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

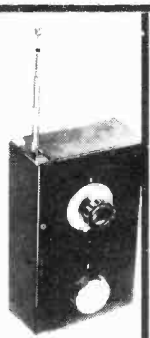
Completely Solderless Electronic Construction Kit. Build these projects without soldering iron or solder

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

Components include: 24 Resistors ★ 21 Capacitors ★ 10 Transistors ★ 5" × 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.

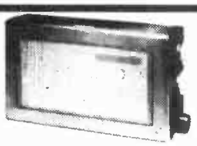
Total Building Costs £9·00
P & P + Ins. 85p.

VHF AIR CONVERTER KIT



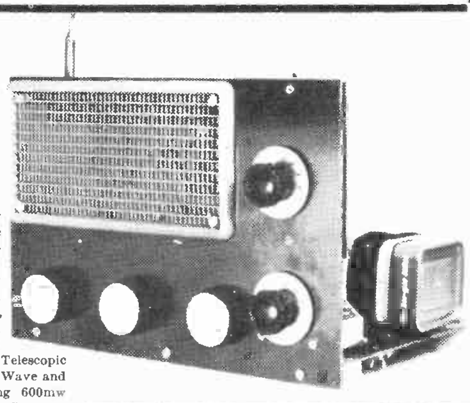
Build this Converter Kit and receive the Aircraft Band by placing it by the side of a radio tuned to Medium Wave or the Long Wave Band and operating as shown in the instructions supplied free with all parts. Uses a retractable chrome plated telescopic aerial, Gain Control, V.H.F. Tuning Capacitor, Transistor, etc.
All Parts including Case and Plans.
£3·95 P & P and Ins. 45p.

POCKET FIVE



NOW WITH 3" LOUDSPEAKER
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 5¼" × 1¼" × 3½" approx.
All Parts including Case and Plans.
Total Building Costs **£3·60** P&P+Ins.60p.

NEW ROAMER TEN MODEL R.K.3.

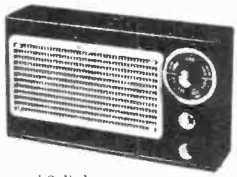


MULTIBAND V.H.F. AND A.M. RECEIVER
13 TRANSISTORS AND FIVE DIODES
QUALITY 5" × 3" LOUDSPEAKER

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, angled 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.

£13·99 Including Post and Packing
Case Enclosure Kit (if required) £1·80 inc. P & P.

NEW Everyday Series



Build this exciting new series of designs.

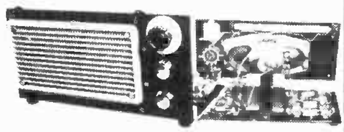
E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3" loudspeaker. Attractive case with red speaker grille. Size 9" × 5¼ × 2¾" approx. All parts including Case and Plans.
Total Building costs **£4·30** P & P + Ins. 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.
Total Building costs **£6·95** P & P + Ins. 70p.

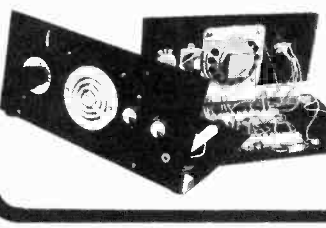
ELECTRONIC CONSTRUCTION KITS

ECK2 Self Contained Multi-Band V.H.F. Receiver Kit. 8 Transistors and 3 Diodes. Push/Pull output. 3" Loudspeaker, Gain Control. Superb 9-section swivel ratchet and retractable chrome plated telescopic aerial, V.H.F. Tuning Capacitor, Resistors, Capacitors, Transistors, etc. Will receive T.V. Sound, Public Service Band, Aircraft, V.H.F. Local Stations, etc. Operates from a 9 Volt PP7 Battery (not supplied with kit).
Complete kit of parts including construction plans.
£7·95 P & P and Ins. 70p.



ECK4 7 Transistors, 6 tuneable wavebands, MW, LW, Trawler Band, 3 Short Wave Bands. Receiver Kit. With 5" × 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. **£7·25** P & P and Ins. 70p.

EDU-KIT JUNIOR



Completely Solderless Electronic Construction Kit. Build these projects without Soldering Iron or Solder.

- ★ Crystal Radio Medium Wave Coverage — No Battery necessary.
- ★ One Transistor Radio.
- ★ 2 Transistor Regenerative Radio
- ★ 3 Transistor Earpiece Radio Medium Wave Coverage.
- ★ 4 Transistor Medium Wave Loudspeaker Radio.
- ★ Electronic Noise Generator
- ★ Electronic Metronome.
- ★ 4 Transistor Push/Pull Amplifier.

All parts including Loudspeaker, Earpiece, MW Ferrite Rod Aerial, Capacitors, Resistors, Transistors, etc. Complete kit of parts including construction plans.
£6·55 P & P + Ins. 60p.

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Tel: 0234 52367

ALL PRICES INCLUDE VAT Reg. No. 788372
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PW/477

PRACTICAL WIRELESS

VOL. 52 NO. 12

ISSUE 842

APRIL 1977

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

PLEASE NOTE: We do not operate a Technical Query Service except on matters concerning constructional articles published in PW. We do not supply service sheets or information on commercial radios, TV's or electronic equipment.

All queries must be accompanied by a stamped, self-addressed envelope otherwise a reply cannot be guaranteed.

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Send letters concerning editorial matters to the **Editor, Lionel Howes.**

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NEWS & COMMENT

CONSTRUCTIONAL

OTHER FEATURES

We regret that we cannot answer technical queries by telephone nor can we provide information or advice on manufacturers' products other than that given in the magazine. We will endeavour to assist readers who have queries relating to articles published but we cannot offer advice on modifications to our published designs. All correspondents expecting a reply should enclose a stamped addressed envelope.

RETURN OF POST MAIL-ORDER SERVICE

R.C.S. 100 watt MIXER/AMPLIFIER ALL VALVE CHASSIS

Four inputs. Four way mixing, master volume, treble and bass controls. Suits all speakers. This professional quality amplifier chassis is suitable for all groups, disco, P.A., where high quality power is required. 5 speaker outputs. A/C mains operated. Slave output. Produced by demand for a quality valve amplifier. Send for details
Suitable carrying cabinet £14. Price **£85** carr. £2·50

ANOTHER R.C.S. BARGAIN !

ELAC 9 + 5in. HI-FI SPEAKER TYPE 59RM

This famous unit now available, 10 watts, 8 ohm.

Price **£3·25** Post 40p

10" ELAC HI-FI SPEAKER

Large ceramic magnet. 50-16,000 cps. Bass resonance 55 cps. 16 ohm impedance. 10 watts.

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MODEL "A". 20 × 13 × 12in. For 12 in. dia. or 10in. speaker. Illustrated **£13·50** Post 95p.

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Size 12½in. × 9½in. × 5½in. Response 50 to 14,000 cps 8 watts rms 4 or 8 or 16 ohms.
£12 pair Post 75p

LOUDSPEAKER CABINET WADDING 18in. wide, 20p ft.

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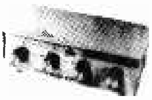
3½in. diam. 18,000 C.P.S. 25 WATTS 8 Ω **£3·25**
8 inch woofer 15 watts £6·75.

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£5·75**



STEREO VERSION OF ABOVE £7·50.

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. Mains Supply £2·95. **£3·95**

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER. suitable for cassettes, and all sizes of tape reels. A.C. mains 200/240V.
Leaflet S.A.E. **£4.25** Post 40p

WAFER THIN HEATING ELEMENTS

OFFERING 1001 USES for every type of heating and drying applications in the home, garage, greenhouse, factory (available in manufacturing quantities). Approx. size 10¾ × 8¼ × 1/16in. Operating voltage 200/250V. a.c. 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photo-copiers and print drying equipment.
Ideal for home handymen and experimenters. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos, etc., to make efficient clothes dryers, towel rails—ideal for airing cupboards. Ideal for anti-frost device for the garage—preventing frozen radiators or acting as oil sump heater. Use in greenhouse for seed raising and plant protection. Invaluable aid for bird houses, incubators, etc., etc. Can be used in series for lower heat. Or in parallel for higher heat applications.

ONLY **40p** EACH (FOUR FOR £1·50)

ALL POST PAID—Discounts for quantity.

BAKER MAJOR 12" £14·95

Post £1

30-14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s rated 25 watts. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. **£18·95**

Please state 4 or 8 or 16 ohms. Post £1·60

BAKER SPEAKERS "BIG SOUND"

Robustly constructed to stand up to long periods of electronic power. As used by leading groups.
Useful response 30-13,000 cps.
Bass resonance 55 cps.

GROUP "25" 12in 30 watt 4, 8 or 16 ohms. **£11·95** Post £1

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GROUP "50/15" 15in 75 watt 8 or 16 ohms. **£24·95** post £1·60

BAKER 150 WATT QUALITY TRANSISTOR MIXER/AMPLIFIER

Professional amplifier using advanced circuit design. Ideal for disco, groups, P.A. or musical instruments. 4 inputs 4 way mixing. Master treble, bass and volume controls. 3 speaker output sockets to suit various combinations of speakers. 4 to 16 ohm. Slave output. A/C mains. Guaranteed.
Details S.A.E. 150w SLAVE £60
Latest 50 watt Model £49 **£68** Carr. £1·00

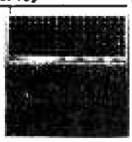
100 WATT DISCO AMPLIFIER CHASSIS

MADE BY JENNINGS MUSICAL INSTRUMENTS **£52**
4 speaker outputs, vol., treble. bass controls
CAN BE USED AS 100WATT SLAVE Carr. £1

B.S.R. SINGLE PLAYER DECK

3 speed. Plays all size records. Stereo Cartridge. Cueing. Ideal Disco Deck Post 75p **£13·50**

QUALITY LOUDSPEAKER ENCLOSURE



Teak veneered ½in thick wood cabinet. Size 18½in × 18½in × 8½in. Weight 23lb. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for 6½in. Woofer £5·95. Rosewood Version £6·95. Carr. £1·60. Baffle could be cut for larger speaker.

P.W. SOUND TO LIGHT DISPLAY

Complete kit of parts with R.C.S. printed circuit. Three channels. 600 to 1,000 watts each. As featured in Practical Wireless. Price **£12·50**
Cabinet extra £3.

8 inch PHILIPS LOUDSPEAKER

4 ohm. 4 watt. ceramic magnet **£1·95**
General purpose replacement unit.

MAINS TRANSFORMERS

Post 50p

6 VOLT ½ AMP. £1·00 3 AMP. £1·40
12 VOLT 300 MA. £1·00 750 MA. £1·30
30 VOLT 5AMP. AND 34 VOLT 2AMP C.T. £3.45
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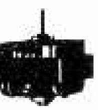
40 VOLT 2 AMP. £2·95. 0-20-40-60 VOLT 1 AMP. £3·50

E.M.I. TAPE MOTOR

4 pole, 240 v. Size 3½ × 2½in. 1200 rpm. Spindle 3/16in. diameter. 75v version £1. **£2** Post 45p



E.M.I. GRAM MOTOR

240V a.c. 2,400 rpm 2-pole. Size 2¼ × 2½in. **£1·25**
Collaro gram motor 120v. 75p. Post 35p

BAKER DISCO SPEAKERS

HIGH QUALITY—BRITISH MADE

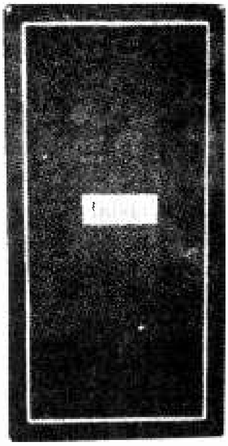
2 x 12" CABINETS

for Disco or PA all fitted with carrying handles and corners. Black finish. Other cabinets in stock. SAE For leaflet

50 WATT R.M.S. **£50** Carr. £3

70 WATT R.M.S. **£55** Carr. £3

100 WATT R.M.S. **£69** Carr. £4



1 x 15" + 1 x 12" 100 WATT CABINET
Size 36" x 24" x 15" £75·00. Carr. £5
Ideal for Disco, Ogran or PA work.
High quality. Full range.

"SUPERB HI-FI"

12in 25 watts

A high quality loudspeaker. its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.
Bass Resonance 25cps
FluxDensity 16,500 gauss
Useful response 20-17,000cps
8 or 16 ohms models.

£21·95 Post £1·60

"AUDITORIUM"

12in. 35 watts

A full range reproducer for high power, Electric Guitars, public address, multi-speaker systems, electric organs. Ideal for Hi-Fi and Discotheques.
Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 25-16,000cps
8 or 16 ohms models.

£20·95 Post £1·60

"AUDITORIUM"

15in. 45 watts

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home Hi-Fi.
Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 20-14,000cps
8 or 16 ohms models.

£24·95 Post £1·60

Loudspeaker Cabinet Wadding 18in wide. 20p per ft.

Hi-Fi Enclosure Manual containing plans, designs, crossover data and cubic tables, 68p

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QUALITY PRODUCTS
FOR HI-FI, DISCO,
P.A. GROUP AND CLUB USE

AMPLIFIER AND MIXER MODULES 25 WATTS — 100 WATTS RMS

TAM1000	100W 4 OHMS 65V		£9·80
TAM500	50W 4 OHMS 45V		£7·50
TAM250	25W 8 OHMS 45V		£4·75

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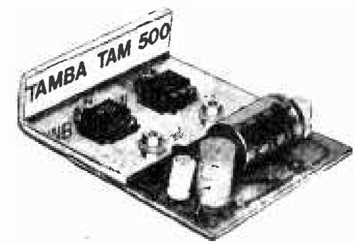
For 1 or 2 TAM250/500	£7·50
For 1 or 2 TAM1000	£9·80

(Carr. 50p on supplies)



- Suits loads 4-16 ohms
- 20-20,000 hz ±1dB
- Silicon circuitry throughout
- Glass fibre P.C.B.
- High sensitivity (100mV 10k)
- Low distortion (0·1%)
- Low profile (1" High 3½" x 3")
- 75% efficient
- Accepts most mixer/preamps
- Four simple connections

High Grade Components used throughout: Texas, Mullard, R.C.A., Plessey, etc.

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ALL PURPOSE MIXER/PREAMP

(WITH 60 mm SLIDER VOLUME)

- Anodised & printed facia
- Suitable for multiple input systems
- High & low impedance inputs
- High sensitivity
- Built in supply smoothing
- 20-20,000 hz ±1dB
- 80dB Noise level
- Accepts a wide variety of inputs
- Wide range bass & treble controls

Use up to 10 preamps with 1 power

COMPLETE & TESTED assembly with Treble & Bass controls plus slider Volume Control. £6·50

You may order as follows: C.W.O. (crossed cheques, P.O.s, M.O.s, etc.) C.O.D. (60p extra). We accept Access and Barclaycard—send or telephone your number—do not send your card. Add VAT at 8% to orders for 50–100W units and at 12½% for 25W units

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★ NEW ★ FULLY GUARANTEED COMPONENT PACKS ★ FULL SPEC. SEMI-CONDUCTORS ★ AVAILABLE IN LOW COST PACKS OF TEN ★ ALL PRICES INCLUDE VAT AND U.K. POSTAGE ★ NO HIDDEN EXTRAS ★ TEN PACKS LESS 15%.

	Price per 10		Price per 10		Price per 10		Price per 10		Price per 10
AC126	£1·50	BD131	£3 00	OA10	£2·00	TIP34B	£14·00	2N2219	£2·20
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BC108	£1·00	BFY50	£2·20	OC71	£1·00	TIPC35C	£15·30	2N2926	£1·20
BC114	£1·00	BFY52	£2 00	TIP29A	£4·50	TIP36A	£30·00	2N3053	£2·20
BC126	£1·00	BFY90	£10·00	TIP29B	£5·50	TIP36B	£32·00	2N3054	£4·50
BC147	£1·20	BFX29	£2·80	TIP29C	£6·90	TIP36C	£38·00	2N3055	£5·00
BC148	£1·20	BFX84	£3·00	TIP30A	£5·40	TIP41A	£6·30	2N3643	£2·60
BC168	£1·20	BFX87	£3 00	TIP30B	£6·90	TIP42A	£8·10	2N3702	£1·50
BC182	£1·20	BFX88	£2·50	TIP30C	£7·80	TXAL228B 3A		2N3703	£2·40
BC183	£1·20	BY127	£1·20	TIP31A	£5·50	400V Triac	£9·50	2N3706	£1·20
BC184	£1·20	BZY59	£1·00	TIP31B	£6·90	1N914	£0·60	2N3707	£1 50
BC212	£1·20	C106B	£5·00	TIP31C	£7·00	1N4003	£0·60	2N3819	£2·20
BC213	£1·20	D30 Diac		TIP32A	£6·80	1N4004	£0·70	2N3820	£2·50
BC214	£1·20		£1·50	TIP32B	£8·50	1N4005	£0 75	2N3904	£1·80
BC237	£1·20	MFC4000		TIP32C	£9·00	1N4006	£0·90	2N3905	£1·80
BCY38	£10·00		£6·00	TIP33A	£9·00	1N4148	£0 70	2N3906	£2·00
BCY70	£2·20	MFP103	£3·00	TIP33B	£11·90	2N706	£1 20	40360	£4·00
BCY71	£2 00	MPF104	£3·00	TIP33C	£13·00	2N708	£1·50	40361	£4·00
BCY72	£2·00	NKT135	£2·00	TIP34A	£13·50	2N930	£2·00	40362	£4·00

SUB-MINIATURE PRESET POTS (horiz. or vert. P.C. Mounting) 10 for 50p. 50, 100, 250, 500, 1K, 2K, 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M, ohms.

THERMAL GAS SENSOR. Figaro TGS105 £2·25 each. As used in Sept. '76 P.E. Gas/Smoke Detector.

Organ Constructors

13-NOTE BASS PEDAL BOARD

Hard wearing plastic covered steel levers. Change-over contacts on each note. Slightly shop-soiled therefore less than half price £12·50 each

Miniature Mains Transformers Pri. 240V a.c. Sec. 12V 150mA 10 for £5·75.

CELESTION 2in and 3in Tweeters. Suitable for systems up to 20W. Available in 4, 8, 16 ohms. Impedance £1·50 each. 2 for £2·90, 10 for £12·50. Crossover network suitable for above tweeters £1·50.

WIRE ENDED ELECTROLYTICS

(Mullard, Sprague, etc.) 10 for 60p.

mF	Volts	mF	Volts	mF	Volts
4	64	10	63	47	10
4·7	63	15	40	50	40
5	50	22	10	64	64
6·8	40	22	35	100	10
10	12	33	40	100	16
10	25	33	100	100	40

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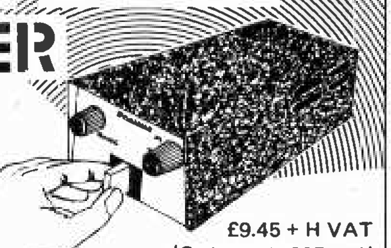

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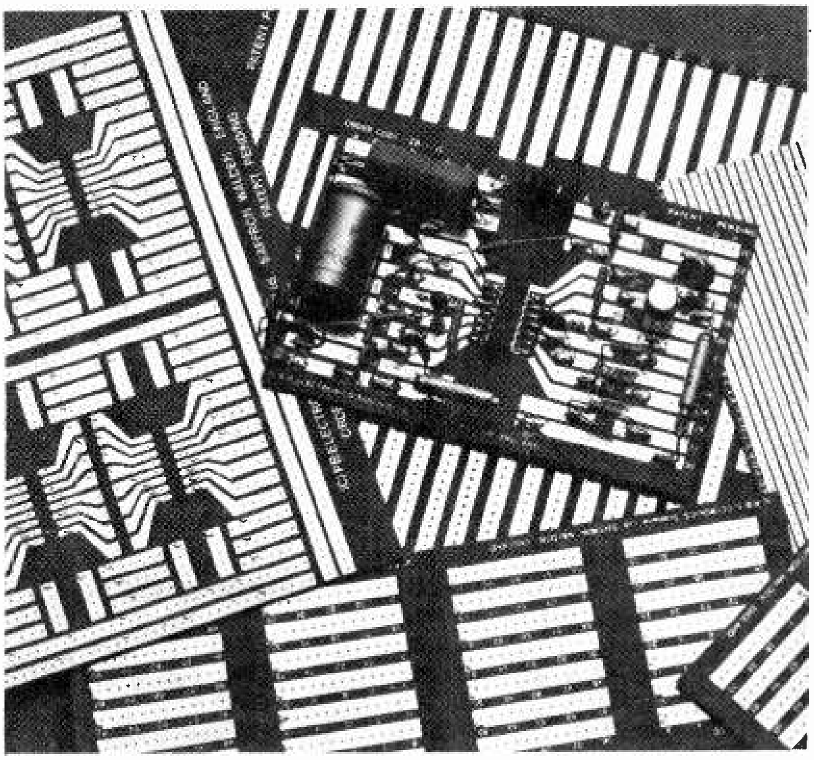

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THIS MONTH'S SPECIALS! Carr. £2·50. Sansui 331 £114·00. Pioneer 7070 £199·00. Trio KR 2600 £109·00. Sugden A21 £130·00. Minimax MK II £46·95. Sansui SC 2000/2002 £160·00.

