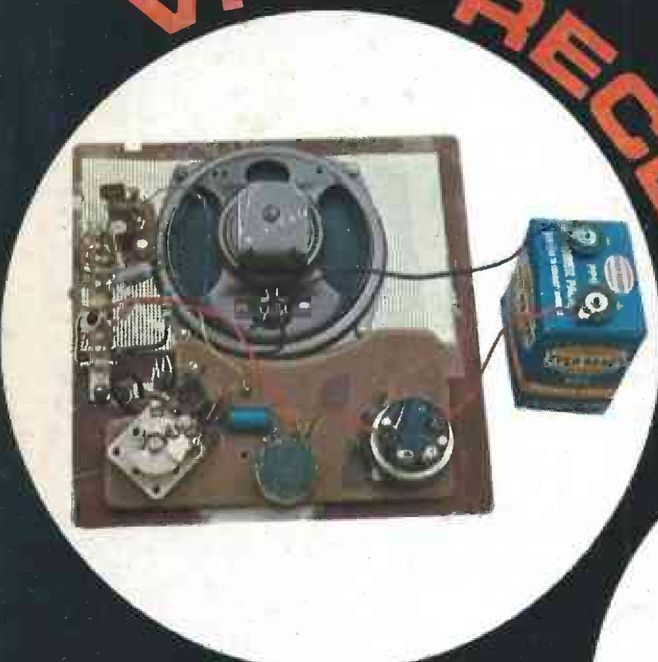
PRACTICAL WIRELESS

SEPTEMBER 1969

3'0

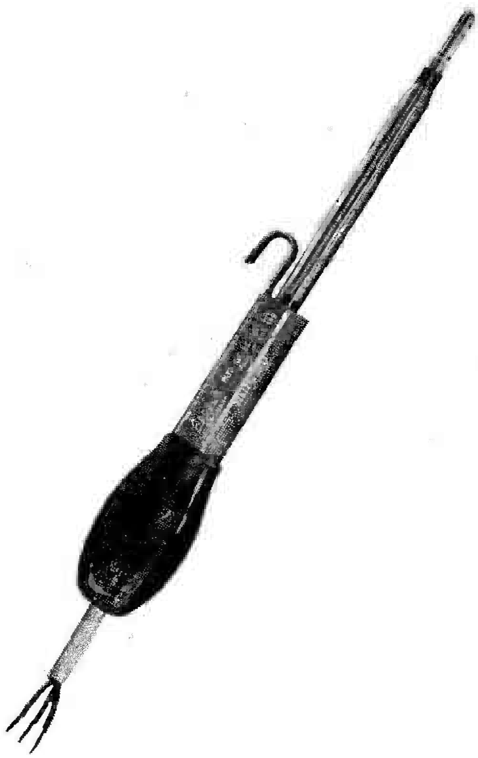
CQ2 VHF RECEIVER



ALSO INSIDE:- THE MINI-TWO

ADCOLA
PRODUCTS LIMITED
(Regd Trade Mark)

THE RELIABLE SOLDERING INSTRUMENT!



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ZTX300	1/11	ZT1613	7/9	ZT3055	20/6	ZR12	16/9	ACY21	5/4
ZTX302	3/-	ZT1700	17/9	KR54	27/6	ZS170	1/11	ACY22	4/-
ZT44	12/9	ZT1701	22/6	KR56	24/9	OC28	19/-	OAZ203	12/-

Mullard LA 2300 **9/5d.**

All above transistors direct from manufacturer.

Unmarked silicon planar transistors suitable for use in divider circuits: **1/6** each or **£5** per 100.

LIGHT SENSITIVE DEVICES

GIANT-SIZE SELENIUM SOLAR CELLS — PRODUCE UP TO 6mA FROM DAYLIGHT! 67mm diameter, **10/-** each. 50mm x 37mm. 2 for **10/-**. Transistors similar to OCP 71, **2/-** each.

ORP 12 CADMIUM SULPHIDE LIGHT SENSITIVE RESISTORS 9/- each. Light sensitive diodes, **10/-** per doz.

WIRE-WOUND RESISTORS

Mains dropper type. Up to 30 watts. Some multi-tapped. Fraction of normal price! **10/-** per dozen.

MULLARD POLYESTER CAPACITORS FAR BELOW COST PRICE! 0·001μF 400V **3d.**, 0·0015μF 400V **3d.**, 0·0018μF 400V **3d.**, 0·0022μF 400V **3d.**, 0·01μF 400V **3d.**, 0·15μF 160V **6d.**, 0·22μF 160V **6d.**, 0·27μF 160V **6d.**, 1μF 125V **1/-**.

RECORD PLAYER CARTRIDGES. COMPLETE WITH NEEDLES. GP67/2 Mono **15/-**, GP91/3 Compatible **£1**, GP93/1 Crystal Stereo **25/-**, GP94/1 Ceramic **30/-**.

TRANSISTORISED SIGNAL INJECTOR KIT 10/- SIGNAL TRACER KIT 10/-. CAR REV. COUNTER KIT 10/-.

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2½ x 1" 0·15 matrix	1/3	5 x 3¾" 0·15 matrix	5/6	3¾ x 3¾" 0·1 matrix	4/9
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5 x 2½" 0·15 matrix	3/11	3¾ x 2½" 0·1 matrix	4/2		

Spot Face Cutter **7/6**. Pin Insert Tool **9/6**. Terminal Pins **3/6** for 36.
Special Offer! Spot Face Cutter and 5 2½ x 1" boards.......... **9/9** only

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Mixed bags 0·001μF to ·5μF, **12/6** per 100.

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Ceramic, Polystyrene Condensers. Well assorted. Mixed types and values, **10/-** per 100.

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Mixed types and values, ½ to 1 watt, **6/6** per 100, **55/-** per 1,000. Wire-wound resistors, 1 watt to 10 watts. Mixed values. 20 for **10/-**.

TRANSISTORS

Mixed, unmarked, mainly O.K. **7/6** for 50.

12 VOLT TRANSISTORISED FLUORESCENT LIGHTS. HALF NORMAL PRICE

8 Watt 12in. tube. Reflector type **£2.19.6.** 15 watt 18in. Batten type **£3.19.6.**

IDEAL FOR CAMPING OR CARAVAN HOLIDAYS! A BRIGHT LIGHT FOR VERY LITTLE CURRENT!

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0·25μF	3 volt	4μF	4 volt	10μF	25 volt	64μF	9 volt
1μF	6 volt	4μF	12 volt	20μF	6 volt	100μF	9 volt
1μF	20 volt	4μF	25 volt	25μF	6 volt	320μF	4 volt
1·25μF	16 volt	5μF	6 volt	25μF	12 volt	320μF	10 volt
2μF	3 volt	6μF	6 volt	25μF	25 volt	400μF	6·4 volt
2μF	350 volt	8μF	3 volt	30μF	6 volt	All at 1/- each.	
2·5μF	16 volt	8μF	12 volt	30μF	10 volt	20 assorted	
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3·2μF	64 volt	10μF	6 volt	64μF	2·5 volt	10/-	

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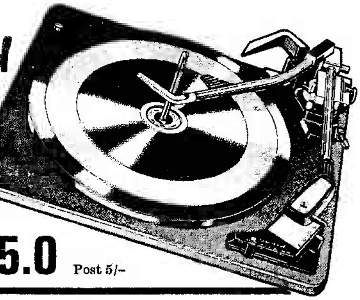
Lasky's



Garrard

AT-60
Mark II
4-speed autochanger
—less cartridge

LASKY'S PRICE £13.5.0 Post 5/-

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1025 less cartridge	£6.9.6
1025 with GCM21 mono cartridge. Stereo compat. ..	£6.19.6
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TRANSCRIPTION DECKS

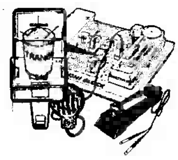
401	£28.10.0

GARRARD BASES
WB1 £3.6.11; WB4 Mk II **£5.8.11; WB5 £5.8.11.**

CLEARVIEW PERSPEX COVERS:
SPC1 £3.5.0; SPC4 Mk II **£4.6.6.**
Postage on all above 5/- extra.

DENSHI BOARD KITS

NEW EXPERIMENTAL AND EDUCATIONAL CIRCUIT SYSTEM



The **DENSHI BOARD** system enables the young experimentor and electronics hobbyist to produce a wide range of transistor circuits of increasing sophistication—without soldering or the use of any tools at all! Basically the system comprises a slotted circuit board into which plug-in components and bridge pieces are set to produce up to 30 different circuits. The components are incapsulated in transparent plastic blocks bearing the appropriate circuit symbol and value thus enabling even the complete novice to visually grasp the fundamentals of circuitry after only a few moments study. In addition each **DENSHI BOARD KIT** comes complete with an 80 page manual of circuits and data.

THESE ARE JUST A FEW OF THE CIRCUITS YOU CAN BUILD IN MINUTES:
VARIOUS RADIO RECEIVERS, AMPLIFIERS, MORSE CODE PRACTISE DEVICE, CONTINUITY TESTER, SIGNAL INJECTOR, SIGNAL TRACER, WIRELESS MICROPHONE ETC., ETC.

DENSHI BOARD KIT SR-1A *comprises:*
Base board; tuner block; 4 resistors; choke coil; transformer; 2SA transistor for RF; 2 diodes; 3 capacitors; battery block; morse key; antenna lead; crystal earphone; various bridge and connecting pieces and 80 page manual. This kit permits the building of 16 basic circuits.

***LASKY'S PRICE* £4.19.6** Post 3/6

DENSHI BOARD KIT SR-2A *as SR-1A but with the following additional parts:*
2SB transistor for AF; 2 resistors; 1 capacitor; crystal microphone; test probes; electrode, additional connecting pieces; 9V battery. This kit permits the building of 30 basic circuits;

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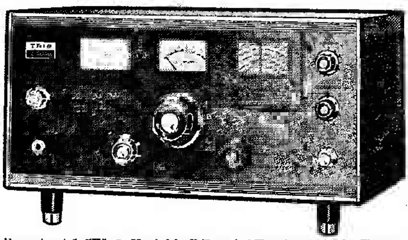
TRIO



MODEL 9R-59DE
Brief spec.: 4 band receiver covering 550 Kc/s to 30 Mc/s continuous and electrical band spread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. **Special features:** SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. band spread dial ● IF frequency 455 Kc/s ● Audio output 1·5W ● Variable RF and AF gain controls. For use on 115/250V A.C. Mains. Beautifully designed control layout finished in light grey with dark grey case, size 7 x 15 x 10in. Weight 19 lbs. Fully guaranteed, complete with instruction manual and service data.

***LASKY'S PRICE* £42.0.0** Carr. FREE

SP-5D "SPEAKER MATE"

TR10 communications speaker unit—matching the above receiver in both style and size. Contains 5 x 3in. elliptical 8Ω speaker specially designed to give extremely crisp reproduction of voice frequencies. Dark grey metal cabinet—size 7 x $3\frac{1}{2}$ x $5\frac{1}{4}$in.

***LASKY'S PRICE* 87/6** Post FREE

NEW LASKY'S SCOOP

THE WORLD'S SMALLEST 6 TRANSISTOR TWO WAVEBAND RADIO RECEIVER FROM RUSSIA

THE ASTRAD ORION

Made to the highest Russian space-age standard—this remarkable micro-size set measures only 1 11/16 x 1 3/10 x 5 5/16in. yet it contains 6 transistors and other components combined in a photo etched circuit, only $\frac{3}{4}$ x $\frac{1}{2}$in.; tuning capacitor, ferrite rod (or core) aerial, battery, waveband selection, switch etc. Output to a high impedance, crystal earpiece, giving ample volume (automatically adjusted) and clear tone. Brief tech. spec. Waveband coverage—Medium wave 525 to 1605kc/s, Long wave 150kc/s to 408kc/s. Sensitivity: 35mV max. Selectivity —10dB (at 30kc/s de-tuning). Power consumption 4mA max. Power source: 1 x 1·4V Mercury battery (Mallory type RM625 or equivalent).

***NOTE:** The battery we supply with the Orion is a rechargeable type. Charger units will shortly be available enabling you to recharge the battery from AC mains 220/240V supply. Price **19/6**—post free if ordered now **with radio**—otherwise **2/-**. **If you purchase your** charger now we will forward as soon as stocks arrive.

The Orion is supplied fully built and tested complete with battery*, left and right fitting earphone supports and attractive black and ivory plastic presentation/carrying case (matching the Orion.) Never miss your favourite music, sport, news—the Orion is an ideal gift for all, providing a constant source of enjoyment without disturbing others. Lasky's price only **39/6**, post 2/6. Extra battery available (rechargeable type) 3/6.

***LASKY'S PRICE* 39/6** Post 2/6. Extra battery available **3/6**

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$3\frac{1}{4}$in.	Triple play, 600ft. Mylar ...	10	0
4in.	Triple play, 900ft. Mylar ...	17	6
5in.	Double play, 1200ft. Mylar...	15	0
5in.	Long play, 900ft. Acetate ...	10	0
5in.	Standard play, 600ft. PVC ..	8	6
5in.	Triple play, 1800ft. Mylar ..	35	0
$5\frac{3}{4}$in.	Double play, 1800ft. Mylar...	22	6
$5\frac{3}{4}$in.	Long play, 1200ft. Acetate...	12	6
$5\frac{3}{4}$in.	Standard play, 850ft. PVC...	11	6
$5\frac{3}{4}$in.	Long play, 1200ft. Mylar	15	0
$5\frac{3}{4}$in.	Triple play, 2400ft. Mylar....	45	0
7in.	Standard play, 1200ft. Acetate	12	6
7in.	Standard play, 1200ft. Mylar	12	6
7in.	Long play, 1800ft. Mylar	19	6
7in.	Double play, 2400ft. Mylar...	26	0
7in.	Long play, 1800ft. Acetate ..	15	0
7in.	Triple play, 3600ft. Mylar....	50	0

P. & P. 1/- extra per reel. 4 reels and over Post Free

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RACAL RA-17

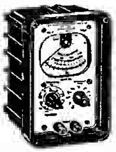
First ministry release of these world famous communication receivers. Frequency range 500 kc/s–30 Mc/s. Available in excellent condition, fully tested and guaranteed. £150. Carr. 40/–.

CLASS D WAVEMETERS

A crystal controlled heterodyne frequency meter covering 1·7–8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. £5.19.6. Carr. 7/6. Or brand new with accessories. £7.19.6. Carr. 7/6.

CLASS D WAVEMETERS No. 2

Crystal controlled. 1·2–19 Mc/s. Mains or 12V. D.C. operation. Complete with calibration charts. Excellent condition. £12.10.0. Carr. 30/–.



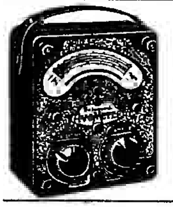
MARCONI CT/44/TF956

AF Absorption Wattmeter

1 μ/watt to 6 watts. **£20.** Carr. 10/–.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

Frequency 0–20 Kc/s. on 2 ranges. Output 500 Ω or 5k Ω. Operation 200/250V. A.C. Supplied in perfect order. £12.10.0. Carr. 10/–.



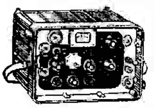
AVOMETERS

Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions. Model 47A £9.19.6. P. & P. 7/6.

SOLARTRON CD-1016 OSCILLOSCOPE

Double beam. D.C. To 5 Mc/s. Excellent condition. £55 each. Carr. 20/–.

AM/FM SIGNAL GENERATORS



Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20–80 Mc/s. AM CW/FM. Incorporates precision dial, level meter, precision attenuator 1μV–100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A.C. Size 12 × 8½ × 9in. Supplied in brand new condition complete with all connectors fully tested. £45. Carr. 20/–.

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Paralux type SD19 230/250V. A.C. Reversible. 30 r.p.m. 40 lb./ins. Complete with capacitor. Excellent condition. 99/6. Carr. 10/–.

SINCLAIR EQUIPMENT

1C10 59/6
Z12 12 watt amplifier, 89/6
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Stereo 25 Preamp. £9.19.6
Q14 Speakers £7.19.6
Micromatic Radio Kit. 49/6. Built 59/6.
ALL POST PAID

SPECIAL OFFER

Two Z12 Amps., PZ4 Power Supply, Stereo 25 Preamplifier, £22, or with two Q14 speakers, £37.

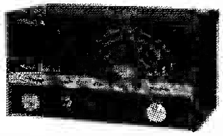
NEW SINCLAIR 2000 SYSTEM

35 watt Integrated Amplifier, £29. Carr. 5/–. Self-powered FM Tuner, £25. Carr. 5/–.

ECHO HS-606 STEREO HEADPHONES

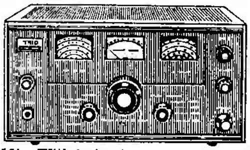
Wonderfully comfortable. Lightweight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25-17,000 cps. 8 ohm imp. 67/6 P. & P. 2/6.

