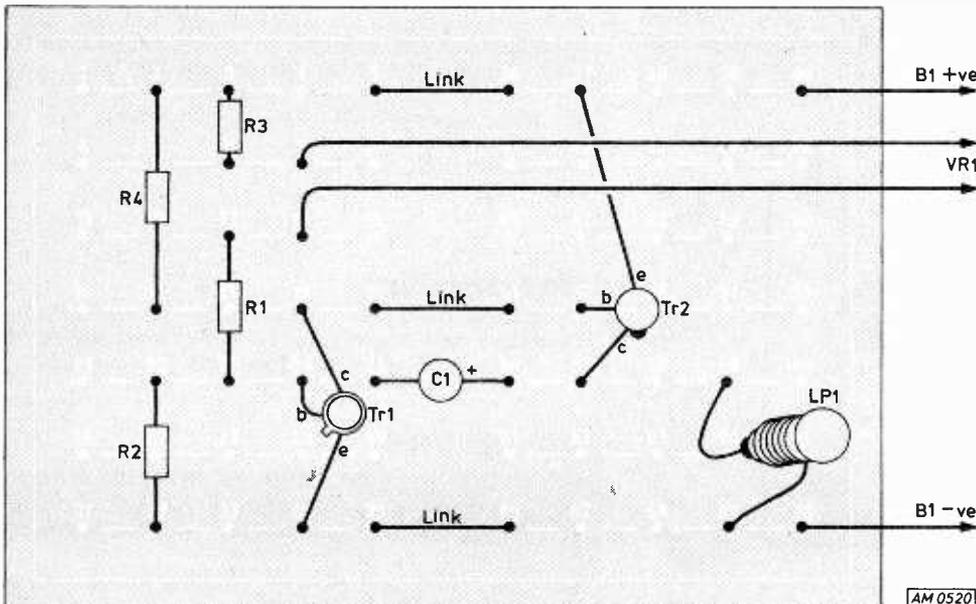


Fig. 2: Full size drawing of the S-DeC giving the exact location of the components necessary for this project.

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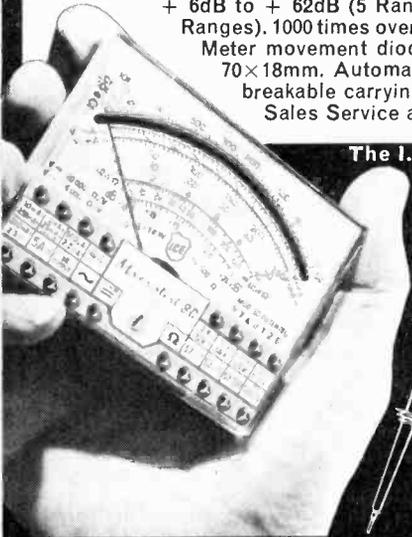
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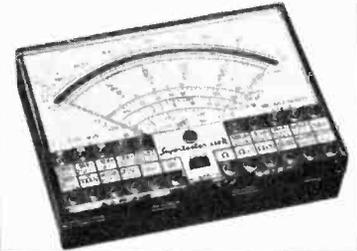
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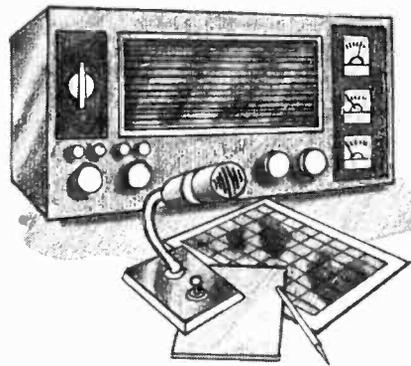
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Frozen motion

If this circuit is to be used as a miniature stroboscope, then the bulb LP1 should be put into some kind of reflector. This will increase the intensity. A cycle lamp reflector is useful but a simple "cup" made from aluminium baking foil is also effective. By shining the light onto something in motion, the motion can be apparently stopped or frozen provided the speed of the movement is within the range of the strobing light or a certain mathematical relationship to it.

If you set the flasher up and point it at a tap in a darkened kitchen, then by adjustment of the tap and the flashing rate, the apparently solid stream of water can be broken up into many tiny individual droplets all suspended in space.

A further use for this month's circuit would be to take it with you to a party. Here it could be used as a pocket disco light. Lay in flat with the bulb and reflector pointing at the ceiling (coz ceilings are usually white and they reflect well). The result is a kind of freezing of motion as people "dance".

A warning

A word of warning about this stroboscope circuit. Under no circumstances use it near anyone who is subject to epilepsy or fits. It will probably trigger them off and it could be very dangerous.

Be careful about looking into the strobe, especially in a darkened room. At some frequencies strange "hallucinations" can be caused in some people. It may be that the flashing rate is, at a particular setting of VR1, synchronised to the brain rhythms of the viewer.

Most of the projects in this series have been aimed at amusement plus, hopefully, some more serious suggested uses. In next month's Practical Wireless the S-DeC circuit will be one which will be of use to everyone and anyone who builds or constructs. An absolute must for any workbench which will save time and money. It's simple, easy to use, very easy to construct and it's called, simply well, bless me, I've run out of space—but I will tell you all about that circuit—in the next issue.

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KINDLY NOTE!

DIGITAL IC TESTER

February 1977

- (1) P831, col 2, line 7—for 'sockets N, K, J, J' read 'sockets A, B, C, D'
- (2) P832, col 1, line 3—delete the figure '5'.

AUDIBLE CONTINUITY TESTER

February 1977

Note that R4 in the components list should be 180k Ω as in the circuit diagram and not 100k Ω .

CHROMACHASE 4.

December 1976/January 1977

1. A fault in the diode matrix prevents operation in the 'forward' modes.

To correct it, remove the cathode (ring end) of D8 and stand the diode vertically. Insert the anode of an extra diode into the hole left by D8. Stand this diode vertically also. Remove the wire from S1a to edge pin 15. Solder a new wire from S1a to both cathodes of the vertical diodes. The diode should be the same type as D8.

To correct the circuit diagram (page 676) replace the direct link between edge pin 15 and the Reverse Stop line by a diode symbol in the same direction as D8.

2. The rotary switch for 'Program' works in reverse to the front panel. To correct, reverse the wiring connections to the switch.

3. A drawing error has been made in the circuit on pages 677. The symbol for Tr10 is shown as NPN when it should be PNP. Provided a PNP transistor is used the drawing error has no effect. To correct, draw the arrow-head inwards on the emitter instead of outwards.

4. A possible fault can occur in that lamps lock on and the display isn't as set. This would be due to sharp pulses from the triggering transformers, T2 to T5, being picked-up on the leads and wiring of IC4. To correct it, add decoupling capacitors (0.1 μ F) between ground and the following points,

- IC4 pin 9
- IC4 pin 10
- IC4 pin 11
- IC4 pin 16

(The circuit board already has holes for these components. The prototypes functioned without them so they were not included on the components list.)

E. If yet more decoupling is required, add 0.1 μ F's from ground to IC4 pins 4, 5 and 6.

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Apr 76	Auto. Slide Synchroniser	AM0441	2.33+15	<input type="checkbox"/>
June 76	Dig. Freq. Meter (set of 5)	A015 and 4x A004	3.17+15	<input type="checkbox"/>
July 76	Transistor Tester	A002	3.08+18	<input type="checkbox"/>
July 76	Disco Preamplifier	A003	0.65+12	<input type="checkbox"/>
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Sep 76	Capacitance Meter	A009	2.59+14	<input type="checkbox"/>
Sep 76	Octavia AF Source	A010	1.30+12	<input type="checkbox"/>
Oct 76	Jingle Machine, Mains Unit	A006	2.08+12	<input type="checkbox"/>
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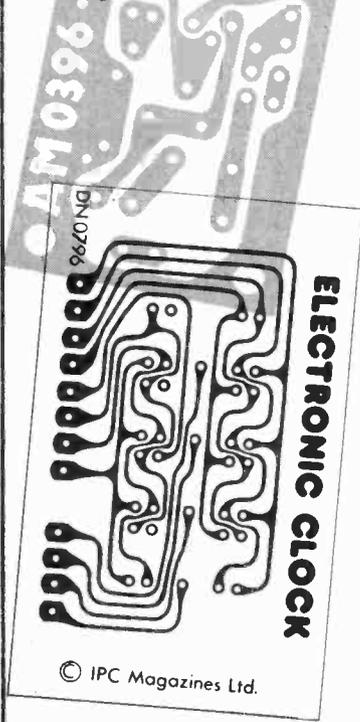
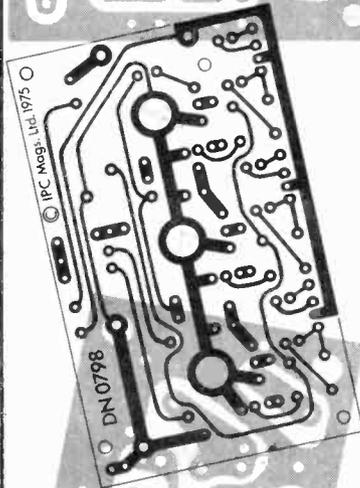
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POWER SUPPLY

THIS power unit has been designed for general purpose, bench use. It is based on the Integrated Circuit regulator type 723. Whilst this regulator is suitable for a wide variety of stabilised circuits this is probably the most common.

The principles of the regulator are the same as those for discrete component devices, i.e. a portion of the output voltage is compared with a known, stable, reference and the difference used to control the output. If the output rises for any reason the positive variation decreases the base current in a

series control transistor which, in turn, decreases the emitter (output) current and the output voltage falls until it becomes that originally set. Similarly,

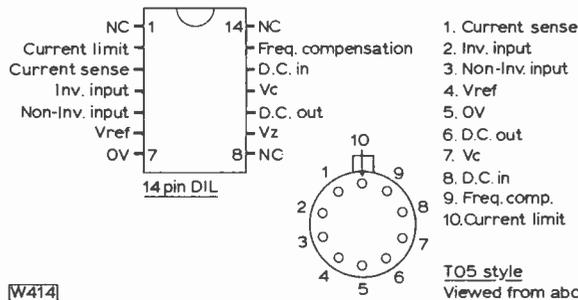
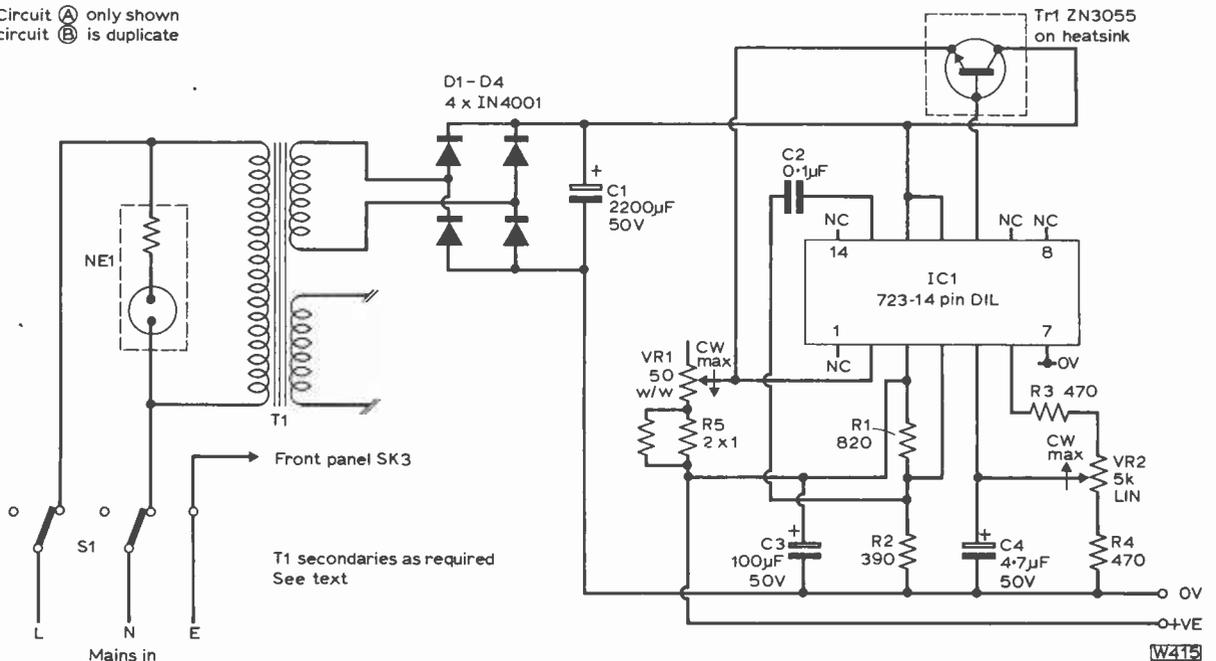


Fig. 1. The pin connections for the two case variations of the 723 integrated circuit. Note that both devices have the same connection sequence but pin 10 on the TO5 corresponds to pin 2 on the DIL

Circuit (A) only shown
circuit (B) is duplicate

W414



W415

Fig. 2. The circuit diagram of one supply. The second supply is identical and the components have been numbered in the series R101, C101, where R1 and R101 perform the same functions in their respective circuits. Note that T1 should be 2N3055.

ATED

PPPLY



T. J. JOHNSON

the circuit increases the emitter current if the output voltage falls below that set. This correction occurs very fast and, to all intents and purposes, the output stays constant.

★ components list

Resistors

R1 and R101	820Ω 5% ½W
R2 and R102	390Ω 5% ½W
R3 and R103	470Ω 5% ½W
R4 and R104	470Ω 5% ½W
R5 and R105	0.5Ω 5% 1W (2 x 1Ω in parallel for each)
R6	To suit meter used (approx 10% of the meter resistance)
VR1 and VR101	50Ω Wire Wound
VR2 and VR102	5kΩ lin.

Capacitors

C1 and C101	2200μF, 50V
C2 and C102	0.1μF Polyester
C3 and C103	100μF 50V
C4 and C104	4.7μF 50V

Semiconductors

IC1 and IC101	723 regulator, 14 pin DIL
Tr1 and Tr101	2N3055, TO3 package
D1 to D4 and D101 to D104	1N4001

Miscellaneous

T1, mains transformer, two separate secondaries as required (16V used in prototype). NE1, mains neon. S1, switch DPDT. S2, switch DPDT. S3, switch DPST. S4, switch DPST. S5, switch 4 pole 2 way rotary. S6, switch DPST. SK1 to SK5, terminals 4mm (two red, two black and one green). M1, meter 0 to 20V dc (type MR38p). M2 meter 0 to 100mA dc (type MR38p). Four round knobs. One pointer knob. Heatsink for two transistors, 4½" x 4" x 1" (Marston type C or similar). Stripboard, 0.1" track, 5" x 3½". Material for front plate and case. Covering for case. Two IC sockets, 14 pin DIL.

The pin configuration for both 14 pin DILs and 10 pin TO5 packages are given in Fig. 1. It should be noted that by aligning the pins on the TO5 package to have 6 in one line and 4 in the other the pins can be made to correspond to those of the DIL and can therefore be inserted into the same holes on the board.

The maximum current for the 723 is 150mA and, since 1A is required from the unit, external power transistors are used. The inbuilt protection of the 723 against short circuits, excessive power dissipation and overheating are still available when extra transistors are used.

CIRCUIT OPERATION

The schematic circuit for one supply is given as Fig. 2. The second supply is identical in design and operation.

The mains supply is stepped down by T1 and the low voltage output is bridge rectified by diodes D1 to D4. Capacitor C1 provides a limited amount of smoothing to enable the 723 to accept the voltage as its input.

Since the input is always higher than 12V there is a reference voltage of a nominal 7.15V at pin 6 and this voltage is used for the stabilisation. However, since the unit is designed to operate down to approximately 2V, the reference voltage has to be divided. R3, VR2 and R4 permit a range of voltages from 0.6V to 5.6V to be selected and applied to the non-inverting input, pin 5.

The output voltage is applied to a second, fixed, potential divider consisting of R1 and R2. The voltage developed across R2 is applied to the inverting input, pin 4.

Now, as the potential at pin 6 is varied, by adjusting VR2, the output voltage will vary in step with it.

The unit is required to produce up to 1A output current and as this is in excess of the IC capability a series regulator transistor, Tr1, is used. The DC

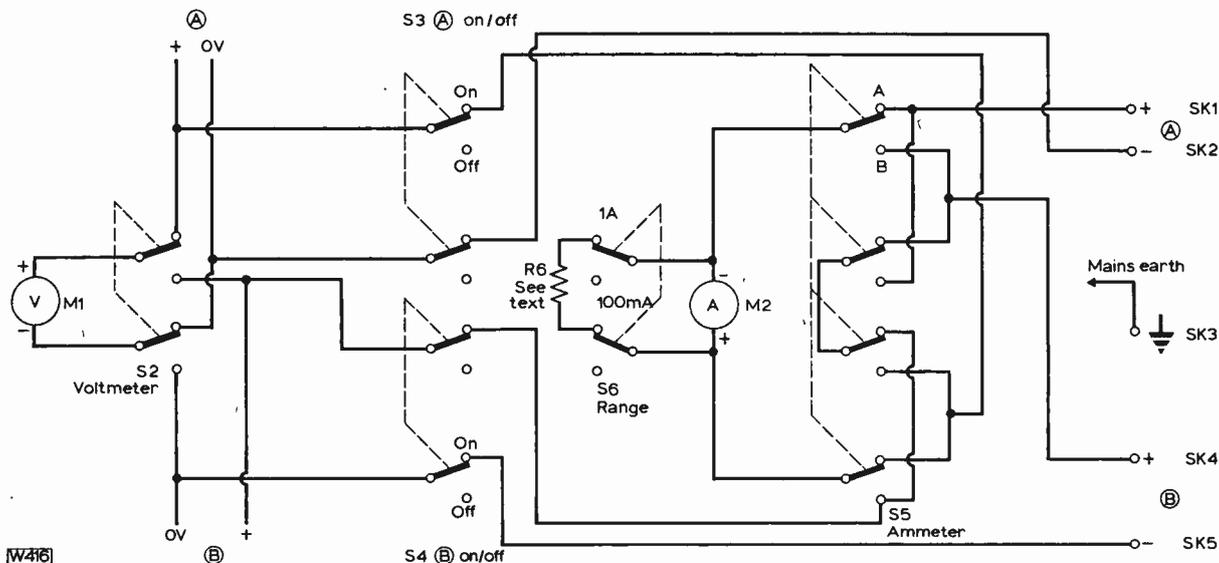


Fig. 3. The switching requirements to monitor both supplies by using only one voltmeter and one ammeter. The use of separate meters for each supply would reduce the switching significantly.

output at pin 10 is used to provide the base current for the transistor, the smoothed output of the bridge provides the collector voltage and current and the output is the emitter load.

The emitter current flows through VR1 and R5 but, since the sampling potentiometer is across the output load only, potentials dropped across VR2 and R5 do not affect regulation.

The 723 has a built in shut down transistor which comes into operation when the potential between pins 2 and 3 reaches 0.65V. This voltage is developed across VR1 and R5 so the maximum current that can flow before the cut-out becomes operative is determined by the setting of VR1 (for large currents R5 is effective). The need for R5 is explained later.

Because of the limited smoothing of the supply voltage there is a certain amount of hum present on the output, unless C3 is fitted, despite the effect of the 723.

Two meters have been used on the prototype, one voltmeter and one milliammeter. To enable the full range of output current to be used the milliammeter can be shunted, by S6, to read 1A. The value of R6 will depend on the resistance of the meter used and may need to be custom made from resistance wire in order to obtain a reasonably accurate scale. Both meters are switchable to read either output A or output B. S2 performs the switching for the voltmeter and S5 for the ammeter.

In addition to the mains ON/OFF switch, S1, both supplies have individual switches, S3 and S4. The switching details are given as Fig. 3. Small dial meters have been used and this results in less than perfect readability, particularly on the ammeter, and if accurate settings of voltage or current are required a larger meter will be needed.

CONSTRUCTION

The integrated circuits and the small components associated with them are mounted on a piece of stripboard. The size, cutting required, component location and orientation is given as Fig. 4. The two power transistors are mounted on the heatsink,

using insulated bushes and mica washers. The heatsink is fixed to the outside of the case to assist cooling.

The transformer and the board are bolted to the base of the case, which is chipboard to give the necessary rigidity to the unit. The switches, meters and the variable controls are mounted on an aluminium front plate. The sides and top are plywood, pre-assembled to form an inverted 'U'. The back is a combination of chipboard and plywood. To improve the appearance of the prototype the top, sides and back were covered with wood-patterned paper.

The major dimensions for the front panel are given as Fig. 5 and those for the remainder of the case as Fig. 6.