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IN PASSING

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

NEWS...

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.

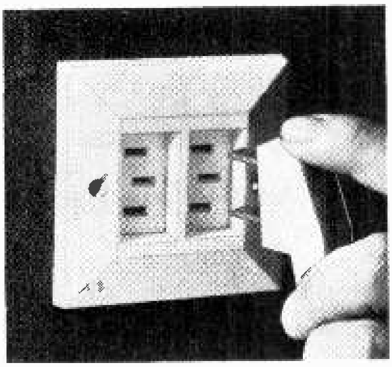
The organisers, Iliffe Promotions Ltd., say that "although the show will retain its appeal to the specialist audio and Hi-Fi enthusiasts, the 1977 Audio Fair will take account of the greatly increased family demand for sound and visual home entertainment".

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 device 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 its 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!

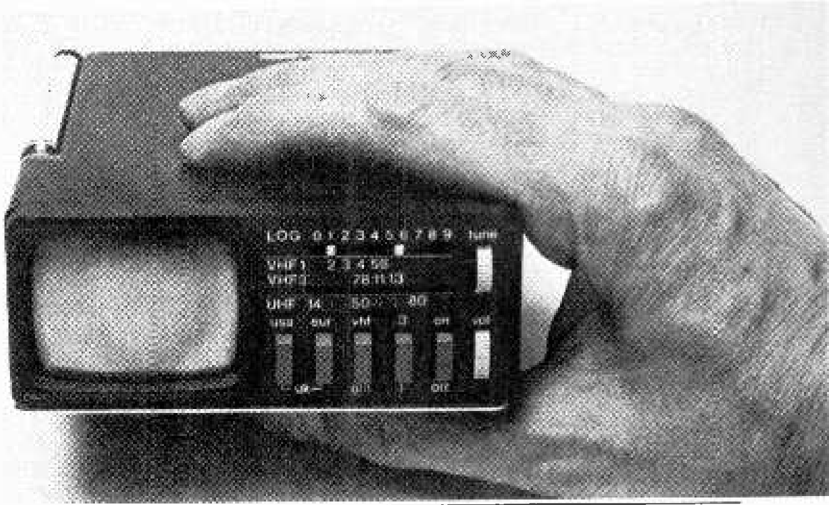
FOR the past four or five years, rumours have been flying around thick and fast concerning the imminent appearance of a pocket sized TV. It's true to say that a couple were produced and shown to the Press, but were never marketed due to some fundamental design fault. There were also more, we are led 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 rechargable 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.

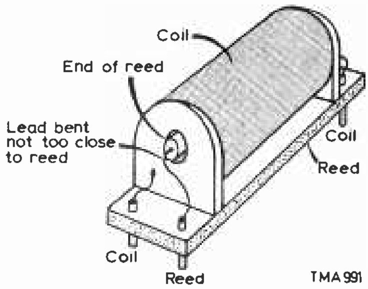


Fig. 6. Diagram of the reed relay assembly as used by the author.

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.

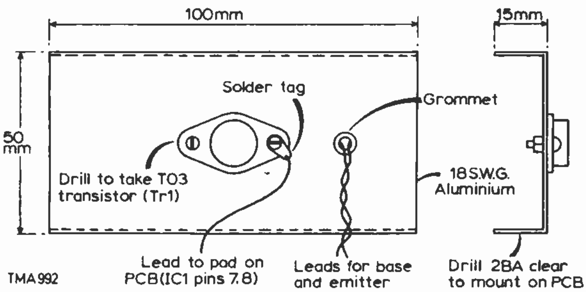


Fig. 7. Details of the heatsink for transistor Tr1, which is bolted on direct without any insulating kit. Avoid shorting the heatsink, which is at +25V, to earth.

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.

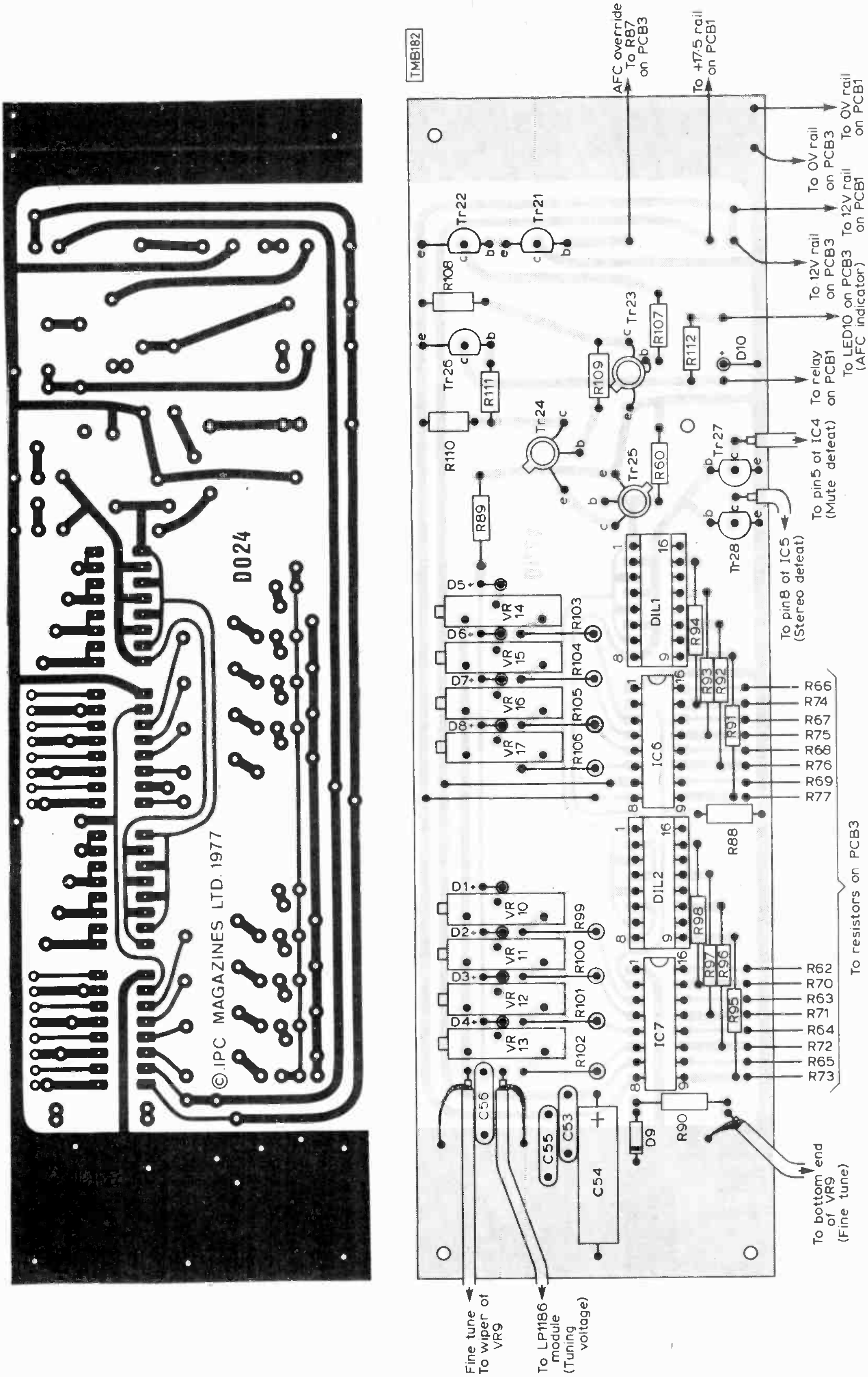


Fig. 8. PCB2 containing the touch and selection and AFC circuitry. The foil side, above, is shown full size with the component layout below. Before mounting any components on this board or on PCB3 it is a good idea to ensure that the mounting holes on the boards are coincident.

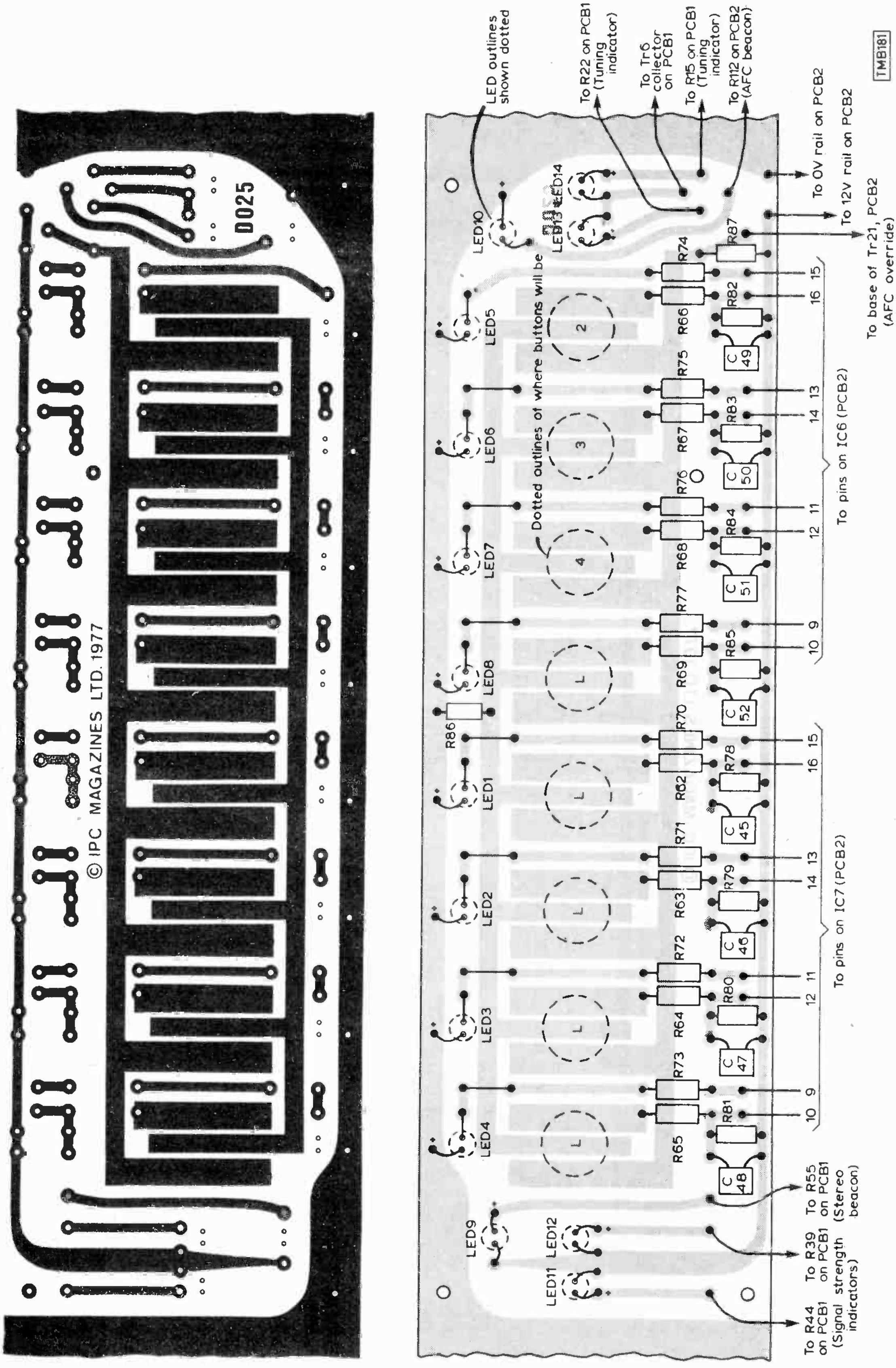
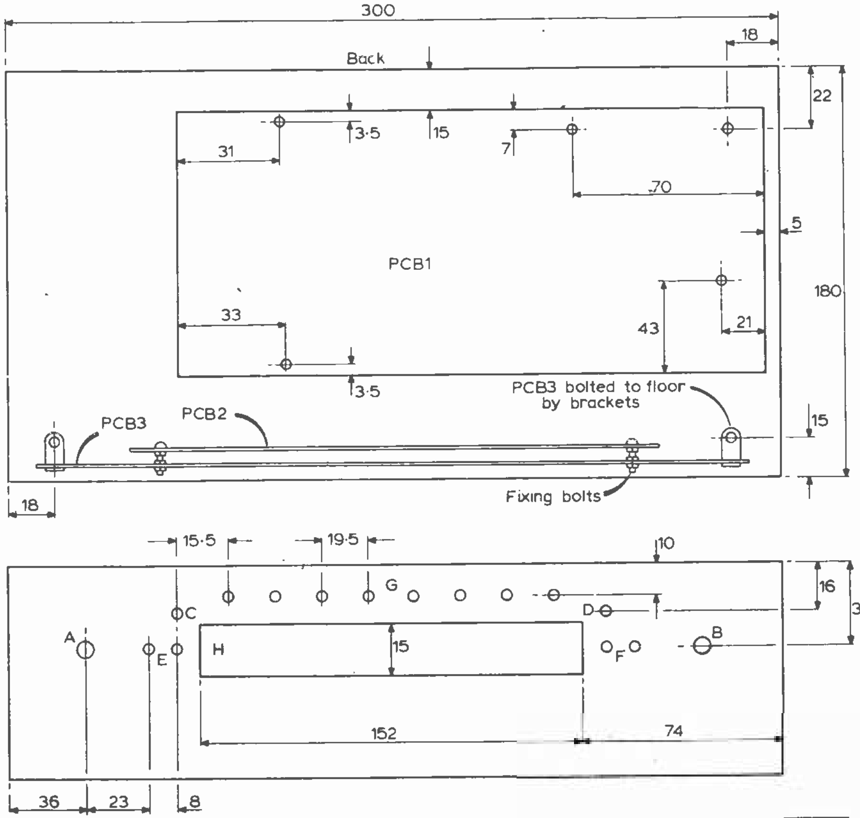


Fig. 9. Touch button board, PCB3. The etched part is shown above, full size, but the foil section either end is extended symmetrically to give an overall length of 280mm (11in). The component layout is shown below. Note that the LEDs are mounted on the copper side.

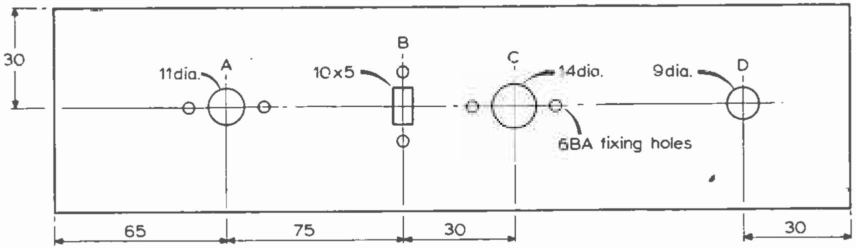


A: Hole for spindle of mains switch } 3/8" dia.
B: Hole for spindle of fine tune control }
C: AFC beacon
D: Stereo beacon
E: Tuning indicators } 0·2" dia. and filed out (See text)
F: Signal strength indicators
G: Station indicators
H: Slot to give access to touch buttons on PCB3

Dimensions in mm

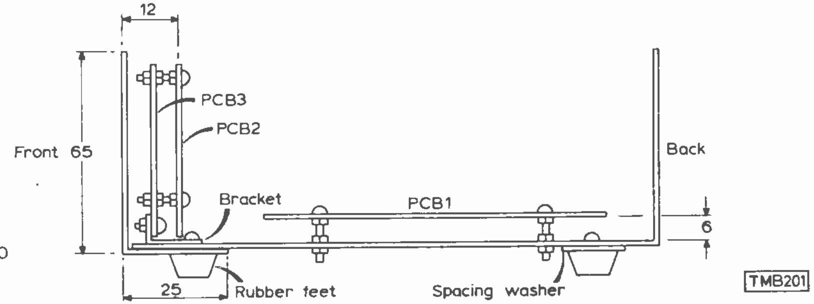
TMB203

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.



All holes drilled and filed to suit fixings. PVC grommet to be inserted in mains lead hole.
A: Coaxial socket (flush mounting)
B: S2 (Mute off)
C: DIN socket
D: Mains cable hole

Dimensions in mm



TMB201

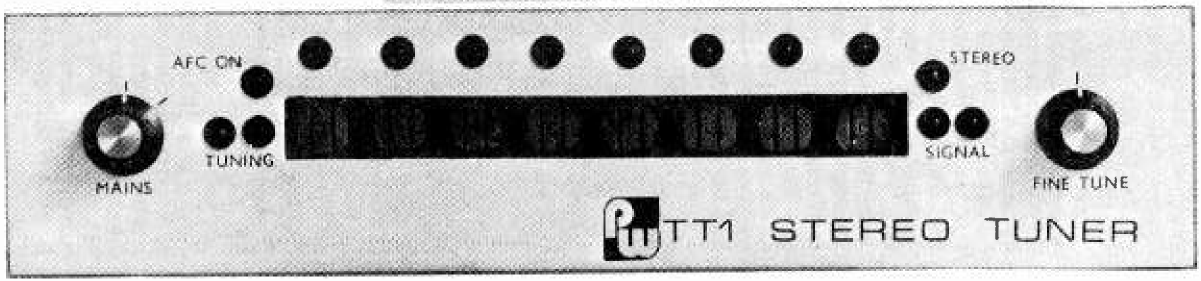
▲

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'.

▼



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.

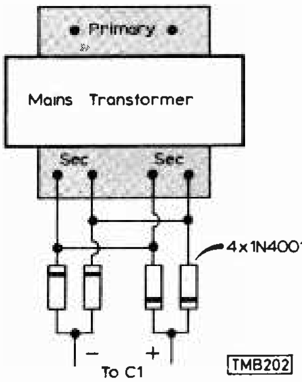


Fig. 12: Method of connecting the four 1N4001 diodes to the secondary tags of the mains transformer to form the bridge rectifier.

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.

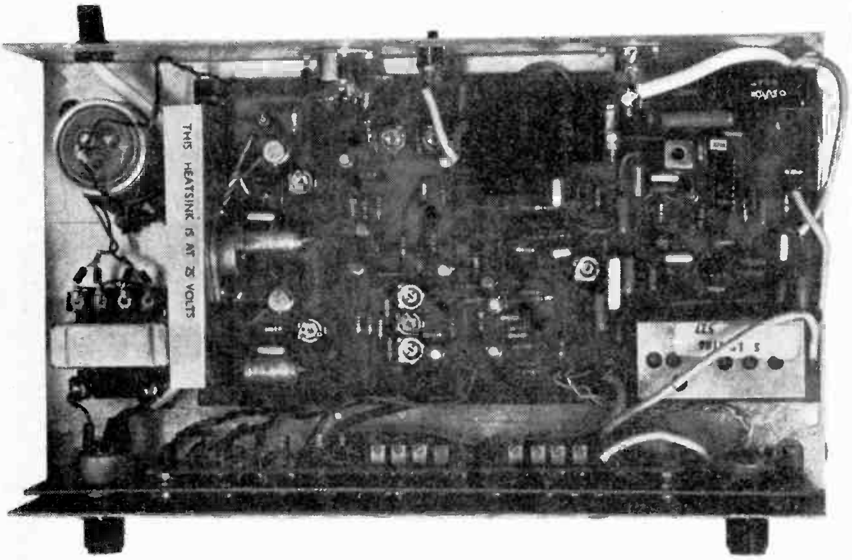
SELECTOR TESTING

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 1/8in 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.