UNR-30 4-BAND COMMUNICATION RECEIVER



Covering 550 Kc/s–30 Mc/s. Incorporates BFO. Built in speaker and phone jack. Metal cabinet. Operation 220/240V. A.C. Supplied brand new, guaranteed with instructions. Carr. 7/6 **13 gns.**

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

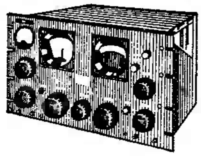


4 band receiver covering 550 Kc/s to 30 Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. bandspread dial ● IF 455 Kc/s ● Audio output 1·5 W. ● Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. £42.10.0, carriage paid. **TRIO COMMUNICATION TYPE HEADPHONES.** Normally £5.19.6. OUR PRICE £3.15.0 if purchased with above receiver.

TRIO JR-500SE 10–80 METRE AMATEUR COMMUNICATION RECEIVER IN STOCK **£69.10.0. Carr. paid.**

SPECIAL BONUS OFFER! TRIO SP5D Matching Speaker Mate and TRIO HS4 Communication Headphones Normal Value £10.7.0., FREE OF CHARGE with every JR.500SE purchased.

HAMMARLUND SP600JX COMMUNICATION RECEIVER

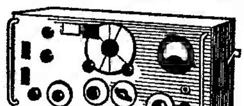


High quality professional dual conversion communication receivers available for the first time in this country at a reasonable price. Frequency range 540 Kc/s–54 Mc/s. in 6 bands variable tuning or 6 channel crystal controlled. 2·5 watt output into 600 ohms. Input 110/230V. A.C. 20 valve circuit incorporating: Xtal filter B.F.O. A.N.L. Xtal calibrator, S meter etc. Size 19 × 12 × 22in. (List £520). Offered in excellent condition, fully tested and checked. £100 each.

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER

19 transistors, 8 diodes, IHF music power, 30W at 8 Ω. Response 30–20,000 ± 2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3–16 Ω. Separate L and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complementary metal case. Size 10½ × 3 9/16 × 7 13/16in. Operation 115/230V. A.C. £28. Carriage 7/6.

MARCONI TEST EQUIPMENT



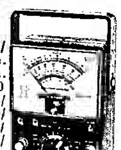
EX-MILITARY. RECONDITIONED. TF.144G STANDARD SIGNAL GENERATORS, 85 Kc/s–25 Mc/s, £25. Carr. 30/–. TF.885 VIDEO OSCILLATOR 0–5 Mc/s £45 Carr. 30/–. TF.195M BEAT FREQUENCY OSCILLATOR 0–40 Kc/s. 200/250V. A.C. £20 Carr. 30/–. TF.142E Distortion Factor Meter, £20 Carr. 20/–. All above offered in excellent condition, fully tested and checked. TF.1100 VALVE VOLTMETER, Brand New, £50. TF.1267 TRANSMISSION TEST SET, Brand New, £75. TF.1371 Wide Band Millivolt Meter, Brand New. £50.

MULTIMETERS *for EVERY purpose!*

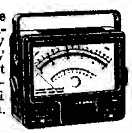
LAFAYETTE DE-LUXE 100K Ω/VOLT "LAB TESTER" Giant 6½in. scale. Built-in meter protection 0/·5/2·5/10/ 0/250/500/1,000V D.C. 0/3/10/50/250/500/1,000V A.C. 0/10/100 μA/10/100/500mA/2·5/10A. 0/1K/10K/100K/10M/10M Ω. – 10 to 49·4dB £13.18.0. P. & P. 5/–.

TE-900 20,000 Ω/VOLT GIANT MULTIMETER mirror scale and overload protection. 6in. full view meter. 2 colour scale. 0/2·5/10/250/1,000/5,000 v. A.C. 0/25/12·5/10/50/250/1,000/5,000v. D.C.0/50 μA/10/100/500 mA/10 amp. D.C 02K/200K/20 MEG. OHM. £15. P. & P. 5/–.

MODEL AS-100D. 100K Ω/VOLT. 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v. D.C. 0/6/30/120/300/600v. A.C. 0/10 μA/6/60/300mA/12 amp. 0/2K/200K/2M/200M Ω. –20 to +17dB. £12.10.0. P. & P. 3/6.



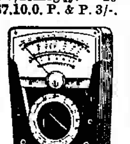
LAFAYETTE 57 Range Super 50k Ω/volt Multimeter. D.C. volts 12 mV –1000V. A.C. volts 1·5V –1000V D.C. current 25μA–10 amp Ohms 0–10meg Ω dB –20 to +81 dB. Overload protection. £12.10.0. Carr. 3/6.



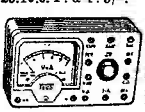
PROFESSIONAL 20,000 opv LAB. TYPE Multitester. Automatic overload protection, mirror scale. Ranges: 1/10/50/250/500/1,000 volts. D.C. and A.C. 0–500μA, 10mA, 250mA Current: 0/20K, 200K, 2 megohm. Decibels: –20 to +22dB. £5.19.6. P. & P. 2/6.

MODEL TE-90 50,000 O.P.V. mirror scale overload protection 0/3/12/60/300/600/1200v. D.C. 0/6/30/120/300/1200v. D.C. ·03/6/60/600mA. D.C. 16K/160K/1·6/16meg Ω. –20 to +63dB. £7.10.0. P. & P. 3/–.

MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200v. D.C. 0/6/30/120/600/1,200v. A.C. 0/30μA/3/30/300mA. 0/16K/160K/1·6M/16 Meg. Ω £5.10.0. P. & P. 3/–.



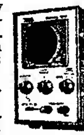
MODEL TE-80. 20,000 O.P.V. 0/10/50/100/500/1,000v A C 0/5/25/50/250/500/1,000v D C. 0–50μA, 5/50/500mA. 0/6K/60K/600 K/6meg. £4.17.6. P. & P. 3/–.



MODEL PT-34. 1,000 O.P.V. 0/10/50/250/500/1,000v. A.C. and D.C. 0/1/100/500/mA. D.C 0/100K Ω. 39/6. P. & P. 1/6.

MODEL TE-12 20,000 O.P.V. 0/0·6/6/30/120/600/1,200/3,000/6,000v. D.C. 0/6/30/120/600/1,200v. A.C. 0/60μA/6/60/600mA. 0/6K/600K/6Meg./60 Meg. Ω 50pF. 0·2mFd. £5.19.6. P. & P. 3/6.

TO-2 PORTABLE OSCILLOSCOPE

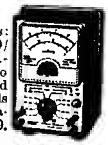


A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPS–1 mHz. Input imp 2 meg Ω 25 pF. Illuminated scale. 2in. tube. 115 × 180 × 230mm. Weight 8lb. 220/240V. a.c. Supplied brand new with handbook. £22.10.0. Carr. 10/–.

FIELD TELEPHONES TYPE L

Generator ringing, metal cases. Operates from two 1·5V batteries (not supplied). Excellent condition. £4.10.0 per pair. Carr. 10/–.

TE-40 HIGH SENSITIVITY A.C. VOLTMETER



10 meg. input 10 ranges: ·01/·003/·1/·3/1/3/10/30/100/300V. R.N.S. 4cps.–1·2 Mc/s. Decibels –40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17.10.0. Carr. 5/–.

AUTO TRANSFORMERS

0/115/230V. Step up or step down. Fully shrouded.

150 W.	£1.12.6.	P. & P. 3/6.
300 W.	£2. 7.6.	P. & P. 3/6.
500 W.	£3.10.0.	P. & P. 6/6.
1,000 W.	£5.10.0.	P. & P. 7/6.
1,500 W.	£6.10.0.	P. & P. 8/6.
7,500 W.	£15.10.0.	P. & P. 20/–.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20c/s to 200 Kc/s on 4 bands. Square: 20c/s to 30Kc/s. Output impedance 5,000 ohms. 200/250V. A.C. Supplied brand new and guaranteed with instruction manual and leads, £16.10.0. Carr. 7/6.

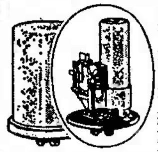
TE111. DECADE RESISTANCE ATTENUATOR

Variable range 0–111dB. Connections, Unbalanced T and Bridge T. Impedance 600 Ω range (0·1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (–3dB). Accuracy: 0·05dB. +Indication dB × 0·01. Maximum input less than 4W (50V). Built in 600 Ω load resistance with internal/external switch. Brand new £27.10.0. P. & P. 5/–.

TE-20D RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s–500 Mc/s on 6 bands. Directly calibrated. Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. £15. Carr. 7/6. Size 140 × 215 × 170 mm.

CAR LIGHT FLASHERS



Heavy duty light flasher employs a condenser discharge principle operating on electro mechanical relay. (As inset). Housed in strong plastic case. Flashing rate between 60–120 per minute. 12V DC operation. Maximum load 6 amps. Size 2-11/16in. dia. x 4in. Supplied brand new at a fraction of original cost. 6/6 each P. P. 2/6. (3 for 17/6 P. P. 4/6).

Full range of all components · valves semiconductors · test equipment receivers · hi-fi equipment · all at discount prices.

G. W. SMITH & CO (RADIO) LTD.
Also see oppos. page

R.S.C. SENSATIONAL HIGH FIDELITY STEREO 'PACKAGE' OFFERS

30 WATT OUTPUT
★ Goldring Transcription Turntable on Plinth
★ Shure or Goldring Magnetic Pick-up Cartridge
★ Super 30 Amplifier in veneered housing **86 Gns.**
★ Pair of Stanton Loudspeaker Units
Special total price. Four fully wired units ready to "plug-in". Carr. 25/-.
TERMS AVAILABLE ALL PACKAGE OFFERS

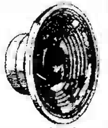
Matching as recommended for optimum performance. Send for coloured brochure showing other money saving offers.

Illustrated with TFMI Mk II Tuner fitted

30 WATT OUTPUT
★ Garrard SP25 Mk II Turntable on Plinth
★ Goldring CS90 Ceramic P.U. Cartridge
★ Super 30 Amplifier in veneered housing
★ Pair Stanton Speaker Units **76 Gns.** Carr. 25/-
Special total price. Four fully wired units ready to "plug-in"

13 WATT OUTPUT
★ Garrard SP25 Mk II 4 sp player unit on plinth
★ Goldring CS90 Ceramic P.U. Cartridge
★ TA12 Amplifier in veneered housing
★ Pair of Dorchester Loudspeaker Units. Special total price. **51 GNS.**
Or Dep. £10 and 9 monthly payments £5.11.0. (Total £59.19.0.) Transparent plastic cover 3 gns. extra.

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

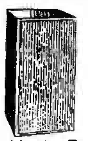


Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround giving low fundamental resonance. "D" indicates Tweeter Cone providing extended frequency range 40-15,000 c.p.s. Impedance 3 or 15 ohms. Please state choice. Exceptional performance at low cost. Prices include carriage.

HF510L	5"	10W	57/9	HF100D	10"	15W	£5.15.0
HF801D	8"	8W	59/9	HF120	12"	15W	79/9
HF811D	8"	10W	4 gns.	HF120D	12"	15W	89/9
HF102D	10"	10W	65/-	HF126	12"	15W	£5. 5.0
				HF126D	12"	15W	£5.15.0

HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets latest style Satin Teak or Afrormosia veneer. Acoustically lined or filled woollen damping. Ported where appropriate, credit terms available



DORCHESTER Size 16 x 11 x 9in. Appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13 x 8in. Dual Cone spkr. Imp. 3 or 15 ohms **£8.19.9** Carr. 7/6

STANTON IIIS Size 18x11x10in. Rating 10 watts. Incorporating Fane 803b speaker with roll rubber cone surround and 15,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 30-20,000 c.p.s. Impedance 15 ohms. Gives smooth realistic sound output. **16 Gns.** Inc. Carr.

GLOUCESTER Size 25 x 16 x 10in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Frequency range 40-20,000 c.p.s. Impedance 15 ohms. **12½ Gns.**

EXTREMELY ATTRACTIVE AND VERSATILE PLINTHS

finished in Teak or Afrormosia veneer. Transparent plastic "roll over" cover with satin chrome handle.

10 W HIGH FIDELITY AMPLIFIERS

LINEAR L10 Separate Preamp and Main Amp. Matched to Magnetic P.U. To clear **10 GNS.**

RECORD PLAYING UNITS

Money saving units. Ready to plug into Amplifier or Tape Recorder.

RP2 Consisting of Garrard SP25 Mk II (with heavy turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus. Mounted on Plinth. Inc. transp. plastic cover. Inc. Carr. **22 Gns.**

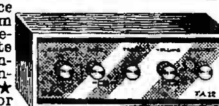
RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Supplied with transp. plastic cover. Inc. Carr. **28 Gns.**

R.S.C. PLINTHS

for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6, AT60, SP25 etc., etc. Available with transp. plastic cover. Inc. Carr. **59/9** **6 Gns.**
Cover sold separately at 3 Gns. Limited number of covers slightly damaged but repaired by makers. 39/9

R·S·C· TA12 13 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION
HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL

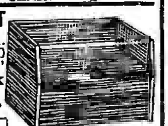


Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge, Radio tuner, Tape recorder, 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v A.C. mains ★ Frequency Response 30-20,000 c.p.s. —2dB ★ Harmonic Distortion 0·3% at 1000 c.p.s. Hum and Noise —70dB ★ Sensitivities (1) 300mV (2) 50mV (3) 100mV (4) 2mV Output rating I.H.F.M. ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams & instructions. Factory built with 12 mth gntee 16 GNS or Deposit £5.2.6 and 9 mthly pymts 31/6 (Total £19.6.0) Or in Teak or Afrormosia veneer housing 19½ Gns. Dep. £5.10.6 and 9 mthly pymts 39/-. (Total £23.1.6). **12½ GNS.** Carr. 7/9

AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 11,000 line 15 watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. Or Senior 15 watt inc. HF 126 15,000 line Speaker £6.15.0 Carr. 6/6 **£5.15.0** Carr. 5/9

E2 EQUIPMENT CABINET



Size 17" wide 14½" deep 11½" high. Cut for TA12. Super 15, Super 30 and other amplifiers. 'Roll over' transp. plastic cover. Satin Teak or Afrormosia veneer finish. Inc. carr. **8 Gns.**

MOTOR BOARDS cut for Garrard Turntables and many other units. Price **12/9**

INTEREST CHARGES REFUNDED

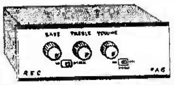
on Credit Sales settled in 3 months.

HI-FI SPEAKER ENCLOSURES

Teak or Afrormosia veneer finish. Modern design. Acoustically lined. Prices Inc. carr.

JE8 Size 16 x 11 x 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi 'speaker. **£4.10.0**
SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. Ported. **£5.10.0**
SE10 For outstanding results with 10in Hi-Fi 'spkr Size 24x15x10in. P'td. **£5.15.0**
SE12 For exclnt prfmnce with 12in Hi-Fi speaker and Tweeter. Size 25 x 16 x 10½in. **£6.15.0**

R.S.C. TA6 6 Watt HIGH FIDELITY SOLID STATE AMPLIFIER



200-250v. AC mains operated Frequency Response 30-20,000 c.p.s. —2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV. Output rating I.H.F.M. Fully enclosed enamelled case, 9¼ x 2¼ x 5½in. Attractive brushed silver finish facia plate 10½ x 3½in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6 **£6.19.9**
Or factory built with 12 months guarantee. £8.19.9

R.S.C. TFM1 SOLID STATE VHF/FM RADIO TUNER

Total cost of parts with detailed wiring diagrams & instructions. Inc. Carr. **14 Gns.**
Or factory built 16½ gns. Or in Teak finished cabinet as illustrated 19½ gns. Terms: Deposit £5 and 9 monthly payments £2. Total £23.

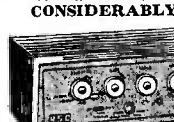
★ High-sensitivity ★ 200-250v. A.C. Mains operation. ★ Sharp A.M. Rejection. ★ Drift-free reception. ★ Output ample for any amplifier (approx. 500 m.v.). ★ Simple alignment instructions. ★ Output available for feeding tuning meter. ★ Output for feeding Stereo Multiplexer. ★ Tuner head using silicon Planar Transistors. ★ Designed for standard 80 ohm co-axial input. Visually matching our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. The pre-wired tuning head facilitates speed and simplicity of construction. Printed circuitry. Only high grade transistors and components used. A quality product at considerably less than the cost of comparable units. Stereo version, all parts 20 gns. Inc. carr. Assembled 22½ gns. inc. carr.