SETTING-UP

Each supply should be switched on in turn and, with no load connected, the voltage control should be checked for the relevant supply. The output should indicate from approximately 2V to 20V.

Set the voltage control of one section to minimum and switch the ammeter to 1A. Connect a high wattage resistor of about 20 ohms to the supply selected. Set the current control to minimum and the voltage control to about 10V. No current should flow. Increase the current control and note that the current increases. The increase should continue until it reaches the expected value (with 10V and 20Ω this would be 0.5A). When further increase in the control produces no corresponding increase in current the overload condition should have been reached. Apply a short circuit to the output. The current should not increase by an appreciable amount but the voltage should fall to nearly zero.

Remove the short circuit and repeat the test for the second supply.

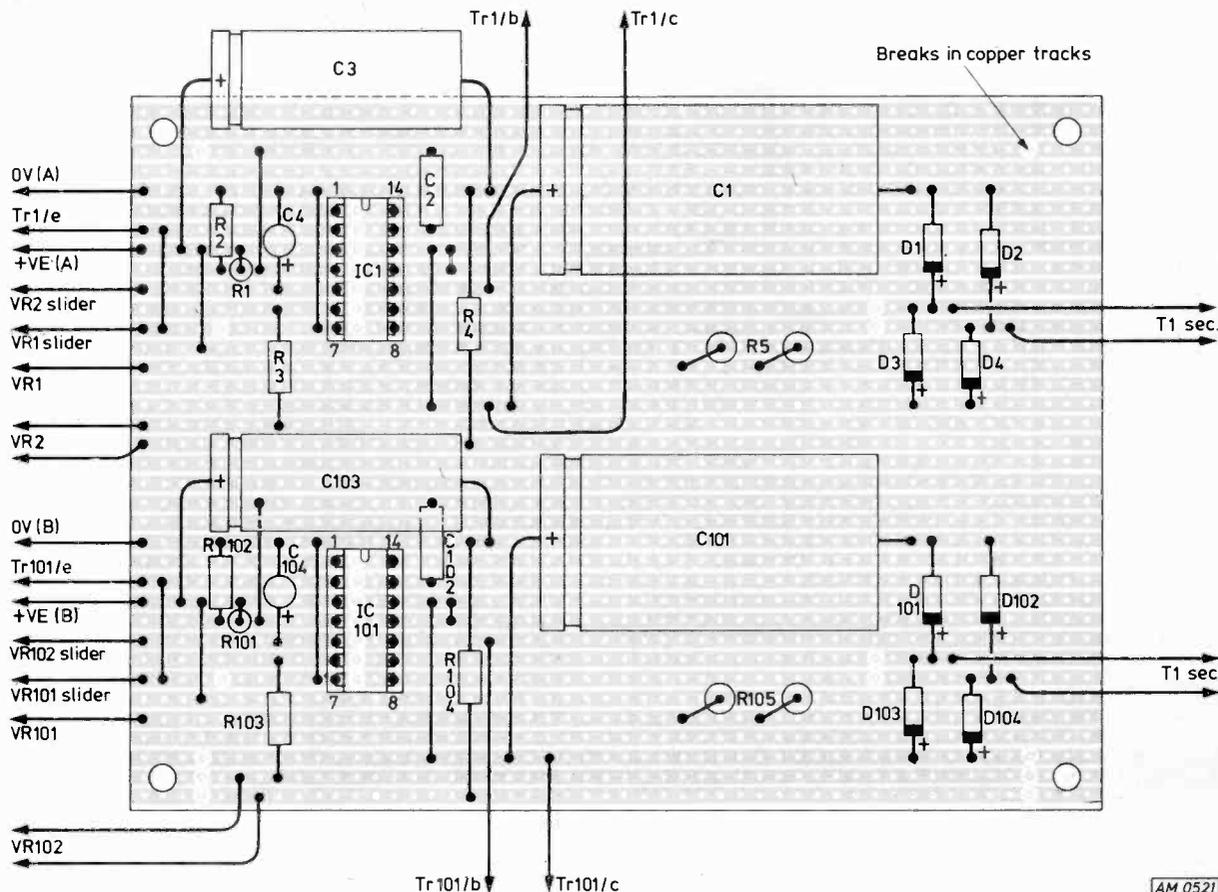
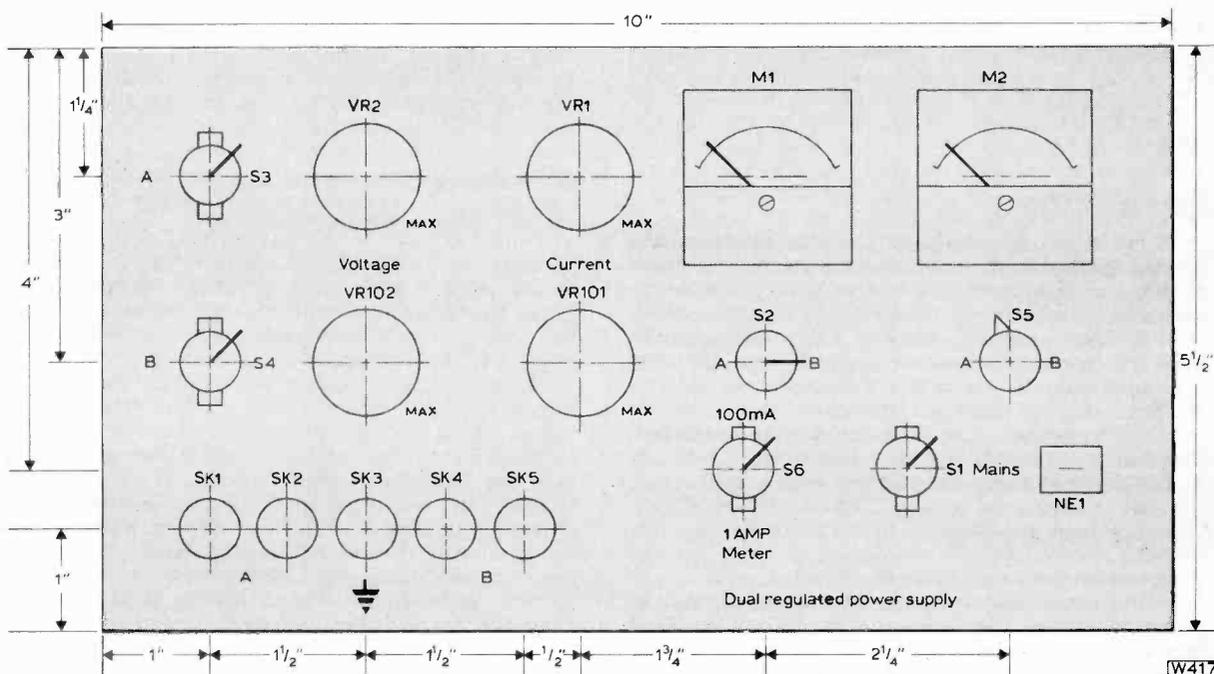


Fig. 4. The cutting and component locations on the stripboard. The minimum number of breaks has been made. If nylon screws and nuts are used the breaks to isolate the fixing holes can be omitted.

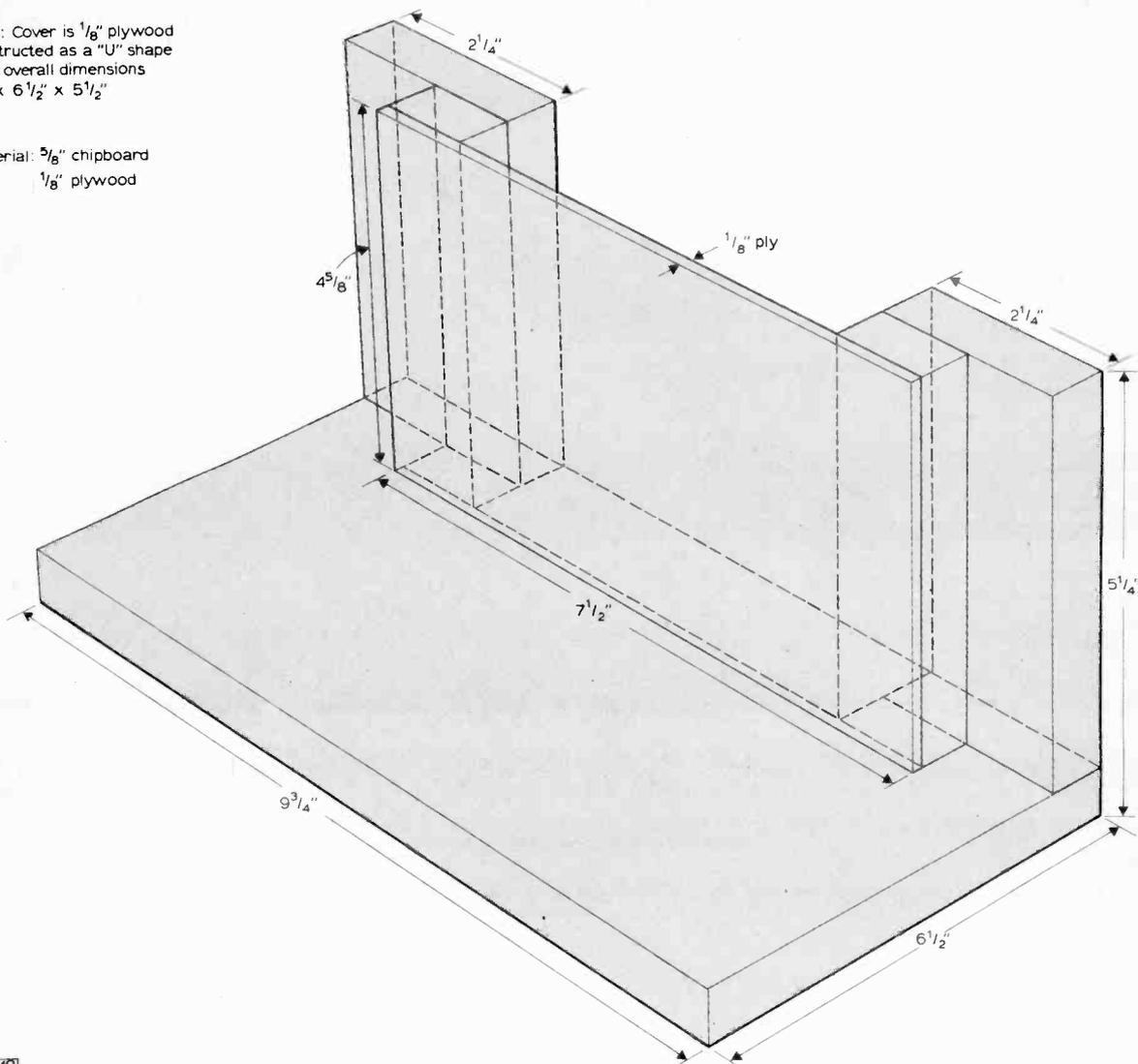
Fig. 5. The layout of components on the front panel of the prototype. This layout is not critical and may be re-arranged to suit other cases or components.



W417

Note: Cover is $\frac{1}{8}$ " plywood constructed as a "U" shape with overall dimensions $10" \times 6\frac{1}{2}" \times 5\frac{1}{2}"$

Material: $\frac{5}{8}"$ chipboard
 $\frac{1}{8}"$ plywood



W418

OPERATION

For standard applications, (i.e. as a single supply or two independent supplies) no external interconnections are required. For use as split supplies the negative of one supply is connected to the positive of the other with the common point, connected to the earth terminal if required, used as the 0V line.

For currents in excess of 1A the two supplies can be connected in parallel. However, some care is required to ensure that both supplies are matched. This can be achieved by setting the voltages, off load, to be identical for both sections before connecting the two sections in parallel. When connected but with the load not applied the voltage on the two sections should still be the same. If they are not then one or the other must be adjusted.

Before connecting the load ensure that both current controls are at minimum. Connect the load and increase both current controls as near simultaneously as possible whilst monitoring the individual

Fig. 6. The dimensions of the base and back of a case to match the front panel of Fig. 5. If alternative cases are used ensure that the heat sink has adequate cooling.

currents. A level will be reached where increases in one supply will cause decreases in the other. When this occurs set both currents to be the same. The short circuit protection still applies in this method of operation.

For applications where the voltage required is higher than 20V the supplies may be connected in series. Again the two supplies need to be balanced. In this case set the voltage controls so each supply will give half the required voltage. Set the current controls to maximum (R5 will give over-current protection at about 1.2A). Connect the load. Reduce the current control of one supply, whilst monitoring the current drawn, until the control decreases the current. Increase the control slightly until it doesn't effect the current. Repeat for the second supply. The short circuit protection will apply in this method as well.

DW

TUG 'O' WAR GAME



Richard DUDLEY

THE fairly complex logic of the PW Tug 'o' War game is contained within 9 CMOS ICs containing about 600 MOS transistors. The game is simple and fun to play in that the reaction times of two players are compared and the player with the faster reaction time wins the point. The score is shown graphically on a row of LEDs and the knot in the "rope" between the two players is represented by a lit LED. The object of the game is to get the "knot" to one's own end by winning sufficient points.

CMOS technology

Complementary Metal Oxide Semiconductor Logic, to give it its full name is based on two types of MOSFETS, n-channel and p-channel enhancement devices. Each has four electrodes, Fig 1, the sub-

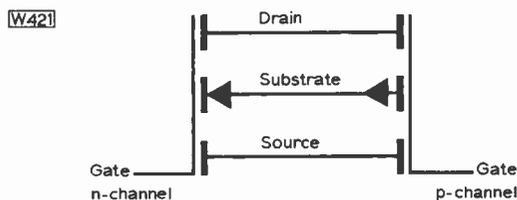


Fig. 1: Drawing of a n-channel and p-channel complementary MOSFET device.

strate terminal is taken to one supply rail, V_{DD} (positive rail) for p-channel transistors, and V_{SS} (-ve) for n-channel devices. The n-channel type can be thought analogous to an NPN transistor in the way it operates, although the gate takes negligible current and the source drain path when the transistor is switched fully on, appears as a resistance (about 500Ω) rather than a voltage drop. For

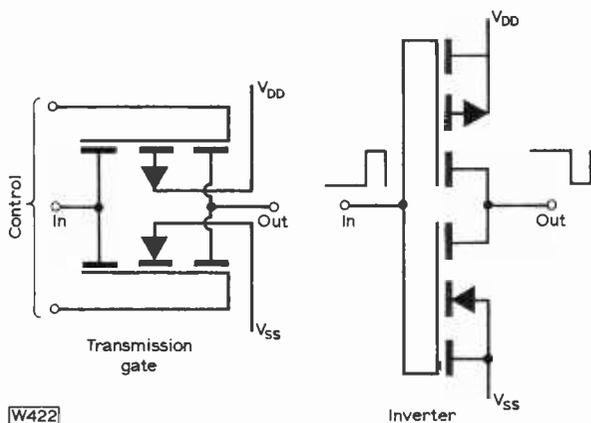


Fig. 2: Transmission gate and Inverter of CMOS logic.

an n-channel transistor, the source is negative with respect to the drain, and conduction occurs when the gate is sufficiently more positive than the source. The p-channel devices require opposite polarities to those of the n-channel version.

Pairs of complementary MOSFETS are used to make up the two basic building blocks of CMOS logic, the transmission gate and the inverter, Fig 2. When an inverted is connected between the control pins, both transistors are either on or off and the transmission gate acts as an analogue or digital

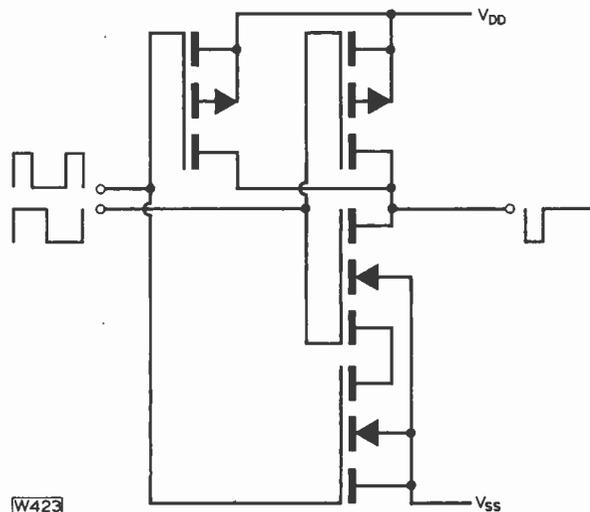


Fig. 3: Combination of transmission gate and inverter, so forming a 2-input NAND gate.

switch capable of passing signals in both directions. The off/on resistance ratio of this solid state switch is better than 3000000:1.

Inverters, when connected in parallel/series combinations can be made to form gates as in Figs 3 and 4. However, the arrangements are asymmetrical,

hence the NAND has a greater pull up capability, while the converse holds for the NOR. If gates with more inputs are needed, the output impedance will rise, unless two extra inverters are added to the

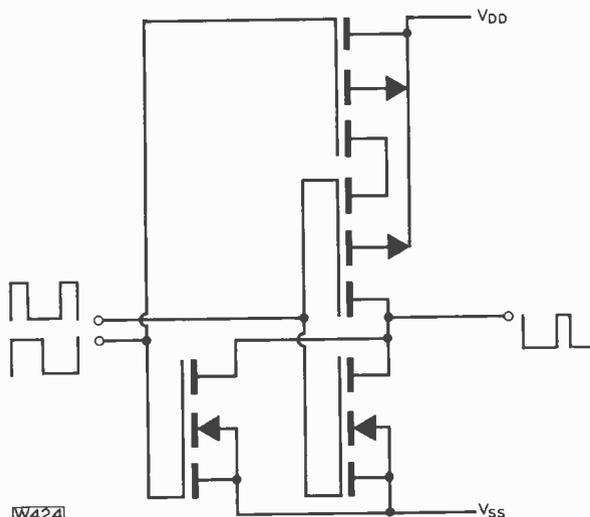


Fig. 4: Similar combination as in Fig. 3, but forming a 2-input NOR gate.

output to restore symmetrical output characteristics. These extra inverters are standard on ICs with a B suffix.

Circuit description

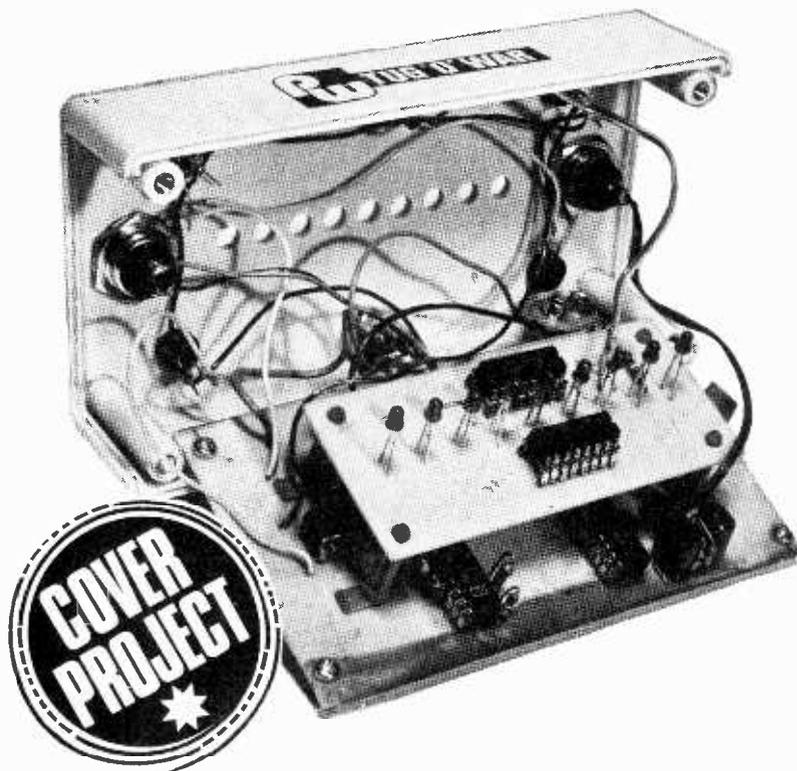
Reference to the circuit diagram in Fig 5 and the block diagram Fig 6, will show that the logic of the game splits into three main parts—the random time

delay monostable, control and scoring logic. The monostable comprises two NOR gates, capacitor C5 and resistors R7-R11. The time delay is determined by the combination of resistors selected by IC2 which, in turn, is controlled by IC1, a 7-bit binary counter (only 4 outputs are used). The latter is clocked by an oscillator formed by IC3c, IC6c, R4, R5 and C4. A logic 1 on the input to the NOR disables the clock.