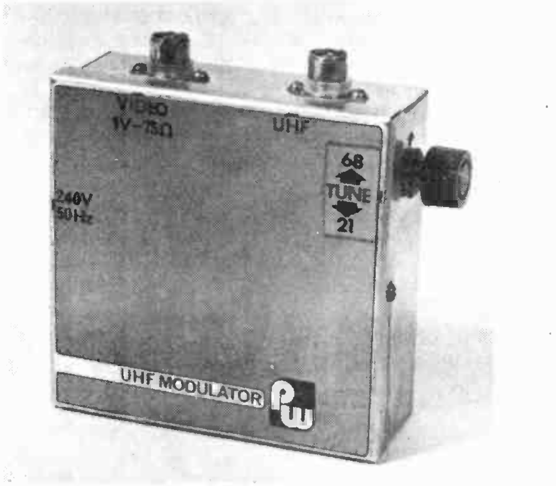
1. The common line at the bottom of R78 to R85 and C45 to C52 should be shown as going to +12V.

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.

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

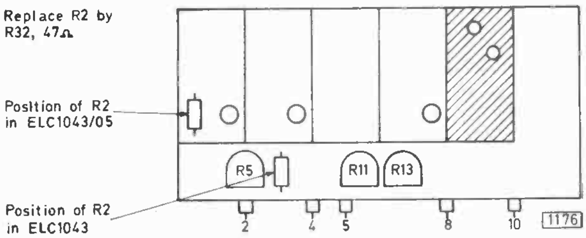


Fig. 2. The location of R2 and the three tuning presets, R5, R11 and R13.

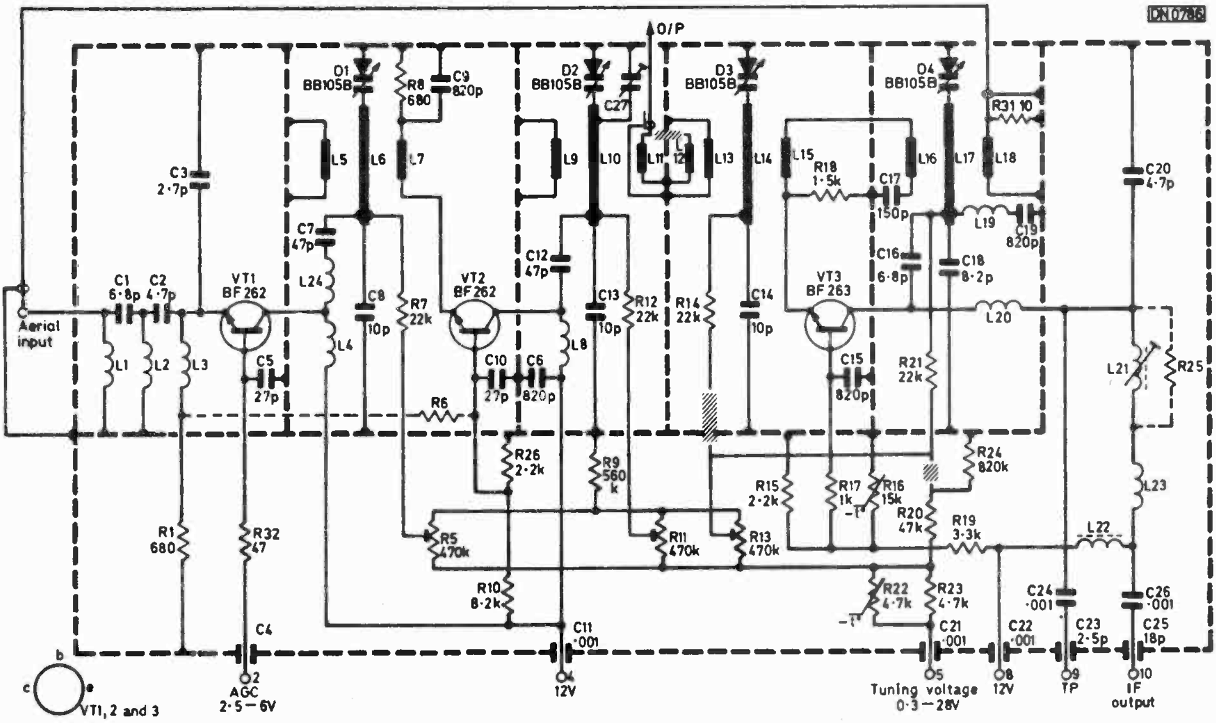


Fig. 1. Circuit of the ELC1043 after modification. The ELC1043/05 is similar apart from transistor types. The shaded areas indicate breaks in the P.C. tracks. R31 is added in series with L18 to provide the oscillator output tapping point.

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.

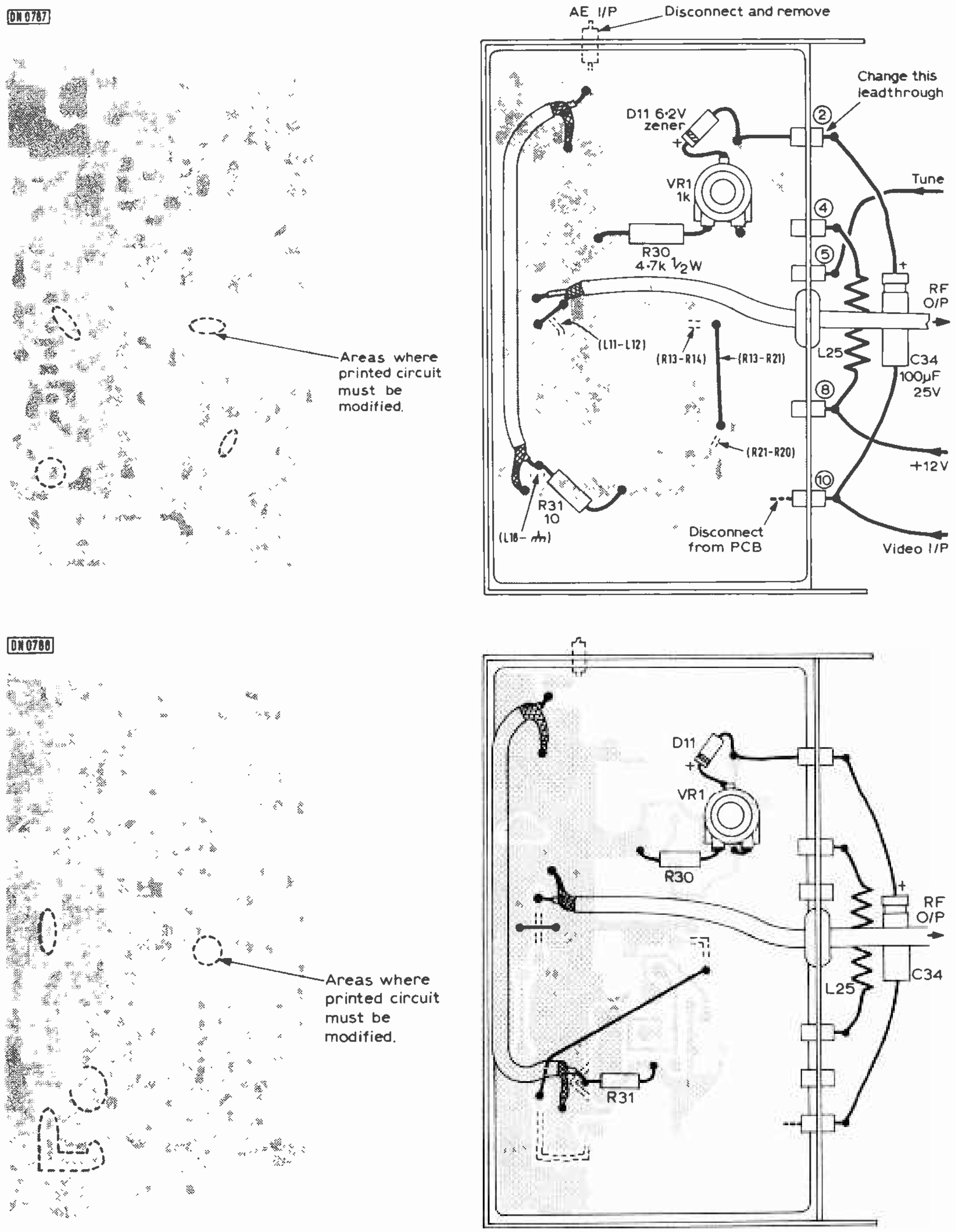


Fig. 3. Layout of the printed boards and modification details for the ELC1043/05 (top) and ELC1043 (bottom). In each case the left-hand drawing shows the print pattern before modification. The right-hand drawing shows track and components to be removed in broken lines, links and components to be added 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 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.

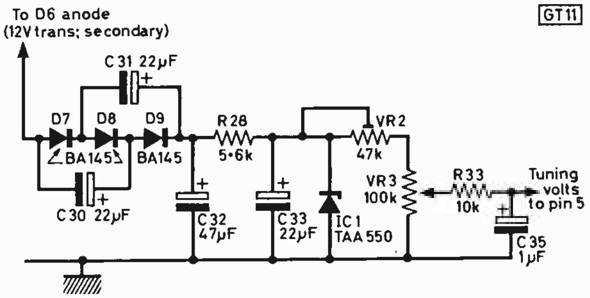


Fig. 6. The circuit for continuous coverage of Band IV and V.

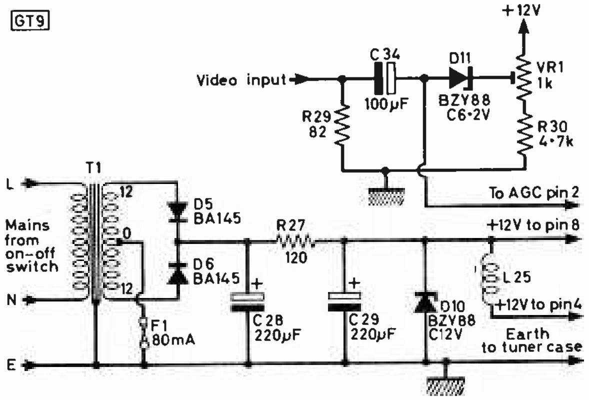


Fig. 4. The Power Supply and Input Bias circuits.

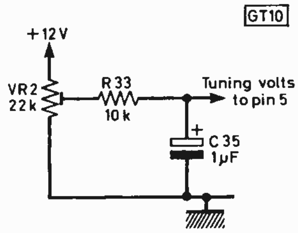


Fig. 5. The tuning circuit for a preset spot frequency output.

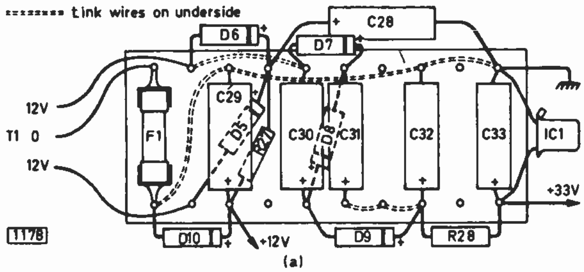
★ components list

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%, ¼W
R29 82Ω 5%, ¼W
R30 4·7kΩ 5%, ¼W
VR1 1kΩ, min. skel. horz.
C28 220μF, 25V
C29 220μF, 25V
C34 100μF, 25V
D5, D6 BA145 or BA148 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%, ¼W
VR2 22kΩ min. skel. horz.
C35 1μF, 35V, tant.

Tuning circuit (Fig. 6)
R28 5·6kΩ 5%, ¼W
VR2 47kΩ, min. skel. horz.
VR3 100kΩ, carbon, linear
C30 22μF, 35V
C31 22μF, 35V
C32 47μF, 63V
C33 22μF, 63V
D7, D8, D9 BA 145 or BA148 or BY206
IC1 TAA550 or ZTK33B or SN76550



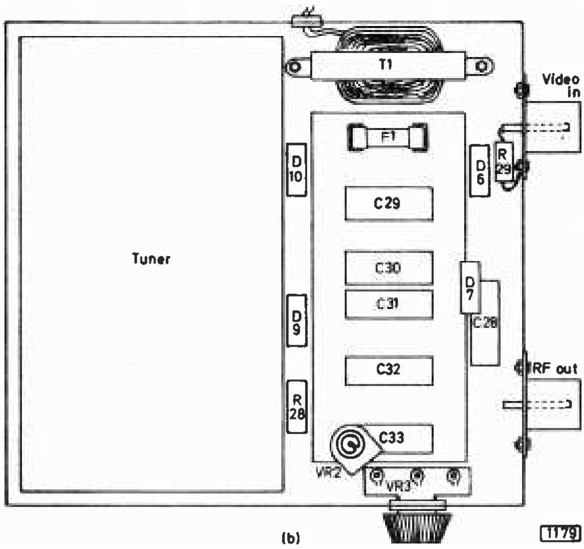
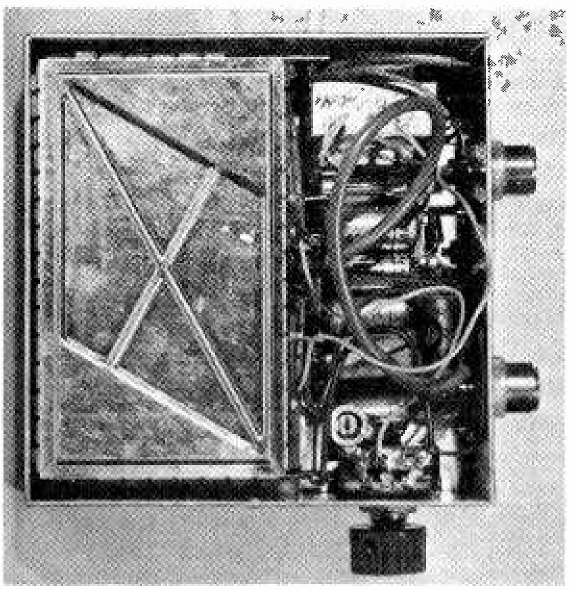


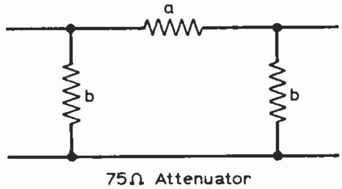
Fig. 7. A diagramatic representation (above) of the extra board, with wiring for the components of the power supply and continuous coverage tuning circuit shown. A photograqh of the inside of the prototype (below) shows that although the extra components are not too cramped there is not much surplus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



Approx Loss	a(Ω)	b(Ω)
6dB	56	220
12dB	150	120
17dB	270	100

GT20

Fig. 8. The arrangement and values of the resistors for a 75Ω attenuator. This unit is not exactly 75Ω impedence 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 position. The pre-set may now be sealed with 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

FM TOUCH TUNER
P.W. MARCH '77

SEMICONDUCTOR PACK £16·95
RESISTOR PACK £2·55 (EXC. VRS)
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Above Prices Include V.A.T. and P. & P.

THYRISTORS

PIV	·8A (TO92)	1A (TO5)	3A (C106)	4A (TO220)	6A (TO220)	8A (TO220)	10A (TO220)	15A (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 PKGE ISOLATED TAB)

	4A (a)	4A (b)	6·5A (a)	6·5A (b)	8·5A (a)	8·5A (b)	10A (a)	10A (b)	15A (a)	15A (b)
100V	0·60	0·60	0·70	0·70	0·78	0·78	0·83	0·83	1·01	1·01
200V	0·64	0·64	0·75	0·75	0·87	0·87	0·87	0·87	1·17	1·17
400V	0·77	0·78	0·80	0·83	0·97	1·01	1·13	1·19	1·70	1·74
600V	0·96	0·99	0·87	1·01	1·21	1·26	1·42	1·50	2·11	2·17

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.

OPTOELECTRONICS

Displays		Discretes		
704	0·95	0·2	Red	0·13
707	0·95	0·2	Green	0·20
727	1·95	0·2	Clear	0·14
728	1·95	OCP71		0·90
747	1·85			
750	1·85			

Special Offer
Red Led
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TTL
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7400	0·16
7401	0·18
7402	0·18
7403	0·18
7404	0·18
7405	0·18
7406	0·51
7407	0·18
7408	0·18
7409	0·18
7410	0·16
7412	0·25
7413	0·25
7414	0·72
7416	0·43
7417	0·43
7420	0·18
7422	0·38
7423	0·40
7425	0·30
7427	0·48
7428	0·53
7430	0·16
7432	0·37
7433	0·49
7437	0·35
7438	0·35
7440	0·16
7441	0·76
7442	0·65
7445	1·50
7446	2·56
7447	0·81
7448	0·81
7450	0·85
7451	0·16
7453	0·18
7454	0·18
7460	0·18
7470	0·32
7472	0·26
7473	0·30
7474	0·32
7475	0·47
7476	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

ITT BRANDED TRANSISTORS
Type BSY65. Med Voltage High gain NPN. To-18. Similar to BC107/8/9.
5 pcs for 0·35.
25 pcs for 1·20.
100 pcs 3·50.

LINEAR ICS

LINEAR	ICS	
307		0·55*
380	14 Pin Dil	0·90*
555	8 Pin Dil	0·45
565	14 Pin Dil	2·00*
566	8 Pin Dil	1·50*
567	8 Pin Dil	2·00*
709	8/14 Pin Dil	0·35
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AC142K	0·28	BD184	1·20	OC71	0·10
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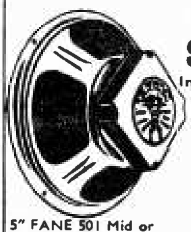

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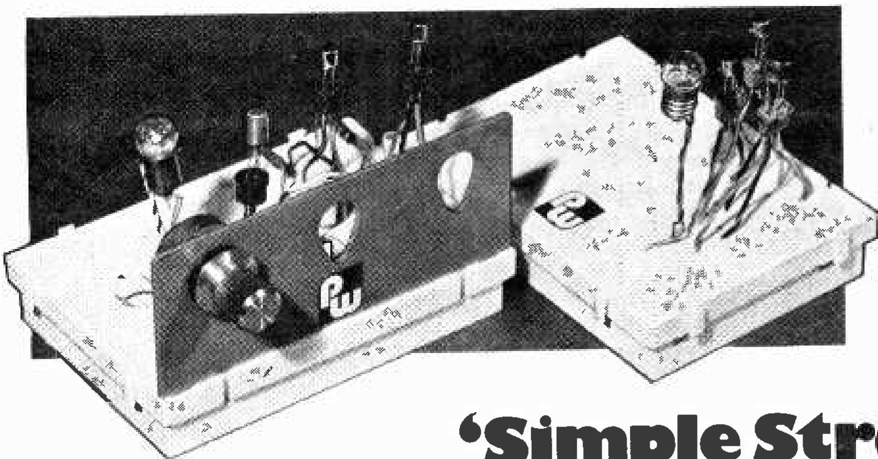
S-DeCnology

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 semiconductors 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 capactor 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.

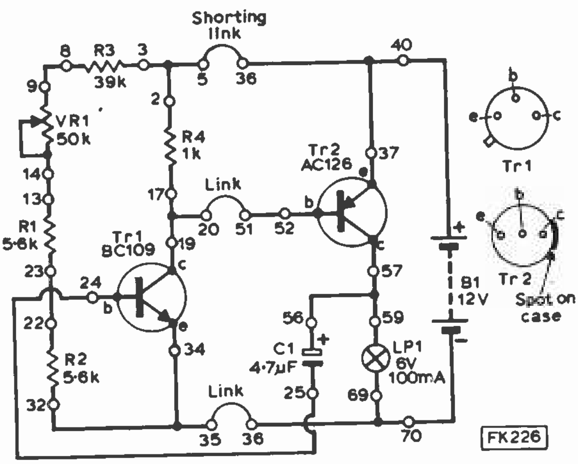


Fig. 1: Circuit diagram of the Simple Stroboscope. Varying the rate of flash can be achieved by experimenting with the values of C1 and R3. The lower link should be connected between 35 and 66.