R.S.C. SUPER 15 HI-FI AMPLIFIER

SOLID STATE CONSTRUCTION

FULLY TRANSISTORISED 200/250v. A.C. Mains.
OUTPUT 10 WATTS R.M.S. cont. into 15 ohms.
15 WATTS R.M.S. cont. into 3-4 ohms.
TRANSISTORS. 9 current types of high quality by leading manufacturers.
5 POSITION INPUT SELECTOR SWITCH
EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2·5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: ±2dB 20-20,000 c.p.s.
TREBLE CONTROL: +15dB to —14dB at 10Kc/s. NEG FEEDBACK: 52dB.
BASS CONTROL: +17dB to —15dB at 50 c/s. HUM LEVEL: —75dB.
HARMONIC DISTORTION at 10 Watts 1,000 c.p.s. 0·2%.
Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **12½ Gns.**
Supplied factory built 15½ Gns. Carr. 12/6. Terms: Deposit 4 Gns. and 9 monthly payments 31/1 (Total £18.3.9). Or in Teak or Afrormosia veneer housing as illustrated. 19 Gns.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING MANUFACTURERS.

SPECIFICATIONS COMPARABLE WITH UNITS COSTING CONSIDERABLY MORE



R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. High quality Ganged Pots. Matched Components. CROSS TALK: —52dB at 1,000 c.p.s.
CONTROL: 5 position Input Selector, Bass Control. Treble Control. Volume Control. Balance Control. Stereo/Mono Switch. Tape Monitor Switch. Mains Switch. INPUT SOCKETS (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone. Operation of the Input Selector Switch assures appropriate equalisation. Rigid 18 s.w.g. Chassis. Size approx. 12in. wide, 3in. high and 8in. deep. Neon Panel indicator. Attractive Facia Plate and Spun Silver Matching Knobs. Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15.
THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon). CURRENTLY AVAILABLE SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. Carr. 15/- **21 Gns.**
Unit factory built 28 Gns. or deposit £7.5.0 and 9 monthly payments 56/3. (Total £32.13.3). Or in veneered housing 31 Gns. Carr. 15/- or Deposit £7.3.6 and 9 monthly paymts 64/- (Total £35.19.6). *Send S.A.E. for leaflet.*

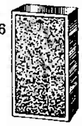
R·S·C HI-FI CENTRES LTD.

BRADFORD 10 North Parade. (Half-day Wed.) Tel. 25349
BLACKPOOL (Agent) O. & C. Electronics, 227 Church Street
BIRMINGHAM 30/31 Gt. Western Arcade opp. Snow Hill Station 021-236-1279 (Half-day Wed.)
DERBY 26 Osmaston Rd. The Spot (Half-day Wed.) Tel. 41361
DARLINGTON 18 Priestgate (Half-day Wed.) Tel. 68043
EDINBURGH 133 Leith St. (Half-day Wed.) Tel. Waverley 5766
GLASGOW 326 Argyle St. (Half-day Tues.) Tel. CITy 4158
HULL 91 Paragon Street. (Half-day Thursday) Tel. 20505

MAIL ORDERS TO: 102 Henconner Lane, Bramley, Leeds 13. No C.O.D. under £1. Terms C.W.O. or C.O.D. Postage 4/6 extra under £2. 5/9 extra under £5. Trade supplied. S.A.E. with enquiries please. Open all day Sats.
Mail Orders must not be sent to shops

32 High Street. (Half-day Thurs.) Tel. 56420 **LEICESTER**
5-7 County (Mecca) Arcade, Briggate (Half-day Wed) Tel 28252 **LEEDS**
73 Dale St. (Half-day Wed.) Tel. CENtral 3573 **LIVERPOOL**
238 Edgware Road, W2 (Half-day Thurs.) Tel. PAD 1629 **LONDON**
60A Oldham Street (Half-day Wed.) Tel. CENtral 2778 **MANCHESTER**
106 Newport Rd (Half-day Wed) Tel. 47096 **MIDDLESBROUGH**
41 Blackett Street (Opp. Fenwicks Store) (Half-day Wed.) Tel. 21469 **NEWCASTLE** UPON TYNE
13 Exchange Street (Castle Market Bldgs.) (Half day Thursday) Tel. 20716 **SHEFFIELD**

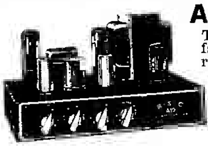
THE 'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM



★ Moderate size, only 25 x 14 x 10in. Complete Kit **20 Gns.**
★ Response 30-20,000 c.p.s. Impedance 15 ohms. Carr. 12/6
★ Performance comparable with units costing considerably more. Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system. (3) 8 x 5in. high flux middle range 'speaker. (4) High efficiency tweeter. (5) Woollen acoustic damping material. (6) Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £5.10.6 and 9 monthly payments 39/- (Total £23.1.0).

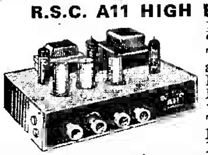
DEMONSTRATIONS AT ALL BRANCHES

R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER



Highly sensitive. Push-Pull high output, with Pre-amp./Tone Control Stages. Performance figures of factory built units: Hum level —70dB. Frequency response ±3dB 30-20,000c/s. Sectionally wound output transformer. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 mV. Suitable for high impedance microphones, Crystal or Ceramic P.U's. Designed for **Clubs, Schools, Theatres, Dance Halls or Outdoor Functions**, etc. For use with **Electronic Organ, Guitar, String Bass**, etc. Gram. Radio or Tape. Reserve L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c/s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts with point-to-point wiring diagrams and instructions. Carr. 12/6 **14 Gns.** Twin-handled perforated cover 27/6. Supplied factory built with EL34 output valves. 12 months' guarantee for 17 gns. **TERMS: Deposit £6** and 9 monthly payments of 32/- (Total £20.8.0). Send S.A.E. for leaflet.

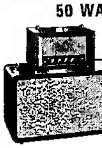
R.S.C. A11 HIGH FIDELITY 12-14 WATT AMPLIFIER



PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP. Two input sockets with associated controls allowing mixing of "mike" and gram, etc, etc. High sensitivity. 5 valves—ECC83 (2), EL84 (2), EZ81. High quality sectionally wound output transformer. IND. BASS AND TREBLE CONTROLS. Frequency response ±3dB 30-20,000 c/s. Hum level —60dB. SENSITIVITY 40 millivolts. For Crystal or Ceramic PUs. High impedance "mikes". For Musical Instruments such as String Bass, Electronic Guitars etc. Size approx. 12 x 9 x 7in. For AC mains 200-250v. 50 cps Output for 3 and 15 ohm spkrs. SAE for leaflet. Complete kit. **9 Gns.** Full instructions and point-to-point wiring diagrams. Carr 11/6 (or factory built 12 Gns.) Twin handled metal cover 27/6. TERMS ON ASSEMBLED UNITS. Deposit 97/6 and 9 monthly payments of 22/-. (Total £14.15.6).

RSC A11T TRANSISTORISED VERSION of above complete kit 9 Gns (Assembled 13 Gns)

R.S.C. BASS-REGENT 50 WATT AMPLIFIER



An exceptionally powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak O/P rating.
★ Two extra heavy duty 12in. Loudspeakers.
★ Four Jack inputs and two Volume Controls for simultaneous use of up to four pick-ups or "mikes". Bass and Treble controls.
55 Gns. Carr. 30/- or dep. £13.4.9 and 9 monthly payments of £5.11.9. (Total 60½ gns.). Send S.A.E. for leaflet.
G100 100 watt peak output with Pr. speaker columns and a Bass Unit (Six 12" and Two 15" Spkrs). 99½ gns

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1 An all-dry battery eliminator. Size 5½x4½x2in. approx. Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 49/11 or assembled 59/11.

SELENIUM RECTIFIERS | F.W. (Bridged)

All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 4/3. 2a. 6/11. 3a. 9/9. 4a. 12/9. 6a. 15/9.

R.S.C. MAINS TRANSFORMERS

FULLY GUARANTEED. Interleaved and Impregnated. Primaries 200-250v. 50c/s. Screened

MIDGET CLAMPED TYPE 2½ × 2⅝ × 2¼in.
250v., 60mA, 6·3v. 2a. 15/11
250-0-250v., 60mA 6·3v. 2a. 16/11

FULLY SHROUDED UPRIGHT MOUNTING
250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a. .. 21/9
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. .. 37/9
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. .. 37/9
300-0-300v. 130mA, 6·3v. 4a., c.t., 6·3v. 1a. For Mullard 510 Amplifier 45/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. .. 37/9
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a. .. 47/9
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a. .. 69/9
425-0-425v. 200mA, 6·3v. 4a., 6·3v. 3a., 5v. 3a. 75/-
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a. .. 87/9

TOP SHROUDED DROP-THROUGH TYPE
250-0-250v. 70mA, 6·3v. 2a., 0-5-6·3v. 2a. .. 21/9
250-0-250v. 100mA, 6·3v. 3·5a. 25/9
250-0-250v. 100mA, 6·3v. 2a, 6·3v. 1a. 26/9
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a. .. 27/9
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. .. 37/9
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. .. 37/9
300-0-300v. 130mA, 6·3v. 4a., 0-5-6·3v. 1a. Suitable for Mullard 510 Amplifier 44/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. .. 37/9
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a. .. 45/11

FILAMENT or TRANSISTOR POWER PACK Types 6·3v. 1·5a. 7/9; 6·3v. 2a. 8/9; 6·3v. 3a. 10/9; 6·3v. 6a. 21/9; 12v. 1a. 8/9; 12v. 3a. or 24v. 1·5a. 21/9; 0-9-18v. 1½a. 17/9; 0-12-25-42v. 2a. 29/9.

CHARGER TRANSFORMERS 0-9-15v. 1½a. 14/11; 2½a. 17/9; 3a. 19/11; 5a. 23/9; 6a. 27/9; 8a. 33/9.

AUTO (Step UP/step DOWN) TRANSFORMERS 0-110/120v. 200-230-250v. ....50-80 watts 15/9; 150 watts, 29/11; 250 watts 49/9; 500 watts 99/9

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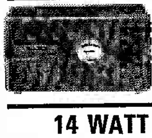
150mA, 7-10H, 250Ω 12/9; 100mA, 10H, 200Ω 10/9; 80mA, 10H, 350Ω 8/9; 60mA, 10H, 400Ω 4/11.

6/12V CAR BATTERY CHARGERS



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High sensitivity. Two separate inputs. Two vol. controls for mixing purposes. Separate Bass and Treble Controls. Valves ECC83, ECL86, ECL86, EZ80. Output for 15 ohm Loudspeaker. 200-250v 50 c.p.s. A.C. mains operation. Size approx. 8 x 8 x 6in. Factory built and fully guaranteed. Limited number to clear at **£7-19-11** Carr. 10/-

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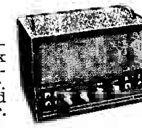

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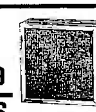

In Teak or Afrormosia veneered Cabinets
L13 13"×8" 10 Watt 10,000 lines 3 or 15 ohms. Carr 7/6 **£4.19.9**
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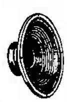

All power ratings are R.M.S. continuous. 2 year guarantee. High Flux 14,000 line ceramic magnets. Heavy cast chassis.

'POP' 100	'POP' 60	'POP' 50
18" 100 Watt	15" 60 Watt	12" 50 Watt
21 GNS. Carr. free	12 GNS. Carr. free	10 GNS. Carr. free

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Consisting of Mains transformer, Metal Rectifier, Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA 6·3v. 2a. Supplied with case in lieu of chassis 29/11. Or assembled 39/11. **25/11**

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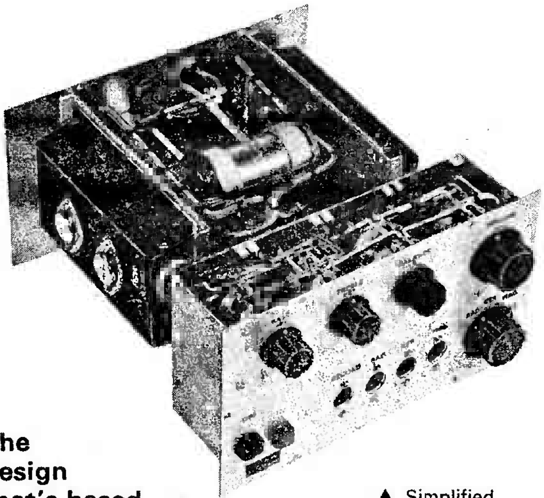

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2 Pre-amp and tone control kits	4	13	0
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2 PA.12-15 Power Amplifier Kits	7	19	0
2 Heat Sink assemblies		12	0
2 P.A. matrix boards		8	0
1 PS.45K 45 volt power supply kit	4	10	0
1 Pack-flat afrormosia teak finished Cabinet kit	2	12	6
5 Controls as specified	2	0	0
TOTAL COST	**£23**	**5**	**6**

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Metalwork cut, shaped and punched. **£2 12 6**

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Transistors—Ultra low noise in pre-amp and tone control stages.

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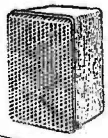
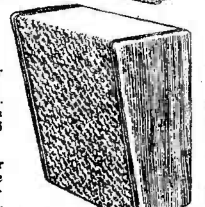
SPEAKER SYSTEMS

All cabinets are new and speakers are mounted on ½in. chipboard baffles. All speakers ex TV reconditioned hi flux magnet. All carefully tested before despatch.

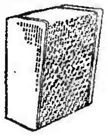
THE CAXTON COLUMN This is a column cabinet. 23¾ × 5½ × 5½in. wide, fitted with 3 speakers. This will handle 8 watts and will improve the quality of any tape recorder, or record player. Finished in wood grain cloth and sandstone Vynair. A real bargain at **59/6**. P. & P. 10/6.



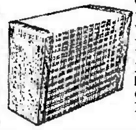
THE MILTON A. Hi-Fi Bookcase Cabinet. Size 9 × 5 × 6in., with 5in. speaker. Finished in Teak cloth with bold silk front **30/-**. P. & P. 4/6.



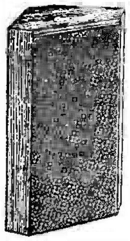
The Tennyson. Wedge shape for table or wall mounting 13½ × 16 × 8¾in. Fitted EMI 13½ × 8in. Speaker. Finished in Grey cloth with matching Vynair. **£4.7.6** P. & P. 7/6.



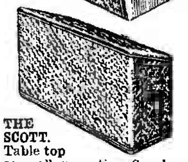
DUO. Wedge shaped Speaker Cabinet. Size 7¾ × 7⅝in. fitted 7 × 4in. speaker. Covered in attractive two tone Vynair. Price **32/6**. P. & P. 4/6.



THE IMP. Extension Speaker Cabinet. Wedge shaped, size 7½ × 6½in. fitted 7 × 4in. speaker. Covered with attractive walnut with fawn Vynair front. Keyhole slot in back. Only **25/6**. P. & P. 4/6.



The Cowdrey. Corner Cabinet in natural teak finish. Fitted 8 × 3in., 7 × 4in. and three 5in. round speakers wired in series to match 15 ohm impedance. **£6.6.0.** P. & P. **8/6**



THE SCOTT. Table top or wall mounting Speaker. Size 16½ × 10½ × 5½in., tapered as illustrated. Fitted 13½ × 8in. Speaker with volume control. Finished in black cloth with matching grey Vynair. (Please state 3 or 15 ohm imp.) **£4.5.0.** P. & P. 7/6.

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ROGERS Ravensbourne in teak case	£64 0 0	£54 8 0
ROGERS Ravensbrook	£41 0 0	£34 19 6
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TELETON 203E	£28 7 6	£23 7 6
TRUVOX TSA.200	£51 9 0	£42 9 0
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DULCI FMT.7 FM Tuner	£22 1 0	£19 0 0
DULCI FMT.7S FM Stereo Tuner	£29 8 0	£23 0 0
GOODMANS Stereomax AM/FM Stereo Tuner	£80 19 0	£69 19 6
LEAK Troughline Tuner with multiplex	£50 11 4	£39 19 6
QUAD Stereo FM Tuner	£50 0 0	£43 19 6
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CELESTION Ditton 15	£30 12 4	£26 5 0
DULCI AS3 Speaker	£8 8 0	£6 19 6
GOODMANS Maxim	£20 0 5	£16 19 6
GOODMANS Mezzo II	£30 18 0	£25 13 0
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GARRARD SL.65	£17 19 4	£15 5 0
GARRARD SL.75	£34 4 11	£26 19 6
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THORENS TD.125	£63 4 9	£55 0 0
THORENS TD.150	£28 16 11	£25 7 0
THORENS TD.150B	£32 17 6	£28 18 0
THORENS TD.150AB	£39 1 7	£32 19 6
THORENS TD.124/11	£45 18 1	£40 7 0

Bases, plinths and covers stocked to suit all the above turntables.