The control logic consists basically of an RS latch IC4a and b, and various other gates and inverters which drive the indicator lamps, and score counter IC8. This is an up/down counter, the direction of counting being dependent on the output of the EXCLUSIVE OR gate, IC7d. A logic "1" on the up/down input of the IC persuades it to count up, a logic "0", down. This up/down counting is the whole basis of the scoring system in Tug 'o' War. The counter is clocked by inverters which are preceded by a pulse delayer R1 and C1. A BCD output is also provided by the counter which drives IC9, a BCD to Decimal decoder which feeds the LEDs.

Circuit operation

Play begins when both push buttons are depressed by the two players. This causes two logic "0"s to appear on the inputs of IC3, whose output then rises to a logic 1. This stops the counting action of IC1 and so produces a random binary output on the four data lines linked to IC2. This IC contains four transmission gates which are wired across each of the resistors R7-R10. If a logic 1 is present on the output lines, the resistor associated with that bit of the counter will be shunted. The overall effect is to produce one of sixteen different resistance values



General interior photograph of the Tug-O-War, showing the board layout, inter-board wiring and switch positioning.

★ components list

Resistors

R1 68k Ω	R7 680k Ω
R2 10k Ω	R8 1.2M Ω
R3 10k Ω	R9 2.7M Ω
R4 220k Ω	R10 5.6M Ω
R5 100k Ω	R11 3.3M Ω
R6 100k Ω	R12 270 Ω

All 10% $\frac{1}{2}$ W

Capacitors

C1 180pF	C4 10nF
C2 100nF Mylar	C5 1 μ F tantalum
C3 100nF Mylar	

Semiconductors

IC1 CD4024AE	IC8 CD4029AE
IC2 CD4016AE	IC9 CD4028AE
IC3 CD4001AE	D1 to D9 TIL209 red LEDs
IC4 CD4011AE	D10 0.2in yellow LED
IC5 CD4069BE	D11 0.2in yellow LED
IC6 CD4069BE	D12 0.2in green LED
IC7 CD4070BE	D13 0.2in green LED

Miscellaneous

S1, S2, S3, single pole push to make switch. S4, single pole miniature toggle switch. Main PCB, 125 x 73mm. LED PCB, 90 x 40mm. Vero case 150 x 80 x 50mm. Four off, Vero 19mm stand-off pillars. Clips for all LEDs. 9V PP3 battery with snap on connector. Lengths of coloured wire.

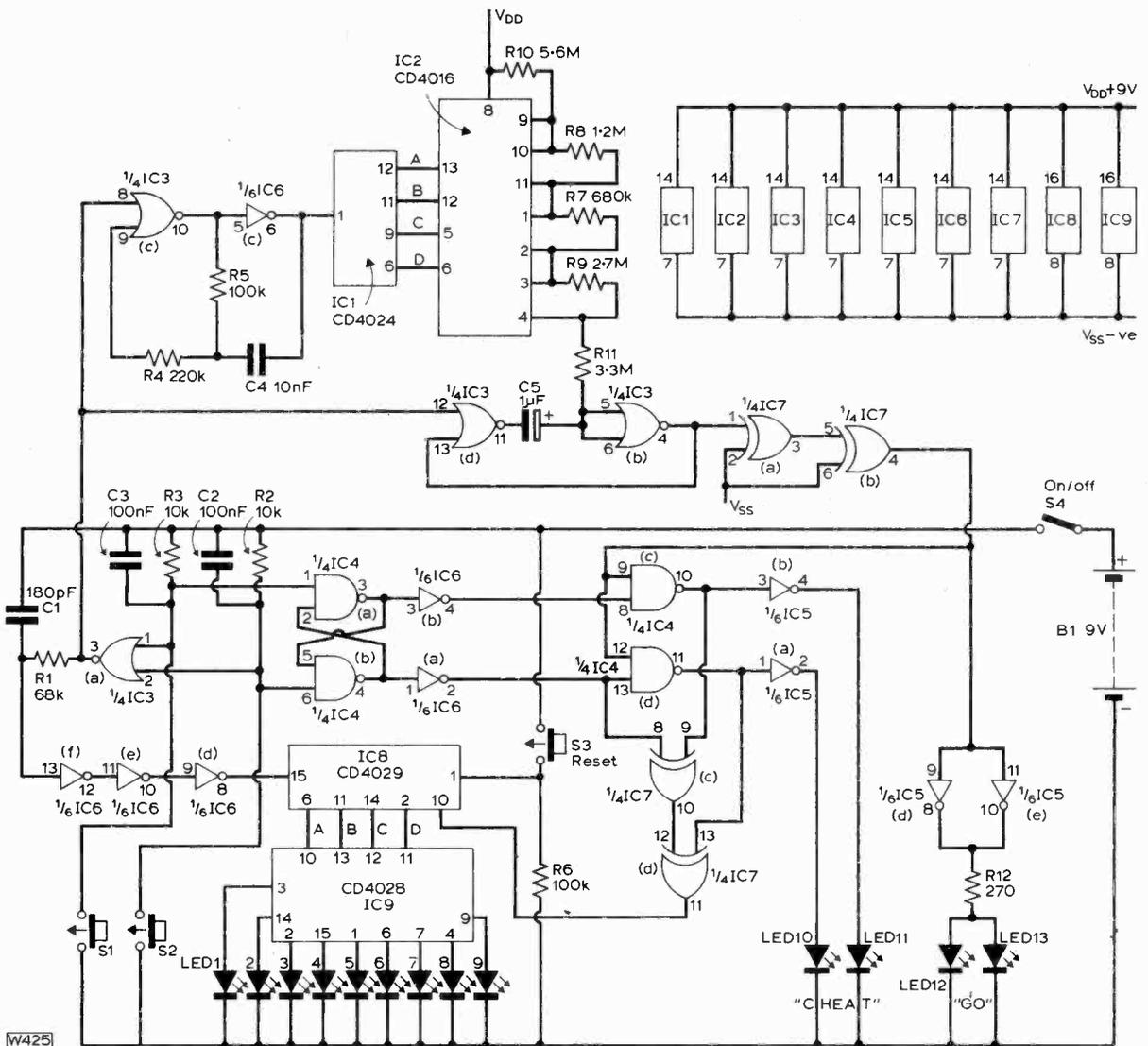


Fig. 5: Full circuit diagram of the Tug-O-War, giving details of the nine integrated circuits used in its construction. The 'rope' is formed by LED's 1 to 9.

which controls the time constant of the monostable.

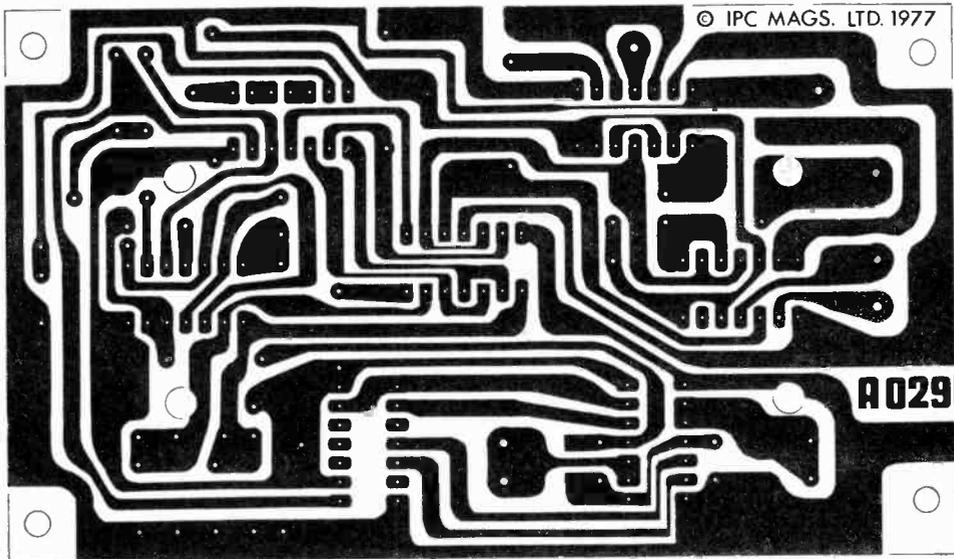
The positive pulse on the input of the monostable which also disables the oscillator means that the output of IC3 will go low. Since C5 is initially uncharged, the input of IC3b will go low also, taking its output high. The output of IC3d is held low during the timing cycle as the output of the monostable is connected to its other input. Meanwhile C5 charges at a rate dependent on the resistance chain, but when the voltage across it reaches the transfer voltage of the gate IC3b (approx 70 per cent of V), the output reverts to low level. This signal is buffered with two EXCLUSIVE OR gates and then inverted and delivered to the two "go" LEDs.

The RS latch connected to the two push buttons is set by the first player to release his button. The

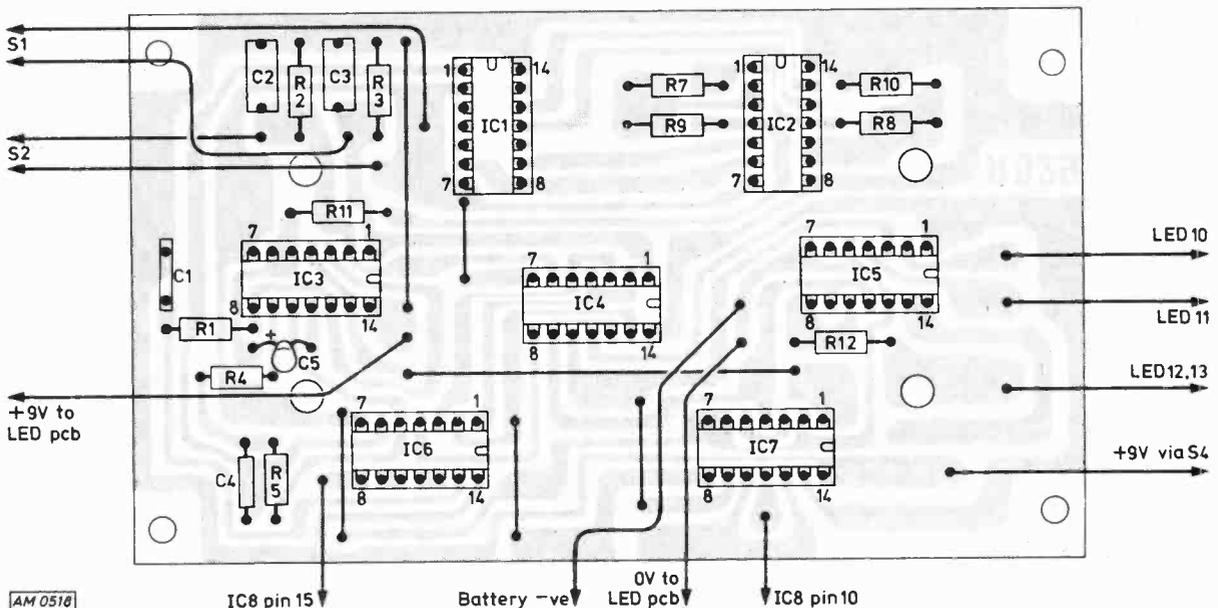
other button will then have no effect. The two outputs are inverted, then compared with the monostable output by IC4c and d. Should the output be high when the latch is set, both inputs to the NAND in question will be high thus its output will go low and the respective "cheat" light will come on.

Cheating

Two EXCLUSIVE OR gates IC7c and d, produce an output from the latch and the "cheat" outputs which causes the counter IC8, to count up or down. If neither player cheats, the outputs of IC4c and d will not go low thus the output of IC7c will be low (an EXCLUSIVE OR gives a 1 output if its inputs differ). The level on the up/down input to the



Main PCB for this project, containing all components with the exception of IC8, IC9, LED's 1 to 9 and R6. Foil side above and component overlay below.



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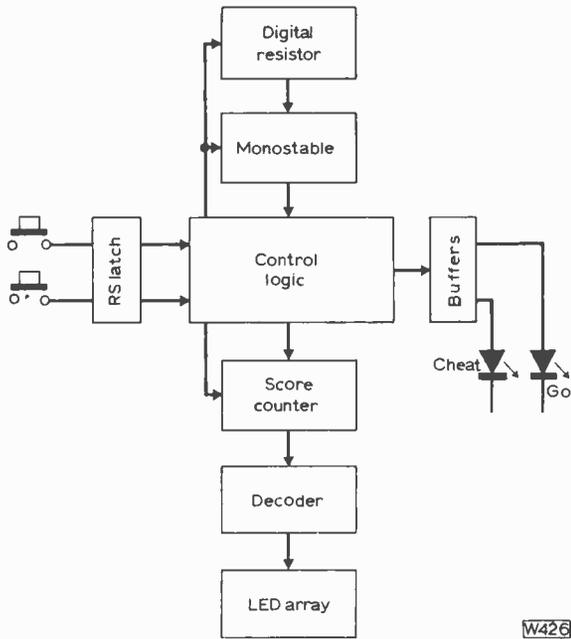


Fig. 6: Simplified block diagram of the logic used in this project.

counter will be high if the input to IC7d is high, and vice-versa. However, should there be a cheat in our midst and he releases his button before the GO signal, one of the inputs of IC7c will be high and the second EXCLUSIVE OR gate will invert its output, and reverse the direction of counting.

The clock pulse to the counter is initiated when one button is released, but it is not delivered until

the time interval set by R1 and C1 has elapsed (about $12\mu\text{s}$). This short delay ensures that the counter is only clocked after all the other logic has settled. The inverters IC6d to f produce a fast rise time pulse for reliable clocking.

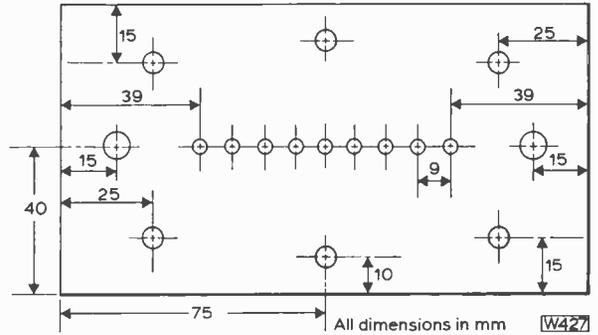
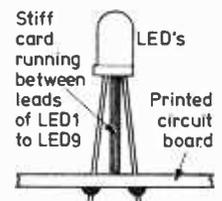
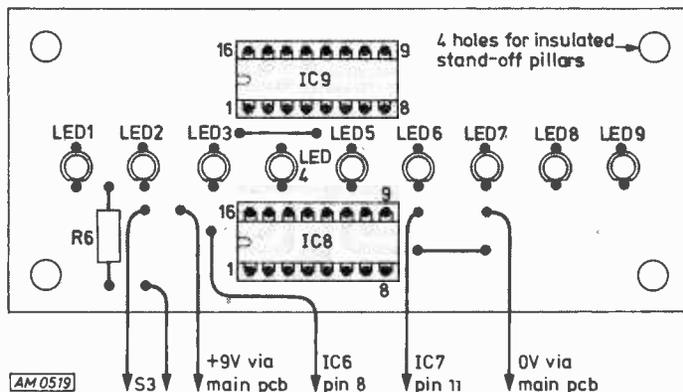


Fig. 7: Dimensions for drilling the front panel which has all switches, and LED's for the 'rope' mounted on it.

Pressing the reset button sets the 'knot' in the centre of the rope of the LEDs. This is accomplished with the help of inputs to the counter which allow presetting of the counter to any required BCD code when the preset enable pin is taken high. In this case the button, when pressed, sets the output to 4, which illuminates the middle LED.

Construction

The unit was housed in a two-tone plastic verobox 150mm x 80mm x 50mm which gives a very neat final appearance. The top should be drilled to take the LEDs and switches, hole positioning is shown in



Full size reproduction of the LED board, showing the foil side above with the component overlay below. A certain amount of pressure is exerted on the LED's when the lid is offered up to them, this tends to lift the track. It is recommended that a stiff piece of card be inserted (between the top of the board and the LED's).

GAS/SMOKE SENSOR ALARM



R. A. JENKINS

SINCE the introduction of gas and smoke detectors various circuits and constructional articles have been published, usually with features that may be redundant in a purely domestic unit. The majority of sensors available have unusual power requirements (typically 1.2V at 500mA), resulting in the need for specially wound transformers or, if portable, very short battery life. Since the introduction of the Type 812 sensor a very economic and easily constructed alarm system can be made without losing facilities or effectiveness and gaining, due to circuit simplicity, overall reliability. This article describes such a unit.

The circuit (Fig. 1) is basically a blocking oscillator formed by Tr1 and 2. In the presence of any de-oxidising agent such as smoke, gas, or petrol vapour the semiconductor coating of the sensor decreases in resistance which increases the bias applied to Tr1 base. This triggers the oscillator, producing both an audio alarm from the speaker and a direct intensity reading by the meter. VR1 sets the sensitivity of the oscillator and may be set to trigger the audio alarm at any given gas/smoke intensity.

The supply requirement of the sensor circuit may be derived from the mains power supply (Fig. 2) or the unit can be made portable and a 12V battery supply used. Diode D1 is included to give reverse polarity protection.

Construction

The printed circuit board Fig. 3a should be assembled as shown (Fig. 3b). The front panel is then cut or drilled to suit the meter, speaker, LED and mains switch. Next the power supply fuseholder and sensor socket are installed in the case. The circuit board is then bolted directly on the meter terminals which establishes the connections to the meter. The unit may now be wired as shown, paying particular attention to the connection of the sensor socket terminals.

Set VR1 to mid-track and plug in the sensor unit. Now switch on, when the alarm should sound almost immediately and then rise in pitch. After five

seconds or so, as the sensor warms up, the pitch will decrease to a steady note, maintaining a meter reading, typically 100 μ A.

If a small amount of cigarette smoke or gas from a butane lighter is released near the sensor the meter reading will rise and the alarm will sound. The sensitivity control VR1 of the audio alarm should be set so that the alarm is not triggered by

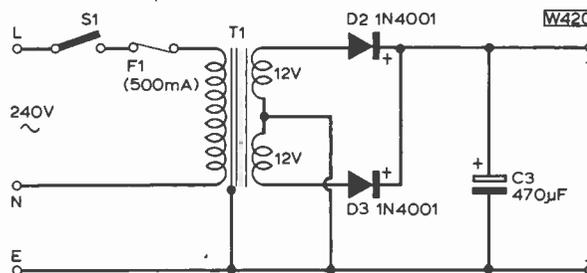
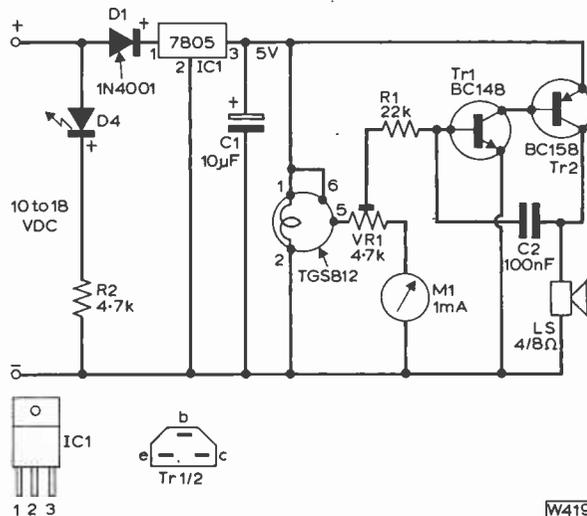
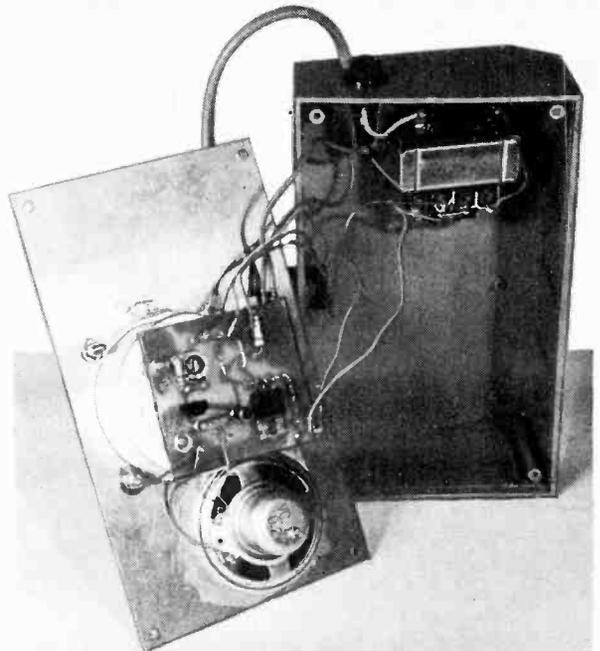
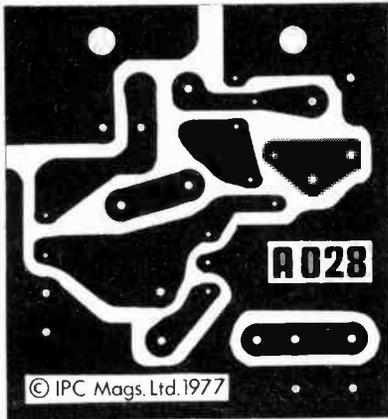
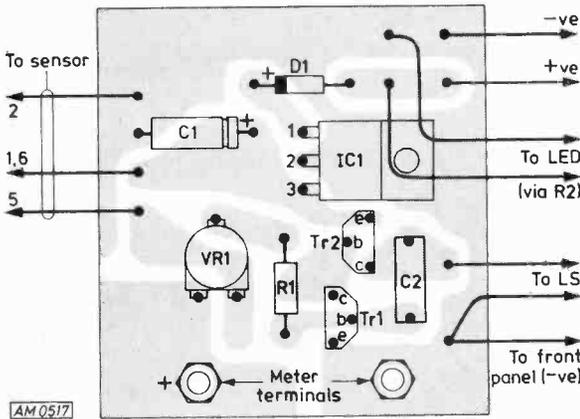


Fig. 1: top, is the circuit of the Alarm with Fig. 2, below, the mains power supply circuit. Both are incorporated in the Alarm shown in the heading photograph.