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

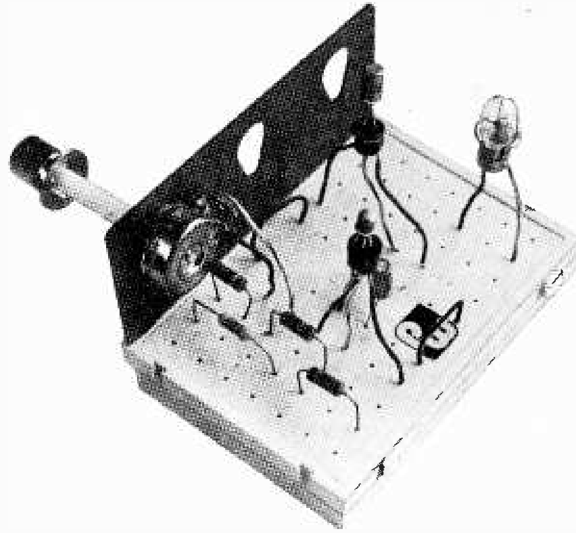
plugged into holes 59 and 69 while R2 is plugged into S-DeC holes 22 and 32. The three lines marked "links" in Fig. 1 are simply short lengths of wire which have their ends plugged into the S-DeC holes as marked. Figure 2 shows a full size drawing of an actual S-DeC and the holes and component locations 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 39kΩ? Why not 47kΩ or 10kΩ? 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 10kΩ 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 10kΩ 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 50kΩ 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 39kΩ.

Changing the value of the capacitor in this circuit did not prove a good move. Using a 10µF component reduced the flashing rate, and swinging VR1 from maximum to minimum gave far less variation in the rate than with a 4·7µF 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.)

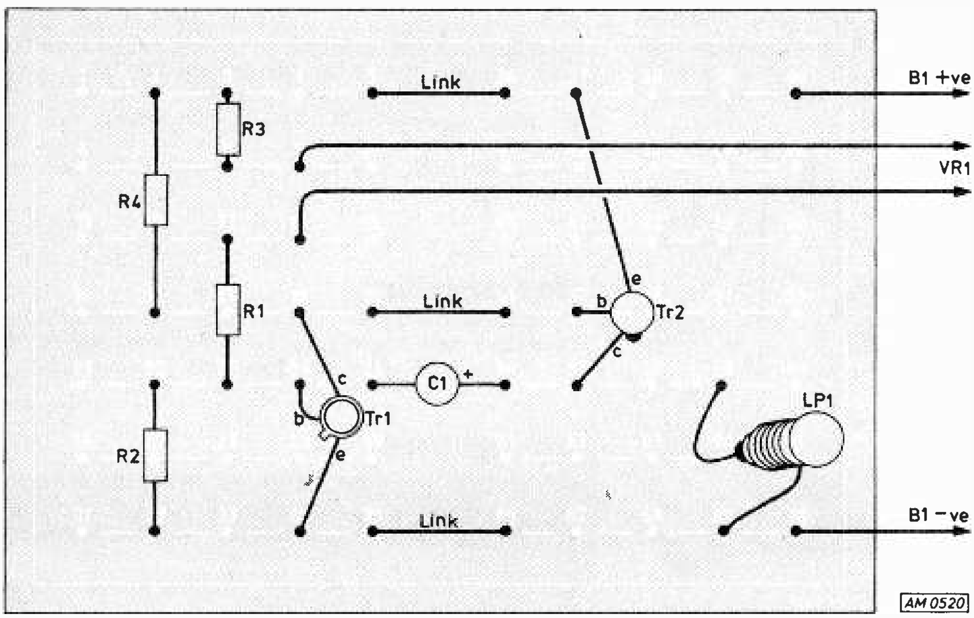


Fig. 2: Full size drawing of the S-DeC giving the exact location of the components necessary for this project.

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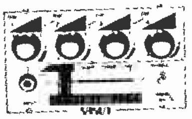

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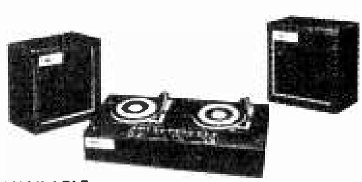

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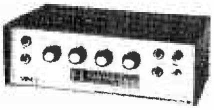

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Frozen motion

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.

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 180kΩ as in the circuit diagram and not 100kΩ.

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 arrowhead 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 (0·1µF) between ground and the following points,

A. IC4 pin 9
B. IC4 pin 10
C. IC4 pin 11
D. 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 0·1µF's from ground to IC4 pins 4, 5 and 6.

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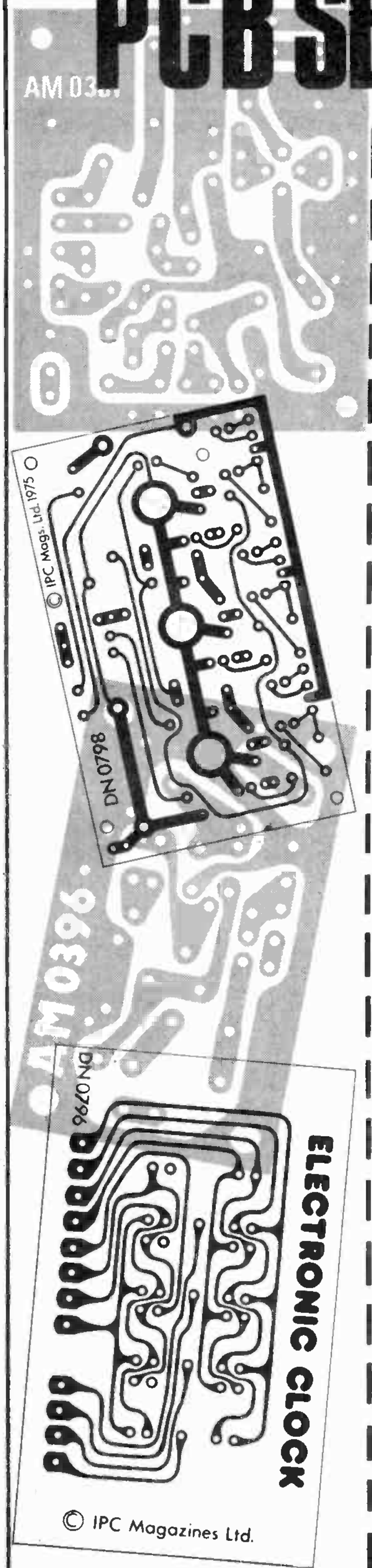

All boards, except SRBP, are glassfibre, drilled and roller-tinned

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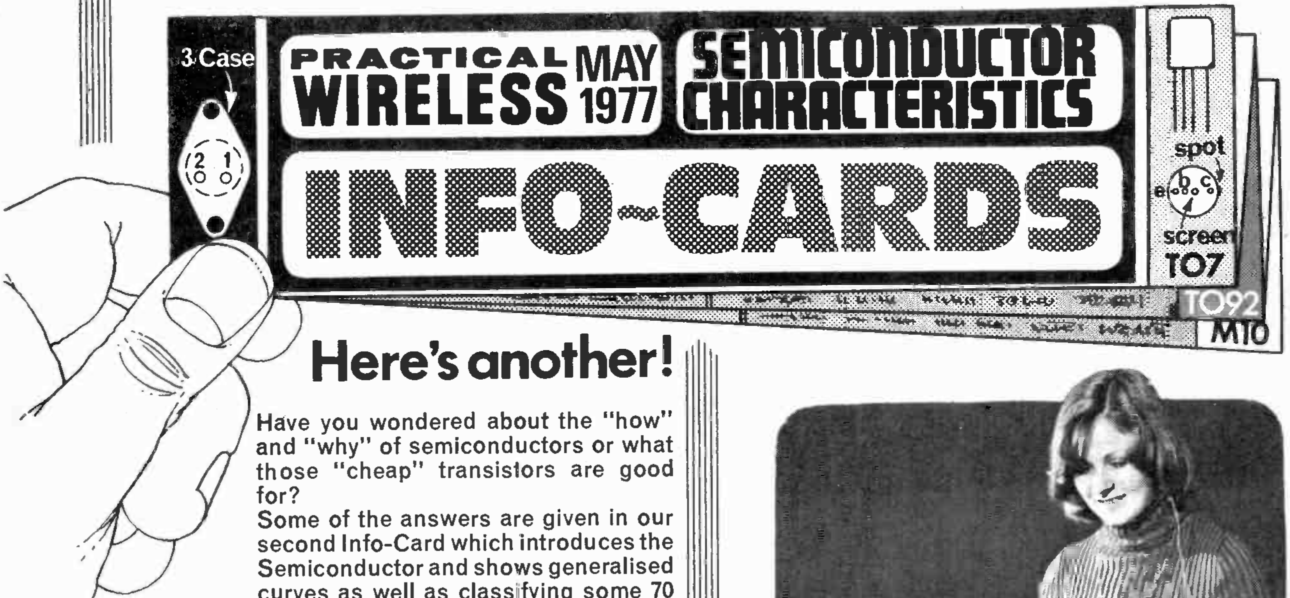

Here's another!

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The PW DUAL REGUL

POWER SU

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,

COVER PROJECT

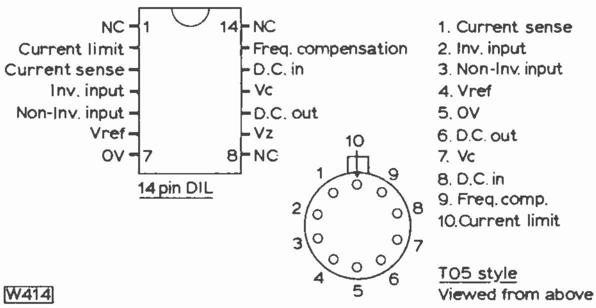

Fig. 1. The pin connections for the two case variations of the 723 integrated circuit. Note that both devices have the same connection sequence but pin 10 on the T05 corresponds to pin 2 on the DIL

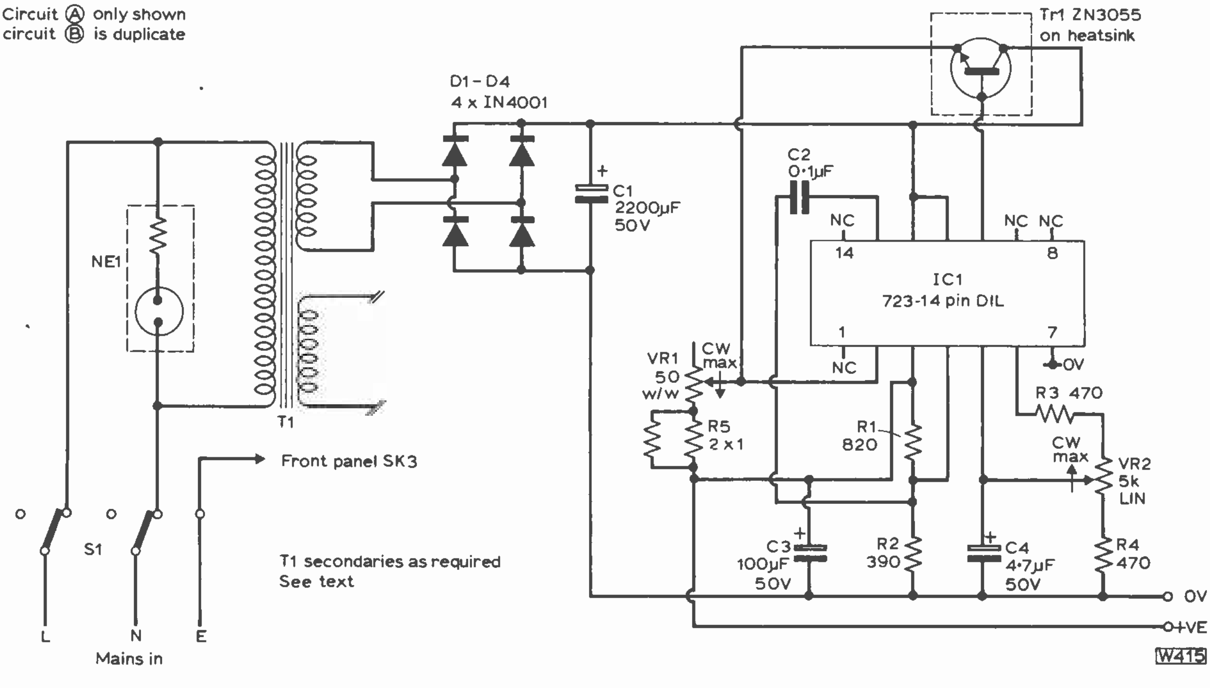

Fig. 2. The circuit diagram of one supply. The second supply is identical and the components have been numbered in the series R101, C101, where R1 and R101 perform the same functions in their respective circuits. Note that Tr1 should be 2N3055.

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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, 4¾" x 4" x 1" (Marston type C or similar). Stripboard, 0·1" track, 5" x 3¾". 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

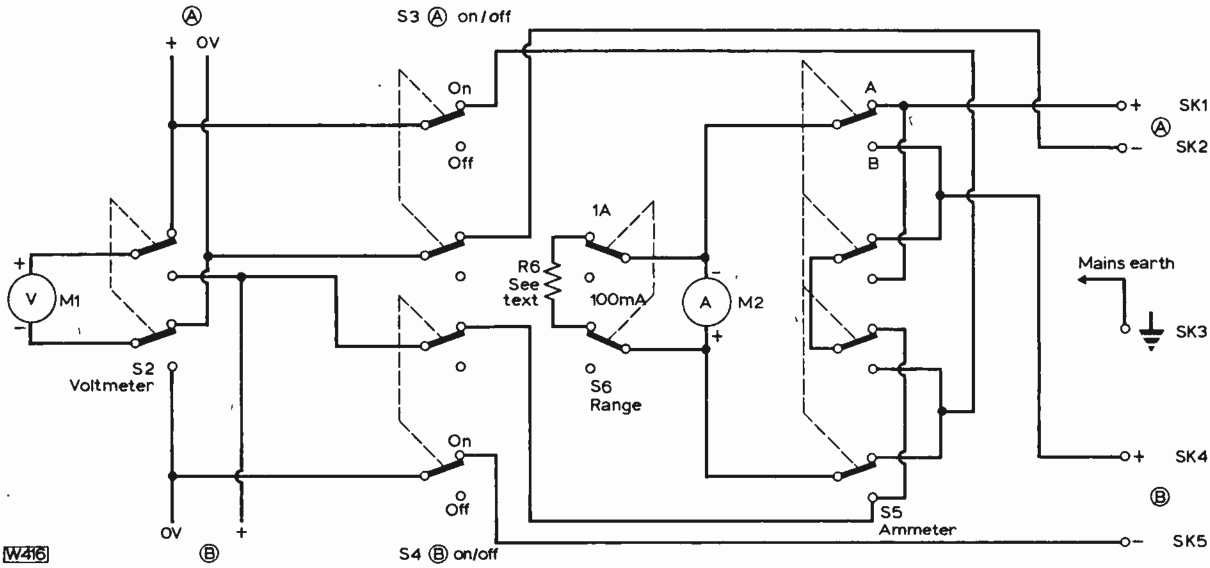


Fig. 3. The switching requirements to monitor both supplies by using only one voltmeter and one ammeter. The use of separate meters for each supply would reduce the switching significantly.

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, preassembled 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.

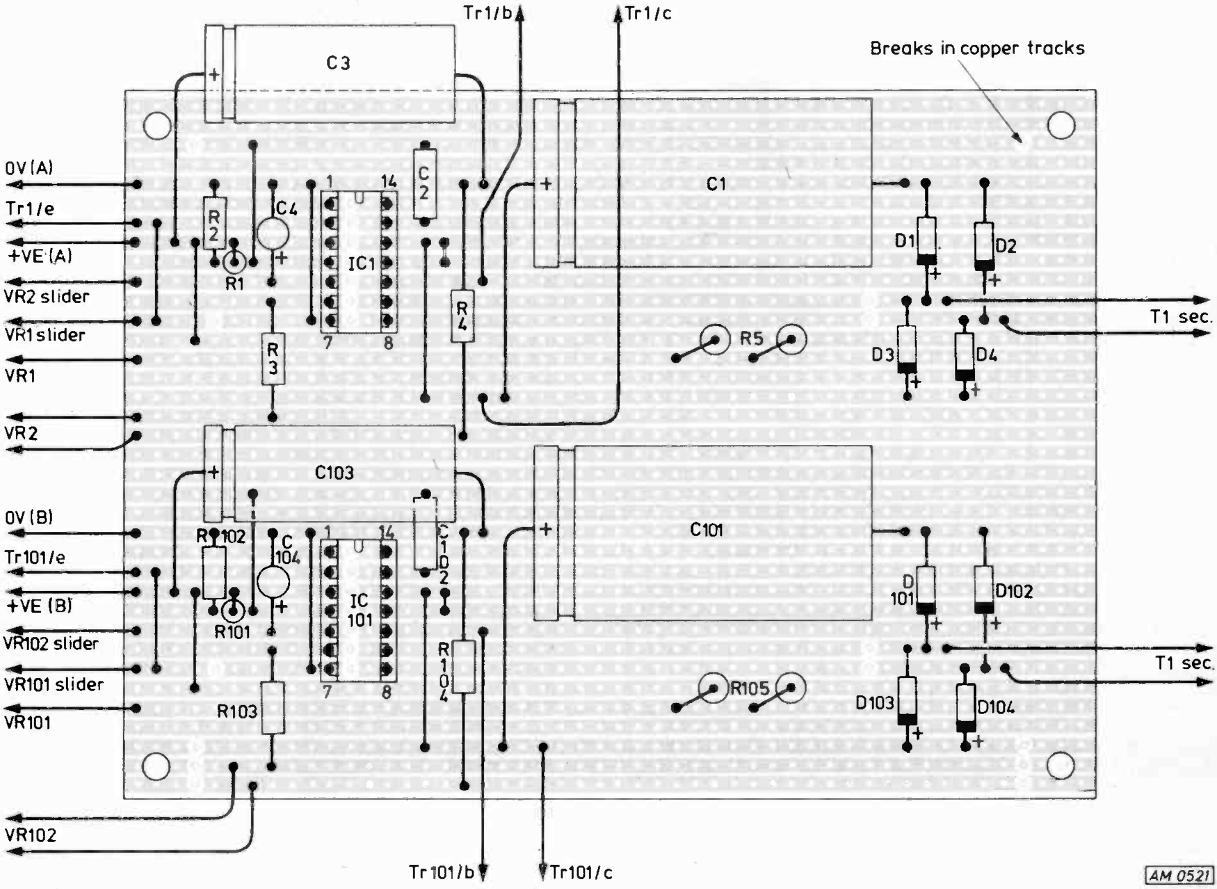
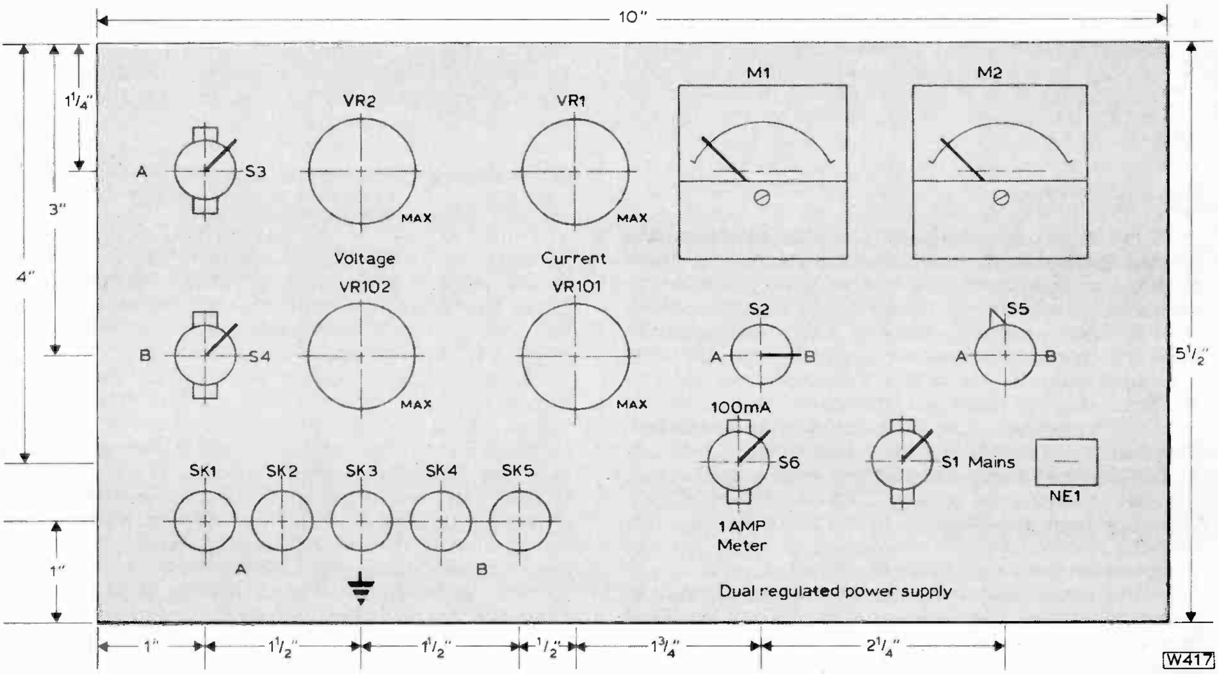


Fig. 4. The cutting and component locations on the stripboard. The minimum number of breaks has been made. If nylon screws and nuts are used the breaks to isolate the fixing holes can be omitted.