HI-FI STEREO TAPE DECKS AND TAPE RECORDERS

	Rec. Retail Price	Comet Price
AKAI X-150D deck 4 track	£130 2 4	£109 0 0
AKAI X-360 4 track	£339 0 0	£284 0 0
AKAI X-360D deck 4 track	£290 0 0	£243 0 0
AKAI 1710 4 track without accessories	£109 0 0	£89 19 6
AKAI 1800 4 track	£158 0 0	£133 0 0
AKAI 1800SD 4 track	£199 0 0	£167 0 0
AKAI 4000D deck 4 track	£99 10 0	£79 19 6
AKAI X-V 4 track	£180 0 0	£151 0 0
AKAI M-9 4 track without accessories	£195 0 0	£139 19 6
FIDELITY HF Playmaster 2 track	£26 15 6	£19 19 6
FIDELITY Braemar 2 track	£30 9 0	£24 17 5
FIDELITY Braemar 4 track	£33 12 0	£27 8 11
MARCONI 4214 twin-track Tape Recorder	£35 16 0	£31 0 0
MARCONI 4216 4-track Tape Recorder	£41 5 0	£35 19 6
MARCONI 4218 Stereo Tape Recorder	£88 0 0	£77 19 6
MARCONI 4238 4 track Tape Recorder	£58 11 0	£49 19 6
PHILIPS battery operated tape recorder Model 4200	£35 6 0	£21 19 6
SHARP 504 battery/mains tape recorder, complete with all accessories guaranteed 5 years	£35 5 3	£24 19 6
TELETON 7D 70 stereo Tape Deck	£85 10 3	£62 0 0
TELETON FXB501D stereo Tape Deck and preamplifier	£65 0 8	£49 0 0
TELETON 401 XFM Multiplex Stereo Tuner/Amplifier 20 watts RMS	£67 2 6	£49 0 0
TRUVOX R54 3 speed 4-track	£72 2 0	£52 2 0
TRUVOX R52 3 speed 2-track	£72 2 0	£52 2 0

PICKUP ARMS

	Rec. Retail Price	Comet Price
Goldring Lenco L75	£12 6 6	£10 10 0
Goldring Lenco G65	£7 13 6	£6 10 0
SME 3009 with S2 shell	£27 19 2	£23 17 6
SME 3012 with S2 shell	£29 0 0	£25 17 6

RECORD PLAYERS, 'GRAMS, RADIO AND TV

	Rec. Retail Price	Comet Price
Fidelity RG33 Radiogram	£64 11 6	£54 11 6
Fidelity HF 35 Record Player with auto change and tone control	£17 6 6	£12 19 6
Fidelity HF 36 Radiogram (Stereo)	£55 11 0	£44 2 6
Fidelity HF 37 Stereo Player	£30 9 0	£25 19 6
Hitachi Transistor Radio, long, medium and short bands, with extra marine band and RDF	£30 9 0	£18 19 6
Hitachi VHF Transistor Radio	£21 0 0	£12 19 6
Philips 265 Radio	£10 13 1	£7 19 6

CAR RADIOS

	Rec. Retail Price	Comet Price
Philips Car Radio, Model 240T	£13 9 9	£11 19 6
Philips Car Radio, Model 268 (push-button)	£18 10 0	£15 19 6
Philips Car Radio, Model RM 368, push-button de luxe	£22 15 0	£20 19 6
Philips Car Radio and Cassette Tape Player, Model RN 582	£43 0 0	£38 19 6

TV AT DISCOUNT PRICES

	Rec. Retail Price	Comet Price
Ferguson 19″ TV (latest model)	£75 2 0	£59 19 6
G.E.C. 2039 23″ TV (latest model)	£83 8 1	£65 0 0
G.E.C. 19″ Colour TV	£276 18 9	£219 10 0
Philips 25″ Colour TV	£347 19 7	£265 14 6

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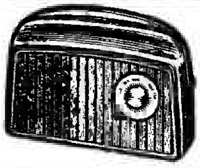


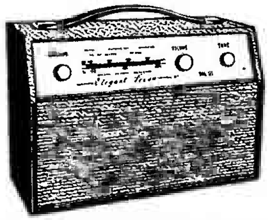
THE DORSET (600mW Output)

7-transistor fully tunable M.W.–L.W. superhet portable —with baby alarm facility. Set of parts. The latest modulised and pre-alignment techniques makes this simple to build. Sizes: 12 x 8 x 3in.

MAINS POWER PACK KIT: 9/6 EXTRA.

PRICE 5 GNS. + 7/6 p. & p. CIRCUIT 2/6 FREE WITH PARTS.

THE ELEGANT SEVEN MK III (350mW Output)



7-transistor fully tunable M.W.–L.W. portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.

MAINS POWER PACK KIT: 9/6 extra.

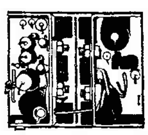
Price £4.9.6 plus 7/6 p. & p.

Circuit 2/6 FREE WITH PARTS.

THREE-IN-ONE HI-FI 10 WATT SPEAKER

A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss cross over network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40-60 c/s. Frequency range 50c/s to 20kc/s. Size $13\frac{1}{2}$ x $8\frac{1}{16}$ x $4\frac{1}{2}$ inches. By famous manufacturer. List Price £7. Our price **74/6** plus 5/- P. & P.
Similar speaker to the above without tweeters in 3 and 15 ohms **44/6** plus 5/- P. & P.

X101 10W SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP



Specifications: *Power Output* (into 3 ohms speaker) 10 watts. *Sensitivity* (for rated output): 1mV into 3K ohms (0·33 microamp). *Total Distortion at* 1KHz. at 5 watts 0·35%, at rated output 1·5%. *Frequency Response:* Minus 3dB points 20Hz and 40KHz. *Speaker:* 3–4 ohms (3–15 ohms may be used). *Supply voltage:* 24V d.c. at 800mA (6–24V may be used).

Control assembly: including resistors and capacitors.
1. Volume: PRICE **5/-**.
2. Treble: PRICE **5/-**.
3. Comprehensive bass and treble: PRICE **10/-**.
The above 3 items can be purchased for use with the X101.

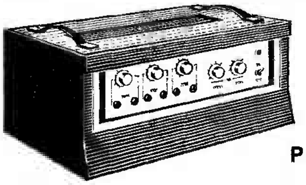
Price 69/6 plus 2/6 p. & p.

Power Supplies for the X101:
P101 M (for mono) **35/-** plus 4/6 p. & p. P101 S (for stereo) **42/6** plus 4/6 p. & p.

CAR TRANSISTOR IGNITION SYSTEM (by famous manufacturer)

For 6 volt or 12 volt positive earth systems. Comprising: special high voltage working hermetically sealed silicon transistor mounted in finned heat-sink, high output ignition coil, ballast resistor and hardwear (screws, washers etc.). PRICE **£4.19.6.** (post and packing 5/- extra).

50 WATT AMPLIFIER A.C. MAINS 200-250V



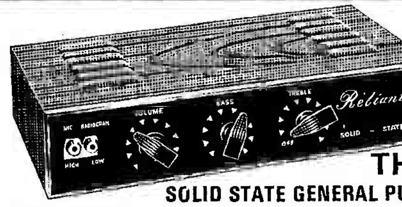
An extremely reliable general purpose valve amplifier—with six electronically mixed inputs. Suitable for use with: mics, guitars, gram, tuner, organs, etc. Separate bass and treble controls. Output impedance 3, 8 and 15 ohms.

Price 27 gns. Plus 20/- p. & p.

SPECIAL OFFER!

Complete stereo system comprising BALFOUR 4-speed autoplayer with stereo head, 2 duo speaker systems, size 12in. x $6\frac{3}{4}$in. x $5\frac{3}{4}$in. Plinth (less cover) and the DUETTO stereo amplifier. *All above items*

19 gns. plus 20/- p. & p.



THE RELIANT
SOLID STATE GENERAL PURPOSE AMPLIFIER

SPECIFICATIONS
Output—10 watts. Output Impedance—3 to 4 ohms
Inputs—1. -xtal mic 10mV; 2. -gram/radio 250mV. Tone Controls—Treble control range ± 12dB at 10KH2; Bass control range ± 13dB at 100H2
Frequency Response—(with tone controls central) Minus 3dB points are 20H2 and 40KH2. Signal to Noise Ratio—better than −60dB. Transistors—4 silicon Planar type and 3 Germanium type. Mains input— −220 −250V. A.C. Size of chassis—$10\frac{1}{4}$" × $4\frac{3}{4}$" × $2\frac{1}{4}$". A.C. Mains, 200-250V. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Separate bass and treble lift control. Two inputs with control for gram. and mike. Built and tested. 8" × 5" speaker to suit price **14/6** plus 1/6 P. & P. Crystal mike to suit **12/6** plus 1/6 P. & P.

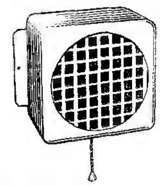
Reliant Mark I. $5\frac{1}{2}$ gns. plus 7/6 p. & p.
As above less teak case.
Reliant Mark II. $6\frac{1}{2}$ gns. plus 7/6 p. & p.
In teak finished case.

CYLDON 2 TRANSISTOR U.H.F. TUNER

Brand new. Complete with circuit diagram.

£2.10.0 plus 1/- p. & p.

EXTRACTOR FAN

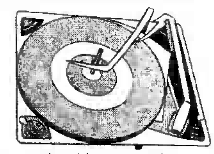


AC Mains 23/250 v. complete with pull switch. Size 6" x 6" x 4". Price **27/6** plus 5/- P. & P.

B.S.R. TD-2 TAPE DECK

This tape deck takes $5\frac{3}{4}$in. spools complete with two-track heads. Size $13\frac{1}{4}$in. long by $8\frac{3}{4}$in. wide. **£8.19.6** plus 7/6 p. & p.

RECORD PLAYER SNIP A.C. MAINS 240V



The "Princess" 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7" to 10" or 12". Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself into its recess, a most useful feature with portable equipment—other features include pick-up height adjustment and stylus pressure adjustment. This truly is a fine instrument which you can purchase this month at only **£5.19.6** complete with cartridge and ready to play. Post and insurance 7/6 extra.

POCKET MULTI-METER

Size $3\frac{1}{4}$ x $2\frac{1}{4}$ x $1\frac{3}{8}$in. Meter size $2\frac{1}{4}$ x $1\frac{3}{8}$in. Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0–15, 0–150, 0–1000 D.C. current 0–150mA. Resistance 0–100kΩ. Complete with test prods, battery and full instructions, **42/6.** P. & P. **3/6. FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value **15/-** to every purchaser of the Pocket Multi-Meter.

FIRST QUALITY P.V.C. TAPE

$5\frac{3}{4}$"	Std. 850ft.	11/6	5"	L.P. 850ft.	12/-
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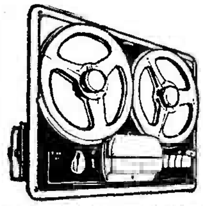
3"	L.P. 240ft.	5/6	5"	T.P. 1800ft.	27/-
$5\frac{3}{4}$"	L.P. 1200ft.	13/-	$5\frac{3}{4}$"	T.P. 2400ft.	34/-
7"	L.P. 1800ft.	20/-	7"	T.P. 3600ft.	44/-
$5\frac{3}{4}$"	D.P. 1800ft.	20/-	4"	T.P. 900ft.	16/6

P. & P. on each 1/6.



MOTEK

3 Speed 2 track Tape Deck complete with heads, takes 7in. spool.

Incorporating 3 motors.

A.C. mains, 240 volts, listed at £21.0.0.

Our Price £9.19.6, plus 10/- P. & P.

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PRACTICAL WIRELESS

VOL 45 No 5

Issue 751

SEPTEMBER 1969

TOPIC OF THE MONTH

Third Opportunity

DURING the heyday of the valve era, designers, constructors, equipment makers and service engineers were plagued with the vast proliferation of valve types. From a handful of basic types, valve manufacturers escalated production to the stage where a complete listing of all new, obsolete and replacement types became well nigh impossible due to sheer numbers.

With the advent of transistors, it seemed that a new era of rationalisation was dawning. Starting with a clean slate it was inconceivable that the same mistakes would be made with transistors as with valves. Alas, the result has been even greater chaos!

There must be tens of thousands of semiconductor devices now in the catalogues, or in replacement lists. Many of these are direct, or almost direct, equivalents, or else the parameters are sufficiently close to make duplication wasteful and frustrating, especially when one considers that there are cases of up to twenty variants of some basic types.

There has been little attempt to rationalise the type numbering system between different countries or even different manufacturers, nor any co-ordination in introducing new types to catalogues. And at this stage of the game, it is too late to remedy matters.

We are now on the threshold of yet another major opportunity for industry to work together for the common good. Integrated circuits are no longer a laboratory novelty and are poised to break into the domestic sphere in a big way. Unless industry can prevent itself—lemming fashion—from making the same mistakes the third time, a situation even more chaotic will result. The possibilities (and the temptations) to proliferate will be greater than ever, for we are all set to be overwhelmed by an avalanche of IC devices within the next few years.

Today, ICs are an appetiser. Tomorrow, on the menu, it will be chips with everything. P.W. is preparing for this situation and will have something of great interest to say to constructors in the next issue.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

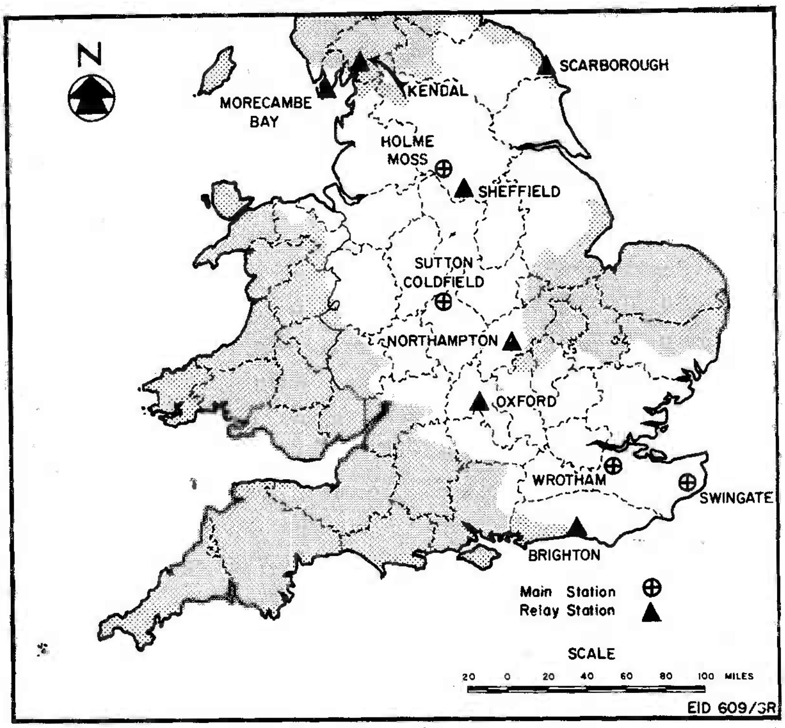
CONSTRUCTIONAL

OTHER FEATURES

OCTOBER ISSUE WILL BE PUBLISHED ON SEPTEMBER 5th

NEWS AND COMMENT...

LATEST RADIO-3 STEREOPHONIC TRANSMISSIONS



The unshaded part of this map shows areas where satisfactory stereo reception should normally be obtained. In places where field-strength is low, increased background noise or interference may be heard. Improvement in the sensitivity of the receiving aerial may enable the noise level to be reduced and a more directional aerial may discriminate against interference. Frequencies are: Brighton, 92·3MHz; Holme Moss, 91·5MHz; Kendal, 90·9MHz; Morecambe Bay, 92·2MHz; Northampton, 91·1MHz; Oxford, 91·7MHz; Scarborough, 92·1MHz; Sheffield, 92·1MHz; Sutton Coldfield, 90·5MHz; Swingate, 92·4MHz; Wrotham, 91·3MHz.

Local Radio—PO confirms policy on wavelengths

The Postmaster General, the Rt. Hon. John Stonehouse, M.P., has rejected Mr Hughie Green's view that 100 local radio stations could be provided on medium wavelengths. A team of Post Office experts has completed a detailed examination of his proposals and their conclusions were sent to Mr Green.

Mr Green submitted two feasibility studies to the Post Office. Both would have involved the use of directional aerials for some stations, including those for London and Manchester. They would also have involved the use of medium wave frequencies allocated to other countries, under the terms of Article 8 of the 1948 Copenhagen Plan. The Post Office conclusion is that, even by day, not all the stations Mr Green proposed would give satisfactory reception; and, that for the remainder service areas would in general be so reduced after dark as to be completely unsatisfactory. For example, the station proposed for London would cover only 10 per cent of the Greater London area after dark.