View of the PCB, mounted directly on the meter terminals. The mains transformer and smoothing capacitor C3 are mounted in the box.



AM0517

Fig. 3a, top, is the full size drawing of the PCB with the component layout, Fig. 3b, below.

any cigarette or cigar smoke that may be present normally. Usually VR1 is set at approx 75% rotation triggering the audio alarm at 200 μ A (0.2mA).

The unit described is suitable for continuous operation. Type 812 sensors have an approximate operational life of two years continuous use and may be periodically checked as previously described. Replacement is a mere formality, just plugging in a new sensor. When the sensor is nearing replacement time the reaction to gas and smoke will be sluggish.

★ components list

Resistors

R1 22k Ω $\frac{1}{2}$ W R2 4.7k Ω $\frac{1}{2}$ W VR1 4.7k Ω submin. horizontal pot.

Capacitors

C1 10 μ F 10V C2 100nF C3 470 μ F 25V

Semiconductors

Tr1 BC148 Tr2 BC158 IC1 7805 regulator D1/2/3 1N4001 D4 LED 0.2" and clip TGS812 Sensor with holder (Watford Electronics)

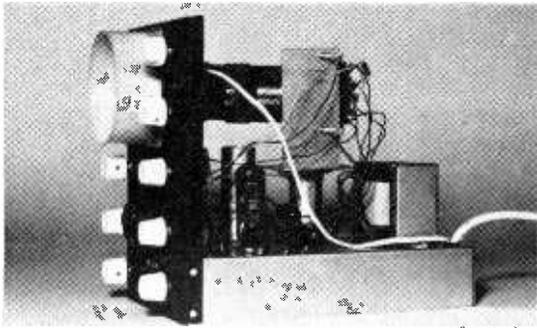
Miscellaneous

Speaker 1 $\frac{1}{2}$ " dia. 4 to 8 Ω . Meter 1mA FSD (Watford Electronics Type T24). Transformer T1, 0-12V, 0-12V 6VA total, 240V primary. Fuse 500mA and holder. Mains on-off switch. Plastic case and panel approx. 6 $\frac{1}{2}$ " x 3 $\frac{1}{2}$ " x 2".

PW TECHNICROSS PUZZLE

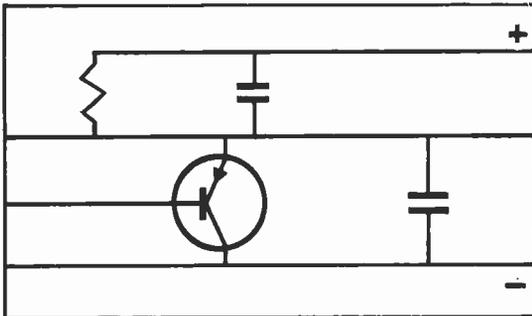
Solution to No. 18
presented last month





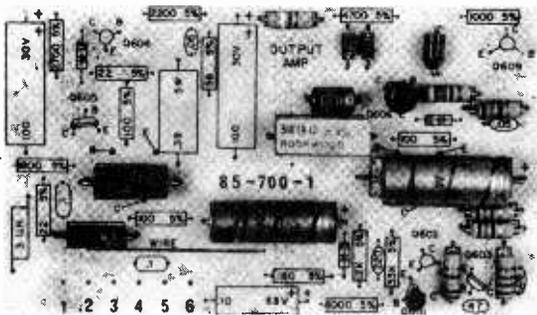
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Circuits for AUDIO AMPLIFIERS

PART 2

F.G.RAYER G3OGR

HEAT SINKS

The power dissipated in a transistor is the product of the current flowing through it and the voltage across the junction. The emitter/collector voltage is lower than the supply voltage, by the extent of the voltage drop in collector and emitter circuits. In low level stages, dissipation will be considerably less than the safe limit for the transistor.

In output stages, and some driver stages, the power dissipated in the transistor becomes quite large. This power causes heating, which can damage the transistor. This damage is avoided either by limiting operation conditions so that dissipation is low enough for the particular transistor when used without a heat sink, or by providing the transistor with a heat sink. A heat sink is a metal clip, plate, chassis or something similar, either flat or finned, thermally in contact with the transistor. It carries away heat from the transistor which can then operate at higher ratings. The heat is lost by convection of air currents, radiation and conduction.

The thermal capacity of the sink, or its ability to carry away heat, is arranged to suit conditions. The heat sink is an essential item and should not be omitted when specified. The chassis or metal case is often used, to avoid a separate heat sink.

It is sometimes necessary to provide electrical insulation between the transistor and its heat sink and a thin mica washer can be used. Sink surfaces should be flat for good thermal contact, with no rough holes

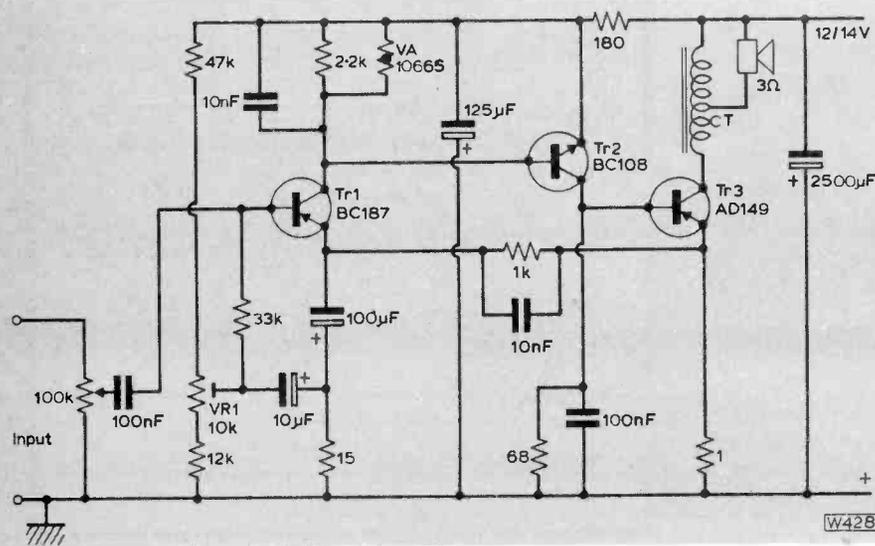
or edges which may penetrate the insulation. To obtain a low thermal resistance (good transfer of heat) silicone grease, available for this purpose, may be smeared on the surfaces.

PNP AMPLIFIER

Fig. 13 is a directly coupled circuit for 14V, either from an accumulator (nominally 12V) or derived from the mains. Pre-amplifier and driver stages are included. VR1 is pre-set and adjusted so that a meter placed in one supply lead reads about 900mA. The output transformer is centre-tapped. With output stages drawing a heavy current, significant voltage is dropped and efficiency reduced if the transformer winding has an unnecessarily high resistance, so a large component intended for such circuits is necessary. Tr3 requires a heat sink which can be 5 x 4in 16SWG aluminium, or a larger area obtained by using the case or chassis.

THERMAL RUNAWAY

If operating conditions of a stage, or directly-coupled stages, are not sufficiently stable, changes in working conditions arise. The amplifier may shift into operating conditions which reduce gain, cause distortion, or increased collector current. With low power stages, emitter and collector resistors assist stabilisation, and limit currents to safe levels. But with higher powered stages, adequate safeguards in this way are not possible.



13

A directly coupled amplifier using an AD149 transistor in the output stage. The supply should be around 12 to 14V, a car battery being an ideal source, the quiescent current of the whole amplifier being about 900mA.

W42B

T.T.L. 74 I.C.'s By TEXAS, NATIONAL, I.T.T., FAIRCHILD Etc

7400	17p	7413	40p	7432	30p	7454	20p	7490	45p	74120	115p	74138	135p	74154	170p	74170	280p	74188	370p
7401	17p	7414	40p	7437	33p	7460	20p	7491	32p	74121	35p	74139	135p	74155	90p	74173	180p	74189	350p
7402	18p	7416	35p	7438	33p	7470	33p	7492	55p	74122	55p	74141	80p	74158	90p	74174	180p	74190	200p
7403	18p	7417	40p	7440	18p	7472	30p	7493	45p	74123	75p	74142	320p	74157	100p	74175	100p	74191	160p
7404	25p	7420	18p	7441	78p	7473	35p	7495	75p	74125	70p	74143	320p	74160	120p	74176	130p	74192	130p
7405	25p	7422	25p	7442	78p	7474	37p	7496	95p	74126	75p	74144	320p	74161	120p	74177	130p	74193	130p
7406	45p	7423	40p	7445	85p	7475	45p	74100	135p	74130	150p	74145	90p	74182	120p	74178	160p	74194	130p
7407	45p	7425	35p	7446	110p	7476	38p	74104	60p	74131	130p	74147	245p	74183	120p	74179	160p	74195	100p
7408	25p	7426	38p	7447	85p	7478	38p	74105	60p	74132	77p	74148	180p	74184	130p	74180	120p	74196	100p
7409	25p	7428	38p	7448	85p	7483	100p	74106	60p	74133	100p	74149	155p	74185	170p	74181	330p	74197	125p
7410	18p	7427	40p	7450	18p	7485	130p	74107	35p	74134	100p	74150	155p	74186	170p	74182	90p	74198	125p
7411	25p	7428	45p	7451	20p	7486	37p	74109	60p	74135	85p	74151	80p	74187	180p	74184	130p	74199	250p
7412	27p	7430	18p	7453	20p	7489	29p	74118	115p	74137	125p	74153	90p	74187	370p	74185	150p	74199	250p

SEMICONDUCTORS

by MULLARD, TEXAS, MOTOROLA, SIEMENS, I.T.T., R.C.A.

AA113	10p	BA138	16p	BC168B	14p	BC548C	14p	BF123	45p	BF336	35p	BY164	50p	OC140	150p	TIP35A	230p	2N1305	30p
AA144	10p	BA148	16p	BC168C	15p	BC549B	13p	BF125	45p	BF337	35p	BYX94	8p	OC171	40p	TIP35C	280p	2N1306	38p
AA217	30p	BA154	12p	BC169C	15p	BC549C	14p	BF127	50p	BF363	60p	C1120	30p	OC200	80p	TIP36A	350p	2N1308	50p
AC121	30p	BA157	15p	BC171	12p	BC557	13p	BF166	30p	BF594	30p	C1164	28p	ORP12	70p	TIP41A	70p	2N1711	22p
AC126	19p	BA173	15p	BC172C	12p	BCY34	80p	BF167	25p	BFV58	20p	E100	42p	R1039	150p	TIP41B	75p	2N2219A	25p
AC127	19p	BA216	16p	BC178A	16p	BCY70	15p	BF173	25p	BFX29	30p	E300	47p	TIP29	45p	TIP41C	80p	2N2483	30p
AC127/01	25p	BA216	16p	BC182	16p	BCY71	20p	BF179	35p	BFX81	130p	E430	125p	TIP29A	47p	TIP42A	80p	2N2906	18p
AC128	15p	BA218	5p	BC182	16p	BCY72	15p	BF180	40p	BFX84	25p	MJ1E340	45p	TIP29C	55p	TIP42B	85p	2N2907	25p
AC128	25p	BA218	5p	BC183	10p	BD121	85p	BF181	35p	BFX85	30p	MPSA06	25p	TIP30A	75p	TIP305	55p	2N3053	20p
AC153K	40p	BB105A	35p	BC183L	12p	BD124	85p	BF182	30p	BFX88	25p	OA47	15p	TIP30B	85p	TIS90	25p	2N3055	60p
AC176	20p	BB110	45p	BC184	10p	BD131	36p	BF183	30p	BFY50	20p	OA90	6p	TIP30C	80p	TIS91	25p	2N3439	50p
AC177	35p	BC107	10p	BC184L	12p	BD132	38p	BF186	25p	BFY51	20p	OA91	6p	TIP31	55p	IN914	5p	2N3702	11p
AC178	35p	BC108	10p	BC186	24p	BD133	45p	BF184	19p	BFY52	20p	QA202	8p	TIP31A	55p	IN975A	10p	2N3703	12p
AD149	60p	BC108C	15p	BC205	14p	BD135	40p	BF195	10p	BFY30	125p	OC23	200p	TIP31B	65p	IN4001	5p	2N3705	12p
AD161	40p	BC109	14p	BC212L	12p	BD136	40p	BF196	10p	BR101	35p	OC25	100p	TIP31C	70p	IN4002	5p	2N3706	11p
AD182	40p	BC109C	14p	BC213L	12p	BD137	40p	BF197	10p	BR102	35p	OC28	75p	TIP32	65p	IN4003	5p	2N3707	11p
AD181/2MP	90p	BC117	19p	BC214	13p	BD139	38p	BF198	25p	BR103	35p	OC35	75p	TIP32A	65p	IN4005	5p	2N3711	12p
AF114	22p	BC125	20p	BC214L	14p	BD141	38p	BF199	25p	BR104	35p	OC42	75p	TIP32B	65p	IN4006	5p	2N3715	300p
AF115	22p	BC126	15p	BC258	13p	BD181	80p	BF200	30p	BSY40	25p	OC43	35p	TIP32C	85p	IN4007	7p	2N3772	175p
AF116	22p	BC146	12p	BC294	35p	BD182	80p	BF201	30p	BSY95	20p	OC45	35p	TIP33	100p	IN4007	7p	2N3886	90p
AF117	22p	BC147	10p	BC303	35p	BD207	70p	BF241	15p	BU105	15p	OC71	25p	TIP33A	105p	IN4148	4p	2N3904	15p
AF118	50p	BC148	10p	BC317	15p	BD233	56p	BF244	15p	BU133	75p	OC72	30p	TIP33B	115p	IS44	4p	2N4062	14p
AF125	25p	BC148C	14p	BC323	60p	BD263	65p	BF257	26p	BU208	220p	OC75	30p	TIP33C	130p	2N456A	90p	2N4126	20p
AF139	35p	BC149	10p	BC328	13p	BDY10	100p	BF258	26p	BY100	20p	OC81	30p	TIP34	115p	2N697	15p	2N5061	35p
AF239	45p	BC157	10p	BC338	12p	BDY62/01	90p	BF259	30p	BY126	15p	OC81D	25p	TIP34A	118p	2N929	20p	2N5163	35p
AS Y26	40p	BC158	10p	BC347	12p	BF120	50p	BF274	15p	BY127	15p	OC83	50p	TIP34B	145p	2N930	20p	2N6227	50p
BA114	9p	BC159	10p	BC347B	13p	BF121	45p	BF324	30p	BY133	22p	OC84	50p	TIP35	225p	2N1302	25p	2SD234	50p
BA121	9p	BC167A	12p	BC348	12p	BF121	45p	BF324	30p	BY133	22p	OC84	50p	TIP35	225p	2N1302	25p	2SD234	50p

BZY88	BZY88
Zeners	10V 10p
	15V 10p
6V8	15V 10p
11V	15V 10p
13V	15V 10p
15V	15V 10p
22V	15V 10p
30V	15V 10p
39V	15V 10p
43V	15V 10p
47V	15V 10p
51V	15V 10p
56V	15V 10p
68V	15V 10p
72V	15V 10p
160V	15V 10p

BZY88	BZY88
4000W. Zeners	10V 10p
	15V 10p
OV7	10p
2V4	10p
2V7	10p
3V0	10p
3V3	10p
3V6	10p
3V9	10p
4V7	10p
5V1	10p
5V6	10p
6V2	10p
6V8	10p
7V5	10p
8V1	10p
8V2	10p
9V0	10p
10V	10p
11V	10p

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2200/35	50p
2200/100	120p
3300/16	40p
3300/25	42p
3300/35	45p
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4700/40	50p
4700/63	120p
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3300/16	40p
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3300/35	45p
3300/50	50p
4700/25	45p
4700/40	50p
4700/63	120p
4700/100	120p

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BC148	100
BC149	100
BC157	100
BC159	100
BF194	100
BF195	100
BF196	100
BF197	100
IN4148	100
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BC147/8/9	8p*
BC157/8/9	11p*
BC167/8/9	12p*
BC177/8/9	16p*
BC182/3/4a/110p	
BC212/3/4a/112p	
BCY70/1/2	15p*
BD131/132ea 36p*	
BFY50/51	15p*
BFY52/53	16p*
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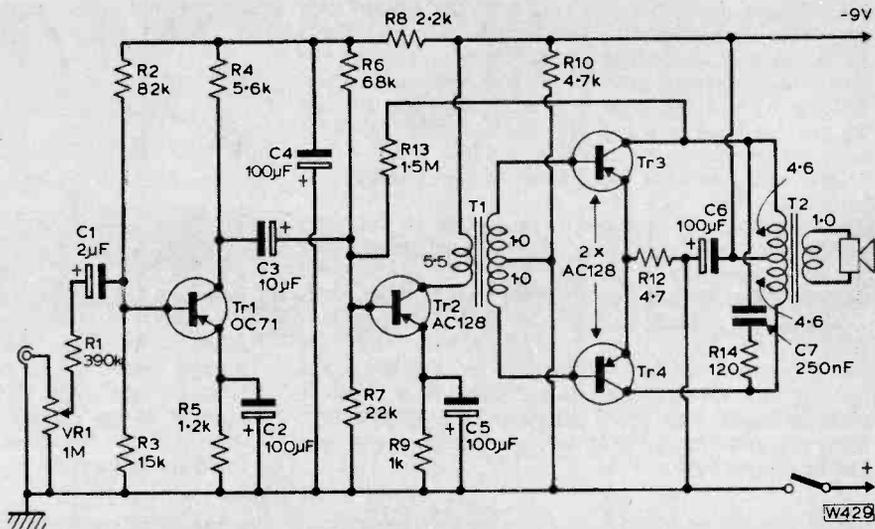
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14

A practical circuit for an audio amplifier having a push-pull output stage. Quiescent current is low so a 9V battery is satisfactory as a power supply.



In these circumstances, when external circuit resistance and operating conditions do not limit current to a safe level, thermal runaway may develop. Power dissipated in the transistor produces heat, and as the junction temperature rises the collector current increases even more. This, in turn, causes a further rise in dissipation and temperature which again increases current. This situation continues until the current and thus the junction temperature is limited by external circuit values or until the transistor is destroyed.

THERMISTORS

Component R2 in Fig. 12 (Part 1) is a thermistor and its resistance falls as its temperature rises. The rise of temperature of R2 may be due to external conditions, to heat in the equipment or to the current passing through it, or both. An increase in ambient temperature or in operating voltage will cause the collector current of the stage to increase. But the effect on R2 will be to reduce the base voltage since the value of R2 falls. The drop in base-emitter voltage reduces collector current. The stage can thus operate satisfactorily over a wider range of temperatures and voltages than it could if the thermistor were not present.

PUSH-PULL OUTPUT

If the audio cycle is divided into two, each peak can be taken to an individual transistor and can drive it into conduction. The outputs of the transistors can be combined to obtain the original audio signal. The advantage of this method lies in the fact that both transistors can have a low resting or quiescent current.

Each transistor of the output pair draws current in turn so this is called a push-pull stage. As the transistors are each dealing with only about one-half of the audio cycle, they are operating in Class B. (This distinguishes operation from Class A, where a single transistor deals with the whole audio cycle.)

Many circuits with Class B push-pull output dispense with transformers, but Fig. 14 is a useful circuit, representative of many transformer coupled

amplifiers. Its push-pull operation is also easy to understand, while it has the advantage that the DC operating conditions of each stage are isolated from other stages. The output is around 500mW ($\frac{1}{2}$ W).