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.



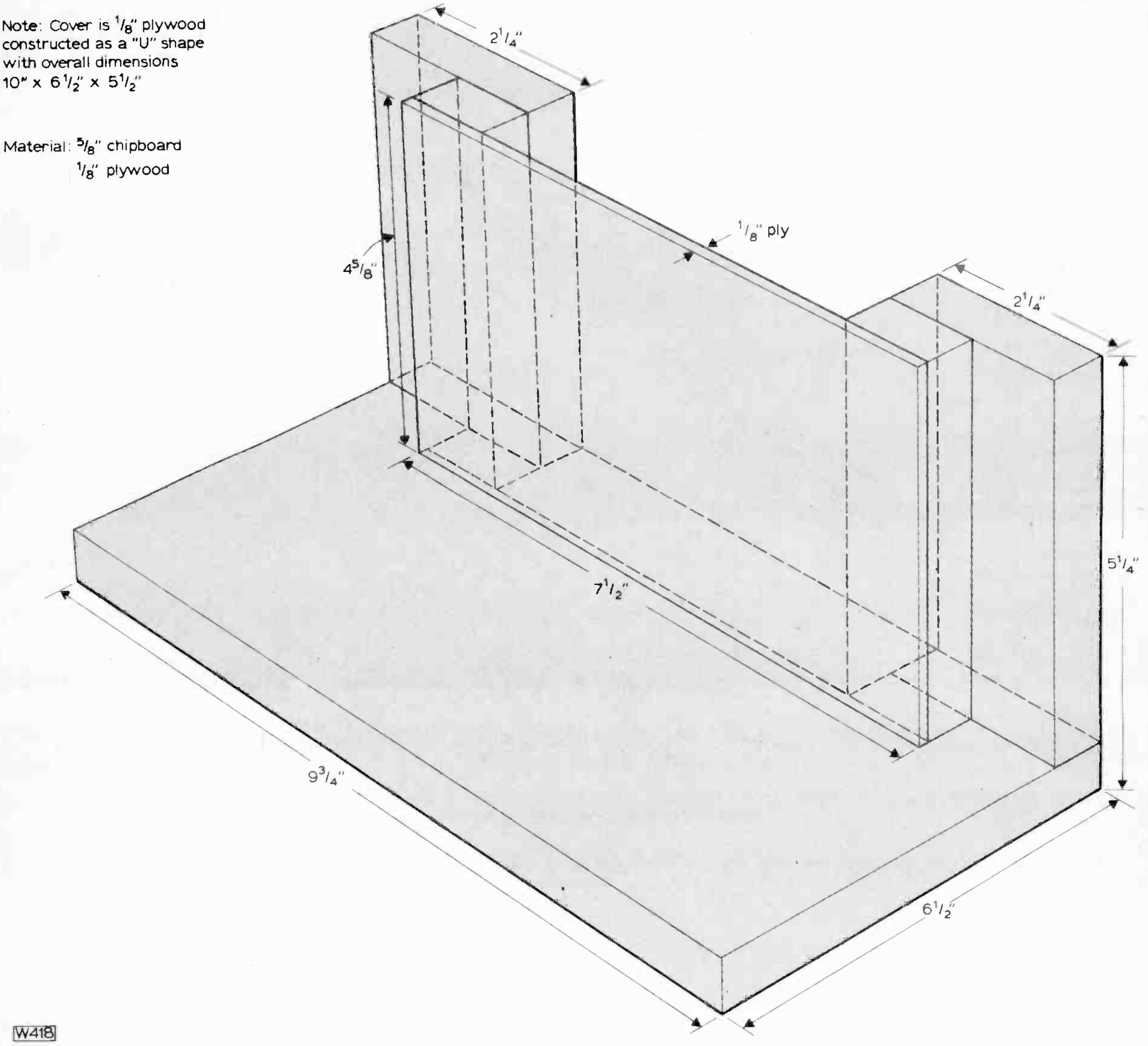


Fig. 6. The dimensions of the base and back of a case to match the front panel of Fig. 5. If alternative cases are used ensure that the heat sink has adequate cooling.

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 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.

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 substrate 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 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.

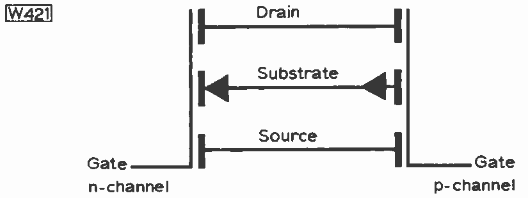


Fig. 1: Drawing of a n-channel and p-channel complementary MOSFET device.

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

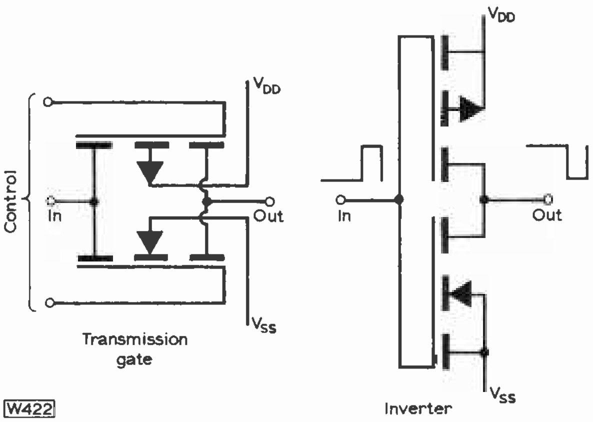


Fig. 2: Transmission gate and Inverter of CMOS logic.

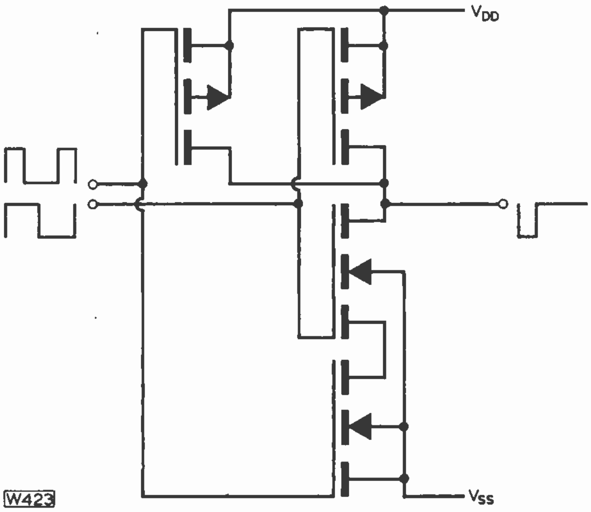


Fig. 3: Combination of transmission gate and inverter, so forming a 2-input NAND gate.

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

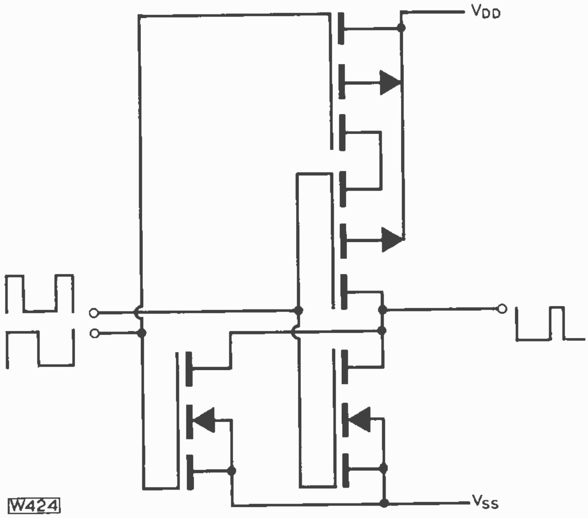


Fig. 4: Similar combination as in Fig. 3, but forming a 2-input NOR gate.

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	68kΩ	R7	680kΩ
R2	10kΩ	R8	1·2MΩ
R3	10kΩ	R9	2·7MΩ
R4	220kΩ	R10	5·6MΩ
R5	100kΩ	R11	3·3MΩ
R6	100kΩ	R12	270Ω

All 10% ¼W

Capacitors

C1	180pF	C4	10nF
C2	100nF Mylar	C5	1μF 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.

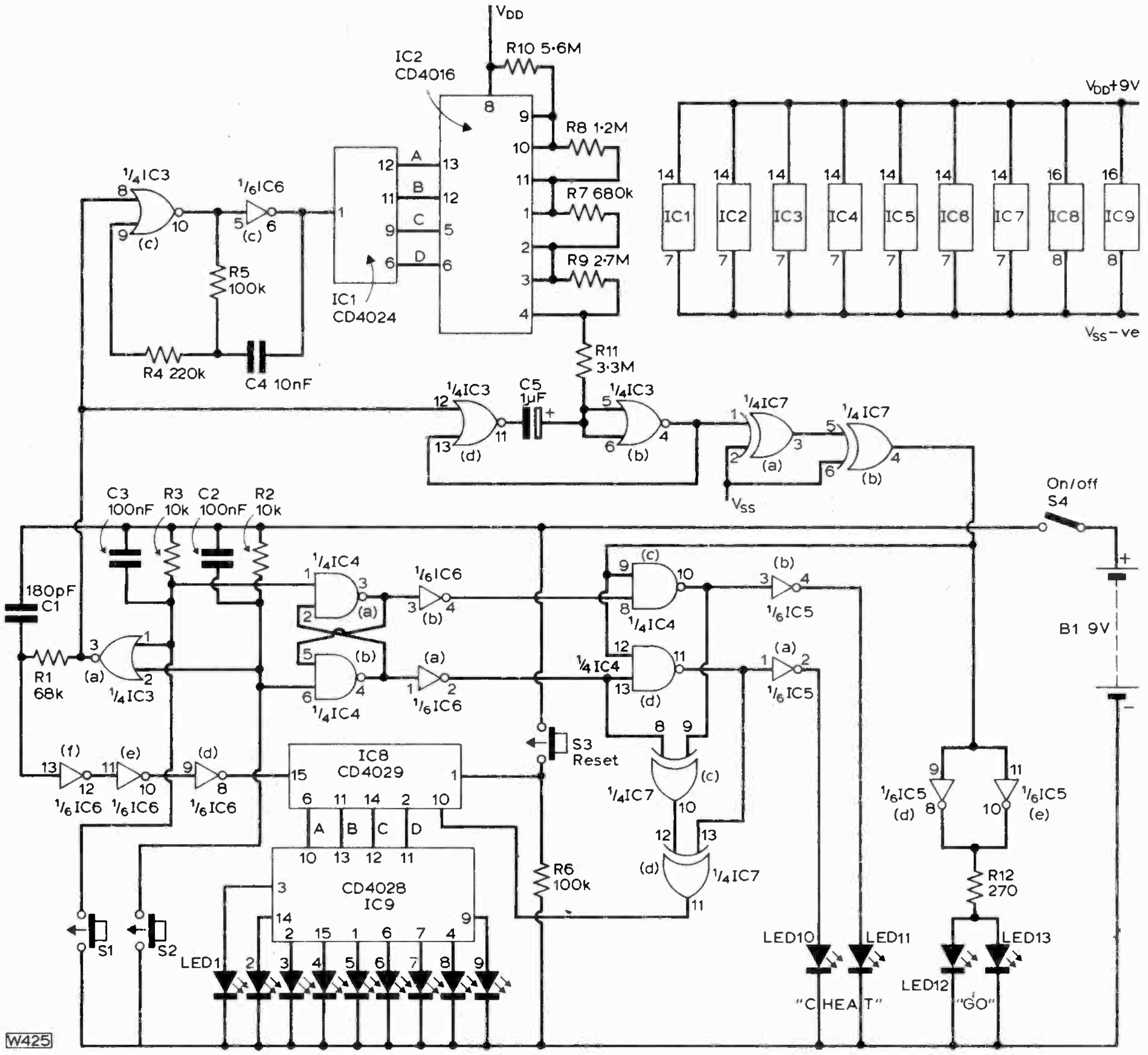


Fig. 5: Full circuit diagram of the Tug-O-War, giving details of the nine integrated circuits used in its construction. The 'rope' is formed by LED's 1 to 9.

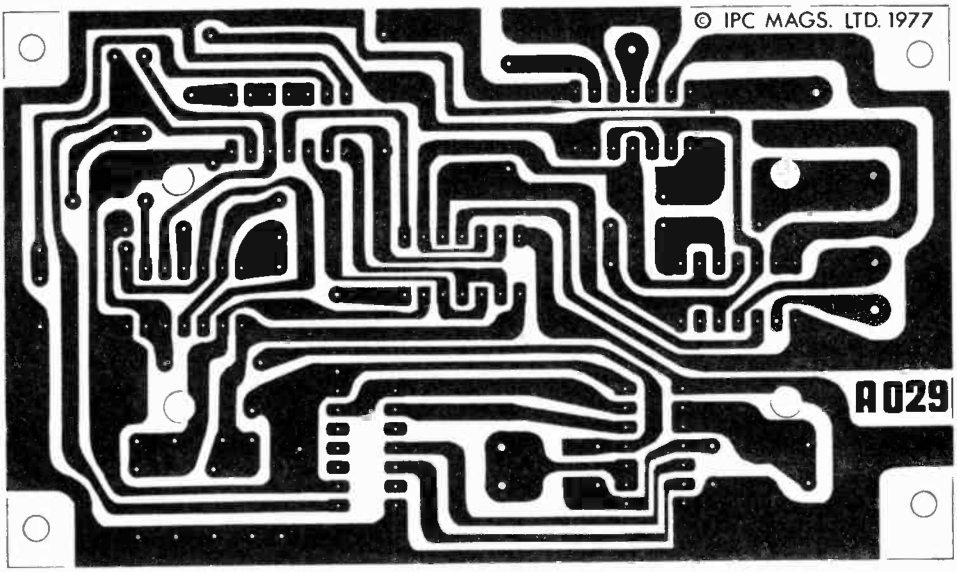
which controls the time constant of the monostable.

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.

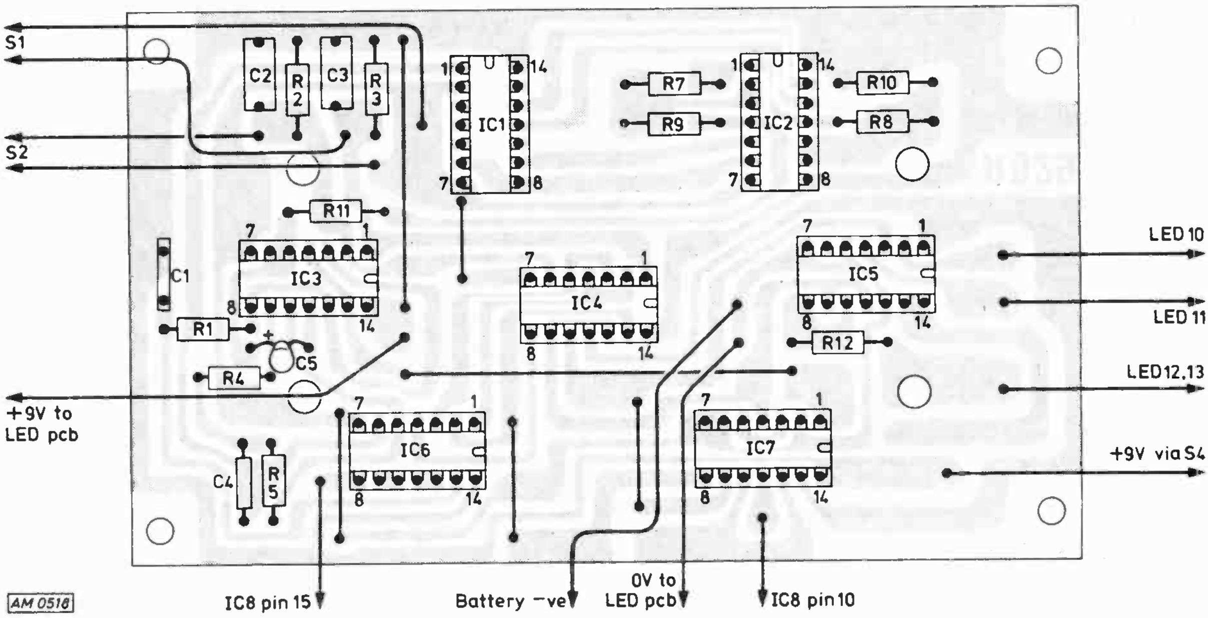
The RS latch connected to the two push buttons is set by the first player to release his button. The other button will then have no effect. The two outputs are inverted, then compared with the monostable output by IC4c and d. Should the output be high when the latch is set, both inputs to the NAND in 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.



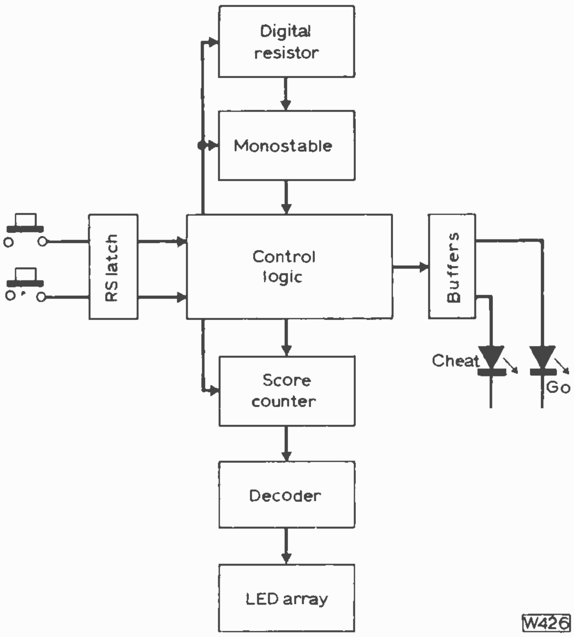


Fig. 6: Simplified block diagram of the logic used in this project.

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 12μs). 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.