Post Office studies reaffirm the conclusions set out in the Government's White Paper on Broadcasting (Cmnd. 3169 para. 32, December 1966) that "no general service of local sound broadcasting, which would be available during the hours of darkness as well as in daylight, can be provided only on medium wavelengths allotted to the United Kingdom."

MINI POTS

Fitted with Cermet resistance elements, these potentiometers, Type S106, shown actual size, are immune to high humidity effects and chemical attack, making them very suitable for operation at elevated temperatures.

Wattage rating when mounted on a steel plate 100 x 100 x 1mm. is 2·5W and when mounted on insulated material, 0·7W. These units are available in values from 100Ω to 1MΩ, linear only. Tolerance is ±20% and working voltage 250V d.c. Manufactured by Rosenthal Isolatoren GmbH, the sole UK distributors are: *Radio Resistor Co. Ltd., 9-11 Palmerston Road, Wealdstone, Harrow, Middx.*

ASPIRING AMATEURS TAKE NOTE

For the last three years at the Knaresborough Further Education Centre, Stockwell Road, Knaresborough, Yorks, they have offered Evening Courses (7–9 p.m.) leading to the City and Guilds Radio Amateurs' Examination and these have included tuition in Morse code.

This year they intend offering the courses again and the timetable for the 1969–70 session is: RAE (1st year) Monday, September 22nd, 1969 to December 15th, 1969 and January 5th, 1970 to March 16th, 1970. RAE (2nd year) Thursday, September 25th, 1969 to December 18th, 1969 and January 8th, 1970 to March 19th, 1970.

Fees will be 30s. from September to March.

WOW! A STRIPPER

Multicore's Model 3 Bib Wire Stripper and Cutter has been improved. This new one enables insulation to be removed without nicking the wire. The aperture setting for different diameters is adjusted by setting a sliding screw set in one handle.

In addition, this stripper features two cutting positions—one for normal flex cutting and the other on the tip of the unit, for cutting wire in a confined space. A good example is the removal of wire after it has been connected to a tag or bolt. This cutting tip is also suitable for separating extruded twin flex.

Each stripper is packed on an instruction card and costs 5s. 6d. from most hardware, electrical and do-it-yourself stores. *Multicore Solders Ltd., Hemel Hempstead, Herts.*

NEWS AND COMMENT...

NEW RELAYS

The range of ITT's PZ style relays for printed circuit boards has been augmented by a two-changeover version, the type PZ-2. Overall dimensions of this miniature relay are only 29 x 16 x 14mm. The connections are for direct soldering on to printed circuit boards.

The two-changeover contacts are of the twin type with a choice of silver/palladium or gold/silver contact alloy. Maximum switched power per contact is 12VA (1A at 100V a.c. or d.c.). The relay is for d.c. operation. *ITT Components Group Europe, Standard Telephones and Cables Limited, Electro-Mechanical Product Division, West Road, Harlow, Essex.*

TO BEAT THE THUGS

The Glasgow Corporation Transport Department, hard on the heels of the Edinburgh and Wolverhampton Transport Departments, has placed an order for 100 v.h.f. f.m. mobile radiotelephones for use by the city's bus services. Hooliganism has resulted in the placing of this order and the Storno mobile units are to be installed in buses running on late-night routes and will enable the crews to establish immediate contact with transport control where a direct link to police headquarters will speed the police to any emergency.

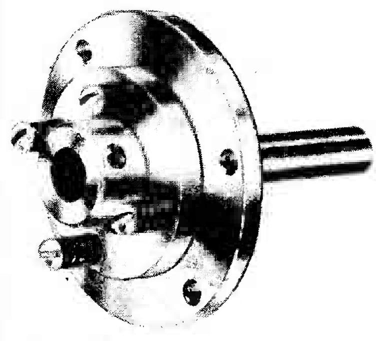
JACKSONS' NEW COMPONENTS

A new range of tuning capacitors is announced by Jackson Bros. Type TX5 are capacitors available in single-stator and split-stator versions and with capacitance-swing values ranging from 30pF to 1,000pF. They have siliconed ceramic end-plates and satin-finished aluminium vanes with radiused edges.

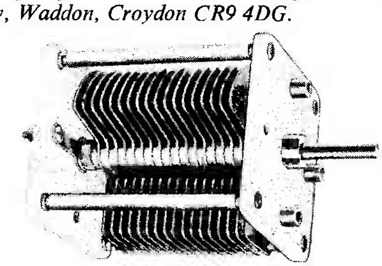
The company also manufactures the "Wavemaster" tuning capacitors with swings ranging from 10pF to 300pF.

New trimmers of the piston type with PTFE dielectric have also been introduced. Ten models are now made and the smallest, measuring $1\frac{1}{4}$ x $\frac{3}{16}$in. has a capacitance swing of $\frac{1}{2}$pF to 8pF.

Completing the range of new products are two epicyclic ball-drives—the Mini which is designed to fit all makes of miniature variable capacitor with solid dielectric ($4\frac{1}{2}$:1 ratio) and the Adjustable-Torque ball-drive which provides a reduction ratio of 6:1. On this unit, four spring-loaded screws effect adjustment. *Jackson Brothers (London) Ltd., Kingsway, Waddon, Croydon CR9 4DG.*



The adjustable-torque ball-drive with reduction ratio of 6:1. The spring-loaded screws to the left of the photograph effect the adjustment of the torque.



Capacitor type TX5. Frontal area is $2\frac{3}{4}$in. and depth varies from 3·6 to 8·4in.

PHILIPS SECOND GENERATION "AUDIO PLAN"

The new Audio Plan incorporates qualities gained from both experience and technical advances that have occurred over the past few years. Advances like the "touch tuning" facilities of the RH790 tuner amplifier where tuning is accomplished by applying a variable voltage to a varicap. This voltage is set by potentiometers; one coupled to the main tuning control and the other three to preset controls. The appropriate control (therefore appropriate voltage) is selected by means of transistor switches actuated by hand capacity, when the appropriate one of the four "touch tuning" panels is approached by the operator's finger. The panel is then illuminated and the frequency selected is indicated by a meter which measures the voltage applied to the varicap. The meter is calibrated in MHz, the frequency selected being proportional to voltage applied. Price of this unit is £125. *Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.*

Tape head cleaning kit

Bib Division of Multicore Solders have introduced a new compact "size J" Head Maintenance Kit. It comprises a 30c.c. bottle of anti-static, non-flammable Bib cleaner, or alcohol for removing oxide and dirt from the tape heads and all parts of the tape path, 10 double-ended, cotton-wool tipped sticks for access where the Bib tools will not reach, and four Bib tools together with a Hi-Fuster absorbent cloth for cleaning the soiled tools and sticks etc.

All these components are contained in a plastic wallet and the recommended retail price is 9s. 9d. including 1s. 11d. P.T. The size J kit is available from all leading stockists. *Multicore Solders Ltd., Hemel Hempstead, Hertfordshire.*

DATE TO REMEMBER

GB3WRA, operated by a group of local radio Amateurs from the annual Wycombe Show on the Rye, High Wycombe, Buckinghamshire, will be on the air on Saturday, 6th September, 1969.

Operation will be on all bands 160–4 a.m., c.w., s.s.b. and visiting Amateurs will be especially welcomed. Further information may be obtained from A. C. Butcher, G3FSN, 70 Hughenden Avenue, High Wycombe, Buckinghamshire.

CQ2 VHF receiver

M.J.GORDON

WHEN it comes to v.h.f., most fixed amateur stations use either a transceiver, a crystal controlled superhet converter (with the s.w. receiver as i.f. and a.f. amplifier), or a de-luxe triple conversion receiver.

However, these units are usually quite expensive or difficult to build and align, unless one has considerable experience of v.h.f. techniques.

This super-regenerative t.r.f. design will satisfy the needs of many s.w.l.s and prospective G8s, as there is only one tuned circuit to adjust; it can be easily built in one evening and is not difficult to set up. Having only one tuned circuit, it is also very easy to change the frequency coverage.

The f.e.t. tuner is the heart of the device and if so desired could be used on its own with a jack plug to feed into the input socket of a ready-made amplifier. In this case the tuner could be made quite small. This set-up was in fact used by a local G8 for his first QSO. It will not do for DX, but at least it's a start. Many readers will have dabbled around with the regenerative t.r.f. type of receiver but in the super-regenerative design, feedback is introduced (via the source to drain capacitor C3 in the author's design) beyond the point where oscillation just occurs, and the stage is in continuous oscillation until this state is disturbed by an incoming signal. The super-regenerative state brings about a condition of extremely high sensitivity to the circuit; there is also a high level of circuit background noise, commonly referred to as "slush".

The complete circuit of the receiver is shown in Fig. 1. Even without an aerial the receiver has received good signals from aircraft, radio amateurs and other services up to a distance of approximately 6 miles. Because the prime purpose of building the receiver was to receive local amateur radio transmissions in the Taunton area, the extra encumberance of an elaborate aerial array has not been tried. It is suggested that for experimental purposes an 18in. length of 18 s.w.g. tinned copper wire is simply fitted to the centre of the coax socket. Vertical orientation of the aerial will normally bring forth optimum performance.

The author has built more than one version of this receiver, but that shown in the photograph was built into a wooden cabinet already on hand. This was approximately 8 × 8 × 4in. deep.

As an alternative to the loudspeaker, a low impedance (80Ω) earpiece could be used.

Layout and Construction

Although layout is important at v.h.f., and the effects of extra-long wires and inter-electrode capacitances undesirable, the circuit allows considerable latitude, even on 2 metres. The original mock-up was in fact, built up on a 1½ × 2½in. paxolin board. Layout will depend on the cabinet and components used, but VR1 should not be more than 6in. from the coil.

VC1 was actually an Eddystone 35pF variable with brass vanes in the prototype. All these were removed except for one stator and one rotor, but a 5pF C804 (Henry's Radio) is a suitable ready made

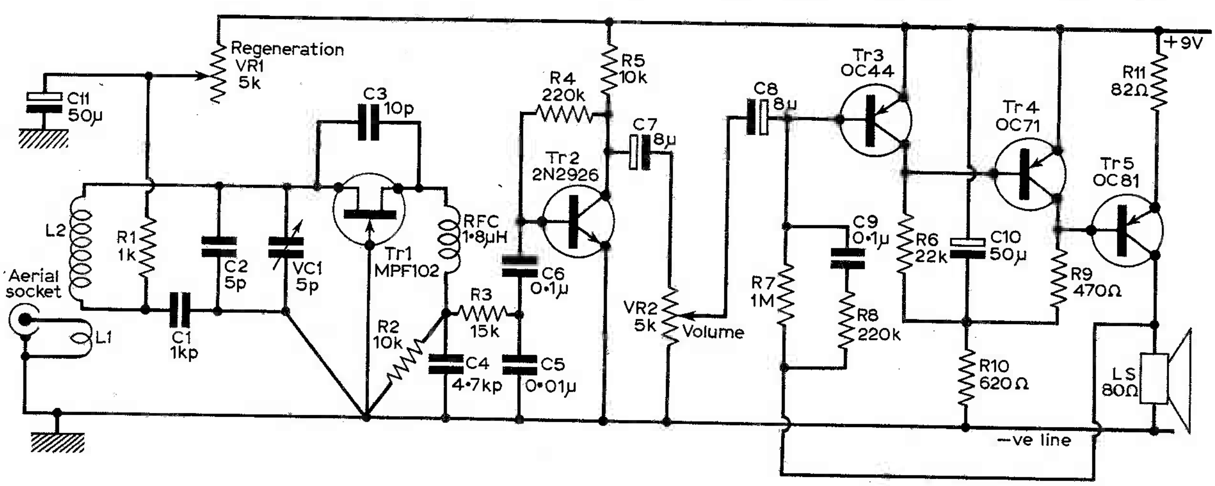


Fig. 1: Circuit of the complete receiver. If only the tuner is required (as depicted in Fig. 2), the audio output should be taken from the slider of VR2. S1 should be shown wired in the +9V supply lead.

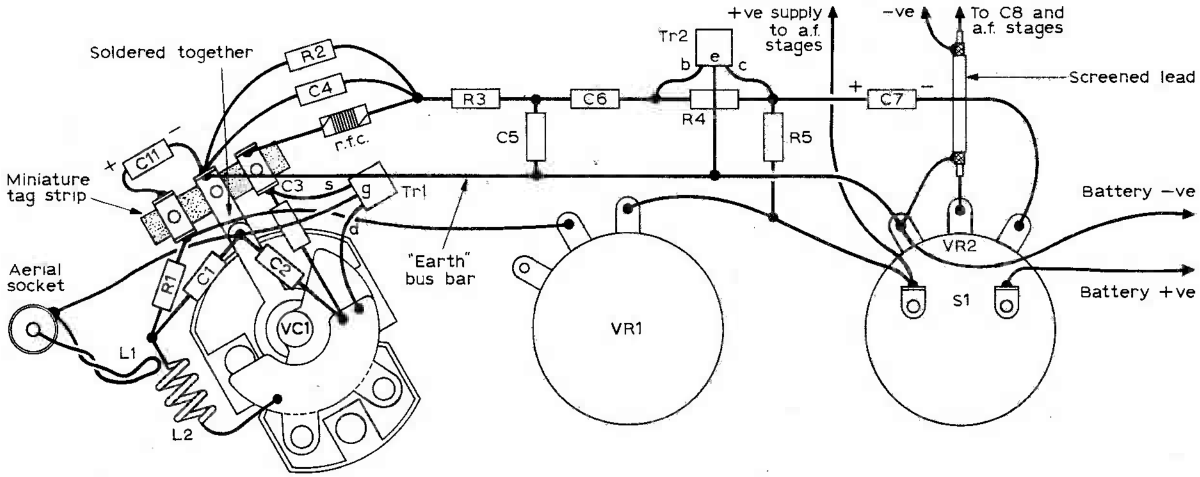


Fig. 2: Layout of the tuner section of the receiver. The audio amplifier stages are not shown. C3 may alternatively be of the "twisted wire" variety (see text). The leads of L2 should be kept as short as possible, one end being soldered directly to the fixed plate of VC1 (5pF type C804 shown in the above diagram).

component. The stator was cleaned and tinned, and direct soldered connections were made to it.

The coil L2 consists of 3½ turns of 18 s.w.g. tinned copper wire close wound to ⅜in. diameter. Tightly spaced this will get aircraft, and stretched over ½in. it will cover the 144MHz Amateur band. Naturally, the coil is sensitive to the effects of hand capacitance. The aerial coupling coil L1 should be a half turn of the same wire placed near to the earthy end of L2.

The 10pF feedback capacitor C3, if preferred, can be replaced by a conventional tubular variable type, which would also provide a good anchorage for the drain and source of the f.e.t. Alternatively, the unconventional variable "twisted wire" variety may be used. About ½in. is sufficient to get the circuit "started".

The 1·8μH r.f.c. in the prototype was filched from a turret-type v.h.f./u.h.f. tuner, but this may be difficult to obtain, and about 25 turns of very thin wire on a 1 megohm ¼ watt miniature resistor works equally well.

Wiring should be kept as short as possible, and the same tag should be used for all earth connections in the first stage.

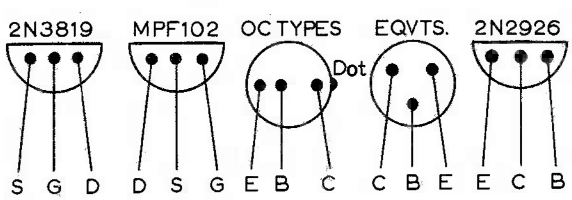


Fig. 3: Transistor lead connections.