Tr1 is a Class A pre-amplifier, and can be fed from a pick-up or tuner. R2 and R3 set base conditions, which R5 is the emitter bias resistor. The audio signal is developed across the collector load R4, and is coupled to Tr2 by C3. Tr2 is also a Class A amplifier, and termed the driver as its purpose is to drive the output pair, Tr3 and Tr4. The primary of the driver transformer T1 furnishes the collector load for Tr2.

The primary of T2 is centre-tapped. Bias conditions of Tr3 and Tr4 (from R10 and R11) are such that Tr3 and Tr4 collector currents are small (say, 10mA for the pair). Since T1 secondary is centre-tapped, Tr3 and Tr4 are alternately driven negative into conduction. Outputs are combined by the centre-tapped transformer T2.

Current drawn by the output pair depends very much on the audio signal level, rising to peaks of 30 to 60mA or more, according to volume. (This can be observed by placing a meter in one battery lead.) The average current is, however, much lower. Battery life is lengthened, and the two transistors can deal with appreciably more power.

R13 provides negative feedback (see later) over Tr2, T1 and Tr3/4. C7 and R14 are to reduce the effects of phase shifts at higher frequencies. Connecting R13 should cause a drop in volume but an improvement in quality. If this effect is reversed or oscillation arises, take R13 to Tr4 collector instead of to Tr3. With the values shown for the "1/2-watt" amplifier, a maximum output of 500mW is obtainable, and no heat sinks are necessary.

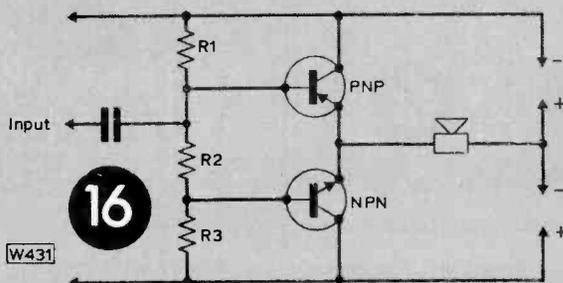
A wide range of transistors can be used in this circuit and the operation of each stage can be checked and adjusted if needed. R10 may be a preset resistor and adjusted so that Tr3/4 draw about 10mA, with no signal. If the value of R10 is too high, current will be low and cross-over distortion caused. On the other hand, if R10 is low in value, the quiescent current is high.

Fig. 15 is typical of circuits using a driver transformer with a split secondary. Each output transistor

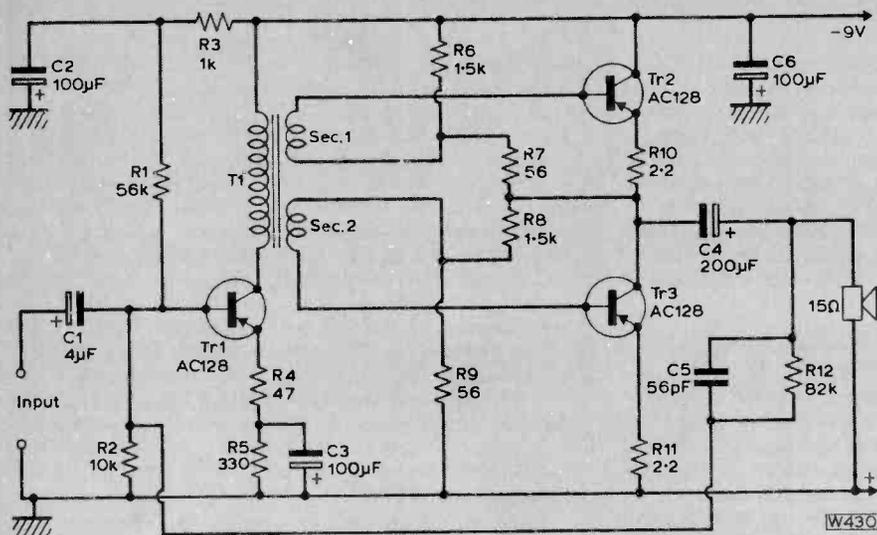
operates on approximately one half the supply voltage. The circuit has the advantage that no output or speaker transformer is necessary. Tr1 is the driver stage, with transformer T1 as described earlier. R6 and R7 provide base bias for Tr2, while R8 and R9 provide base bias for Tr3. Each output transistor has its own emitter resistor R10 and R11.

It is essential that the halves of the transformer secondary, Sec.1 and Sec.2, are correctly phased for the transistors to operate in push-pull. If not, connections to one secondary will be reversed. The negative feedback network C5/R12 is to improve response, and operates over the whole amplifier.

The circuit allows an identical or matched pair of transistors to be used, as for Fig. 14. Maximum output is reduced but battery drain is smaller than that for Fig. 14. Overall gain is sufficient if a tuner is used as input. For other purposes, any of the low-level pre-amplifier circuits with a positive earth line can be placed before Tr1.



duction. As phase shifts may arise near upper frequency limits, it may be necessary to suppress these, as by using C7 and R14, Fig. 14, so that they are not applied to an earlier stage in positive phase. Circuits with no transformers are arranged so that the feedback is correct.



In this circuit a transformer with a split secondary drives the output transistors, their output being directly coupled to the speaker.

NEGATIVE FEEDBACK

A negative feedback circuit of some kind will be seen in virtually all but the very simplest amplifiers. This circuit takes a part of the amplifier output and applies it to the amplifier input. The feedback must be arranged so that it is out of phase. If it were fed back with the same phase as the original input signal, it would cause uncontrollable oscillation.

An amplifier does not normally give exactly the same amplification at all frequencies, because components in it (especially capacitors, transistors and transformers) do not have the same characteristics over a wide range of frequencies. Thus, some frequencies may be emphasised. If so, they are of greater amplitude in that part of the signal fed back to the input, and so help maintain a more level response at all frequencies.

Negative feedback may be over a single stage or may extend over two or more stages. In some circuits, negative feedback is purposely made frequency sensitive. This is one method of obtaining tone control, or in securing more satisfactory repro-

COMPLEMENTARY SYMMETRICAL OUTPUT

With a PNP transistor, a negative-going base input increases the collector current. The NPN transistor, however, requires a positive-going base input to increase collector current. So by combining PNP and NPN transistors it is possible to make a push-pull output stage which does not require a centre-tapped driver transformer or other means of phase splitting. Such circuits are used extensively.

In the basic circuit, Fig. 16, forward bias is developed across R2 in conjunction with R1 and R3. As explained, the audio input will cause first one transistor to conduct, then the other, for successive half cycles. The speaker is connected to the emitters, and two batteries (or a tapped battery) provides a supply for the transistors.

In Part 3 next month the matching of speakers to amplifiers is dealt with together with the use of IC's in audio amplifiers.

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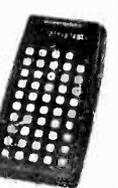
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3130	Dual Op. Amp. 8 pin DIL	75p
3130	CMOS/Bipolar Mosfet	108p
3140	BIMOS/FET Input 8 pin DIL	108p
3900	Quad. Op. Amp. 14 pin DIL	70p

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CA 3028A	Diff. Cascade Amp. TO 99	112p
CA 3046	5 Transistor Array 14 pin DIL	85p
CA 3048	Quad. Low Noise Amp.	250p
CA 3053	Diff. Cascade Amp. T.O.S/DIL	250p
CA 3080	Op. Transconductor 14 Amp 8 DIL	97p
CA 3089E	FM IF System 16 pin DIL	250p
CA 3090A	FM Stereo Decoder QIL	500p
ICL8038CC	VCO Fun.ken 14 pin DIL	370p
LM3800	2W Audio Amp 14 pin DIL	112p
LM3801	Stereo Pre Amp 14 pin DIL	190p
LM3802	Aud Amp +3 Tris. Arr. 18 DIL	175p
M252	Rhythm Ken 16 pin DIL	850p
MC1310	FM Stereo Decoder 14 pin DIL	180p
MC1351P	Lim/Det. Audio Preamp	104p
MC1495	Multiplexer 14 pin DIL	370p
MC1496	Bal. Mod/Demod 14 DIL	115p
MC3340P	Elec. Attenuator 8pin DIL	150p
MFC4000B	1W Audio Amplifier PCB	90p
NE540L	Audio Pwr. Driver TO99	140p
NE555V	Timer 8 pin DIL	40p
NE556	Dual 555 14 pin DIL	78p
NE561B	PLL with AM Demod	425p
NE569B	PLL with VCO 16 pin DIL	425p
NE565	PLL 14 pin DIL	200p
NE566V	PLL Function Gen 8 pin DIL	200p
NE567V	PLL Tone Decoder 8 pin DIL	200p
2567	Dual 567 15 pin DIL	400p
SN72733	Video Amplifier 14 pin DIL	400p
SN76003N	Audio Pwr. Amp with HS	275p
SN76008	10W in 4 ohms spin Plas.	280p
SN76013N	Audio Pwr Amp with HS	175p
SN76023N	Audio Pwr Amp with HS	175p
SN76033N	Audio Pwr. Amp with HS	275p
TAA621A	Aud. Amp. for TV QIL	310p
TAA661B	FM IF Amp L/Detector QIL	150p
TBA614B	Audio Amp QIL	300p
TBA800	5W Audio Amp QIL	100p
TBA810	7W Audio Amp QIL	125p
TBA820	2W Audio Amp QIL	100p
XR2240	20W Audio Amp QIL	400p
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ZN414	TRF Radio Receiver TO18	140p

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OC74	50p	OC75	140p
OC76	50p	OC77	140p
OC78	50p	OC79	140p
OC80	50p	OC81	140p
OC82	50p	OC83	140p
OC84	50p	OC85	140p
OC86	50p	OC87	140p
OC88	50p	OC89	140p
OC90	50p	OC91	140p
OC92	50p	OC93	140p
OC94	50p	OC95	140p
OC96	50p	OC97	140p
OC98	50p	OC99	140p
OC100	50p	OC101	140p

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BFR70	34p	TIP30C	72p	40382	45p
BFR80	34p	TIP31A	56p	40410	75p
BFR88	37p	TIP31C	68p	40419	75p
BFX30	32p	TIP32A	63p	40411	325p
BFX45	30p	TIP32C	30p	40504	90p
BFX66	30p	TIP33A	97p	40595	97p
BFX87	30p	TIP33C	120p		
BFX88	30p	TIP34A	124p		
BFX90	30p	TIP34C	160p		
BFY50	17p	TIP35A	243p		
BFY51	17p	TIP35C	297p		
BRY39	48p	TIP36A	297p		
BRY39	48p	TIP36C	297p		
BSX19	20p	TIP41A	84p		
BSX20	20p	TIP41C	70p		
BU105	175p	TIP42A	78p		
MJE108	312p	TIP42C	92p		
MJE340	48p	TIP2955	78p		
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MJE3055	70p	TIS93	28p		
MPSA06	37p	ZTX108	11p		
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MPSU65	90p	ZN698	43p		
MPSU85	90p	ZN706	22p		
MPSU95	90p	ZN708	22p		
MPSU95	90p	ZN718	42p		
MPSU95	90p	ZN719	42p		
MPSU95	90p	ZN720	42p		
MPSU95	90p	ZN721	42p		
MPSU95	90p	ZN722	42p		
MPSU95	90p	ZN723	42p		
MPSU95	90p	ZN724	42p		
MPSU95	90p	ZN725	42p		
MPSU95	90p				



AMATEUR BANDS

by Eric Dowdeswell G4AR

NIGEL Roberts G8JEF of Prescot got a bit hot under the collar over my comments on repeaters so here is an agreed version of his comments.

"I feel that I must take strong exception to Eric Dowdeswell's unwarranted attack on repeater users. (On the Air, Amateur Bands, January). I am not an FM or repeater nut, my main interest lies with SSB DX on 144MHz but I do use it for local working and the repeaters for mobile. There is abuse, mostly 'things' without a callsign, making funny comments which admittedly don't reflect much credit on FM and repeaters. But the public service potential, especially with Raynet (Emergency Network) does. It is not my intention to perform a defence of repeater operation, the fact that a large number of amateurs use them justifies their existence but to but to point out that there are abuses on other bands and methods of operation. Excessive power is one. On 160m where the limit is 10W it has been reported that one station has a capability of 1kW! Bad manners is another.

If the amateur movement starts publicly squabbling over the best way to operate then in 1979 we might turn round and find no repeaters, and no other bands either."

Now I must point out to Nigel that I had been asked by several readers for my views on repeaters, and I gave them, but I did not even mention the users! I could have said that the service is often abused but I didn't. You did, Nigel! (The problem with abuse, whatever band is involved, is that the Home Office must catch the offender in the act, and that is patently just about impossible!) The number of amateur licencees is around 23000 but how many use the repeaters for their intended purpose? A few hundred, at the most. And how many of these are members of the RSGB? So how does this 'large number' justify all the trouble that the RSGB has gone to to get the repeater service established? They should distribute their services to suit the majority not the minority!

Several readers have commented on the continuing improvement of the 15m band. Steve Cottis A8961 (Harrogate) wonders why so many stations stay on 20m fighting the QRM when they could work just as much DX on 15m! So it's back to my long-held theory that the bands are never as bad as we make them out to be but just lack of activity. Steve says that 15m has opened regularly to west and south Africa on most week-ends but, of course, it is probably like that every day but, unfortunately, most of us have to earn a living! Steve is very pleased

with some of his QSL returns lately which included M1D, D4CBS, A6XR, 5U7AG and F08DO.

J. Taylor in Cheadle Hulme, Cheshire, bemoans the fact that, in his opinion, there is no good textbook for the RAE. He'd like one written in the style of the ARRL Handbook. He goes on to make some blush-making comments on this column which have been duly framed! He'd also like to see some good articles in PW on general coverage communication receivers as 'there would appear to be a gap between the crystal set and the Video-Writer! Point taken! Paul Bradbeer writing from Braunton in N. Devon was pleased to find that J. R. Beer (PW Feb) lives only five miles away. Have a look at your names OM, you could be related! Anyway, Paul wonders if there is enough activity among types like himself to form a club in that part of the world. He hopes to be getting a PR40 preselector for his CR70A very soon but at the moment his life revolves around mock 'O' levels!

Paul Barker BRS34898 DXing from Sunderland added TG9 on 20m for a new one and KP4 and FP8 on 80m to swell the list there. However Paul is now busy playing with his new baby, a Robot 70C SSTV monitor, for which it seems no praise is too great. Apparently it is regarded as the Rolls Royce of SSTV. His previous monitor is now up for sale so ring him on Sunderland 226883 or write to 11 Dipton Gardens, Tunstall Estate, Sunderland, if you have some cash to spare. Down in the Channel Islands Alan Troy sports a Trio 9R59DE with an indoor aerial in a downstairs flat so he hasn't exactly got the best start for DXing. He's been fiddling around for about ten years and now feels he really ought to have a go at getting his ticket. What better OM, if you don't want to waste time listening for the unobtainable DX! For those who may be out of touch Alan points out that the general C.I. prefix of GC has now become GJ for Jersey where Alan resides and GU for neighbouring Guernsey. The Jersey ARS station GJ3DVC has had massive pile-ups, doling out the new prefix!

Calling you out there in Leeds land! Bob Firth G3WWF Hon. Sec. of the Wakefield and District RS tells me that they have recently conducted a wide-ranging survey, in the form of a questionnaire, into the likes and dislikes of members and potential members, with a view to rejuvenating the club. A special all-comers meeting has already been held but if you slipped through the net and live in the district why not contact Bob on Leeds 825519. Meetings are held at 1930 at the Youth Centre, Ings Road School, Wakefield. On 15 March it's John Hey G3TDZ speaking and showing off his constructional projects, on 29 March a ragchew and operating night while 12 April should be quite popular, it's a Junk Sale.

If your QTH is in the Derby area then you should be off to the Derby and District ARS AGM at 1930 on 16 March to be held at the clubroom at 119 Green Lane, Derby. Old news now, but at their Annual Dinner in February the new President of the RSGB, Lord Wallace of Coslany was their guest of honour.

John Wood G3YQC of the British Amateur Television Club has just sent me details of their new publication A Guide to Amateur Television. Written by members of BATC it covers all aspects of receiving and transmitting amateur TV signals including colour TV and closed circuit systems. The price for 112 pages of concentrated information is

just £1.25 post paid to members, which strikes me as remarkable value today! For non-members it's £1.75 so it might pay one to join the BATC at the same time! Orders to BATC Publications, 64 Showell Lane, Penn, Wolverhampton, Staffs WV4 4TT.

In Leyland, Lancs, **Paul Cowburn** has had continuing trouble with his CR300/2 receiver but a multimeter and soldering iron for Christmas helped him to put it right and he is active on the bands again. His efforts to learn the code using records are bearing fruit as Paul has been copying a lot of CW stuff from 160m to 20m. Paul was one of those fooled by GJ3DVC of Jersey, mentioned earlier! **Eric Hill** of Guildford got bitten by the bug and returned to the bands about a year ago with a National Panasonic RF1700 but soon graduated to a Hammarlund HQ100A plus a Codar PR30, which together with about 170ft of wire, seems a pretty good set-up. First DX for the New Year was ZD8EW on 80m SSB so let's hope that is a portent of good DX to come!

John Reynolds in Bridgend very wisely decided to stay on the amateur bands having abandoned the broadcast frequencies. He has completed a regenerative set which can copy SSB so we can look forward to some logs soon. A letter from **Neil Braeman**, near Horsham, sent me details of the December RAE paper. Unfortunately, I can't tell you the pass mark Neil so you will have to wait out the couple of months or so. Let's all hope you made it Neil since you have now passed the morse test! Congrats! **D. Peck** BRS37621 of Cambridge sends in a detailed log of stuff copied in a new mode for this column, RTTY! He's logged over 30 countries so far but doesn't mention the gear. So let's have some more info OM, please.

Now lads and lassies, there were several logs received after the deadline this month. Please make it a bit earlier or, regrettably, they will not make the column.

Log Extracts

P. Barker:— 20m TG9DV TG9QK 5V7WT 80m FP8DX KP4AST SSTV 20m DJ8LV EA2JO F3RT HA5KBM K4TGC SP3PJ VE3PT W8KZM YU1NWJ

A. Troy:— 80m CN8BF CT3BM D4CBS (Cape Verdes Is.) EA8CR EA9FE (Mellila) FP8ZZ HK4DF KZ5HP PZ1AC W6NLZ 9G1JX

B. Harrison:— 80m FG7AO VP9CP 7Z8VA (Saudi Arabia) 9M2MK 20m FY7AW P29GR XT2AE

S. Cottis:— 80m EA8CR EL7F KP4AST KZ5HP 20m YB1KW 9J2PC 15m CT2BB EA8CR EA9FC

P. Bradbeer:— 80m EA8JP JA6DG 20m YN1CCA ZL3FV AH6UM (KH6)

P. Cowburn:— 160m CW K1PBW W3HXK W4BRB W8LRL KV4FZ 80m FP8ZZ HI8LC HK4DF JH0BQU JX2FL KZ5HP PY7BZD UK9AAN W7KW 5Z4GX 9Y4NP 40m PY2CAR PY8AKA LU4MEE VK3ZL ZL1AIZ 6W8AAD 20m KG6SW VK5BC YB4ACJ ZL1GG

D. Peck:— 15m TU2GG WB2CJS/HZI VE2ZN/SU WB6EWH/VQ9 DK5EC/ET3 WB4BWG/KG6 20m RTTY AC3KEK CT1EQ EA8IT VE2QO VK2SG WB6EWP/VQ9 3A2FB 9H1EL 9M2MW

N. Braeman:— 80m CT2BS CT3BM KZ5HB VP2LDU XE1KB 20m WB6EWH/VQ9 8P6AH

E. Hill:— 80m FM7WS JY3ZH PJ2FR VP2LCT VP2SN ZD8EW 5B4PW 9K2DR

All stations are SSB except CW, in bold, and RTTY in italic.



SHORT WAVE BROADCASTS

by Derek Bell

I RECENTLY stated with much conviction that Radio Australia could not be heard around mid-day in the UK. However, the unprecedented conditions over Christmas and New Year period proved me wrong. This is pointed out by **Alan Spencer** from Ryhall, in Lincolnshire, who, on his Heathkit SW717 plus a long wire, pulled the signal in on 9560 from 1230 to 1300, admittedly at low strength but there, nevertheless. This disturbance was one of the strongest winter upsets that I have experienced and it lasted for around six days, from Christmas Eve onwards.