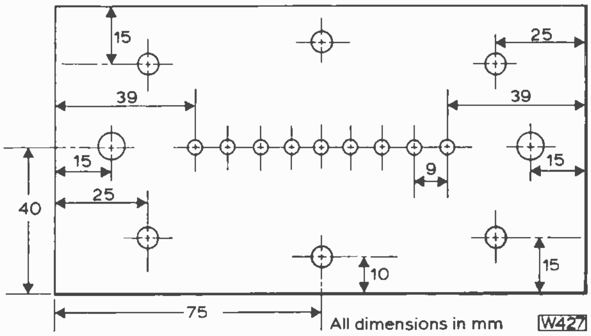
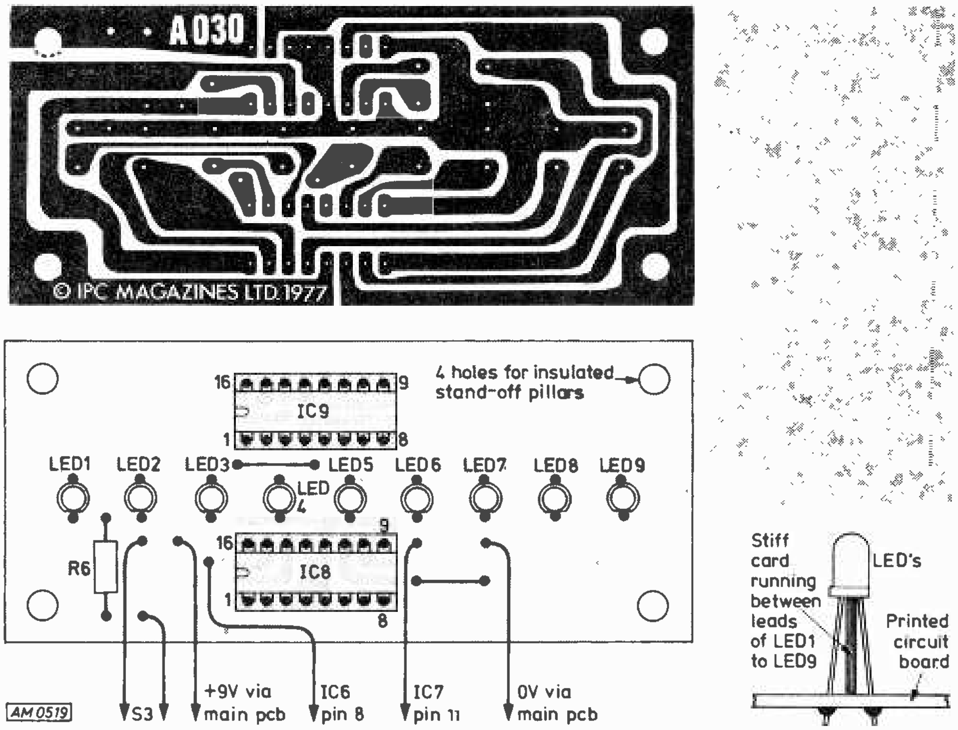


Fig. 7: Dimensions for drilling the front panel which has all switches, and LED's for the 'rope' mounted on it.

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 leads) between the top of the board and the LED's.

Fig. 7. When drilling the case, take care not to let the drill bit slip, as bitter experience has shown how easily an expensive plastic case can be ruined with little or no effort! The electronics is held on two printed circuit boards, to enable the components to be mounted in a reasonable space, and to reduce the amount of free wiring to the lid, see Figs 8 and 9.

Begin construction with the nine wire links, then go on to the passive components, flying leads and finally the ICs. The latter should be kept in their conductive foam until needed. Check the polarity of LEDs, tantalum capacitor and especially the ICs before soldering. The small red LEDs should be soldered as proud of the board as their leads will allow or they will not protrude through the lid. To this end the PCB is mounted with a nut between board and case in each corner so that the LEDs can be secured to the lid by means of the clips supplied.

When soldering the LEDs, beware of keeping the iron on them too long, as the red plastic is easily softened and then all that holds the leads on, is the light emitting junction itself.

Resistors R1 and R4 and capacitor C1 should be mounted flush with the board so that the battery will not foul the push button when it is installed. The push buttons S1 and S2 must be wired up correctly or the game may well become a push, rather than a tug 'o' war.

Playing the game

After switching the game on, the score should be reset with the push button opposite the on-off switch. Both players should now press their push buttons whereupon the green 'go' LEDs will go out. After a random time interval which was from 2 to 10s on the prototype, the LEDs will come on again. The first player to release his button after this signal, has the light moved one place closer to his end. A cheat who removes his finger before the signal will have the light moved one place closer to his opponent. Play then continues in this manner until the light reaches one end. The player at that end is declared the winner of the contest.

Modifications

The game can be expanded for team use—the push buttons for each member of the team are wired in series. The fastest person in the two teams will then win the point but who it was . . . ?

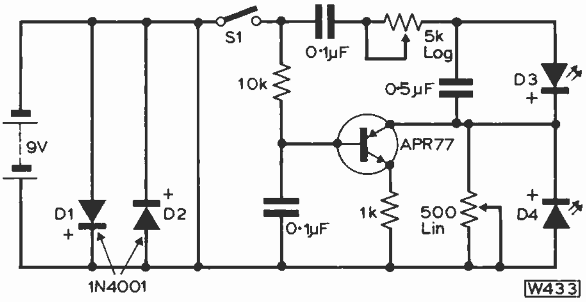
A small problem encountered with the prototype was that the switches used were rather prone to contact bounce causing irregularities in the scoring, however one does get used to the feel of the buttons after a while. A worthwhile improvement would be to replace S1 and S2 with touch switches etched from copper clad board offcuts, this would eliminate contact bounce and reduce strain on the finger whilst waiting for the 'go' signal. If this modification is carried out then R2 and R3 should be increased in value to about 3·3MΩ; C2 and C3 may need to be reduced in value or omitted altogether to achieve the desired effect. PW

THE PW 'SUREFIRE'

D. JONES

THIS project is aimed at those constructors who are unable to make an electronic circuit work first time. It is hoped that even the most ham-fisted reader, with little trouble, should be able to build and operate this device.

The main function of the circuit, Fig. 1, is to do nothing, a very difficult achievement in a continually changing universe. The circuit layout has been designed so that it would take a very large number of mistakes for nothing not to happen. Should a constructor wish, peripheral devices can be added, but he is warned that too complicated a circuit may do something.



The battery was obtained from a transistor radio that did nothing when switched on; this is a good indication of the batteries condition. It should also do nothing when connected across a meter. But to make certain of its integrity a length of wire was connected between its terminals and left for a few hours. The two protection diodes D1/2 were taken from a burnt-out bridge rectifier, but new ones would work just as effectively.

The mechanical switch was included because it was felt that a touch switch would have increased the price of the project and may have caused something to happen contrary to the aim of this project. The potentiometers were added to fill two holes in the box used to house the circuit board, but having included them it became apparent that they were a 'must', especially when showing the finished product to admiring relatives.

VR1 acts as a Kenotron and causes all positrons present in the surrounding magnetic medium to undergo an adiabatic contraction. This contraction excites the ICW from VR2 causing the Lorenz transformations to be temporarily invalid within the immediate Hamaltonian space. The combined effect is that nothing is created and then passed on to the detector.

When the circuit is assembled and switched on nothing should happen. If, however, something does happen it is advised that the builder does not take up a career in electronics.

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.

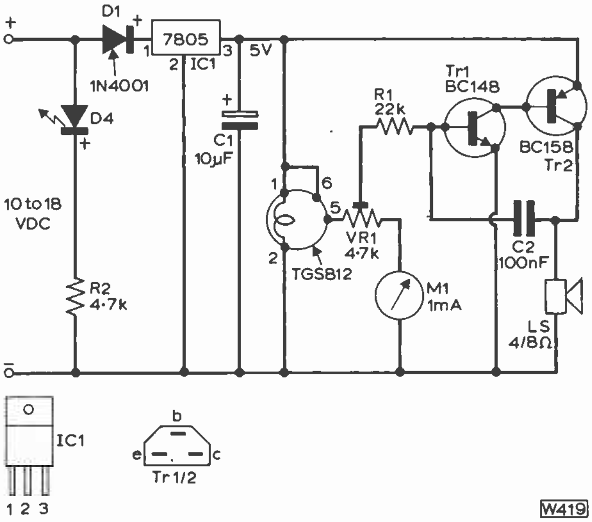
The supply requirement of the sensor circuit may be derived from the mains power supply (Fig. 2) or the unit can be made portable and a 12V battery supply used. Diode D1 is included to give reverse polarity protection.

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 100μA.

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



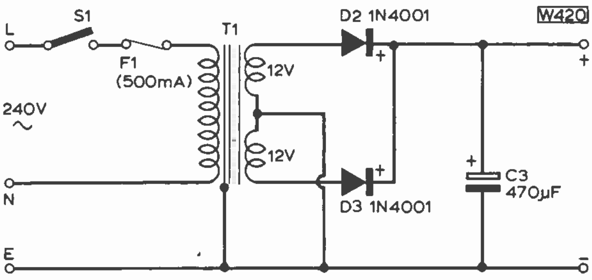
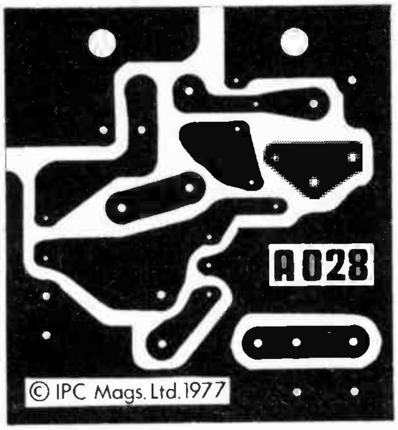


Fig. 1: top, is the circuit of the Alarm with Fig. 2, below, the mains power supply circuit. Both are incorporated in the Alarm shown in the heading photograph.



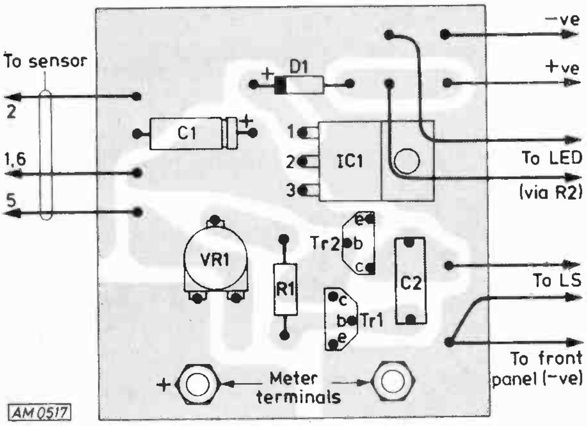


Fig. 3a, top, is the full size drawing of the PCB with the component layout, Fig. 3b, below.

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

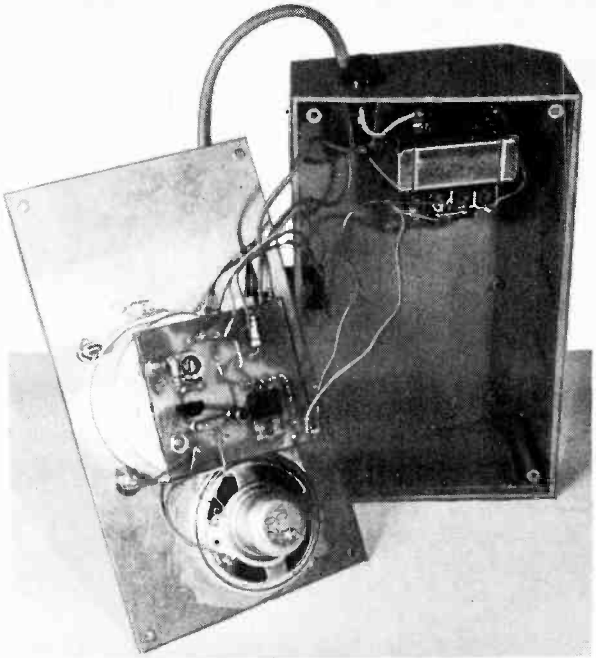
★ components list

Resistors
R1 22kΩ ¼W R2 4·7kΩ ¼W VR1 4·7kΩ submin. horizontal pot.

Capacitors
C1 10μF 10V C2 100nF C3 470μF 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 1½" dia. 4 to 8Ω. 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. 6½" x 3¾" x 2".



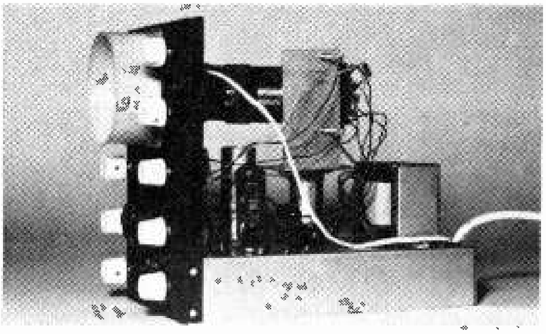
View of the PCB, mounted directly on the meter terminals. The mains transformer and smoothing capacitor C3 are mounted in the box.

Meter M1 may be omitted and the terminations linked if an audio type alarm only is required. The audio output is surprisingly effective for general alarm purposes and indeed quite startling!

The prototype was proved effective with many inflammable gases including carbon monoxide, petroleum vapour, carbon 'tet', flux vapours, alcohol and many types of smoke all triggered the alarm.

PW TECHNICROSS PUZZLE
Solution to No. 18 presented last month

1 F		2 S		3 C	4 O	M	5 P	O	6 N	E	7 N	T
8 R	O	T	A		N		A		A		U	
E		R		9 M	U	L	T	I	B	A	N	10 D
11 Q	U	I	P		S		E		O			E
U		D		12 A		13 P	R	14 O	B	15 L	E	M
16 E	L	E	C	T		A		C		E		O
N		N		17 O	U	N	C	E		V		D
C		C		L		I		18 A	D	I	E	U
19 I	D	Y	20 L	L	21 I	C		N		A		L
E			E		R		22 I		23 E	T	N	A
24 S	25 P	E	A	K	E	A	S	Y		H		T
	R		S		N		L		26 H	A	L	O
27 V	O	L	T	M	E	T	E	R		N		R



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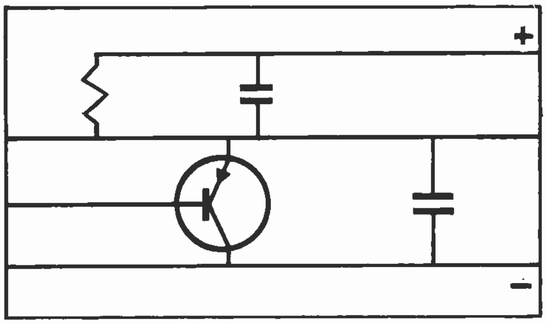

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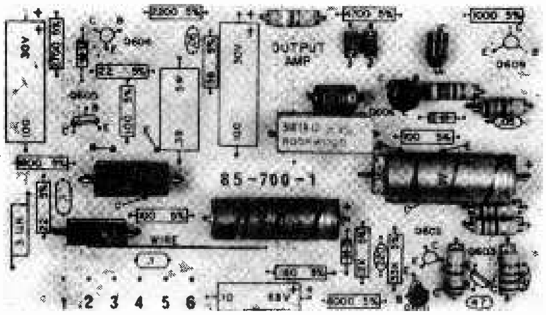

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Circuits for AUDIO AMPLIFIERS

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.

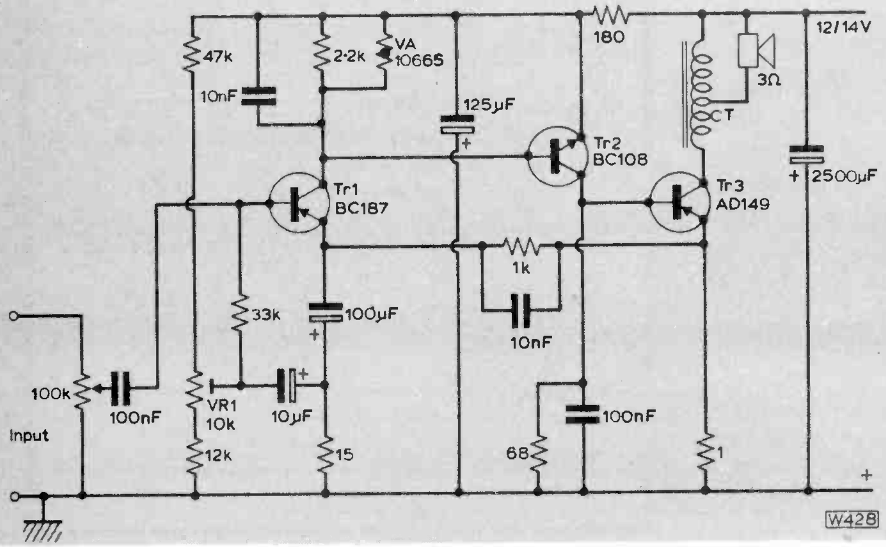
It is sometimes necessary to provide electrical insulation between the transistor and its heat sink and a thin mica washer can be used. Sink surfaces should be flat for good thermal contact, with no rough holes or edges which may penetrate the insulation. To obtain a low thermal resistance (good transfer 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.

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	80p	7437	33p	7460	20p	7491	82p	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	100p	74174	180p	74190	200 p
7403	18p	7417	40p	7440	18p	7472	30p	7493	45p	74123	75p	74142	320p	74157	100p	74175	100p	74191	160 p
7404	25p	7420	18p	7441	76p	7473	35p	7495	75p	74125	70p	74143	320p	74160	120p	74176	130p	74192	130p
7405	25p	7422	25p	7442	76p	7474	37p	7496	85p	74126	75p	74144	320p	74161	120p	74177	130p	74193	130p
7406	45p	7423	40p	7445	95p	7475	45p	74100	135p	74130	150p	74145	90p	74162	120p	74178	160p	74194	130 p
7407	45p	7425	35p	7446	110p	7476	36p	74104	60p	74131	130p	74147	245p	74163	120p	74179	160p	74195	100 p
7408	25p	7426	36p	7447	85p	7483	100p	74105	60p	74132	77p	74148	180p	74164	130p	74180	120p	74196	125p
7409	25p	7427	40p	7448	85p	7485	130p	74107	35p	74135	100p	74150	155p	74165	170p	74181	330p	74197	125p
7410	18p	7428	45p	7450	18p	7486	37p	74109	86p	74136	85p	74151	80p	74166	150p	74182	90p	74198	250 p
7411	26p	7430	18p	7451	20p	7489	295p	74118	115p	74137	125p	74153	90p	74167	370p	74184	185p	74199	250 p
7412	27p			7453	20p											74185	150p		

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
AAZ17	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	BFS94	30p	C1164	20p	ORP12	70p	TIP41A	70p	2N1711	22p
AC126	19p	BA173	15p	BC172C	12p	BCY34	80p	BF167	25p	BFW58	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	BA316	16p	BC182	10p	BCY71	20p	BF179	35p	BFX81	130p	E430	125p	TIP29A	47p	TIP42A	80p	2N2906	18p
AC128	18p	BAX13	5p	BC182L	12p	BCY72	15p	BF179C	40p	BFX84	25p	MJE340	45p	TIP29C	75p	TIP42B	85p	2N2907	20p
AC151	25p	BAX16	5p	BC183	10p	BD121	85p	BF180	30p	BFX85	30p	MPSA06	25p	TIP30	55p	TIP2955	70p	2N3053	20p
AC153K	40p	BB105A	35p	BC183L	12p	BD123	100p	BF181	35p	BFX87	25p	OA10	40p	TIP30A	58p	TIP3055	55p	2N3054	50p
AC176	20p	BB110	45p	BC184	10p	BD124	85p	BF182	30p	BFX88	25p	OA47	15p	TIP30B	65p	TIS90	25p	2N3055	60p
ACY17	35p	BC107	10p	BC184L	12p	BD131	36p	BF183	30p	BFY50	20p	OA90	6p	TIP30C	80p	TIS91	25p	2N3439	50p
ACY21	30p	BC108	10p	BC186	24p	BD132	39p	BF186	25p	BFY51	20p	OA91	6p	TIP31	55p	IN914	5p	2N3702	11p
AD149	60p	BC108C	15p	BC205	14p	BD133	45p	BF194	10p	BFY52	20p	QA202	8p	TIP31A	58p	IN3754	10p	2N3703	12p
AD161	40p	BC109	10p	BC212	11p	BD135	40p	BF195	10p	BFY90	125p	OC23	200p	TIP31B	65p	IN4001	5p	2N3704	11p
AD162	40p	BC109C	14p	BC212L	12p	BD136	40p	BF196	10p	BR101	35p	OC25	100p	TIP31C	70p	IN4002	5p	2N3705	12p
AD161/2MP	90p	BC113	12p	BC213L	12p	BD137	40p	BF197	10p	BRY39	35p	OC28	75p	TIP32	60p	IN4003	5p	2N3706	11p
		BC117	19p	BC214	13p	BD139	38p	BF198	25p	BRY56	35p	OC35	75p	TIP32A	65p	IN4004	5p	2N3711	12p
AF114	22p	BC125	20p	BC214L	14p	BD140	40p	BF199	25p	BSX20	20p	OC42	35p	TIP32B	85p	IN4005	5p	2N3715	300p
AF115	22p	BC126	15p	BC258	13p	BD181	80p	BF200	30p	BSY40	25p	OC43	35p	TIP32C	90p	IN4006	6p	2N3772	175p
AF116	22p	BC146	12p	BC294	35p	BD182	80p	BF224	20p	BSY95	20p	OC45	35p	TIP33	100p	IN4007	7p	2N3819	25p
AF117	22p	BC147	10p	BC303	55p	BD207	70p	BF225	20p	BT100A	80p	OC71	25p	TIP33A	105p	IN4148	4p	2N3866	95p
AF118	50p	BC148	10p	BC317	15p	BD233	50p	BF241	16p	BU105	150p	OC72	30p	TIP33B	115p	IS44	4p	2N3904	15p
AF125	25p	BC148C	14p	BC323	60p	BD263	65p	BF244B	35p	BU133	75p	OC75	30p	TIP33C	130p	2N456A	90p	2N4062	14p
AF139	35p	BC149	10p	BC328	13p	BDY10	100p	BF257	26p	BU208	220p	OC81	30p	TIP34	115p	2N697	15p	2N4126	20p
AF239	45p	BC157	10p	BC338	12p	BDY62/01	90p	BF258	26p	BY100	20p	OC81D	25p	TIP34A	118p	2N929	20p	2N5061	35p
ASY26	40p	BC158	10p	BC547	12p	BF120	50p	BF259	30p	BY126	15p	OC83	50p	TIP34B	145p	2N930	20p	2N5163	35p
BA114	9p	BC159	10p	BC547B	13p	BF121	45p	BF274	15p	BY127	15p	OC84	50p	TIP35	225p	2N1302	25p	2N6027	50p
BA121	9p	BC167A	12p	BC548	12p			BF324	30p	BY133	22p							2SD234	50p