Distinguish carefully the leads of the f.e.t. and if using the 2N3819 remember that the lead-out is different from that of the MPF102. Although the f.e.t. is silicon and should stand up to about 10 seconds heat from a 15 watt iron, it is best to use a heat shunt when soldering, such as long nosed pliers with a rubber band wound around the handles. An earthed soldering iron should be used, as the f.e.t. can be damaged by mains-derived capacitive

★ components list

Resistors:

R1	1kΩ	R7	1MΩ
R2	10kΩ	R8	220kΩ
R3	15kΩ	R9	470Ω
R4	220kΩ	R10	620Ω
R5	10kΩ	R11	82Ω
R6	220kΩ		

All 10% ¼W miniature

Capacitors:

C1	1000pF ceramic
C2	5pF ceramic
C3	10pF (see text)
C4	4700pF ceramic
C5	0·01μF ceramic
C6	0·1μF miniature
C7	8μF 12V electrolytic
C8	8μF 12V electrolytic
C9	0·1μF miniature
C10	50μF 12V electrolytic
C11	50μF 12V electrolytic
VC1	5pF variable (see text)

Semiconductors:

Tr1	MPF102 or 2N3819
Tr2	2N2926
Tr3	OC44
Tr4	OC71
Tr5	OC81

(Tr2–Tr5) or equivalents

Inductors:

L1	½–1 turn, near earthy end of L2, 22 s.w.g. insulated copper wire.
L2	3½ turns, 18 s.w.g. tinned copper wire, ⅜in. diameter, air cored.
r.f.c.	1·8μH r.f. choke (see text)

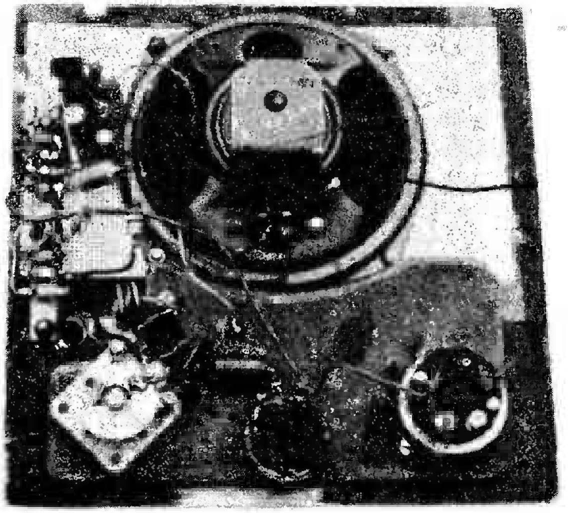
Miscellaneous:

VR1, VR2 5KΩ potentiometer, S1 single pole on/off switch (may be combined with VR2), 80Ω loudspeaker, paxolin board, tagstrip, coax socket, battery clips, PP9 battery, wire, solder, etc.

voltages. As a further precaution, all the f.e.t. leads could be shorted together by the "heat shunt" whilst being fitted.

Operation

Check the polarity of the battery, and the wiring before switching on. If the circuit of Fig. 1 is used the current drain on a 9V battery should be about 35-40mA. Check that none of the f.e.t. leads are shorting and switch on, with VR1 at minimum. A lively background hiss will indicate that the f.e.t. is oscillating. If it is not, advance VR1 towards maximum. The hiss should be extremely loud, much louder than ordinary background hiss with which it should not be confused. Experiment with various settings of VR1 to produce optimum results.



The photograph shows the author's prototype.

When a station is tuned-in there will be a reduction in the circuit background hiss, this depending upon the strength of the received signal. It is usually best to adjust L2 for the desired band on Sunday mornings or evenings as radio amateurs are usually more active on v.h.f. at these times.

The only likely cause of trouble may be C1 working loose or fracturing as a result of the manipulation of L2.

The amount of radiated interference, once the scourge of this class of receiver, appears to be negligible. ■

BASIC SEMICONDUCTOR TECHNOLOGY

PART FOUR

by M. F. DOCKER, M.Sc.

IN Part 3 the methods of preparing a p-n junction diode were described. The basic p-n junction device is the best known example of the modern diode since it is used extensively in power rectification circuits.

These devices have taken the place of the thermionic diode in most applications. The obvious reason for this is the very significant increase in efficiency over the thermionic counterpart. The voltage drop across a semiconductor diode carrying one ampere is measured in fractions of a volt whilst the voltage drop across the valve is measured in volts. Also the valve requires a filament or heater supply which itself consumes several watts.

The earlier solid state diodes had one disadvantage, their low reverse breakdown voltage. The rectifier has to withstand a voltage several times the peak voltage and in many circuits this can amount to many hundreds of volts. However there are now available diodes with reverse breakdown voltages measured in thousands of volts.

Care has to be taken that this reverse voltage is not exceeded otherwise the diode will suffer irreparable damage. The damage is caused by the excessive heat dissipated by the large reverse current flowing across the high impedance junction.

Point Contact Diodes

The capacitance which a junction diode has between its terminals is dependent upon the area of the junction. For very high frequency applications and for fast switching it is necessary to reduce this capacitance to a minimum. This is achieved in the point contact diode by using a tungsten metal wire with a very fine point which is pressed against a small piece of semiconductor material. This constitutes the simplest type of point contact rectifier similar to the early "cats whisker" detector used in crystal sets.

A much improved performance is obtained when the device is "formed" by passing a short pulse of current through the diode in the forward direction. This produces a heating effect and changes the character of the contact region, although the exact nature of the operation of the device is not wholly clear.

The Metal Rectifier

Although not normally considered when talking about semiconductor diodes the metal rectifier which was used extensively in power rectification in the fifties and before is worth mentioning here. It consists of a metal to semiconductor junction as in the point contact device but a much larger area is used in order to reduce the series resistance of the diode. A layer of copper oxide, Cu_2O, is produced on a piece of copper by oxidation. The oxide layer acts as a donor, or n-type semiconductor, and the equilibrium energy band diagram can be drawn as in Fig. 1.

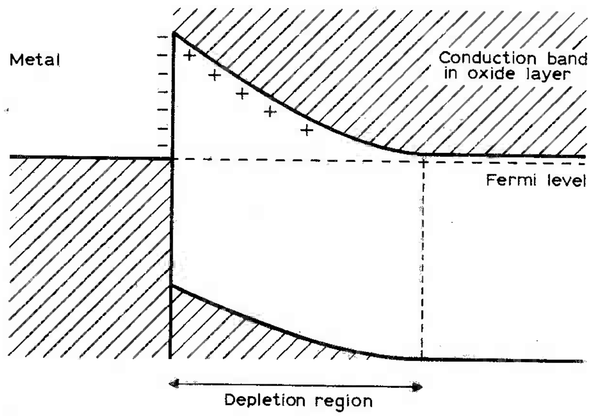


Fig. 1: Equilibrium energy band diagram for a metal-oxide rectifier.

The Fermi levels of the oxide layer and the metal must coincide at distances from the junction as in the case of the p-n junction. However the carrier concentrations in the metal are such that the conditions in the metal are unaltered and the result is that electrons from the donor sites in the oxide layer diffuse into the metal leaving a wide region with a positive space charge. It can easily be shown, using the same arguments that were used in Part 3, that the device will act as a rectifier. When the n-type oxide layer is negative with respect to the metal the diode is biased in its forward direction. The opposite polarity is of course the reverse bias case. This form of diode is inferior to the junction or point contact diode in that its reverse current is much larger, it has a large parallel capacitance and its reverse breakdown voltage is low.

The Gold Bonded Diode

This type of diode is used in high speed switching circuits. It consists of an alloyed p-n junction with a very small area in order to keep the capacitance to a minimum. This is achieved by using a very fine gallium doped gold wire pressing against an n-type germanium base wafer. The p-type gold wire acts as an anode when it is alloyed to the germanium by passing a short pulse of current through to heat the junction.

A silicon version of the golded bonded diode is also made using an aluminium wire as the p-type anode, with an n-type silicon wafer. This device gives a lower reverse leakage current than the germanium equivalent but the forward offset voltage is considerably larger; silicon devices typically have offset voltages of 0·6V compared with 0·3V for the germanium device. This is undesirable in many circuits as it leads to distortion when the diode is used to detect a low level signal. Consequently a compromise has to be adopted in most applications.

Variable Capacitance Diode

It was shown earlier that when the reverse voltage applied to a diode is altered the width of the depletion layer changes. This effect can be likened to separating the plates of a capacitor. This produces a change in capacitance; an increase in separation leads to a decrease in capacitance and vice versa. The same effect occurs in the diode, with some modification because of the presence of ionised atoms between the plates of the "capacitor". This gives rise to the diode capacitance which changes as the reverse bias is altered.

In the case of the alloyed junction diode the capacitance varies as the inverse square root of the voltage, doubling as the voltage is divided by four. In the case of the diffused junction diode which has a built-in gradient of impurity ions the capacitance increases as the inverse cube root of the voltage, so that an increase in the reverse voltage by a factor of eight is required to halve the capacitance.

The variable capacitance diode is used extensively in circuits which would formerly have used variable reactance valves. Such applications are automatic frequency control of receivers, electronic tuning circuits and parametric amplifier circuits. Diodes are now available which have capacitance ranges of from 500pF with a reverse voltage of 1V to 75pF with reverse voltages of around 100V.

Zener Diodes

The reverse breakdown of a p-n junction has been shown to be due to one of two effects. Breakdown below 6V is due to the zener effect in which the field across the junction leads directly to ionisation; above 6V the breakdown is due to the avalanche process. In practical devices these effects can be made to occur at specific voltages by varying the doping levels and junction widths. A typical characteristic curve is shown in Fig. 2. This type of diode can be used to stabilise a voltage power supply either by using amplification and a series stabilising transistor or by simply using the zener diode as a shunt stabiliser. Breakdown diodes can be obtained with breakdown voltages of from 2V to several hundred volts, capable of controlling hundreds of watts of power.

Unfortunately the breakdown voltage varies with temperature. The temperature coefficient of the devices varies between ±0·1% per degree centigrade. The negative temperature coefficient applies to the zener diode, the positive to the avalanche diode. The dynamic resistance of the breakdown diode can vary from a few ohms for a good device to several thousand ohms for a low current device.

It is worth mentioning that reference voltages of less than 2V can be obtained by using the forward offset voltage of forward biased junction diodes. Several diodes can be connected in series to obtain voltages in steps of 0·3V using germanium devices.

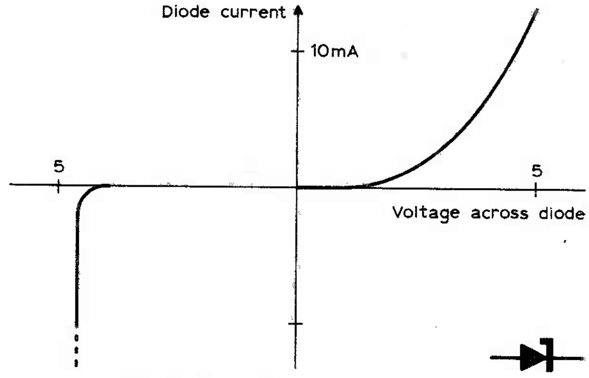


Fig. 2: Zener diode characteristic curve.

Photodiodes

Another form of diode which is used in the reverse biased condition is the photodiode. The reverse current of a diode increases if light is allowed to fall on to the junction. It was explained in Part 3 that the reverse saturation current is due to the thermal generation of minority carriers near to the depletion region, these being swept across the junction by the internal field. If the junction region is illuminated electron-hole pairs are generated by the photoelectric effect. The minority carriers produced near the junction then increase the reverse current.

This effect occurs in any reverse biased junction and consequently care is normally taken to ensure that no light can reach the junction. However in the case of the photodiode a transparent encapsulation is used so that the junction can be illuminated. Sometimes a lens is used to focus the light to the most sensitive area. The lens is formed in the material of the encapsulation.

From Fig. 3 it can be seen that the dynamic resistance of the photodiode is large so that the reverse current is insensitive to the reverse voltage applied to it.

Light Emitting Diodes

Various semiconducting diodes emit radiation when they are forward biased. This is because the hole-electron recombination occurring in the junction

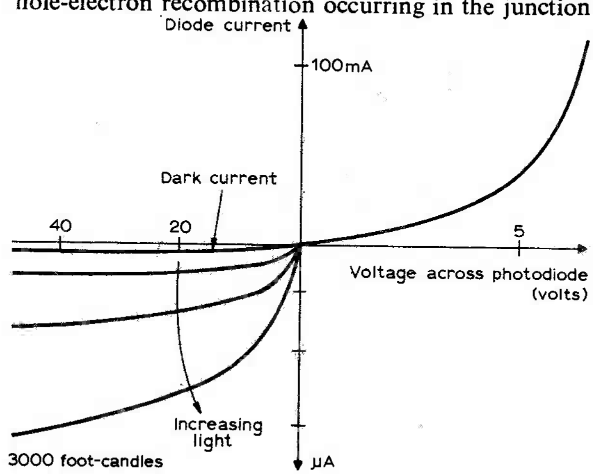
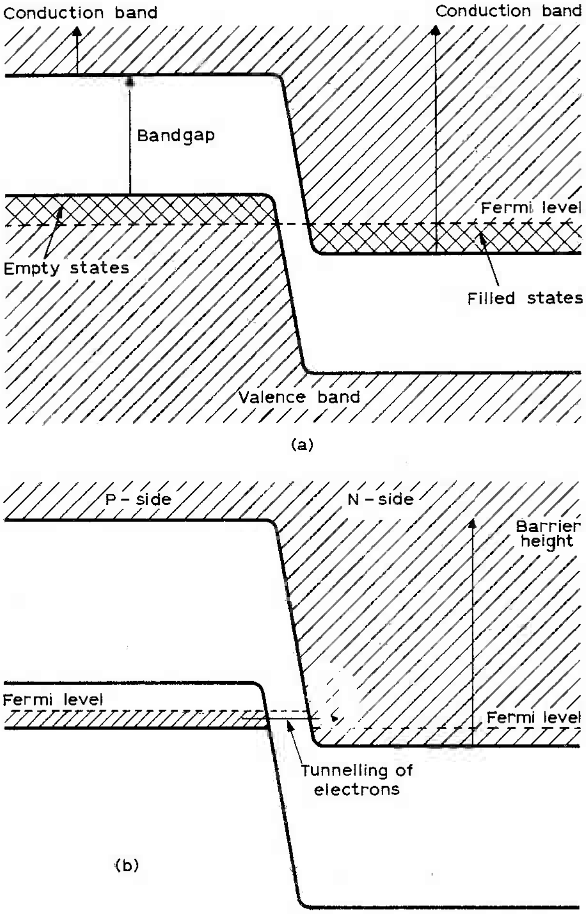


Fig. 3: Photodiode characteristic curve showing change in reverse current with change of light intensity.



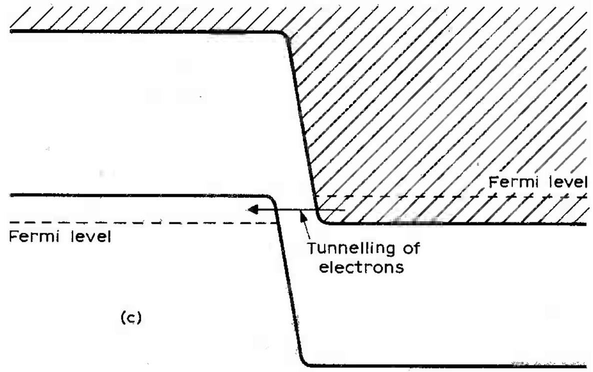


Fig. 4: (a) Tunnel diode energy band diagram when in an open circuit state of equilibrium. (b) Tunnel diode with reverse bias, (c) with small forward bias.

region leads to the production under certain circumstances of radiation. Numerous light emitting diodes are now available, exhibiting laser action when very narrow beams of "in phase" or coherent light are produced.

Wavelengths of between 8,500Å and 500Å are available from the devices, giving radiation from the infra red to the ultra violet ends of the spectrum. Only relatively small amounts of light are yet available from the devices; suitable applications are in card reading machines for computers and short range communications systems.

The Tunnel Diode

It might be thought that if an electron meets an obstacle that requires a greater energy to surmount than the energy possessed by the electron, then the electron would be stopped. However the quantum theory of matter predicted that the electron would under these circumstances be able to penetrate a small distance into the barrier, and if the barrier were thin enough the electron could pass straight through it. This process is called tunnelling.

If a diode is made with a very high level of doping the Fermi level will lie within the conduction band in the n-type region and within the valence band in the p-type region. Thus when the junction is unbiased the p- and n-type regions will have overlapping valence and conduction bands respectively, as shown in Fig. 4 (a). If a small reverse bias is applied the situation becomes that of Fig. 4 (b), where electrons in filled states in the p-type material are opposite empty states in the n-type material so that the conditions for tunnelling apply. This results in a large reverse current flowing.

If a small forward bias is applied electrons from the n-type material will tunnel into the p-type material as long as the conduction and valence bands still overlap as in Fig. 4 (c). However when the forward bias is such that there is no overlap tunnelling stops and only the normal diode forward current flows, this initially being smaller than the tunnelling current.

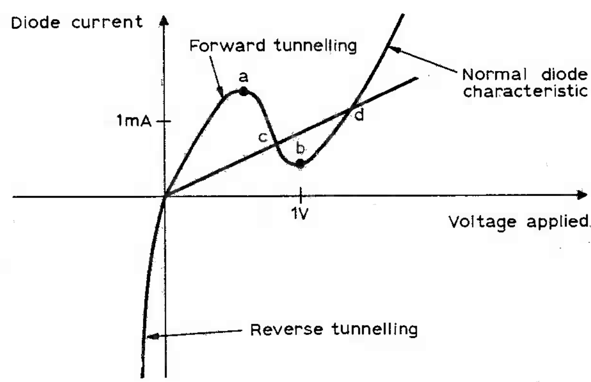


Fig. 5: Tunnel diode characteristic curve.