This month's overseas letter comes from Radio Finland who sent me their schedule from March to May and they offer a service from 0930 to 1000 on 9550, 11755 and 15270. From 1430 to 1500 on 6120, 11755 and 15110 and from 1900 to 1930 on 9720 and 11755. From 2000 to 2030 it's 6120, 9550. It seems that Radio Finland has thrown in the towel as far as North America is concerned. They admit that the Pori transmitter is too far north to give an adequate signal to the US and Canada, due to the beam having to cross the auroral zone which attenuates the lower frequencies.

Bournemouth School has among its after-hours activities a thriving radio club and the boys sent along a very wide ranging log pulled in on their Eddystone 730 and AR88. They managed to gather the following:—

Radio Pekin	on 7590 at 1700
Radio Cairo	on 17920 at 1436
WYFW	on 15110 at 1745
Radio Sweden	on 9630 at 2300
R. Nac. Do. Brasil	on 11780 at 2010
Radio Athens	on 15345 at 1520

Mind you, if the lads were to admit the truth their master Mr Thomas must come in for some credit! Word is coming in of the assorted literature that the stations have been sending out recently. **Jim Coombs** of Walsall has had two copies of a questionnaire from Radio Kiev pointing out that 1977 is the 60th anniversary of the great October revolution and what would you like to hear from Radio Kiev, all in one sentence! I personally have had two similar style items, from Radio Poland and Radio Sofia.

David Wyatt of Oswestry has come up with a log of rarely reported items, and, although few, are stations that seldom seem to figure in reports these days.

Radio Pyongyang	on 9678 at 1605
Korean BS Seoul	on 9640 at 1140
UNRS	on 9615 at 0635

The last service is the broadcast of the proceedings of the United Nations, relayed through Voice of America and of course it is only available during sittings of the General Assembly of the U.N. A Vega Selena hung on the end of a 78ft long wire is the equipment that young **David Birch** uses. He

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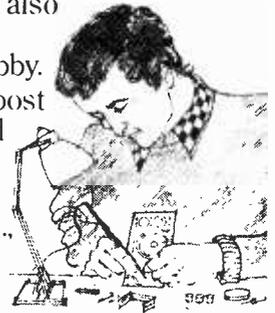
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0C2	45	8BG8	35	6K7G	35	12B17	85	35D5E	90	DK40	70	ECC82	80	250		PCF80	40	800		U801	80	AC178	83	BY126	18
1A3	60	8BA6	40	6K8G	50	12B7Y	85	35L6GT	80	DK92	100	ECC84	80	YE51	45	PCF82	45	Q895/10	100	U4020	75	AC179	83	BY127	21
1A5GT	55	8BC8	90	6K8GT	55	12E1	350	35W4	55	DK96	70	PCF84	70	YE71	45	PCF84	70	100		VP23	85	AC179	81	BY120	80
1A7GT	60	8BE6	40	6L1	250	12M6GT	40	35Z3	80	DL96	80	PCF86	67	YE83	80	PCF86	67	Q8160/15	150	VP41	80	AC179	83	BY211	80
1B3GT	55	8BH6	70	6L8GT	70	12N7GT	70	35Z4GT	70	DM79	80	PCF2001-20	80	YE84	80	PCF201-10	80	QV04/7-30	30	VU111	100	AC178	81	BY213	80
1F5GT	80	8B76	55	6L7	50	12K6	100	35Z5GT	70	DM79	80	PCF201-10	80	YE85	55	PCF201-10	80	QV06/20	20	VU120	100	AD140	42	FSY11A	86
1L4	80	8BK7A	85	6L18	80	12K7GT	50	42	150	DY87/6	85	PCF801	49	YE91	50	PCF802	54	300		VU133	100	AD149	58	FSY41A	87
1N5GT	75	8BQ7A	80	6L19	200	12K8	75	43	125	DY802	45	PCF805	53	YE92	50	PCF805	53	R19	75	W107	75	AD161	53	FSY49	14
1R5	50	8BR7	100	6LD20	80	12Q7GT	50	50B5	95	E800C	250	PCF806	53	YE93	50	PCF806	53	UABC80	45	W729	120	AD162	53	OA47	18
184	40	8BR8	125	6N7GT	70	12M7	50	50C5	50	E800F	500	PCF807	53	YE94	50	PCF807	53	UAF42	70	X41	100	AF14	80	OA70	18
1T4	30	8BR7	170	6Q7G	50	12M7	50	50D5G	50	E800F	200	PCF808	53	YE95	50	PCF808	53	UBC41	50	X66	160	AF15	80	OA73	18
1U4	70	8BW6	100	6Q7G	50	12M7	50	50E5H	85	E800C	70	PCF809	53	YE96	50	PCF809	53	UBC81	55	Z759	585	AF17	83	OA79	11
1U5	85	8BW7	65	6Q7(M)	65	12M7	50	50F5H	85	E800C	70	PCF810	53	YE97	50	PCF810	53	UBF80	50			AF121	35	OA81	11
2D21	55	8B7	60	6R7G	70	12M7	50	50G5H	85	E800C	70	PCF811	53	YE98	50	PCF811	53	UBF89	50			AF121	35	OA82	11
2K5	75	8C6	40	6R8A	55	12R7	75	85A2	75	E182CC		PCF812	53	YE99	50	PCF812	53	UBF99	50			AF121	35	OA83	11
2X2	70	8CG5	60	6R8GT	75	14H7	75	85A3	75		300	PCF813	53	YE100	50	PCF813	53	UBF99	50			AF121	35	OA84	11
3A4	55	8C6	45	8R87	50	1487	50	108C1	40	E188CC		PCF814	53	YE101	50	PCF814	53	UBF99	50			AF121	35	OA85	11
3D6	40	8C9	300	8R87	55	14A95	65	108C2	40	E188CC	250	PCF815	53	YE102	50	PCF815	53	UBF99	50			AF121	35	OA86	11
3Q4	80	8CB6A	60	8R87	60	14G8	60	1148	60	E1148	60	PCF816	53	YE103	50	PCF816	53	UBF99	50			AF121	35	OA87	11
3Q5GT	70	8CB6B	60	6R8GT	55	19H1	400	807	110	EA50	40	PCF817	53	YE104	50	PCF817	53	UBF99	50			AF121	35	OA88	11
384	45	8CG8A	90	6R7G	60	20D1	70	1625	80	EA76	130	PCF818	53	YE105	50	PCF818	53	UBF99	50			AF121	35	OA89	11
3V4	80	8CL6	75	6V6G	30	20P2	85	5702	120	EABC80	40	PCF819	53	YE106	50	PCF819	53	UBF99	50			AF121	35	OA90	11
4CB6	75	8CL8A	85	6V6GT	55	20L1	120	5763	185	EAC91	55	PCF820	53	YE107	50	PCF820	53	UBF99	50			AF121	35	OA91	11
5CG8	75	8CM7	100	6X4	45	20P1	100	6057	100	EAF42	70	PCF821	53	YE108	50	PCF821	53	UBF99	50			AF121	35	OA92	11
6R40Y 100	80	8C95	90	8R87	45	20P3	100	6060	100	EAF42	70	PCF822	53	YE109	50	PCF822	53	UBF99	50			AF121	35	OA93	11
6U4G	50	8D3	75	7B6	80	20P4	84	6067	100	EAF42	70	PCF823	53	YE110	50	PCF823	53	UBF99	50			AF121	35	OA94	11
6V4C	80	8DE7	80	7B7	80	20P5	150	7025	150	EB91	20	PCF824	53	YE111	50	PCF824	53	UBF99	50			AF121	35	OA95	11
8Y3GT	55	8DT6A	85	7B7	80	25A6G	70	7193	90	EB41	75	PCF825	53	YE112	50	PCF825	53	UBF99	50			AF121	35	OA96	11
8Z3	100	8E6W	85	7B7	80	25L6G	70	9002	85	EB8C1	45	PCF826	53	YE113	50	PCF826	53	UBF99	50			AF121	35	OA97	11
8Z4G	48	8E6	100	7Z4	80	25Y6G	80	9006	85	EBP90	40	PCF827	53	YE114	50	PCF827	53	UBF99	50			AF121	35	OA98	11
8Z4GT	55	8F3	65	7Z4	80	25Z4G	80	9007	85	EBP90	40	PCF828	53	YE115	50	PCF828	53	UBF99	50			AF121	35	OA99	11
8Q4	75	8FG6	60	8D2	50	25Z5	75	8458	85	ECPEN	60	PCF829	53	YE116	50	PCF829	53	UBF99	50			AF121	35	OA100	11
8A8G	140	8G13	90	9D7	70	25Z6	80	AL60	120	EB21	200	PCF830	53	YE117	50	PCF830	53	UBF99	50			AF121	35	OA101	11
8AC7	55	8H14	80	10C2	70	28D7	200	ARP3	80	EC86	84	PCF831	53	YE118	50	PCF831	53	UBF99	50			AF121	35	OA102	11
8AG5	35	8F15	85	10DE7	80	30A5	75	ATP4	50	EC88	84	PCF832	53	YE119	50	PCF832	53	UBF99	50			AF121	35	OA103	11
8AG7	60	8F18	80	10F1	67	30C15	77	AZ1	50	EC92	55	PCF833	53	YE120	50	PCF833	53	UBF99	50			AF121	35	OA104	11
8AH6	70	8F23	65	10F9	65	30C17	77	AZ1	60	EC93	200	PCF834	53	YE121	50	PCF834	53	UBF99	50			AF121	35	OA105	11
8AJ5	70	8F24	80	10F18	65	30F5	70	AZ41	50	EC93	200	PCF835	53	YE122	50	PCF835	53	UBF99	50			AF121	35	OA106	11
8AK5	45	8F25	100	10LD11	75	30L15	75	B36	75	EC93	200	PCF836	53	YE123	50	PCF836	53	UBF99	50			AF121	35	OA107	11
8AK6	70	8F28	74	10P13	80	30L17	70	BL63	80	EC94	90	PCF837	53	YE124	50	PCF837	53	UBF99	50			AF121	35	OA108	11
8AM8A	70	8F32	70	10P14	250	30P4MR	90	CL33	175	ECC81	84	PCF838	53	YE125	50	PCF838	53	UBF99	50			AF121	35	OA109	11
8AN8	70	8G6	60	12A6	85	30P12	74	CY1C	100	ECC82	84	PCF839	53	YE126	50	PCF839	53	UBF99	50			AF121	35	OA110	11
8AQ5	47	8G6A	80	12AC6	80	30P19	80	CY31	70	ECC83	84	PCF840	53	YE127	50	PCF840	53	UBF99	50			AF121	35	OA111	11
8AR5	80	8G6K	75	12AD6	80	30P4	90	D1	50	ECC84	85	PCF841	53	YE128	50	PCF841	53	UBF99	50			AF121	35	OA112	11
8AS7G	100	8G7U	90	12AE6	80	30P11	100	DAF91	35	ECC85	85	PCF842	53	YE129	50	PCF842	53	UBF99	50			AF121	35	OA113	11
8AT6	50	8H8GT	30	12AT6	45	30P13	100	DAF96	60	ECC86	125	PCF843	53	YE130	50	PCF843	53	UBF99	50			AF121	35	OA114	11
8AU6	40	8J5GT	50	12AU6	50	30P14	120	DAF90	70	ECC88	85	PCF844	53	YE131	50	PCF844	53	UBF99	50			AF121	35	OA115	11
8AV6	50	8J6	35	12AV6	60	30P15	100	DF91	80	ECC189	80	PCF845	53	YE132	50	PCF845	53	UBF99	50			AF121	35	OA116	11

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CD4009	0.84	CD4028	1.03	CD4047	1.04	CD4072	0.24	CD4510	1.57
CD4010	0.84	CD4029	1.30	CD4048	0.94	CD4073	0.24	CD4511	1.88
CD4011	0.20	CD4030	0.64	CD4049	0.94	CD4074	0.24	CD4512	3.15
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CD4013	0.64	CD4032	1.23	CD4051	1.07	CD4076	0.80	CD4518	1.23
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CD4016	0.64</								

has written giving the background to the Radio Athens English service, David logged them on 17830 at 1230 and has forwarded the address which is:— Director of Technical Services, EIRT, 16 Mourouzi Street, Athens, Greece. The latest schedule is as follows:—

0115 on 11730
0230 on 9760 and 9750
1230 on 17830 and 15345
1530 on 17830, 15345 and 11730
1930 on 9675, 7215 and 6140
0930 on 15345 and 9530

Since starting this month's column I have had the pleasure of being able to assist, in a practical way, a member of the DXing fraternity. Some time ago Jim Coombs asked for any information on an R1392D receiver. By the good offices of another reader a circuit diagram arrived chez Bell, so Jim is happy. On that happy note I will close this month and wish 73s to you and yours.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy

VINTAGE Radio is not usually associated with DXing so readers may be surprised to learn of transatlantic reception this winter by a DXer using a vintage medium wave receiver. Tudor Rees Vintage Services, who advertise in PW, mention in the January issue of their Antique Wireless Newsheet, their reception the previous month of WINS New York City on 1010kHz with a 1930 TRF receiver. Quite a remarkable achievement! Transatlantic medium wave reception was commonplace in the early days of radio, and wireless magazines of the mid-twenties made frequent reference to it. The circumstances were quite different then. Anti-fading transmitting aerials had not been invented and the flat-topped aerials of the day radiated lots of sky wave. There was little interference either electrical or from other stations and the unselective wireless sets in use could really pull in the DX. The writer is attempting to refurbish a receiver of circa 1924 vintage with the intention of trying it under the very different conditions that prevail today. Has any reader tried DXing with a vintage radio? The most likely channels for North America are 710kHz, 930kHz and 1010kHz and at this time of year it will be 0100GMT before the path is open.

It appears that we have now reached the minimum of the current sunspot cycle, a period that favours DXing on the lower frequencies, and logs are now recording some of the less common North Americans. F. T. Shortridge of Llandudno Junction has his AR88 back in circulation and he reports hearing, when using a loop, CHNS in Halifax NS on 960kHz, CKEC New Glasgow NS on 1320, WVOJ Jacksonville, Florida also on 1320, WEVD New York on 1330, WPOP Hartford on 1410 and WOKO Albany NY on 1460. G. Braithwaite who writes from Belfast

used a Drake SW4A and loop to log VOXM St John's, Newfoundland on 590kHz, WHAS in Louisville, Kentucky on 840, WHDH in Boston on 850, CFRB Toronto on 1010, WWWE Cleveland, Ohio, on 1100 and WHAM in Rochester NY on 1180. Michael Tallent does his DXing in Stafford with a Realistic DX160 and a 300ft long wire. His log includes KDKA Pittsburg on 1020 and he mentions that he can pick up many distant broadcasts which he cannot identify. All North American broadcasters on the medium waves are allotted call letters which they are obliged to give over the air but with the characteristic slow fading that occurs on this band it requires time and patience on many occasions in order to obtain a positive identification.

Reader James Birkett of South Kensington sends a report of stations heard between 1245 and 1355GMT during December using a Telefunken portable receiver attached to his TV aerial! Broadcasts from as far away as Monte Carlo on 1466 and Andorra on 701 were heard in daylight. In mid-winter, when the sun rises only to a low angle above the horizon, there are occasions when the D layer in the ionosphere only partly reforms at sunrise. Normally the D layer reforms completely then and absorbs signals in the medium wave band, inhibiting long distance reception. At the time of the last sunspot minimum in 1965-66 North American DX was heard as late as 1000 because of this phenomena but it is very unusual. Readers might follow James's example and try their TV aerial for MW DXing as it makes a good vertical for medium wave reception. Try connecting the receiver to the inner and the screen of the co-ax lead in turn for optimum reception, or both!

Monday morning is a familiar time for DXers in North America. Many high power outlets in that area, though nominally on the air 24 hours a day, close down for transmitter maintenance between midnight on a Saturday and 0500 on Monday, local time. DXers in the United States regard Monday morning as the best time of the week for local and foreign DXing. In the UK too, advantage can be taken of this period of quiet, provided that the DXer is prepared to be out of bed at five in the morning! Owing to the different time zones in operation in the USA, midnight in New York corresponds to 2300 in Chicago and 2100 in Seattle and 0500 in the UK, which means that stations on the east coast close down earlier than those further inland. When conditions are good it is worth trying the band at 0500 on a Monday. KING in Seattle on 1090 has been heard on a Monday with WBAL in Baltimore off the air, KEX in Portland, Oregon on 1190 was logged by the writer with WOWO in Fort Wayne, Indiana off and WOKJ Jackson, Mississippi on 1550 with CBE Windsor, Ontario off the air.

VHF

by Ron Ham

ON December 29th, Cmdr. Henry Hatfield (Sevenoaks) located two sunspots and an angry-looking filament with his spectrohelio-

scope (see *Amateur Photographer*, March 24, 1976) and, true to form, both he and your scribe recorded strong radio noise at 136MHz from this event the following day. Henry found another pair of sunspots on January 11th and, like the earlier ones, these were active and emitting radio noise at metre wavelengths. Although several tiny bursts of solar noise were recorded between the 12th and 17th the strongest and most continuous was heard on the 12th at both 95 and 136MHz, and again on the 14th, but this was limited to the higher radio frequency. (Reports of exceptional HF DX during this period would be most welcome.)

From the heavens came the Quadrantid meteor shower (Jan 1 to 6), and this looked good by radio. As the earth approached the shower on January 2nd the writer's equipment counted 5,515 "pings", of signal from the Gdansk broadcast station (70.31MHz) during the 15-hour observation period (0800 to 2300hr daily). On the 3rd, peak day, more than 28,000 "pings" were recorded which should have given excellent conditions for the meteor scatter enthusiasts. As usual the daily rate of "pings" reduced *pro rata* as the earth passed through the main swarm of particles; 4th was 11,100, 5th was 8,612 and 6th was 6,858.

Throughout the peak day "pings" of signals were also heard simultaneously with Gdansk from a Russian TV transmitter on 49.75MHz (R1) which shows that signals can bounce off meteor trails at a variety of radio frequencies. Last month's report about the Geminid meteors prompted Chris Webster G3TBJ (Ringwood) to write about meteor "pings" on signals in Band II. During the early hours of the morning Chris often turns his 6-element beam (with 3N200 pre-amp) north-east for a listen to Capitol Radio on 95.8MHz. "This provides a splendid stereo signal", says Chris, "except for interruptions every few minutes by chunks of German speech or music", probably from the GDR 50kW DDR1 from Berlin. Chris suggests that readers without 4m gear wishing to observe radio meteor "pings" should tune to a quiet spot in Band II and listen for a German station. Chris leaves his receiver tuned around 96.5MHz for this purpose. The next meteor shower to watch out for is the April Lyrids, April 19 to 24, peaking 22nd.

Whilst on the subject of Band II, another interesting letter came from Nick Taylor (Sunbury-on-Thames) who has now added a barometer to his station equipment and will be watching for those atmospheric pressure changes which bring the VHF DX. He already has a good score on Band II judging from the copy of his log which includes more than 20 each German and French broadcast stations, plus a dozen Italians; and a few Dutch and Spanish, all between 88 and 104MHz, and of that lot 32 broadcasts were heard in stereo! A most interesting list Nick and one that we can refer to when your future reports come in. Needless to say there is a good selection of both G and GW DX in his log. You are dead right, Nick, the VHF's were quiet in January, however there was a pressure change between the 6th and 9th which gave a mild "lift" to parts of the VHF spectrum.

During the evening of the 6th, Alan Baker G8LGQ (Newhaven) was listening to the Kent repeater, GB3KR Dover, and heard a station in Ipswich say that he was receiving a colossal signal from the repeater as well as signals on "two" from both PA0 and DL. It is interesting to note that there has to be a slight lift in conditions before G8LGQ can use

the Kent repeater. At midday on the 8th, the writer received a good picture from the IBA transmitter at Lichfield on Channel 8 (189MHz), but this did not last long.

Alan Baker is a member of the Brighton Repeater Group and reports that the equipment for GB3BR on 70cm had satisfactory tests on January 15th and 16th and by now should be on the air permanently (RB6, input 434.750, output 433.150MHz).

Although the recognised sporadic-E "season" in Europe is between mid-April and mid-August, our fellow enthusiasts "down under" had sporadic-E disturbances throughout the Christmas period. A most welcome letter, dated January 8th, came from Anthony Mann, a reader in Applecross, Australia, who says "we are at present enjoying an active sporadic-E season which has seen Malaysian TV (Channels E2 and E3) received here and Samoan TV (Channel A2) received in Sydney on Christmas day. The distances involved being 2,400, 2,600 and 2,700 miles respectively."