BZX61 Zeners 1·3W

6V8	15p
9V1	15p
11V	15p
13V	15p
15V	15p
22V	15p
30V	15p
39V	15p
43V	15p
47V	15p
51V	15p
56V	15p
68V	15p
72V	15p
160V	15p

BZY88 400M.W. Zeners

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
8V2	10p
9V1	10p
10V	10p
11V	10p

BZY88

12V	10p
13V	10p
15V	10p
18V	10p
20V	10p
22V	10p
27V	10p
30V	10p
33V	10p

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BZY88 Zeners 850p

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LM723 14P DIL	75p
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LM741 14P DIL	30p
LM747 14P DIL	80p
LM748 8P DIL	45p
NE555 8P DIL	45p
ME556 14P DIL	100p
TAA300	150p
TAA350	190p
TAA550	50p
TAA570	220p
TAA700	390p
TAD100	250p
TAD110	200p
TBA120	125p
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TBA550Q	400p
TBA560C	400p
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TCA 270Q	250p
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1/16	5p	330/35	16p
1/25	5p	330/50	18p
1/50	5p	470/10	12p
2·2/25	5p	470/25	16p
2·2/35	5p	470/35	18p
3·3/25	5p	470/50	22p
4·7/10	5p	680/25	25p
4·7/16	5p	1000/16	25p
4·7/25	5p	1000/35	30p
4·7/50	5p	2200/10	28p
6·8/25	5p	2200/16	35p
10/10	5p	2200/63	60p
10/16	5p	2200/100	120p
10/25	5p	3300/16	40p
10/35	5p	3300/25	42p
10/50	5p	3300/63	80p
22/6V3	5p	4700/25	45p
22/10	5p	4700/40	50p
22/16	5p	4700/63	120p
22/25	5p		
22/35	5p		
22/50	6p		
33/6V3	5p		
33/16	6p		
33/25	6p		
33/40	6p		
33/50	7p		
47/10	6p		
47/16	6p		
47/25	6p		
47/35	6p		
47/50	7p		
100/10	6p		
100/16	6p		
100/25	6p		
100/50	8p		
100/63	10p		
125/15	6p		
220/16	10p		
220/25	12p		
220/50	20p		

POLY'TER CAP'ITORS Mullard or Erie

μF	
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·0022	5p
·0033	5p
·0047	5p
·0068	5p
·01	5p
·022	5p
·033	5p
·047	5p
·1	6p
·22	7p
·33	9p
·47	12p
1·00	20p
2·2	25p
4·7	35p
6·8	40p

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10K Lin	30p
25K Lin	30p
50K Lin	30p
100K Lin	30p
250K Lin	30p
500K Lin	30p
1 Meg Lin	30p
2 Meg Lin	30p
5K Log	30p
10K Log	30p
25K Log	30p
50K Log	30p
100K Log	30p
250K Log	30p
500K Log	30p
1 Meg Log	30p
2 Meg Log	30p

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E298ED/A260	VA1106
E298ED/A265	VA1107
E299D/P118	VA1110
E299DD/P224	VA1111
E299DD/P226	VA2600
E299DD/P236	VA3210
E299DD/A238	VA3410
E299DD/P342	VA3420
E299DD/P350	VA3430
E299DD/P354	VA3708
VA1008	VA8604

CMOS

4000	20p	4023	20p	4055	140p
4001	20p	4024	100p	4056	145p
4002	20p	4025	20p	4060	130p
4006	120p	4026	200p	4066	55p
4007	20p	4027	85p	4069	30p
4009	70p	4028	155p	4071	30p
4011	20p	4029	130p	4072	30p
4012	20p	4030	60p	4081	20p
4013	55p	4032	150p	4082	30p
4015	90p	4043	220p	4510	145p
4016	55p	4046	150p	4511	200p
4017	110p	4047	115p	4516	140p
4018	250p	4049	70p	4518	110p
4020	140p	4050	50p	4528	130p
4022	180p	4054	130p		

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2A 50V	35p	6A 200V	85p
2A 100V	50p	6A 400V	95p
2A 200V	55p		

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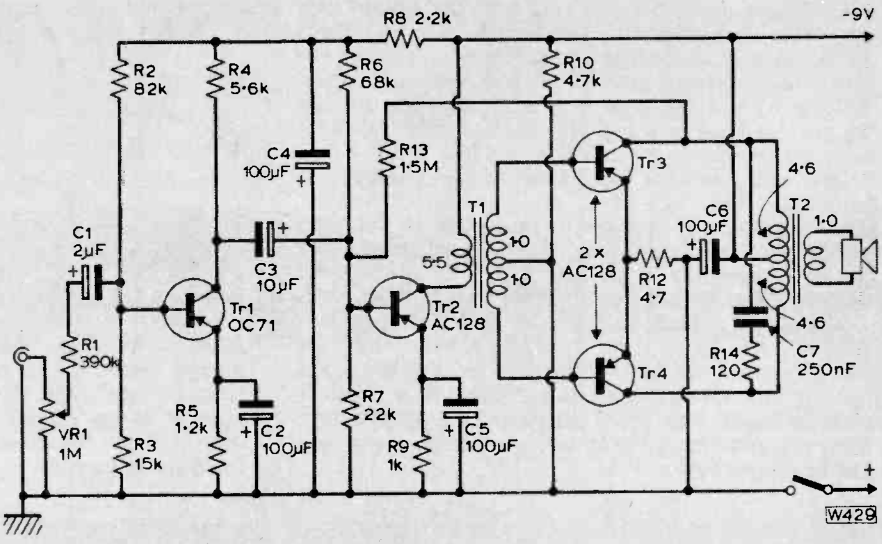
14

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 (½W).

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.

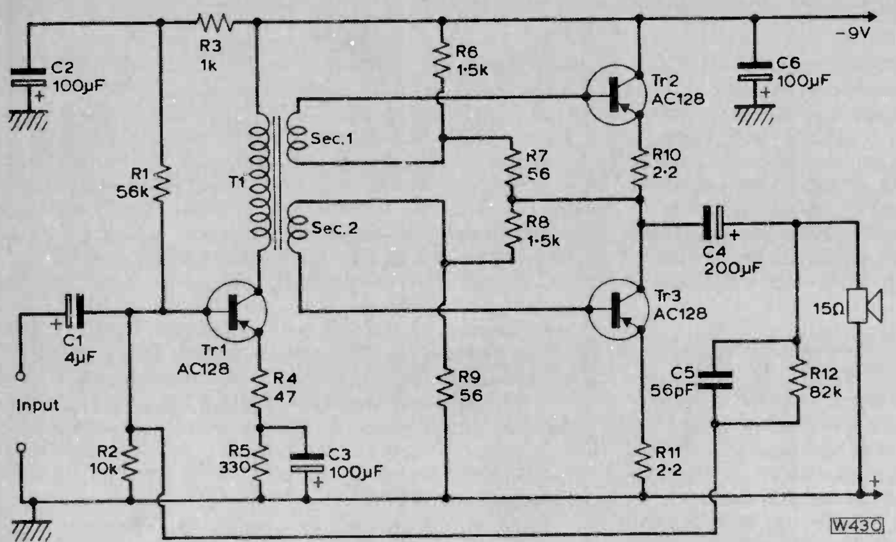
R13 provides negative feedback (see later) over Tr2, T1 and Tr3/4. C7 and R14 are to reduce the effects of phase shifts at higher frequencies. Connecting R13 should cause a drop in volume but an improvement in quality. If this effect is reversed or oscillation arises, take R13 to Tr4 collector instead of to Tr3. With the values shown for the "½-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 ealier. 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 must 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.



15

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

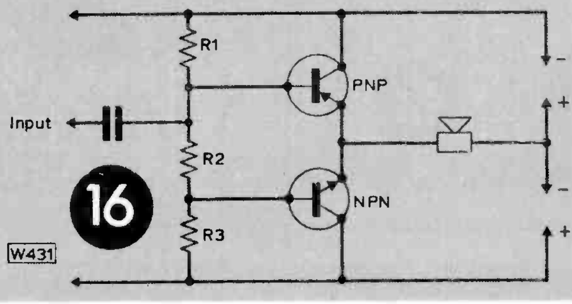
NEGATIVE FEEDBACK

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 reproduction. 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.

16



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.

ON THE AIR

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 effender 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 FO8DO.

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 is 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/HZ1 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.

BROADCAST BANDS

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 questionaire 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

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 VOCM 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 spectrohelioscope (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 VHFs 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": DL0IGI 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, Ashtead, Surrey, KT21 2TW.**

VHF

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

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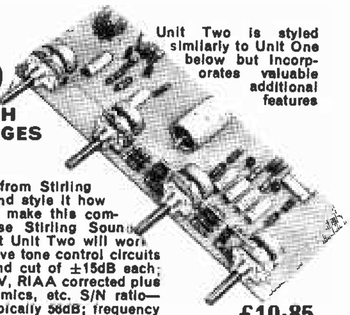

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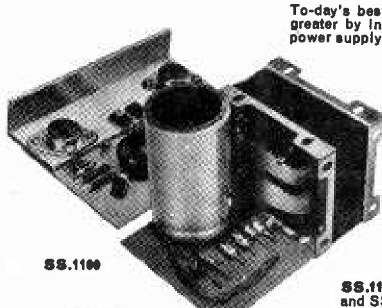

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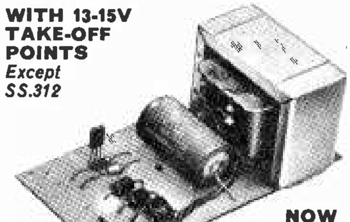

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100watt Mains Transformer. 240v 50hz primary wound in separate halves, primary screen. This has three secondries 24–0–24v, 0–49v and 0–88v tapped to 80v. Any one of these secondries may be loaded up to the 100 watts or the load can of course be spread over to all the secondries. Upright mounting, impregnated and varnished. Size 4″ × 3½″ × 3″. Price £3·50p + 28p Post 80p + 6p.
Stereo Flex twin screen fig. 8 type. PVC insulated overall. 10 metres for £1 + 8p.
Latching Relay by Guardian 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 remain locked until manually 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 £1·95p + 16p.
Connecting Wire. 7 stranded PVC insulated on 500 metre drums, 6 different colours available, price £4 per 500 metres + 32p. Post £1 + 8p. Please give alternative colours when ordering.
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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 were faulty on arrival from Japan but have been serviced. Price £9·50p + £1·99p. Post 50p + 7p. We also have few of these still in need of a repair but complete and we believe quite repairable. Price £6·50p + 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 conplies 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. 836. Completely adjustable from 30″ of vacuum to zero then up to 75lbs 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 + £1·20p.
Air Flow Senser, American made by the Foxborough Company. We have two different types. One bears ref. NF8–503A and the other MF8–502B. These are beautifully made precision units obviously intended for fitting into very high pressure air or gas lines. There is an inbuilt turbine and transducer/convertor with electrical contacts but other than this we have no information on these sensers, price is negotiable.
Convertor Amplifier, again made by the Foxborough Company, their part no. N 137 CR. We believe these are for use with the above air flow sensers, price again negotiable.
Motor with Gear Box made by Klaxon, their type no. EK3Q J2–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 × ⅞″ 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 powered 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 £4·95p + 50p. Post £1·50p + 19p.
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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.
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Dry Film Lubricant. In a aerosol can for easy application and for putting lubricant into places where the normal oil can cannot reach. Home and everyday uses. We have purchased a large quantity of these from the Liquidator 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. fluon L169.

MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fans, blower, heaters, etc. New and perfect. Snip at 95p + VAT & Postage 35p. 1″ stackmotor £1·56 + VAT & postage 35p. 1½″ stack-motor. £2 + VAT and Postage 40p.

MULTI SPEED MOTORS

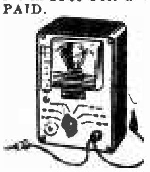
Six speeds are available 500, 850 and 1,100 r.p.m. and 7,000, 9,000 and 11,000 r.p.m. Shaft is ¼ in. diameter and approximately 1 in long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx, 2 in. dia × 5 in. long. Price £2·00 including Post & VAT. Speed control switch 50p + 4p.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 6 feet of flex cable. Wired up ready to work. £2·75, VAT & postage 65p.

MOTORISED DISCO SWITCHES

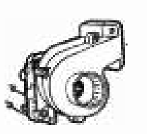
With six 10 amp changeover switches. Multi adjustable switches are rated at 10 amp each so a total of 2000w's can be controlled and this would provide a magnificent display. For mains operating £4·25 post & VAT Paid. Ditto 9 switch £4·95 Post & VAT Paid. DITTO BUT 12 SWITCH £5·75 POST & VAT PAID.



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—nicad—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 3½″ × 6½″ × 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 4½″ × 4½″ × 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. etc. A real bargain at £3·30. 60p post & VAT.

BREAK-DOWN UNIT

Contains hundreds of useful parts some of which are as follows—66 silicon diodes equivalent OA91, 68 resistors, mostly ¼ watt 5% covering a wide range of values 4 × ·1 mfd 400v mfd condensers, 15 × ·01 mfd 100v condensers. 2 RF chokes 8 × B9 valve holders, 1 × 4H choke, 1 × 115v transformer, 1 boxed unit containing 4 delay lines also tag panels, trimmer condensers, suppressors, etc., on a useful chassis sized approx. 9″ × 5″ × 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 for 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 £9·96. £1·00 Post and VAT. Don't miss this terrific bargain.

TERMS: Where order is under £6 please add 50p surcharge to offset packing expenses

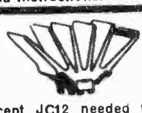
J. BULL (ELECTRICAL) LTD.

(Dept. P.W.), 103 TAMWORTH ROAD, CROYDON CR9 1SG.

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 different 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, current regulating capacitor, two bi 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 £4·50p + 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 £9·50p + 76p and £5·50p + 44p, So if you have 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 unsaturated 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 amps AC rating requiring 75mA DC control current at bargain price of £22·50p + £1·86p. Carriage £5·00 + 40p. This choke weighs approx. 60lbs.
Panel Meter 0–1mA. Japanese made full vision perspex front, flush mounting. Price £2·00 + 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 volts, beautifully made by an American Company. Two models available 500w £35 + £2·80p. Post £2 + 16p. 750w model £50 + 4. Carriage £3 + 24p.
Tangential Blower, paddle type 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 9½″ × 1½″ approx. so they are ideal for fitting into a cooker head, forced draft heater etc.. Price £3·00 + 24p. Post 80p + 6p.
Tubular Heating Element. Spiral wire element, wound on a porcelain tube approx. 1½″ dia. and 3¾″ long. 500w rating at 240 volts with flat tag connectors. Internal diameter of the porcelain tube is ¾″ and it is completely free from obstructions and live parts so this 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. Polished aluminium panel with ridged top and angles underneath to strengthen it. This is approx. 10″ × 4½″ 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 fitted warmer or for an airing cupboard etc. Price 75p+ 6p. Post 20p + 2p.
Miniature Mains Transformer, standard primary centre tape secondary giving 4·5v–0–4·5v 200 mA. Price £1·50p + 12p.
Mains Transformer 20volt ½ 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 membrain to stretch and dryness causing it to contract. The stretching of the membrain 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 AV. Overall size of the device approx. 3¼″ long 1″ wide and 1¾″ deep. Price 60p + 5p.
Panel Meter 100mA flush mounting 3½″ around 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 a 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.P.O., rather old design but still we feel will fill an urgent need. Basically 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 within the instruments are auxilliary 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 ins 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
Type 1 for magnetic pickups, mics and tuners. Mono **£1·50**. Stereo **£3·00**. Type 2 for ceramic or crystal pickups. Mono **88p**. Stereo **£1·76**.

SINCLAIR IC20
IC20 10W+10W stereo integrated circuit amplifier kit with free printed circuit and data **£4·95**.
PZ20 Power supply kit for above **£3·95**.
VP20 Volume, tone-control and preamp kit **£8·55**.

JC40 AMPLIFIER
New integrated circuit 20W amplifier kit complete with chip, printed circuit and data **£4·45**,

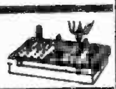
FERRANTI ZN414
IC radio chip **£1·44**. Extra parts and pcb for radio **£3·85**. Case **£1**. Send sae for free data.

BATTERY ELIMINATOR BARGAINS
RADIO MODELS
50mA with press-stud battery connectors. 9V **£3·75**. 6V **£3·75**. 9V+9V **£5·45**. 6V+6V **£5·45**. 4½V+4½V **£5·75**.
CASSETTE MAINS UNITS
7½V with 5 pin din plug. 150mA **£3·95**
3-WAY MODELS*
With switched output and 4-way multi-jack connector. Type 1: 3/4½/6V at 100mA **£3·20**. Type 2: 6/7½/9V at 150mA **£3·30**.
FULLY STABILIZED MODEL £5·45*
Switched output of 3/6/7½/9V stabilized at 400mA.
CAR CONVERTORS £5·10*
Input 12V DC. Output 6/7½/9V DC 1 Amp stabilized.

BATTERY ELIMINATOR KITS
Send sae for free leaflet on range.
100mA radio types with press-stud battery terminals. 4½V **£2·10**. 6V **£2·10**. 9V **£2·10**. 4½V+4½V **£2·80**. 6V+6V **£2·80**. 9V+9V **£2·80**.
100mA cassette type 7½V with 5 pin din plug **£2·10**.
Translstor stabilized 8-way type for low hum. 3/4½/6/7½/9/12/15/18V. 100mA **£3·50**. 1Amp **£6·50**.
Heavy duty 13-way types 4½/6/7/8½/11/13/14/17/21/25/28/34/42V. 1 Amp model **£4·95**. 2 Amp model **£7·95**.
Car convertor kit Input 12V DC. Output 6/7½/9V DC 1A transistor stabilized **£1·95**.
MILLENIA KITS*
5 Transistor highly stabilized power units. Switched 1 to 30V in 0·1V steps. Send sae for free leaflet. 1 Amp kit **£12·45**. 2 Amp kit **£14·95**. Case **£2·95** extra.

MAINS TRANSFORMERS
6-0-6V 100mA **£1**. 9-0-9V 75mA **£1**. 18V 1A **£1·95**. 0/12/15/20/24/30V 1A **£4·30**. 12/0/12V 50mA **£1**. 0/12/15/20/24/30V 2A **£5·95**. 20V 2½A **£2·95**. 6-0-6V 1½A **£2·85**. 9-0-9V 1A **£2·55**. 12-0-12V 1A **£2·95**. 15-0-15V 1A **£3·20**. 30-0-30V 1A **£4·10**.