The important point in the characteristic above is the sloping region between a and b. This corresponds to a negative resistance region where an increase of the voltage across the device leads to a decrease in current through it. This enables the device to be used in oscillators and amplifiers.

A second point of importance is the fact that at a certain current there are three voltages at which the device can operate. For example the line cd in Fig. 5 cuts the curve at three points. This feature enables the tunnel diode to be used in switching applications.

Impatt Diodes

Various diodes have recently been constructed which are capable of producing oscillations at microwave frequencies. Examples are the Gunn and Read diodes. The theory of these devices is rather involved to discuss here but depends on the bunching of charge carriers as they move across a block of suitable semiconductor.

TO BE CONTINUED

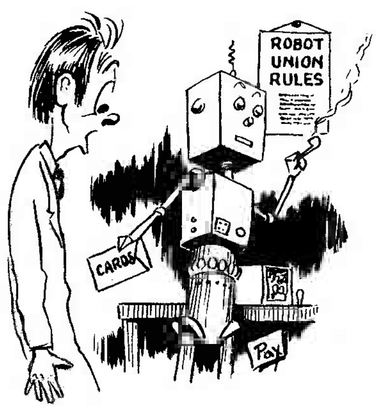
practically wireless commentary by HENRY

No. 60

Modular Modernity

OUR Scientific Correspondent in my daily paper is always quick to tell us that this is the age of automation.

What with telecasts from lunar floorshows and David Frost



Made redundant by a robot.

jumping onto the rocket-wagon, anything so mundane as a hand-wired valve radio almost qualifies as an *objet d'art*. Modules are the order of the day.

Is it any wonder that the average chap begins to fear he will soon be made redundant by a robot? Orwell lurks around the corner. My uncle's pacemaker is a Mark II model and Bob Hope is said to hang a sign at the foot of his hospital bed: 'Just dozing—no transplants.'

Henry has heard it all before. Dire predictions that progress would soon make radio engineers a drug on the market have sounded with every innovation. The Jeremiahs welcomed transistors with grim warnings that sets-to-be would never go wrong. Printed circuitboards were heralded similarly. Integrated circuits, in theory, should make fault-finding as archaic as the Morris dance. Modules, I repeat, are the in thing.

Funny thing is that I remember somewhat similar remarks when the double-diode-pentode first appeared. 'A complete output portion . . .' one advertisement trumpeted. Lee deForest should have lived to see the day!

It was when television receivers first broke out in a rash of modules that big business took up the cry. Service departments were reorganised to cope with module-changing techniques. We were told that a small stock of P-C boards held by each field engineer would whittle down servicing time. And men, we wondered? Bench engineers surreptitiously studied plumbing between module transplants. Diagnosis, it was whispered, would become a dying art.

Bench engineers perforce began servicing modules, and soon it became a habit. It was cheaper than packaging them, returning them for replacement and hoping a good one would come back.

More important, it was a blow to the pride of a bench engineer to have to send back to the makers a simple printed circuit with a few components, when a modified fault-tracing technique quickly proved where the trouble lay.

In the trade magazines, 'Service Gen' articles began to appear, with C33 and R21 spotlighted as persistent failures. Before the modules had been sculling around long enough to outrun their guarantee, service was back to normal; just a little more difficult because testing a module *in situ* was not so easy as probing around a tag board.

Biggest joke of the lot was—and still is—the attitude of the copywriters. To read them seriously, one would imagine a setmaker was the engineer's favourite uncle. 'Plug-in modules for easy servicing' claim the blurbs. If you believe that, you'll fall for anything.

Plug-in modules *do* make for easier fault-finding, true, if all you are concerned to do is swop around willy-nilly. In practice, when half our equipment is . . . what is the word? moduled, modulised modulated (no, can't be *that*) . . . any shop carrying sufficient replacements would have too much capital tied up in spares.

So we are back to square one, but this time complicated by the hazard of inaccessibility.

Have you ever looked closely at these modular designs? The method of construction keeps the actual circuit out of reach when it is operating. To test many modern modules, one has first to make a multi-plug jumper lead. Every plug and socket differs.

In one tuner-amplifier I recently serviced, nine dinky modules, completely shielded, plugged into what looked like conventional valve-bases. Good, we thought, what an excellent way of using up old stock. Until we peered a little more closely and discovered that the pin formation of these ceramic bases was like nothing BVA had ever envisaged.

A blow to the bench engineer's pride.

I saw a service instrument once, a magnificent piece of apparatus with more tentacular probes than a Portuguese Man-o'-War. It hooks into a receiver and feels its pulse all over. Could PW please have a constructor's project for such a Henry de-moduliser, Mr. Editor?

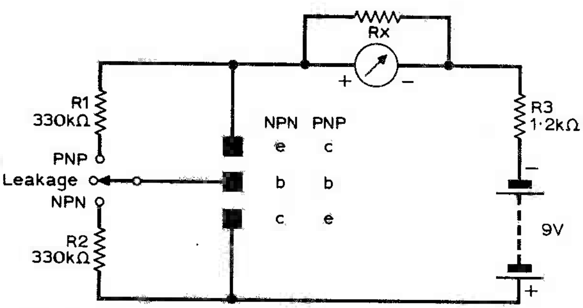
TAKE 20

JULIAN ANDERSON

No. 5
TRANSISTOR TESTER PLUS

A series of simple transistor projects, each using less than twenty components and costing less than twenty shillings to build

LOOKING at the circuit I bet that several of you are doubting last month's claim that our project would fulfil several functions. In fact it will test p-n-p and n-p-n transistors for leakage and comparative gain, test both silicon and germanium diodes, test its own battery and other batteries up to 9V, measure resistance between about 470Ω and 47kΩ and check electrolytic capacitors.



Circuit of the tester. See text for details on meter and Rx. The switch is a single pole three way.

TRANSISTORS

With the switch in the leakage position and a transistor connected in the correct way around (as shown in the circuit), 9V is applied between the emitter and the collector. A meter in the circuit will indicate the current passed—by definition this is the leakage current.

If the switch is then made to the appropriate position a 330Ω resistor is connected between the base and the collector providing the necessary bias allowing the transistor to conduct. If the transistor under test is O.K. the current passed should increase thus indicating gain. By noting the leakage and gain of good transistors it will be possible to get an idea of what the acceptable readings are. It will be found that the most common faults of the transistors in the surplus packs are either short or open circuit or high leakage while some have low gain. Don't worry if no leakage is indicated as this is so low in silicon transistors that this instrument will not measure it.

DIODES

Diodes are tested by clipping the leads between the emitter and collector contacts and then reversing them—one way round a negligible current will be measured, the other way a substantially higher one. As with transistors the readings are comparative.

BATTERIES

If R3 is chosen so that when the emitter and collector clips are shorted the meter will read full scale deflection (f.s.d.) it will follow that when the battery voltage is low, f.s.d. will not be achieved. Other 9V batteries can be substituted and the deflection compared; in fact this test is better than using a sensitive multimeter as, instead of drawing a few dozen microamps, it will test the battery under a 3mA load. Lower voltage batteries will give smaller deflections and the scale can be calibrated for 1·35V (mercury cells) 1·5V, 3V, 4·5V, 6V and 9V.

RESISTANCE

The tester will measure (if not very accurately) resistance between about 470Ω and 47kΩ by clipping the resistor between the emitter and collector contacts. If much use is to be made of this facility it would be a good idea to make R3 variable so that the meter can be "zeroed" each time to compensate for battery voltage variation. The scale will have to be calibrated using close tolerance resistors.

ELECTROLYTICS

If an electrolytic capacitor is connected with its positive to the p-n-p emitter and its negative to the collector clip, the meter should kick over and fall slowly. Note that electrolytics with working voltages of less than 9V should not be tested in this manner.

ADJUSTMENT

The meter in my prototype is a tiny one from an old tape recorder but almost any meter with a sensitivity better than 3mA can be used. Build a mockup of the circuit in Fig. 1 and substitute a 1kΩ pot, initially set at minimum resistance, for Rx and connect a multimeter set on a scale to read 3mA between the emitter and collector contacts. A 5kΩ pot should be substituted for R3. The switch R1 and R2 can be ignored.

First adjust the 5kΩ pot so that the multimeter reads 3mA then adjust the 1kΩ pot so that your meter reads f.s.d. Trim the two pots so that f.s.d. on your meter coincides with 3mA on the multimeter. Finally remove the multimeter and short out the emitter and collector connections and adjust the 5kΩ pot to give f.s.d. again. Measuring the values of the two pots will give you Rx and the exact value of R3.

Next month's project will be a one transistor radio which operates a loudspeaker without the use of an external aerial. ■

AERIALS

A. J. WHITTAKER

PART 5—MATCHING & RADIATION

THIS is the final part in this series describing transmitter and receiver aerial principles. Most aspects have been covered in sufficient detail, but two important details that have been ignored up to now are aerial matching and radiation patterns. These two subjects will be described in this article, and although the treatment does not pretend to be comprehensive, there should be enough information to be of interest to the beginner and experimenter.

Matching circuits

The most convenient and common impedance matching device for coupling an aerial feeder to a transmitter or receiver is a high frequency transformer using conventional coils and capacitors. If, for example, a 75 Ω coaxial line is to be connected to a transistor receiver, an impedance step-up is required, and this can be achieved with the circuit in Fig. 5.1. L1 C1 form the input tuned circuit, with the aerial feeder tapped up the coil, and L2 is the output coil wound to suit the base input impedance. Under these circumstances, there would be an impedance ratio step-down between the feeder part of L1 and L2, and a step-up ratio between the feeder section of L1 and the whole winding of L1 to avoid damping the tuned circuit severely.

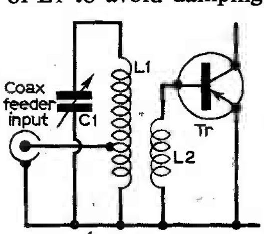


Fig. 5.1: A tuned impedance matching circuit for a coaxial feeder to a transistor.

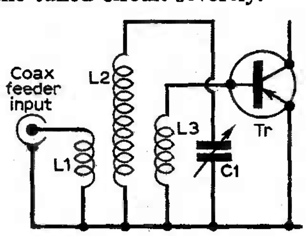


Fig. 5.2: As Fig. 1, but with a completely isolated tuned circuit.

Another way of achieving the same result is shown in Fig. 5.2, where a transformer input is used instead of the tapping on the tuned circuit. The coaxial cable is connected to its own winding, the tuned circuit is completely independent, and the output to the base again has its own winding. A typical transformer for a receiver working over the range 1·6MHz to 3MHz would have 6 turns for L1, 40 turns for L2 and 4 turns for L3. The physical dimensions of the transformer would be determined by the capacitor used.

Matching transmitter aerial

One of the most practical ways of matching a transmitter to an aerial feeder is to use a tapped transformer or coil. Figure 5.3 shows one way of doing this.

The end-fed Marconi Aerial is tapped into L_1 at a convenient point. L_1 is also tapped to match the 40 ohm aerial to a 600 ohm feeder line. This couples to a distant transmitter and is tapped into the tank circuit at 600 ohms, the turns ratio so being arranged to match the feeder to 15k ohms of the tank (typical figures).

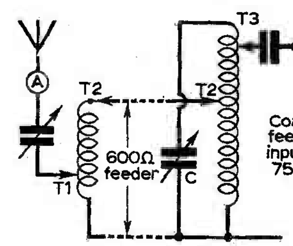


Fig. 5.3: A transmitter output impedance match for balanced lines.

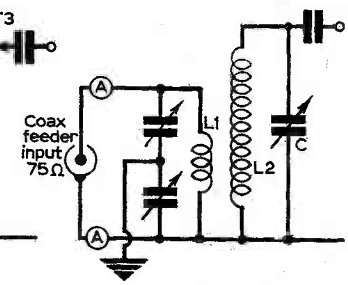


Fig. 5.4: A z-match for connecting a balanced transmitter output to a coaxial line.

The turns ratio is given by $T_2/T_1=\sqrt{\frac{600}{40}} \simeq 1:4$

and $T_3/T_2=\sqrt{\frac{15{,}000}{600}} \simeq 1:5.$

Figure 5.4 shows one method of connecting a coax feeder to a transmitter.

The 75 ohm coax is fed into a balanced input transformer which matches this to the tank circuit. Assuming the feeder to be 75 ohms and the tank circuit typically 15k ohms the turns ratio would be

$$L_2/L_1=\sqrt{\frac{15{,}000}{75}}=1:14.$$

Where it is desired to use one aerial system for transmitting or receiving as in the usual amateur or professional set-up it is usual to employ an aerial change-over switch. This is commonly a relay remotely operated.

Polar diagrams

The behaviour of an aerial system in space may be expressed by polar diagrams. As the aerial length becomes commensurate with the wavelength in use, current variations along it become pronounced and phase differences appear, causing interference effects between radiation components from different parts of the aerial. These may reinforce the signal radiated in some directions and cancel the radiation in others.

Figure 5.5 depicts an aerial slightly longer than $\frac{1}{2}\lambda$ At the point Y radiation may arrive via the direct path XY or by incident path XEY. Provided the radiation arriving at Y via each path is similarly polarised, cancellation may occur when the difference in the length of the path is equivalent to an odd number of half-

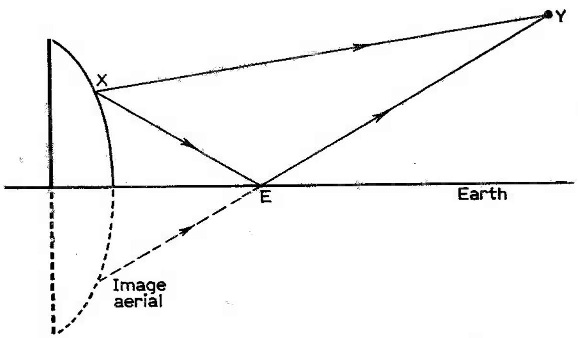


Fig. 5.5: How the image of an aerial affects its radiating properties.

waves. In that case these will be 180° out of phase. The total effect at Y may be assessed by adding together the direct ray radiation with the field due to the image aerial in the earth.

The earth acts as an imperfect mirror to electromagnetic waves. If the reflecting area is damp soil or the sea, over 80% of the energy in the wave will be reflected, but dry sand or wooded countryside are poor reflectors of radio waves. The hilliness of the terrain will also affect radio waves especially at h.f. where a hill may become comparable with the wavelength in use. Furthermore, the earth is a much better reflector of long waves than short waves. Peat is also a poor reflector. During the war the author was in charge of a transmitting station sited on peat (Lochar Moss, Tinwald Downs, Dumfriesshire), where an earth mat of copper strip had to be laid down around the station and aerial system to form an effective counterpoise. This extended beyond the plan view of the aerial system by a distance equal to the height of the aerial masts.

Aerial reactance

When the frequency is low, the length of the aerial is a fraction of a wavelength and acts as a capacitance. As the frequency is increased the capacitive reactance decreases and the aerial becomes resistive at a quarter wavelength. If the frequency is increased further still the aerial becomes inductive and tends towards infinite inductive reactance at half wavelenth. The aerial next becomes infinite capacitance and follows through the same cycle approaching zero for three-quarter wavelength aerial and on to infinite inductive reactance at a full wavelength.

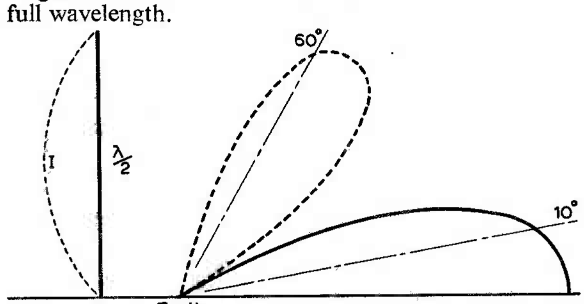


Fig. 5.6: An earthed $\frac{1}{2}\lambda$ aerial produces a 55° lobe (theoretically) and a 10° lobe (in practice).

Figure 5.6 is the vertical polar diagram of an earthed $\frac{1}{2}\lambda$ aerial. The full line occurs when the earth is a perfect conductor. The dotted curve is what happens in practice owing to a poor conducting earth.

The effect of raising the aerial above the ground is to

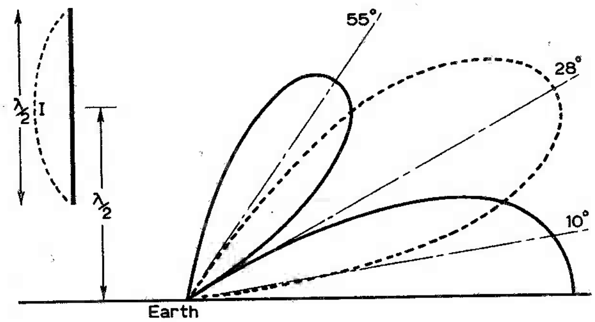


Fig. 5.7(a): The radiation patterns from a λ/2 aerial λ/2 above ground.