Anthony is a keen TV and VHF DXer and regularly monitors the 10m band looking for any unusual activity which might indicate that sporadic-E or high MUF-F2 is present. The writer is always pleased to hear about VHF activity from any part of the world, because, apart from the interest for our readers, it all helps to build up a general pattern which aids the study of propagation. The only International Beacon Project station that Anthony has heard so far is 3B8MS (28.190MHz) in Mauritius and he asks for the frequency of the others on "ten": DL0IG1 is on 28.195MHz, GB3SX on 28.185MHz and 5B4CY on 28.180MHz.

Your scribe heard a 549 signal from the Cyprus beacon (5B4CY) at 0826 on January 1st and again at 0929 on the 7th and would like to hear more from readers about their reception of the 10m beacon signals.

It is worth remembering that there is a great deal of enjoyment to be had and a lot of knowledge about propagation to be gained by listening in, or taking part in the RSGB VHF/UHF contests and there are some good ones in store; 144MHz Open on March 5/6, 432MHz Open on March 20, 70MHz Open in April 2/3. So what about it readers, have a go, and good luck!

Thanks again for your letters, several of you have said that you are pleased to see a VHF report again in PW so keep on writing and between us we will make it an interesting feature for both our regular readers and for science in general.

BROADCAST BANDS

Short Wave Reports by the 15th of the month to Derek Bell, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.
Medium Wave Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS

Logs covering any amateur band/s in band/ alphabetical order by the 25th of the month to Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashted, Surrey, KT21 2TW.

VHF

Reports on VHF matters to Ron Ham, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

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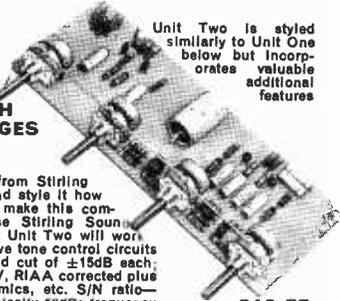
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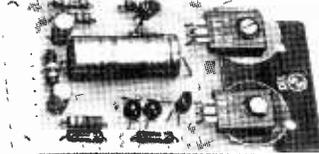
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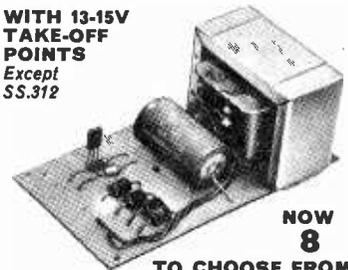
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CA3045	1.40LM386N	80p	NE555	53p	TAA350A	2.48	TBA810	1.16
CA3046	89pLM387N	1.05	NE556	1.05	TAA521	1.00	TBA820	1.03
CA3048	2.23LM388N	1.00	NE565	1.00	TAA522	1.90	TBA920	1.79
CA3049	1.66LM389N	1.00	NE566	1.65	TAA550	60p	TBA920Q	2.99
CA3052	1.62LM702C	75p	NE567	1.80	TAA560	1.60	TBA940	1.62
CA3053	60pLM709C	65p	SA550	1.00	TAA570	1.30	TCA160C	1.85
CA3080	68pLM709N	45p	SA5570	1.00	TAA511B	1.85	TCA160B	1.61
CA3080A	1.88LM710C	60p	SO42P	1.00	TAA621	1.25	TCA270	2.85
CA3086	51pLM710N	60p	76001N	1.57	TAA661B	1.32	TCA280A	1.30
CA3088	2.52LM723C	85p	76003N	2.55	TAA700	3.91	TCA290A	3.13
CA3089	2.52LM723N	75p	76008K	1.70	TAA930A	1.00	TCA420A	1.84
CA3090	3.80LM741C	94p	LM741N	50p	76013ND	1.57	TAA930B	1.05
LM301A	65pLM741-B	40p	76018K	2.50	TAD100	1.95	TCA740	2.76
LM301N	44pLM747N	90p	76023N	1.70	TBA400	1.50	TCA760	1.38
LM304	2.45LM748-B	50p	76023ND	1.57	TBA500	2.21	TCA800	3.13
LM307N	65pLM748N	90p	76033N	2.55	TBA500Q	2.30	UAA170	2.00
LM308N	1.17LM1800	1.76	76110N	1.40	TBA510	2.21	UAA180	2.00
LM309K	2.10LM1808	1.92	76115N	1.87	TBA510Q	2.30	CD4000	20p
LM317K	3.00LM1828	1.75	76116N	2.00	TBA520	2.21	CD4001	20p
LM318N	2.25LM3301N	85p	76131N	1.30	TBA520Q	2.30	CD4002	20p
LM323K	6.40LM3302N	1.40	76221N	1.94	TBA520Q	2.30	CD4006	1.10
LM339N	1.75LM3401N	75p	76227N	1.51	TBA530	2.07	CD4007	20p
LM348N	1.91LM3900	75p	76228N	1.57	TBA530Q	2.21	CD4008	97p
LM360N	2.75LM3905	1.60	76530N	1.50	TBA540	2.30	CD4009	57p
LM370N	3.00LM3909	68p	76532N	1.50	TBA540Q	2.30	CD4010	57p
LM371N	2.25MC1035	1.75	76533N	1.30	TBA550	3.13	CD4012	20p
LM372N	2.15MC1303	1.47	76544N	1.44	TBA550Q	3.22	CD4011	20p
LM373N	2.25MC1305	1.88	76545N	2.09	TBA560Q	3.22	CD4012	20p
LM374N	2.25MC1306	1.00	76546N	1.44	TBA570	1.29	CD4013	57p
LM377N	1.75MC1310	1.91	76550N	41p	TBA570Q	1.38	CD4014	1.01
LM378N	2.25MC1312	1.98	76552N	65p	TBA641Q	2.50	CD4015	1.01
LM379S	3.95MC1327	1.54	76570N	2.08	TBA651	1.80	CD4016	56p
LM380-B	90pMC1330	92p	76620N	1.10	TBA700	1.52	CD4017	1.01

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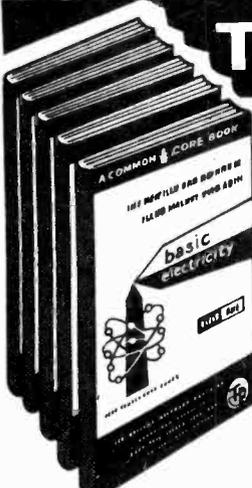
2N696	35p	2N2907	21p	2N3791	3.10	2N6121	38p	BC107	15p
2N697	30p	2N2907A	22p	2N3792	3.50	2N6122	41p	BC108	15p
2N698	62p	2N2924	15p	2N3794	20p	2N6123	45p	BC109	15p
2N699	55p	2N2926	12p	2N3819	36p	2N6126	45p	BC113	17p
2N706	24p	2N3019	55p	2N3820	38p	40361	45p	BC115	19p
2N706A	12p	2N3053	30p	2N3823	75p	40362	48p	BC116	19p
2N708	21p	2N3054	60p	2N3904	21p	40363	1.20	BC116A	20p
2N709	50p	2N3055	70p	2N3908	22p	40406	58p	BC117	22p
2N718	27p	2N3300	25p	2N4036	67p	40407	45p	BC118	19p
2N718A	50p	2N3391	25p	2N4037	55p	40408	65p	BC119	30p
2N720A	80p	2N3391A	25p	2N4058	20p	40409	65p	BC121	45p
2N914	35p	2N3392	16p	2N4060	20p	40410	65p	BC132	30p
2N916	30p	2N3393	15p	2N4061	17p	40411	2.85	BC134	15p
2N918	38p	2N3394	15p	2N4062	18p	40594	75p	BC135	15p
2N929	25p	2N3439	88p	2N4126	17p	40595	86p	BC136	19p
2N930	28p	2N3440	64p	2N4289	20p	40673	73p	BC137	14p
2N1131	30p	2N3441	85p	2N4919	65p	AC126	37p	BC140	40p
2N1132	60p	2N3442	1.35	2N4920	70p	AC127	44p	BC141	45p
2N1613	35p	2N3638	16p	2N4921	50p	AC128	37p	BC142	30p
2N1711	37p	2N3638A	16p	2N4922	55p	AC151	35p	BC143	30p
2N1893	30p	2N3639	30p	2N4923	70p	AC152	50p	BC147	12p
2N2102	60p	2N3641	20p	2N5190	64p	AC133	49p	BC148	12p
2N2218	37p	2N3702	17p	2N5191	70p	AC153K	55p	BC149	13p
2N2218A	37p	2N3703	16p	2N5192	75p	AC176	40p	BC153	27p
2N2219	30p	2N3704	15p	2N5195	90p	AC176K	60p	BC157	12p
2N2219A	32p	2N3705	15p	2N5245	35p	AC187K	55p	BC158	12p
2N2220	35p	2N3706	16p	2N5294	40p	AC188K	55p	BC159	11p
2N2221	22p	2N3707	18p	2N5295	40p	AD161	85p	BC160	50p
2N2221A	26p	2N3708	16p	2N5296	20p	AD162	85p	BC161	50p
2N2222	25p	2N3709	18p	2N5298	40p	AF106	55p	BC167	12p
2N2222A	25p	2N3710	16p	2N5447	15p	AF109	75p	BC168	12p
2N2368	25p	2N3711	18p	2N5448	15p	AF124	65p	BC169	12p
2N2369	25p	2N3712	1.20	2N5449	19p	AF125	65p	BC170	16p
2N2369A	25p	2N3713	1.30	2N5452	22p	AF126	65p	BC171	14p
2N2646	75p	2N3714	2.45	2N5458	33p	AF127	65p	BC172	12p
2N2647	1.40	2N3715	2.55	2N5459	29p	AF139	69p	BC177	20p
2N2904	36p	2N3716	2.80	2N5484	34p	AF186	50p	BC178	20p
2N2904A	37p	2N3771	1.85	2N5486	38p	AF200	70p	BC179	23p
2N2905	37p	2N3772	2.90	2N6027	53p	AF125	74p	BC182	11p
2N2905A	28p	2N3773	2.90	2N6101	85p	AF240	98p	BC182L	14p
2N2906	28p	2N3789	2.90	2N6107	42p	AF279	80p	BC183	11p
2N2806A	25p	2N3790	3.10	2N6109	42p	AF280	85p	BC183L	14p

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Radiant Wall Heaters for bathrooms, workshops etc. advantage with this type of heater is that the benefit is felt immediately and there is virtually no warm up period. Due to a recent large purchase we can offer the Springfield 750w. This is a 750w heater 20 1/2 inches long. Quite nice design with highly polished reflector and chrome plated guard, wall mounting brackets and pull cord switch. Retail price originally intended to be £65.00, we are able to see it at £39. Post 79p + 9p.

5 Pole Motor. Carefully balanced spindle fitted with belt drive pulley for tape recorders etc. Normal mains running, speed 1250 rpm. Price £100w + 19p. Post 30p + 13p.

100watt Mains Transformer. 240v 50hz primary wound in separate halves, primary screen. This has three secondaries 24-0-24, 0-40v and 0-98v tapped to 80v. Any one of these secondaries may be loaded up to the 100 watts or the load can of course be spread over to all the secondaries. Upright mounting, impregnated and varnished. Size 4" x 3 1/2" x 3". Price £3.50 + 25p Post 80p + 6p.

Stereo Plate twin screen fig. 8 type. PVC insulated overall. 10 metres for £1 + 8p.

Leaching Relay by Gurrilow Electric, mains operated it is in fact two relays mounted on a metal base plate. The relays being mounted in such a way to ensure that when one closes the other opens and vice versa thus when closed, relay A would be locked in. It is electrically released or electrically released by energising relay B. Each relay has 2 sets of 10 amp change-over contacts. Should be ideal for burglar alarms and similar applications. Price £1.90p + 16p.

Connecting Wires. 7 stranded PVC insulated on 500 metre drums, 5 different colours available. Price £4 per 500 metres + 32p. Post £1 + 5p. Please give alternative colours when ordering.

3 Track Stereo Cassette Deck. Complete mechanism with push button operated track selection. Tape head and pre-amp, Japanese made with front flap for cassette entry. Price £5.50p + 68p. Post 40p + 8p.

Mains Power Supply to suit deck £2 + 25p.

8 Track Stereo Car Cassette Player. 12 volt with polarity reversing switch. Speakers not included, these were sold under the trade name "Elpico" at just under £20 each. The ones we have are faulty on arrival from Japan but have been serviced. Price £9.50p + £1.90p. Post 50p + 7p. We also have few of these still in need of a repair but complete and we believe quite repairable. Price £8.60p + 82p. Post 50p + 7p.

Shaver Light with isolated socket. As you know normal mains sockets must not be used in bathrooms on account of the danger of an accident through touching the live side when earthed through bath or sink etc. However, provided it is isolated from earth a shaver socket is allowable and the one we are offering complies with this requirement. It is also fitted with a pull cord switch and is ideal for use over the mirror in the bathroom. Price £8.50p + 68p. Post £1.50p + 12p.

Pressure Control Switch made by Allan Bradley of the U.S.A., their ref. no. 338. Completely adjustable from 30" of vacuum to zero then up to 70lbs per square inch of air pressure. This also has an adjustable differential which can be set to pressure tolerance of between 2-15 psi. The switch operates changeover contacts which look capable of breaking up to 15 amps AC. Few only of these, price £15 + £1.90p.

Air Flow Sensor, American made by the Foxborough Company. We have two different types. One bears ref. NPS-503A and the other MFS-502B. These are beautifully made precision units obviously intended for fitting into very high pressure air or gas lines. This is an inbuilt turbine and magnetically coupled electrical contacts but other than this we have no information on these sensors, price is negotiable.

Converter Amplifier, again made by the Foxborough Company, their part no. N 137 CR. We believe these are for use with the above air flow sensors, price again negotiable.

Motor with Gear Box made by Klaxon, their type no. EK3Q 32-M21. This is a very popular type of motor, final drive shaft comes out at right angles to the motor. Final speed is 10 rpm. Approximate size of the motor casing 07" long x 1 1/2" diameter. These are ex-equipment but guaranteed o.k. supplied complete with transformer for use on standard 230v 50hz mains. Price £4 + 32p. Post 80p + 6p.

Mains Table Radio, Japanese made. This is a Medium wave valve receiver with built in aerial, plenty of volume and reasonable tone. Will receive all strong and medium power stations on the wave bands—medium wave. This type of radio is coming back into popularity owing to the very high price of batteries. Price £4.90p + 50p. Post £1.50p + 19p.

Auto Transformer 20 watt 240 volt to 115 volt. This is the same as the transformer above as this has a centre tapped primary. Price £1.50p + 19p.

Mains Battery Eliminator, Japanese made. Bakelite encased with two prongs for shaver and adaptor. This has output of 4.5v at 100 mA and is, therefore, suitable to use in radios or similar equipment that use three 1.5 cells or by small internal alterations the voltage can be stepped up to 6 volts very easily or 9v and 12v. Price £2.00 + 25p. ditto but 9V, Price £2.50p + 30p.

Car Starter. Most drivers who use their car around town find that on a very cold morning they have difficulty in starting because the battery has not any charge left in it. This may seem to happen on the morning when you are in a particular hurry so a charger/starter is well worth having. Our kit for this comprises: a heavy duty 250w transformer and full wave rectifier which for short periods will deliver 20 amps. This is usually enough to get the car started, directly it has started the circuit can be disconnected from the battery as the car's internal charger will take over. Special offer price of this is £6.50p including post and VAT.

MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Celestion speakers normally £8. This should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £14 including VAT and postage.



PAPST MOTOR

West German make, these fine motors are noted for their performance and reliability. Special features are the rotating heavy outer which acts as a flywheel to eliminate wot and flutter and switchable reversing.

We have four types in stock, all 1350 revs., including starting capacitor.

(1) Reference No. KLZ 20.50-4, 230 volts 50HZ, price £5.50
(2) Reference No. KLZ 32.50-4, 230 volts 50HZ, price £6.50
(3) Reference same as above, 115 volts 60HZ, price £2.50
(4) Reference same as above, 110 volts 60HZ, price £2.50
Post and VAT 80p each extra.

AEROSOL RELEASE LUBRICANT

Try Film Lubricant. In a special can for easy application and for putting lubricant into places where the normal oil can cannot reach. House and everyday use. We have purchased a large quantity of these from the Lubricator and are able to offer them to you for about half of the original list price. 88p per 8oz can or 12 cans for £3 Post & VAT Paid. The lubricant is I.C.I. fluid L169.

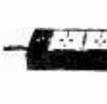


MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fans, blower, heaters, etc. New and perfect. 8hp at 95p + VAT & Postage 35p. 1" stackmotor £1.50 + VAT & Postage 35p. 1 1/2" stackmotor. £2 + VAT and Postage 40p.

MULTI SPEED MOTORS

Six speeds are available 500, 850 and 1,100 r.p.m. and 7,000, 9,000 and 11,000 r.p.m. Shaft is 1/8 in. diameter and approximately 1 in. long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia x 5 in. long. Price £2.00 including Post & VAT. Speed control switch 50p + 4p.



DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon charging light. Supplied complete with 6 feet of flex cable. Wired up ready to work. £2.75, VAT & Postage 65p.

MOTORISED DISCO SWITCHES

With six 10 amp changeover switches. Multiple adjustable switches are rated at 10 amp each so a total of 2000w's can be controlled and this would provide a magnificent display. For mains operating £4.25 post & VAT Paid. Ditto 9 switch £4.95 Post & VAT Paid. DITTO BUT 12 SWITCH £5.75 POST & VAT PAID.



BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nickel—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace", "weak" or "good". The tester is complete in its case, size 3 1/2" x 6 1/2" x 2" with leads and prod. £4.50 post & VAT paid.

CENTRIFUGAL BLOWER

Miniature mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quick running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4 1/2" x 4 1/2" x 4". When mounted by flange, air is blown into the equipment, but to suck it out, mount from centre using clamp. Ideal for cooling electrical equipment or fitting into a cooker hood, film drying, cabinet or for removing flux smoke when soldering, etc. A real bargain at £3.30. 60p post & VAT.



BREAK-DOWN UNIT

Contains hundreds of useful parts some of which are as follows—86 silicon diodes equivalent OA91, 68 resistors, mostly 1/2 watt 5% covering a wide range of values 4 x .1 mfd 400v mfd condensers, 15 x .01 mfd 100v condensers, 2 RF chokes x BD valve holders, 1 x 4H choke, 1 x 115v transformer, 1 boxed unit containing 4 delay lines also tag panels, trimmer condensers, suppressors, etc., on a useful chassis sized approx. 9" x 8" x 7". Only 75p (the 66 diodes would cost at least 10 times this amount). This is a snip not to be missed. Post and VAT 75p.

HONEYWELL PROGAMMER

This is a drum timing device, the drum being calibrated to equal divisions. The switch-setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips, thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control. Boiler firing. Dispensing and Vending machines. Display lighting animated and signs. Signalling, etc. Price from makers probably over £20 each. Special snip price £9.95. £1.00 Post and VAT. Don't miss this terrific bargain.



TERMS: Where order is under £8 please add 50p surcharge to offset packing expenses

J. BULL (ELECTRICAL) LTD.

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Light for Growing. With the ever increasing price of oil, more and more growers are using insulated buildings without any daylight and are using electric lamps for light and heat. Various types of lamps are recommended, amongst these are 8' fluorescent tubes, warm white with internal reflector. We recently acquired a quantity of these with suitable control gear and can, therefore, make a special offer as follows: If you buy 100 sets each set comprising 8ft tube, instant start ballast, electric regulating capacitor, two 4 pin tube connectors and two terry clips for holding the tube. Price £3 + 24p per set. Collected from our depot in Sussex or delivered to you—delivery charge at cost. We have only 1000 of these sets so this offer should be taken up quickly.

Mains Volt Drop Compensation Transformer. Another irritating thing which happens in cold weather is that the mains voltage drops and this can often drop to such a low point as to make soldering irons unusable or very slow in operation and also upsets the working of other instruments. Even in normal weather if you put a long line through to a distant workshop you may find that the voltage is low, due to voltage drop along the line so the compensation transformer may be the cheap way of restoring voltage to normal. The other alternative is to install a much heavier cable. Our 500w Auto Transformer will give voltage increases of 10, 20, 30 or 50 volts depending on which tapping you use. Price £4.60p + 36p. Post £1.00 + 8p.

Cable Bargains. We have now sold out of all the 7029 3 core and also all the 1.5mm 3 core. We are also rapidly going through our stocks of 7029 3 core and earth and 1.5, 3 core and earth. You will recall that we made a special offer of these cables at £9.60p + 75p and £5.50p + 75p. The special installation work planned then we advise you to buy early to avoid disappointment. We have most other sizes of cable in stock but of course these are not so popular.