S-DECS AND T-DECS
S-DeC **£2·24**. T-DeC **£4·05**.
u-DeCA **£4·45**. u-DeCB **£7·85**.
IC carriers with sockets:-
16 dil **£2·05**. 10T05 **£1·95**.



SINCLAIR CALCULATORS & WATCHES
Cambridge Memory **£5·95**. Cambridge Scientific **£8·95**. Oxford Scientific **£13·30**. New Sinclair pocket television set **£165**. Mains adaptors for other models (state type) **£3·20**. Assembled Grey Watch with free stainless steel bracelet **£16·45**. White watch **£13·95**.

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S450 tuner **£20·95**. AL60 **£4·60**. PA100 **£14·95**. MK60 audio kit **£31·95**. Teak 60 **£12·95**. Stereo 30 **£16·95**. SPM80 **£3·95**. BMT80 **£3·62**. Send sae for free data.
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DEPT. PW, PO BOX 68,
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Mail order only. We will not serve callers under any circumstances. Post 30p on orders under £2·23, otherwise free. Prices include VAT. Official orders welcome. Overseas customers please deduct VAT. Send sae for free leaflets on kits.

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to speed your building

- Super 30 Kit (30 Tools) (incl. drill without stand)
  £17·62 plus P. & P. 85p
- Mk. II Drill Stand
  £4·40 plus P. & P. 35p
- Mk. II Drill only
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  £6 plus P. & P. 70p
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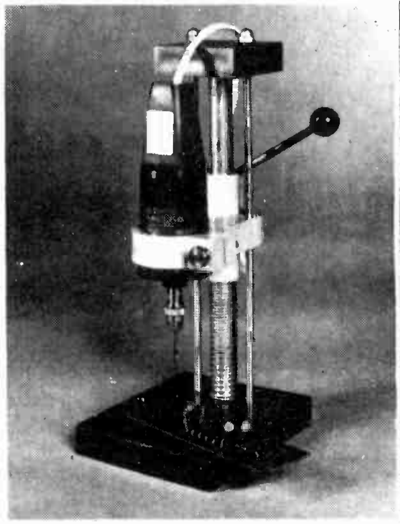

Replacement drills, stones, burrs, etc. **40p** each. Circular saw blades **50p** each. **£2** per set of 4 sizes. P. & P. any quantity 20p.

All VAT inclusive

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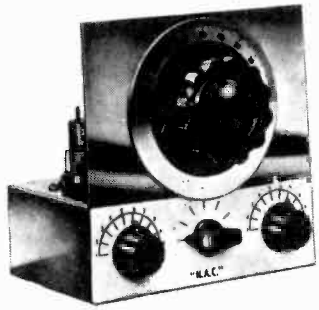
H.A.C. SHORT-WAVE KITS
WORLD-WIDE RECEPTION



Famous for over 35 years for Short-Wave Equipment of quality. "H.A.C." were the Original suppliers of Short-Wave Receiver Kits for the amateur constructor. Special offer AR8 valves—70p each.

1977 "DX" RECEIVER

Complete kit—Price £6·60 (incl. p. & p. & V.A.T.). Customer writes: "I think the performance is astonishing for such an inexpensive and foolproof kit. I would wholeheartedly recommend this kit to anyone, however inexperienced, as an antidote to TV-itis, and as an entry into a fascinating hobby".

This kit is ready to assemble and contains all genuine short-wave components, drilled chassis, valve, accessories and full instructions. Full range of other S.W. kits, including the famous model "K plus" (illustrated above). All orders despatched within 7 days. Send now for free descriptive catalogue of kits and components.

Send stamped envelope for details.

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"QUALITY" Branded Valves—90 day guarantee. ALL NEW & BOXED VALVES (incl. tax)—many makes. Radio Societies, trade etc. welcome.

AZ31	80p	PCC85	44p	PY801	41p
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DY802	42p	PCC89	50p	UCC85	46p
EB91	18p	PCC189	53p	UCH42	75p
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ECC82	35p	PCF82	45p	UCL82	42p
ECC83	34p	PCF86	58p	UCL83	58p
ECC85	40p	PCF200	95p	UF41	72p
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ECH84	52p	PCF808	£1·40	U25	72p
ECL80	52p	PCH200	85p	U26	60p
ECL82	47p	PCL82	40p	U191	60p
ECL83	68p	PCL83	50p	6/30L2	70p
ECL86	48p	PCL84	48p	6BW7	68p
EF80	30p	PCL85 / PCL805	62p	6F23	60p
EF85	37p	PCL86	50p	6F28	75p
EF86	52p	PCL200	£1·40	6V6	60p
EF89	36p	PD500	£2·50	6L6 (near equiv KT66)	99p
EF183	38p	PFL200	73p	20L1	80p
EF184	38p	PL36	70p	20P4	80p
EH90	56p	PL81	50p	30C1	40p
EL34	99p	PL81A	54p	30C15	78p
EL41	68p	PL82	38p	30C17	80p
EL84	38p	PL83	46p	30C18	£1·40
EL509	£2·50	PL84	46p	30F5	60p
EM84	50p	PL500 / PL504	90p	30FL1 / 30FL2	97p
EY51	47p	PL508	£1.10	30L1	35p
EY86/7	38p	PL509	£2·00	30L15	78p
EY500A	£1·45	PL519	£2·80	30L17	72p
EZ40/1	53p	PL802	£2·00	30P12	75p
EZ80	35p	PY33	52p	30P19	70p
EZ81	35p	PY81/3	41p	30PL1	£1·40
GY501	£1·10	PY88	41p	30PL13	75p
GZ30	55p	PY500 / PY500A	110p	30PL14	85p
PC86	63p	PY800	41p	30PL15	85p
PC88	63p			30P4MR	90p
PC97	45p				
PC900	49p				
PCC84	35p				

We offer return of post service. Post free over £15·00. **Postage:** 1st valve 12p, extra valves 6p, Max. 75p. Most types available, *send sae for lists.* Discount Prices. All prices subject to alteration without notice due to market fluctuations etc. *Telephone enquiries welcomed, sae with enquiries* PLEASE!. C.W.O. ONLY. No C.O.D. Export enquiries welcomed. VAT invoices on request. Mail order only. (LARGE valves 2p extra).

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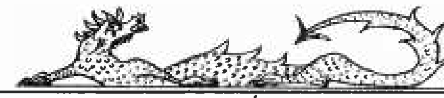
THE GREENWELD DRAGON—GUARDIAN OF GOOD VALUE



TAPE DECKS

Reel to reel chassis, takes 7" spools. Single motor operation. Made by Telefunken. No heads or electronics, mechanics only. Diecast ally frame 13¾ x 9¼ x 6¼" overall depth. Free head (no data) supplied with every order. Only £3·50.

CALCULATORS-£2·75!!!

There has to be a catch—these Rapidman 1208 machines are a mains powered desk top calculator with 0-9 and dec point, and 7 function keys inc %, but the liquid crystal display is missing. However, apart from this they are complete with PSU, 3 IC's + discrete components. Overall size 11 x 7 x 3". Only £2·75. Few complete working and boxed, as new £10.

KEYBOARDS

Front half of calculator, really. Case 130 x 75mm has display window, 2 slide switches, and 25 keys. Only £1.

DISPLAYS

Brand new 7-segment LED's, 9 MAN3M on PCB with multiplexed output. £1·35.

1 WATT AMPLIFIER

PCB 100 x 80mm with LM380 and associated components to make 1W amp operating from 9V. (Can be increased to 3W output by raising supply voltage and fitting heat sink). Complete with volume control. Connexion sheet included. Also on the board is a speed control circuit comprising 10 transistors, 2 presets, 4 pole 3 way switch, etc., but no data on this. Only £1.

POT PACKS

An overwhelming abundance of pots of all shapes and sizes, including duals, switched, sliders, etc., prompts us to make this offer: 20 asstd for £2·20, 100 for £8·50.

PO 4 DIGIT METERS

Ex-equip, 500R coil, operates on 18V only 40p, 10 for £3, 100 for £20.

RELAY UNITS

Units vary slightly, but a guaranteed minimum 20 relays, PO 3000 type, various coil resistances and contact arrangements. May be a few bent contacts, but excellent value at only £4·00.

SWITCHES

Wafer switches, 6p3w 30p.
Wafer switch mechanism, 12 way. Room for 2 wafers. 15p. Wafers to fit, 7p2w 20p, 1p 12w (few only) 40p. Bank of 5 push button switches, 4 are 6 pole c/o, interlocking, 5th is independant dpco. No knobs 70p. Sub-min dpco slide 15p; push to make 15p; push to break 20p. 10A 250V rocker 10p; DPCO rocker 40p. Sub-min toggles spco 62p; dpco 74p; dpco centre off 80p.
PO 1000 type lever switches, in vertical bank of 4, each 4 pole c/o, centre off. Ex-equip. 50p. Also with 4th switch biased, 50p. Few horizontal banks of 10, £1·50. Push button switch (No knob) DPCO, non-locking 12p. As above, but locking on or off, rated 250V 2A 18p. Microswitch 18 x 9 x 6mm, 5A 240V rating, has 55mm lever 18p.

TRIMMERS

2–7pf, 4–15pf, 6–25pf, 8–30pf ceramic. All 15p each. Compression types, 3–40pf 18p; 100–500pf 34p; 500–1250pf 40p.

NEON BANKS

Bank of 40 sub-min neons £1·00p
Bank of 20 std neons 60p
Recording heads, ½" ¼ track, type X/RPS/18 £1·00p

HIGH POWER POTS

Berco preset rheostat, type SEF 28·5 ohms 3·3A, with metal cover £2·30. 11 ohm 3·4A without cover £1·50. Rotary types: 25W, 6R, 25R, 114R £1·17 each; 50W, 50R, 160R 1k5 £1·44 each; 100W, 70R £1·86.
Moulded Carbon High Voltage Pots, ideal for scope brill and focus controls, etc. Rated 3W. 2k5, 3k, 5k, 10k, 50k, 100k, 250k, 500, 1M, 2M5, all 62p each.

7lb BARGAIN PARCEL

Hundreds of new components—pots, switches, resistors, capacitors, PC Boards with semiconductors, loads of odds and ends. Amazing value at only £2·00.

COMPUTER PANELS

Large quantity always available; 3lb asstd. £1·75; 7lbs £3·65; 56lb £16. Pack with about 500 components inc. at least 50 transistors £1·00; Pack with 12 High quality panels, incl. IC's, power transistors, multiturn trimpots, hundreds of small signal transistors, resistors, zeners, capacitors, etc. Only £2·75.
7400 IC pack—20 74 series IC's on panels £1·20.

PC ETCHING KIT

Contains 1lb Ferric Chloride, 100 sq ins copper clad board, DALO Quick Dri Etch resist pen, abrasive cleaner, 2 miniature drill bits, etching dish and instructions. £3·65.

FERRIC CHLORIDE

Anhydrous technical quality in 1lb double sealed packs. 1lb £1·00; 3lbs £2·18; 10lbs £5·60; 100lbs £39·00.

FIBREGLASS PCB

Large quantity of offcuts, all usable pieces. 200 sq ins, single sided, double sided or mixed £1·40.

DEVELOPMENT PACKS

50V ceramic plate capacitors, 5%. 10 of each value 22pF to 1000pF, total 210 caps. £2·70.
CR25 carbon film 1/3rd watt resistors, 5%, 10 of each value 10 ohms to 1M Total 610 resistors £6·00. Electrolytics, wire ended 25V working 10 each of: 1, 2·2, 4·7, 10, 22, 47 and 100mfd. 70 capacitors for £3·20. 400mW zeners 5% 10 each 3V to 30V, 260 in all. Only £14·00.
1 watt Metal Film resistors, 5% 10 off each value 27R to 10M, E12 series. Total 680 resistors £10·00. Polystyrene capacitors, 160V 2½% 10 off each value from 10pF to10,000pF. Total 370 capacitors £12·50.

COMPONENT PACKS

400 asstd. carbon resistors £1·35
100 Wirewounds 2-15W £1·00
200 Miniature resistors, ⅛, ¼ and ½W, mostly carbon film £1·20
200 poly, mica, ceramic caps £1·10
100 Polyester, ·01-2·2μF £1·00
200 miniature electrolytics, but many unmarked so only £1·00

RELAYS

Miniature Plug-in types: 1250 ohm 4c/o 40p; 700 ohm 4c/o 50p. PO 3000 type 650 ohm with 6 heavy duty c/o contacts (Ex-equip) 75p; 10 for £4·00. 6 1" easily removable reeds in 3580 ohm coil 50p; Plug in relay, B7G Base 17mm dia x 42mm long 10k coil 1 c/o contact 40p. Omron MK3P plug in relay. 230V AC coil, 3 sets 10Ac/o contacts. £1·25. Bases 30p. 6V PC type, SPCO contact 70p.
Ex-equip on PC board, min sealed type, 22 x 20 x 10mm 200R coil (ops on 6-12V) 2 c/o contacts 40p.
Ex equip 34 x 30 x 15mm. 250R coil, ops on 6-12V 4 c/o contacts, 60p. Delay relay, 115V 20 sec coil, mains contact 60p; 230V coil 30 sec delay £1.

CRYSTAL FILTER UNIT

Chassis 210 x 115 x 80mm containing 24 way switch, 24 HC6U xtal holders, 24 beehive trimmers, + board with 4 BF115, R's C's, etc. £3·50.

5MHz FREQUENCY SOURCE

High stability, better than 2 x 10⁸ short term, better than 1 x 10⁻⁷ per month. 12·6V drive voltage, output 5MHz into 50R £12. 4·433619MHz colour sub-carrier crystals 60p.

BOOKS

All by R. M. Marston, these titles use readily available components.
20 Solid State Projects for the Home £2. 20 Solid State Projects for the Car & Garage £2. 110 Semiconductor Projects for the Home Constructor £2·70. 110 Thyristor Projects for the Home Constructor £2·70. 110 Integrated Circuit Projects for the Home Constructor £2·70. 110 Op Amp Projects for the Home Constructor (uses 741) £2·70. 110 CosMos Digital IC Projects for the Home Constructor £2·95. 110 Electronic Alarm Projects for the Home Constructor £3·15.

VERO BOXES, CASES & BOARD

VEROBOARD

Size	0·1"	0·15"	0·1" plain
3¾ x 3¾"	44p	40p	N/A
5 x 3¾"	50p	55p	40p
17 x 3¾"	£1·90	£1·60	£1·30

PINS

Full or half pins, 0·1 or 0·15 35p 100.

Spot face cutter for 0·1 or 0·15" 75p.

DIP BREADBOARD

Accommodates 20 x 14 way or 16 x 16 way IC's £2·00.

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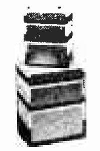
Pack A, All 0·1"
Pack B, All 0·15"
Pack C, Mixed
Pack D, All 0·1" plain

Each pack contains 7 or 8 pieces with a total area of 100 sq ins. Each pack is £1·30. Also available by weight, 1lb £3·45, 10lbs £28.
We are also VERO wholesalers—Trade price list on request from Bone Fide Companies.



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Plastic top and bottom, ally panels front and back.

Type		
1410	205 x 140 x 40mm	£3·30
1411	205 x 140 x 75mm	£3·70
1412	205 x 140 x 110mm	£4·00
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2520	150 x 80 x 50mm	£2·60
2522	188 x 110 x 60mm	£3·50

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Type 2523 220 x 174 x 100/52mm £6·60
Type 1798 171 x 121 x 75/37·5mm £4·50
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Hand Controller box, shaped for ease of use in the hand, 94 x 61 x 23mm 62p

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S-DEC Breadboard £2·10
T-DEC Breadboard £3·75

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Antex 15W Model CCN £4·00
DeeGee 25W Model 3612 £2·80
Litesold 10W £4·00
EK400 40W £2·40
Instant Heat Soldering Gun with built in lighting unit and 5 spare tips £4·50.

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15,000μF 6V 35mm dia x 55mm PC 10p
1,250μF 16V 20 x 50mm, tags 10p
1,250μF 40V 25 x 80mm, tags 20p
800μF 40V 25 x 50mm, tags 16p
10,000μF 10V 35 x 80mm, tags 18p
6,400μF 16V 35 x 80mm, tags 20p
4,000μF 25V 35 x 80mm, tags 25p
10,000μF 16V 40 x 80mm, tags 30p
50μF 350V 25 x 50mm tags 12p
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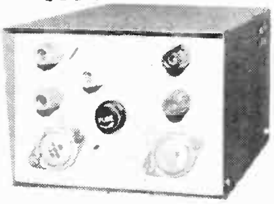

240v-50Hz from your 12v car battery

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240v-50Hz–150 watt inverter with built in battery charger. In event of power failure switches over automatically from battery charging to inverter operation. Cct. as appeared in Dec. 72 P.W. Complete kit of parts (excluding meter) £24·50 plus £1·70p.p.

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FOUR FUNCTION DIGITAL WATCH FOR ONLY £16 with 1 Year Guarantee HOURS . MINS. . SECONDS . DATE American Design, UK Manufacture.

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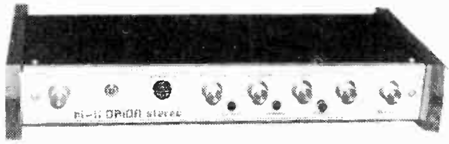

20 + 20 Watts r.m.s. into 8 ohm load. Distortion less than 0·01% 100Hz–10kHz. Frequency response ± 1dB 20 Hz to 20kHz. Hum level virtually nil with volume full on.

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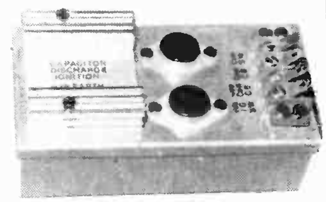

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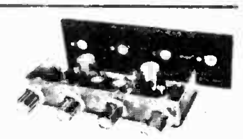

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4001	0·20	4040	1·19	4082	0·24	14506	0·57
4002	0·20	4041	0·93	4085	0·80	14507	0·60
4006	1·31	4042	0·93	4086	0·80	14508	3·08
4007	0·20	4043	1·12	4089	1·74	14510	1·51
4008	1·07	4044	1·04	4093	0·89	14511	1·74
4009	0·60	4045	1·56	4094	2·08	14512	1·03
4010	0·60	4046	1·48	4095	1·16	14514	3·47
4011	0·20	4047	1·01	4096	1·16	14515	3·47
4012	0·20	4048	0·60	4097	4·13	14516	1·51
4013	0·60	4049	0·60	4098	1·22	14517	4·02
4014	1·12	4050	0·60	4099	2·03	14518	1·39
4015	1·12	4051	1·04	40101	1·76	14519	0·57
4016	0·60	4052	1·04	40102	2·16	14520	1·39
4017	1·12	4053	1·04	40103	2·16	14521	2·77
4018	1·12	4054	1·29	40104	2·26	14522	2·15
4019	0·60	4055	1·46	40107	0·66	14526	2·15
4020	1·24	4056	1·46	40108	6·18	14527	1·76
4021	1·12	4057	29·81	40109	2·21	14528	1·22
4022	1·07	4059	6·20	40181	4·30	14529	1·72
4023	0·20	4060	1·24	40182	1·73	14530	0·95
4024	0·87	4061	25·60	40194	2·26	14531	1·74
4025	0·20	4062	10·10	40257	2·26	14532	1·39
4026	1·92	4063	1·22	4700	1·75	14534	8·15
4027	0·60	4066	0·69	7083	4·25	14536	4·00
4028	1·00	4067	4·13	14160	1·18	14537	13·17
4029	1·27	4068	0·24	14161	1·18	14539	1·24
4030	0·60	4069	0·24	14162	1·18	14541	1·62
4031	2·46	4070	0·65	14163	1·18	14543	1·82
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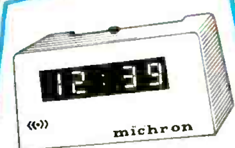

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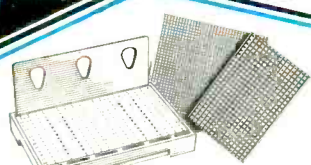

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