Variable Inductance Choke. In an unstarated core state a choke will oppose the flow of AC very much more than when its core is saturated, therefore, if the choke is built with a separate coil to deliberately saturate the core, a very small current of variable dimension will act as a voltage regulator. Use this for lamp dimming and a multitude of other purposes. We offer such a choke of 8 amp AC rating and 10 amp AC rating. Control current at bargain price of £3.50p + £1.90p. Carriage £2.00 + 40p. This choke weighs approx. 60lbs.

Panel Meter 0-1mA. Japanese made full vision perspex front, flush mounting. Price £2.50 + 16p. Constant Voltage Auto Transformer for operating 110v equipment off our standard 230/240v mains. Input voltage can be plus or minus 20%, output voltage will be a steady 115 volt, beautifully made by an American Company. Two models available 500w £35 + £3.90p. Post 2 + 16p. 750w model £38 + 4. Carriage £3 + 4p.

Tangential Blower with quiet metal impeller driven by a powerful but quiet mains operated induction motor. These give a real blow (or suck) with the minimum of noise. The air outlet is 9 1/2" x 1 1/2" approx. so they are ideal for fitting into a cooker hood, forced air heater etc.. Price £3.00 + 24p. Post 80p + 6p.

Tabular Heating Element. Spiral wire element, wound on a porcelain tube approx. 1 1/2" dia. and 3 1/2" long. 500w rating at 240 volts with flat tag connectors. Internal diameter of the porcelain tube is 1 1/2" and it is completely free from obstructions and live parts so it can be slipped over a tube to heat the contents of the tube or the tube could simply be used to support the element, for instance if this was being mounted in front of the tangential blower mentioned above. Price 50p + 4p.

Rectangular Hot Plate Element with aluminium, with ridged top and angles underneath to strengthen it. This is approx. 10" x 4 1/2" of flat plate. Beneath plate is 100w element and sensor switch which will maintain the surface of the plate just too hot to touch. With leads and tags. This is ideal if you are making up a main up a wiring cupboard etc. Price 75p + 6p. Post 20p + 2p.

Miniature Mains Transformer, standard primary centre tap secondary giving 4.5v-0-4.5v 200 mA. Price £1.50p + 12p.

Mains Transformer 80volt 4 amp. Upright mounting standard primary centre tapped and fixing feet. Price £1.50p + 19p.

Humidity Switch, American made by Ranco, their type No. J 11. The action of this device depends upon the dampness causing a membrane to stretch and dryness causing it to contract. The stretching of the membrane through the dampness will trigger a sensitive microswitch. The actual point of switching is adjustable by a screw within the device. It is quite sensitive breathing on it for instance will switch it on. The rating of the micro-switch we understand is 3 amp at 250v AC. Over the top of the device approx. 3 1/2" long 1 1/2" wide and 1 1/2" deep. Price 60p + 5p.

Panel Meter 100mA flush mounting 3 1/2" round face, moving coil movement face printed 0-100 divided into single divisions. Made by Taylor Electrical this has long terminals protruding from the back so can be mounted on thick panel also it would be a relatively simple matter to add shunts to convert this to read amps or tens of amps etc. Price £1.50p + 12p.

Charge/Discharge Indication meter. This is a heavy panel mounting instrument made originally for the G.F.O., former oil design but still useful with all fuel. Bargain price. The operation of this depends upon a Mercury motor which revolves clockwise or anti clockwise depending upon whether the batteries are charging or discharging. A pointer shows the state of charge of the batteries at any time. Also fitted with the instruments auxiliary contacts which could be used to set off alarms like lamps etc. Price £4.50p + 36p. Post £1.00 + 8p.

PRINTED CIRCUIT KIT £4.25

Make your own printed circuits. Contains etching dish, 100 sq. in. of pc board, 1 lb ferric chloride, etch resist pen, drill bit and instructions.

JC12 AMPLIFIER

6W IC audio amp with free data and printed circuit
£2.25



DELUXE KIT FOR JC12

Contains extra parts except JC12 needed to complete the amp including balance, volume, bass and treble controls. Mono £2.39. Stereo £5.25.

JC12 POWER KIT

Supplies 25V 1 Amp £3.95.

JC12 PREAMP KITS

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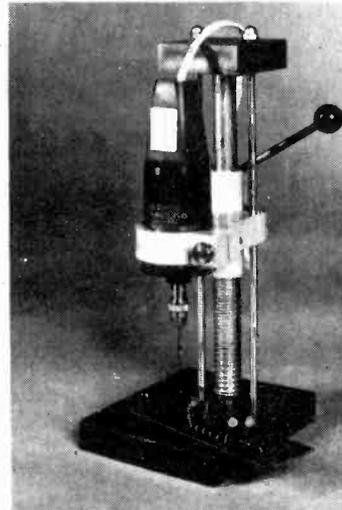
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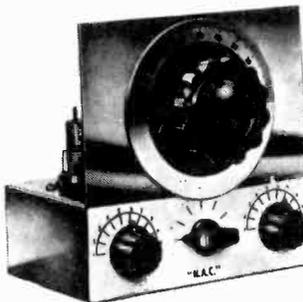
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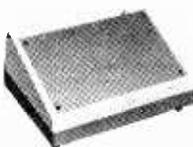


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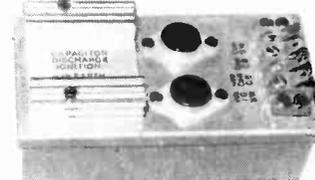
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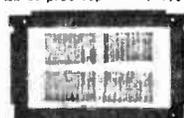
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POLYESTER CAPACITORS: Axial lead type. (Values are in μ F).
400V: 0-001, 0-0015, 0-0022, 0-0033 7p; 0-0047, 0-0068, 0-01, 0-015, 0-018 8p; 0-022, 0-033, 9p; 0-047, 0-068, 0-1, 1.1p; 0-15, 0-22 12p; 0-33, 0-3, 0-47 28p; 0-68 38p.
160V: 0-039, 0-1, 0-15, 0-22 11p; 0-33, 0-47 19p; 0-68, 1-0 22p; 1-5 29p; 2-2 32p; 4-7 38p.
DUBILIER: 1000V: 0-01, 0-015, 0-02, 0-022 18p; 0-047 16p; 0-1 29p; 0-47 16p; 0-1 29p; 0-47 43p; 1-0, 8p.

POLYESTER RADIAL LEAD (Values in μ F): 250V: 0-01, 0-015 5p; 0-022, 0-027 6p; 0-033, 0-047, 0-068, 0-1 7p; 0-15 10p. **FEED THROUGH CAPACITORS 10p; 0-22, 0-33 12p; 0-47 14p; 0-68 18p; 1-0 21p; 1-5 24p; 2-2 28p. 1000pF/350V 8p**

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in μ F).
250V: 100 μ F, 49p; 100V: 20, 6p; 83V: 0-47, 1-0, 1-5, 2-2, 2-5, 3-3, 4-7, 8 7p; 8, 10, 15, 22, 30, 47, 32, 50, 10p; 63, 100, 12p; 50V: 1-0, 5p; 50, 100, 12p; 220, 10p; 470, 30p; 1000, 38p; 25V: 10, 22, 47, 6p; 80, 100, 10p; 80, 100, 16p; 220, 250, 13p; 470, 640, 25p; 1000, 27p; 1500, 30p; 2000, 34p; 3300, 37p; 4700, 47p; 16V: 1-0, 10, 47, 68, 6p; 100, 125, 7p; 470, 12p; 1000, 1500, 18p; 2200, 25p; 10V: 4, 100, 6p; 540, 10p; 1000, 14p.
TAG-END TYPE: 70V: 2500, 98p; 4700, 121p; 64V: 3300, 94p; 10000 165p; 40V: 4000 70p; 2500, 85p; 25V: 4700, 48p; 16V: 4500 38p; 84V: 2000+2000 95p.

TANTALUM BEAD CAPACITORS
35V: 0-1 μ F, 0-22, 0-33, 0-47, 0-68, 1-0, 2-2 μ F, 3-3, 4-7, 8, 8, 25V: 1-5, 10, 20V: 1-5, 16V: 10 μ F, 22, 47, 10V: 4-7, 15, 25, 33, 8V: 47 μ F, 68, 3V: 100 μ F, 12p each.

MYLAR FILM CAPACITORS
100V: 0-001, 0-002, 0-005, 0-01 μ F 5p
0-015, 0-02, 0-04, 0-05, 0-056 μ F 8p
0-1 μ F, 0-15, 0-2 7p. 50V: 0-47 μ F 10p

CERAMIC CAPACITORS 50V.
Range: 0-5pF to 10,000pF 3p
0-015 μ F, 0-022 μ F, 0-033 μ F, 0-047 μ F 4p
TETTER Trimmer (Jackson) 10pF, 58p.

JACKSONS VARIABLE CAPS.
Dielectric 100pF
100/3000F 10p
500pF 12p
DILEMIN 18p
300pF/500pF 18p
4532/K 2 special
Drive Unit complete
with knobs and
coupling 35p*
8.1 Drum 5mm 30p*
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Dial Drive 4103
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0-1-365pF 268p
0-2-365pF 275p
0-208/178 285p
... with
motion drive 305p
C804-5pF; 10; 15; 20;
25; 50pF 135p*
0-1, 50pF 185p*
'L' 3x10pF 332p
'0'-3x25pF 348p

SILVER MICA (pF)
3, 3, 4, 7, 8, 10, 12, 18,
22, 33, 47, 50, 68, 75, 82,
85, 100, 120, 150, 200,
250, 300, 330, 360, 390,
500 & 820pF 9p each.
1000, 2200pF 12p each.

CERAMIC TRIMMER CAPACITORS
2-7pF; 4-15pF; 6-25pF; 8-30pF 20p

MINIATURE TYPE:
2-5-6pF; 3-10pF; 3-30pF; 10-40pF 22p
5-25pF; 60pF; 88pF 30p

COMPRESSOR TYPE
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20-140pF; 50-200pF 31p
80-500pF 1250pF 38p

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0-1W 50p-2.2M Mini Vert. Horiz. 7p
0-25V 100 Ω -3-3M Ω Horiz. 1p
0-25V 200 Ω -4-7M Ω Vert. 8p

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RANGE Val. 1-99 100+
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0-5W 2-20-4-7M E24 2-1p 5p
1W 2-20-10M E12 5p 4p
2 $\frac{1}{2}$ Metal Film 10 Ω -1M Ω 8p

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TO9 9p
TO18 8p
TO18 22p
TO3 22p
TO66 22p
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Mica plus
3 Bushes for
TO3/TO6 or
Plastic Trns5p
Silicon
Grease 12p

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6-7 B, Y, R 70p
1-5 Green 85p
'T' Type (Tr. tuning)
Rng. 1-5 B, Y, R, W
86p
B9A Valve Base 23p
RDT2 85p
RFC 5 chokes 84p
RFC 5 (719MHz) 90p
IFT 12/14/15/16/17 78p
IFT 18/1-6 or 465 95p
TOCI 80p
MW 5FR 78p
MW/LW 5FR 95p

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2-5mm 18p
3-5mm 18p
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DIL Sockets*
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(Texas)
Red, Black,
Yellow, 21p
8pin 11p
14pin 12p
16pin 13p
24pin 30p
28pin 45p
40pin 80p
PPS 10p

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8pin 6p
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Open
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p	p	p	p	p	p	p	p
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AC125* 22	BC157 19	BF181* 33	MPSU06 52	TIS44 27	2N3053* 49		
AC126* 18	BC158 12	BF182* 33	MPSU55 52	TIS46 40	2N3054* 48		
AC127* 18	BC159 13	BF183* 33	MPSU56 74	TIS74 47	2N3055* 49		
AC128* 18	BC160 32	BF184* 33	MPSU57 28	TIS75 47	2N3056* 78		
AC129* 18	BC161 32	BF185* 30	MPU131* 38	TIS91 24	2N3814 189		
AC131* 38	BC162 12	BF186 12	OC167 59	TIX107 12	2N3815 18		
AC132* 20	BC163 14	BF187 10	OC28* 58	TIX108 12	2N3863 32		
AC134* 38	BC164 11	BF188 14	OC29* 58	TIX109 11	2N3702 11		
AC135* 38	BC165 11	BF189 15	OC35* 54	TIX300 14	2N3703 12		
AC136* 18	BC166 11	BF190 15	OC36* 58	TIX301 14	2N3704 11		
AC137* 18	BC167 11	BF191 15	OC37* 58	TIX302 19	2N3705 12		
AC138* 19	BC168 11	BF192 15	OC41* 18	TIX303 22	2N3706 11		
AC139* 18	BC169 11	BF193 15	OC42* 18	TIX304 24	2N3707 11		
AC140* 18	BC170 11	BF194 10	OC44* 25	TIX311 15	2N3708 0		
AC141* 18	BC171 11	BF195 10	OC45* 25	TIX312 15	2N3709 0		
AC142* 20	BC172 11	BF196 14	OC46* 35	TIX341 20	2N3710 12		
AC143* 38	BC173 11	BF197 15	OC70* 35	TIX500 17	2N3711 12		
AC144* 38	BC174 11	BF198 15	OC71* 23	TIX501 15	2N3712 15		
AC145* 38	BC175 11	BF199 15	OC72* 23	TIX502 19	2N3713 15		
AC146* 38	BC176 11	BF200 15	OC73* 23	TIX503 19	2N3714 15		
AC147* 38	BC177 11	BF201 15	OC74* 23	TIX504 19	2N3715 15		
AC148* 38	BC178 11	BF202 15	OC75* 23	TIX505 19	2N3716 15		
AC149* 38	BC179 11	BF203 15	OC76* 23	TIX506 19	2N3717 15		
AC150* 38	BC180 11	BF204 15	OC77* 23	TIX507 19	2N3718 15		
AC151* 38	BC181 11	BF205 15	OC78* 23	TIX508 19	2N3719 15		
AC152* 38	BC182 12	BF206 15	OC79* 23	TIX509 19	2N3720 15		
AC153* 38	BC183 11	BF207 15	OC80* 23	TIX510 19	2N3721 15		
AC154* 38	BC184 11	BF208 15	OC81* 23	TIX511 19	2N3722 15		
AC155* 38	BC185 12	BF209 15	OC82* 23	TIX512 19	2N3723 15		
AC156* 38	BC186 22	BF210 15	OC83* 23	TIX513 19	2N3724 15		
AC157* 38	BC187 22	BF211 15	OC84* 23	TIX514 19	2N3725 15		
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AC159* 38	BC189 22	BF213 15	OC86* 23	TIX516 19	2N3727 15		
AC160* 38	BC190 22	BF214 15	OC87* 23	TIX517 19	2N3728 15		
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AC162* 38	BC192 22	BF216 15	OC89* 23	TIX519 19	2N3730 15		
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AC164* 38	BC194 22	BF218 15	OC91* 23	TIX521 19	2N3732 15		
AC165* 38	BC195 22	BF219 15	OC92* 23	TIX522 19	2N3733 15		
AC166* 38	BC196 22	BF220 15	OC93* 23	TIX523 19	2N3734 15		
AC167* 38	BC197 22	BF221 15	OC94* 23	TIX524 19	2N3735 15		
AC168* 38	BC198 22	BF222 15	OC95* 23	TIX525 19	2N3736 15		
AC169* 38	BC199 22	BF223 15	OC96* 23	TIX526 19	2N3737 15		
AC170* 38	BC200 22	BF224 15	OC97* 23	TIX527 19	2N3738 15		
AC171* 38	BC201 22	BF225 15	OC98* 23	TIX528 19	2N3739 15		
AC172* 38	BC202 22	BF226 15	OC99* 23	TIX529 19	2N3740 15		
AC173* 38	BC203 22	BF227 15	OC100* 23	TIX530 19	2N3741 15		
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AC197* 38	BC227 22	BF251 15	OC124* 23	TIX554 19	2N3765 15		
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AC199* 38							

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Sensitivity A.C.	667 o.p.v.	2,000 o.p.v.	2,000 o.p.v.
D.C. Current	300 μ A-6A	60 μ A-1.5A	50 μ A-2.5A
A.C. Current	1.5mA-6A	0.6mA-1.5A	0.5mA-2.5A
D.C. Volts	75mV-900V	75mV-600V	75mV-1000V
A.C. Volts	300mV-900V	15V-600V	1V-1000V
Resistance	0-02-3k Ω	1K-1M	300 Ω -500k Ω
Capacity	—	0.5 μ F	0.5 μ F
Accuracy	1% D.C., 1.5% A.C.	1.5% D.C., 2.5% A.C.	2.5% D.C., 4% A.C.

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TYPE U4341

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16700 Ω /V D.C.,
330 Ω /V A.C.

Ranges:
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A.C. current 0.3-3-30-300mA
D.C. Voltage: 0.3-1.5-6-30-60-150-300-900V
A.C. Voltage: 1.5-7.5-30-150-300-750V
Resistance: 2-20-200 Ω -2M Ω
Transistor collector cut-off current 60 μ A
Transistor D.C. current gain in two ranges 10-350
Accuracy: 2.5% D.C.,
4.0% A.C.,
5% D.C. current gain
Power supplies: 4.5V battery (Eveready 1289)

Complete with steel carrying case, test lead, battery and instruction manual £14.50

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TYPE U4324

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A.C. Current: 0.3-3-30-300mA-3A
D.C. Voltage: 0.6-1.2-3-12-30-60-120-600-1200V
A.C. Voltage: 3-6-15-60-150-300-600-900V
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30x30 WATT AMPLIFIER KIT

Specially designed by RT-VC for the experienced constructor, this kit comes complete in every detail. Same facilities as Viscount IV amplifier. Chassis is ready punched, drilled and formed. Cabinet is finished in teak veneer. Black fascia and easy-to-handle aluminium knobs. **£2900**
Output 30+30 watts rms, 60+60 peak.
+ p & p £2.10



35-WATT DISCO AMP

Here's the mono unit you need to start off with. Gives you a good solid 35 watts rms, 70 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble **£2750**
controls and master volume. + p & p £1.50

STEREO CASSETTE DECK KIT

Again, this kit is specially designed for the experienced constructor - for mounting into his own cabinet. Features include solenoid-assisted AUTO-STOP, **£3250**
3-digit counter, record/replay PC board, + p & p
mains transformer and input and output controls. AC BIAS AND ERASE. £1.50



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£395
Comprises of a matched pair of dynamic mics. and two replacement slider level controls. P & P + p & p £1.00

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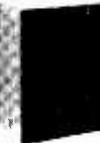
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Specially designed by RT-VC for cost-conscious hi-fi enthusiasts, these kits incorporate two teak-simulate enclosures, two EMI 13" x 8" (approx.) woofers, two tweeters and a pair of matching cross-overs. Easily constructed, using a few basic tools. Supplied complete with an easy-to-follow circuit diagram, and crossover components. Input 15 watts rms, 30 watts peak, each unit. **£2550**
Cabinet size 20" x 11" x 9 1/2" PER PAIR
(approx.) + p & p £5.50



20x20 WATT STEREO AMPLIFIER



£2900
+ p & p £2.10

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HOW YOU CAN SAVE

SYSTEM 1B For only £80, you get the 20+20 watt Viscount IV amplifier, a pair of our 12-watt-rms Duo Type 1b matched speakers, a BSR MP 60 type deck complete with magnetic cartridge, de luxe plinth **£8000**
and cover. + p & p £10.00
Carriage surcharge to Scotland

SYSTEM 2 Comprising our 20+20 watt Viscount IV amplifier; a pair of our large Duo Type III matching speakers which handle 20 watts rms each, and a BSR MP 60 type deck with magnetic cartridge, **£9200**
de luxe plinth and cover. + p & p £10.00

SPEAKERS Two models: Duo 1b, teak veneer, 12 watts rms, 24 watts peak, 18 1/2" x 13 1/2" x 7 1/4" approx. **£34** PER PAIR
+ p & p £5.50
Duo III, 20 watts rms, 40 watts peak, 27" x 13" x 11 1/2" approx. **£52** PER PAIR
+ p & p £7.50

TURNTABLE Popular BSR MP 60 type, complete with magnetic cartridge, diamond stylus, and de luxe plinth and cover. **£2900**
+ p & p £4.50

4x4 STEREO AMP KIT

£14.50 + p & p £2.00

For the experienced constructor who wants to design his own stereo, kit includes all necessary components including constructors manual. Plus Pair of easy to build 4 watt speakers in kit form, with teak simulate finish cabinets 12" x 9" x 5" approx

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How about this for incredible bookshelf value from RT-VC! A pair of high efficiency units for only £7.50 - just what you need for low-power amplifiers. These infinite baffle enclosures come to you ready mitred and professionally finished. Each cabinet measures 12" x 9" x 5" (approx.) deep, and is in wood simulate. Complete with two 8" (approx.) speakers for max. **£750** per pair
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