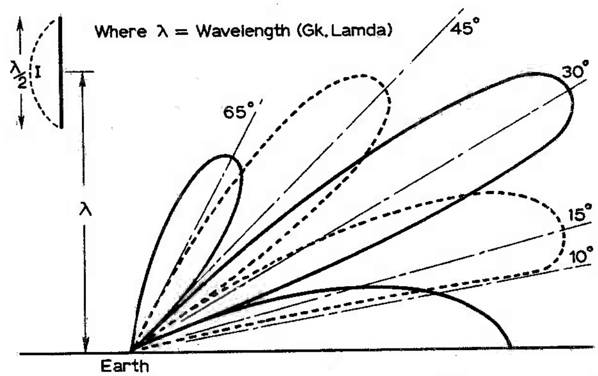


Fig. 5.7 (b): The λ/2 aerial one wavelength above ground produces a much more satisfactory pattern.

cause the radiation to break up into beams. Figure 5.7 (a) is of the $\frac{1}{2}\lambda$ dipole suspended $\frac{1}{2}\lambda$ above the ground.

Figure 5.7 (b) shows the state of affairs when the aerial is raised a full wavelength above the ground (λ=wavelength).

The narrow beams of radiation caused by raising the height of the aerial above the ground are concentrated at definite angles increasing as the aerial height is increased. Use is made of this in the design of aerial systems for low-angle radiation. For instance, by stacking arrays of dipoles either in a horizontal or vertical plane and raising these above the ground, usually $\frac{1}{2}\lambda$, the desired polar diagram may be achieved. The Koomans Array is a practical example of this, and the general form is given in Fig. 5.8 below.

Note the stub matching arrangements and the method of terminating the 600 ohm feeder.

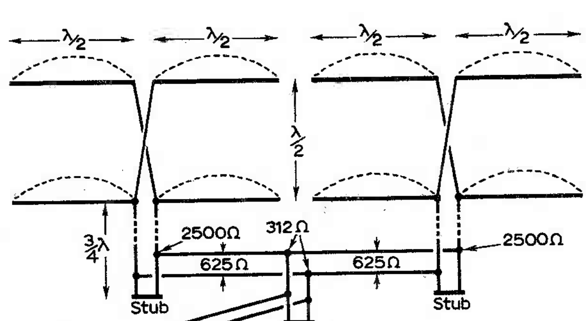


Fig. 5.8: The Koomans multi-element aerial array produces a much more predictable pattern than single λ/2 aerials.

The horizontal Rhombic aerial

The Rhombic or horizontal diamond shaped aerial is substantially aperiodic when correctly terminated and may be operated over a 2/1 frequency band. Its principle of operation is attributed to the fact that a wire in free space carrying travelling waves produces a cone of radiation around it. Figure 5.9 shows the form of such a system with the lobes of radiation around the wires.

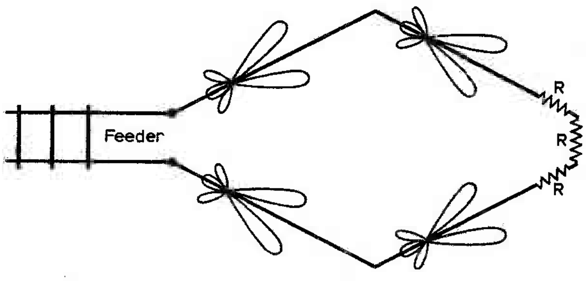


Fig. 5.9: The Rhombic aerial which enjoys great favour in commercial communications systems where space allows its use.

For h.f. aerials the sides should be 5λ and the terminating resistance 900 ohms, while for l.f. aerials the sides should be 4λ with a terminating resistance of 600 ohms.

As a transmitting aerial the Rhombic wires carry travelling waves and become in effect a special type of transmission line arranged to radiate. The input or characteristic impedance varies between 900 ohms at l.f. (30–300kHz) and 600 ohms at h.f. (3–30MHz). The terminating resistance is usually made up of three carbon rods in watertight tubes dissipating 30–60% of the power input to the system.

Rhombics may be made more efficient for transmitting purposes by grouping two or three either in series or parallel and in such a way that their combined directivity is maintained and the radiation efficiency may exceed 90%.

For the radiation or reception of ultra short waves (i.e. 17cm.) aerial arrays based on optical principles are employed. These take the form of a paraboloid reflector (usually made of aluminium) with the aerial, a half-wave dipole, fixed at the focus. The aperture of the reflector is typically 18λ across. Figure 5.10 shows the general arrangement of this system.

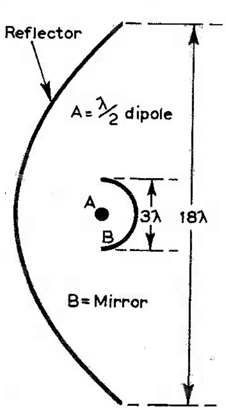


Fig. 5.10: A parabolic dish aerial for s.h.f.
A is ½λ dipole.
B is the hemispherical mirror to reflect the forward energy back on to main reflector and hence into the radiated beam.

The gain of this arrangement is in the order of 30dB. The sharpness of the radiated beam is such that turning the dish reflector through 3° reduces the received signal by 10dB (i.e. about 3/1).

To conclude this series on aerials details are given below of a pracical power indicator (Fig. 5.11). This practical low-power meter for indicating line or aerial current may be made up from a 0–5 milliammeter. A silicon diode type NKT914 is used as the rectifier. Sufficient coupling can be achieved by fixing the coupling wire close to the feeder, aerial or one wire of a balanced feeder. By this method of coupling a deflection of several mA can be recorded on the meter. This instrument may be used for aerial tuning or for checking standing waves on a feeder.

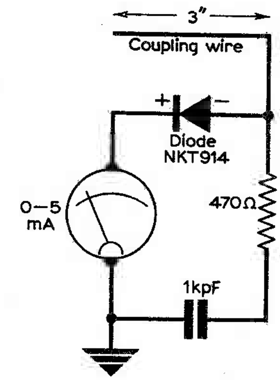


Fig. 5.11: A useful meter for checking line or aerial current. This is invaluable for detecting standing waves on a transmission line.

Components:
470Ω resistor
1000pF capacitor
NKT914 diode
0–5mA meter

The general constructional details are left to the constructor. The few components used may be grouped at the back of the meter on a piece of Veroboard and the assembly then mounted in a suitable wood or metal box.

Aerials for amateur use

The most suitable aerial system for amateur use will be determined largely by experience and inspired guesswork, as it is seldom possible to predict with any accuracy the performance of a particular system adopted for the frequency in use. It can be shown that the best height of an aerial is 0·625λ for maximum power efficiency to produce a given field strength at a distant point. Aerials erected at a height of 0·58λ are the usual practice. ■

References

Radio Communication Handbook, R.S.G.B.
Short wave Radio communication, Ladner & Stoner.
Admiralty Handbook *Wireless Telegraphy*.

CORRIGENDA

A Comprehensive Audio Mixer. Andrew Dicks
The author has drawn our attention to the following errors in his article. VR1, VR2, VR4 and VR6 should be 250kΩ log. and the wiring of S2, S4, S6 and S9 must be ignored. In Fig. 5, VR3/VR4 and VR5/VR6 should be interchanged; the last hole on the front panel is for Sk8 (not Sk7). In Fig. 3, R22 should be 27kΩ.

Transistor Output Stages. I. Sinclair
At the foot of the second column on page 118 (May issue), the first formula should read Power out= $Vc^2/8R_{load}$, and the second should be Power Dissipated=$A \times Vc^2/R_L$.

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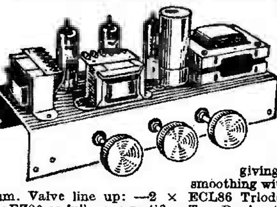

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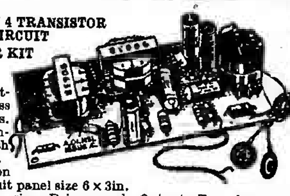

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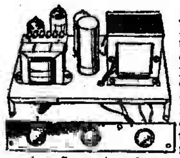

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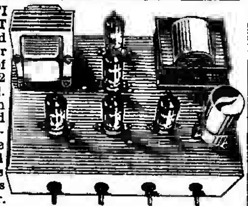

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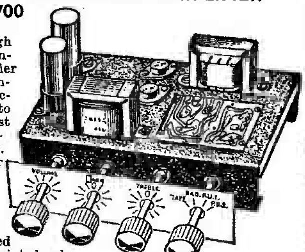

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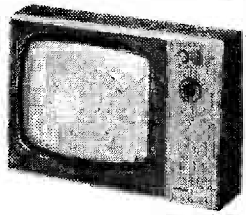

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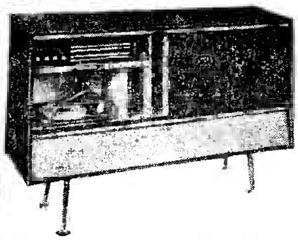

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simple electronic keyer

S. NIEWIADOMSKI

YOU should be familiar with the Morse key, which is the simplest device that can be satisfactorily used to operate a transmitter. The key is usually connected in such a way that it causes the output from the transmitter to be interrupted, and all that is needed is some dexterity in manipulating the Morse key in accordance with a recognised code, such as the Morse Code. Quite high keying speeds can be attained—25w.p.m. (words per minute) are not out of the way—but to better this figure considerable practice is demanded.

There is a way to improve one's speed more easily, fortunately, and this involves using a semi-automatic keyer, preferably of the electronic variety. An electronic keyer, unlike a straight Morse key, has a "paddle" which moves in a horizontal plane between contacts on each side so that moving it to the right produces a succession of, say, long pulses (dashes), or moving it to the left produces short pulses (dots). This is a keyer of the simplest type which forms the subject of this article, but it should be noted that there are many improvements which can be made such as the addition of circuitry to avoid breaking up the last dash if the "paddle" is moved prematurely to the opposite contact (self-completion of characters), and circuits to make sure that all character spacing is perfect, even during the transition from dot to dash and vice-versa. It is even possible to build a simple memory into the more sophisticated keyers.

To gain practice, however, the simple transistorised keyer which the author has designed is ideal, and cheap to build. The contact assembly uses commonly available components, and the elec-

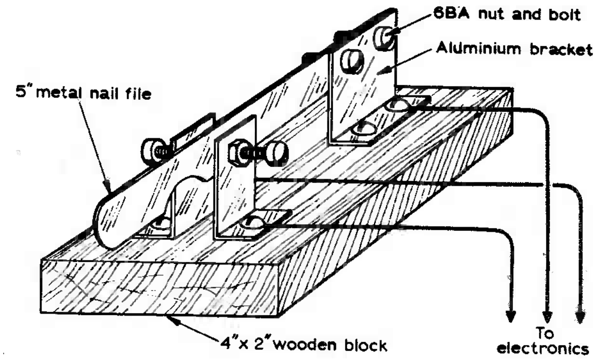


Fig. 2: The keyer paddle mounted on a wood block.

tronic circuitry comprises three multivibrators plus a relay amplifier. Describing the electronics first, the heart of the keyer is a couple of multivibrators Tr1/Tr2 and Tr3/Tr4 (Fig. 1), which are operated by taking their supply lines to the differential key. The first multivibrator, Tr1/Tr2, produces a square wave output at the collector of Tr2, and is used as the dot generator. The rate is controlled by VR1, and the mark-to-space ratio is governed by VR2. This multivibrator operates when the key is moved to the left. The second multivibrator Tr3/Tr4 produces the dash signal. As before, the overall speed is controlled by VR3, and the mark-to-space ratio by VR4. By juggling the settings of VR1, VR2, VR3 and VR4 the correct ratio of dot to dash and a constant interval between characters can be achieved for any speed. Unfortunately, with this simple circuit it is not possible to incorporate an overall speed control which would preserve the pre-set ratios.

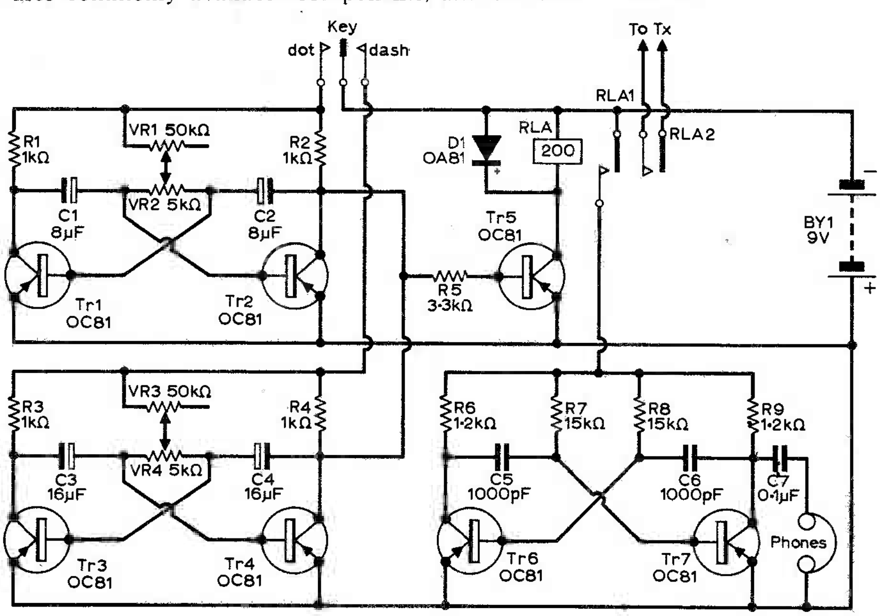


Fig. 1: The complete circuit of the electronic keyer.

The outputs from the multivibrators are combined and fed to Tr5, the relay current amplifier. The relay RLA is in the collector circuit of Tr5, and in parallel with it is connected a diode which protects the transistor from high back-e.m.f.s resulting from the interruption of current through an inductor. One set of contacts is used to key the transmitter, while a second set operates a higher frequency multivibrator Tr6 and Tr7, which is used as a keying monitor in conjunction with the headphones. This circuit is particularly useful if the keyer is to be used by an unlicensed enthusiast for practice, but do

—continued on page 331

LIE DETECTOR

C. R. BRADLEY

THE title of this article is not to be taken too seriously. The instrument to be described is a skin resistance meter or "psycho-galvonometer", which operates by measuring the resistance between two electrodes held in a person's hands or taped to the wrists by passing a negligibly tiny current through. The resistance is found to vary erratically over a range of about 1 to 50k Ω brought on by perspiration which causes large, slow resistance changes, muscle contractions which produce small, slow variations that are hard to detect or sudden changes of emotional mood which can produce large, very fast changes and oscillations of resistance. These form the basis of the uncertain claims for "lie detector" devices.

The circuit of the instrument is shown in Fig. 1. It consists of a two transistor direct coupled current amplifier which drives a 0–1mA moving coil meter. Tr1 is normally non-conducting because R2 holds the base at emitter potential. Tr2 is normally conducting because current flows from emitter to base and through R3. Full collector current flows through R4 and the 1mA meter which indicates full-scale deflection.

When skin resistance electrodes are connected to terminals T1 and T2 a small current flows from Tr1 emitter to base through R1, VR1 and the subject's skin resistance. Tr1 starts to conduct and passes collector current through R3. The potential at Tr1 collector becomes less negative so that Tr2 passes less base current. The collector current therefore decreases also and the meter needle moves towards zero.

VR1 is used to adjust the meter to half-scale deflection (0·5mA) or slightly above. Any slight change in skin resistance will now produce a large swing of the needle to left or right. Half-scale deflection is regained by readjusting VR1. This control should be fitted with a fairly large knob as it will be in constant use and its adjustment is fairly critical. The meter can be brought to half-scale deflection for any resistance up to about 40 to 50k Ω (depending on component tolerances) between T1 and T2. Changes of resistance of as little as 10 Ω can be seen on the meter. In view of this the instrument might find use in comparing high tolerance resistors and particularly in finding matched pairs of resistors.

The instrument can be constructed in any kind of cabinet and component layout is not critical. The author used a "Norman" aluminium chassis as a cabinet. The components were mounted on a tiny piece of Veroboard as an enjoyable exercise in miniaturisation and the layout is shown in Fig. 2. There is no need to build so small unless one has the inclination (and the patience) as there is plenty of room in the cabinet. It is easy to convert the layout in Fig 2 to a larger piece of Veroboard by (say) disregarding alternate holes.

Tr1 and Tr2 were OC71 in the prototype but any small signal transistors with current gains of 40 or more, such as the surplus "red spot" variety will work. They should be soldered as quickly as possible to avoid heat damage. The higher their current gains, the more

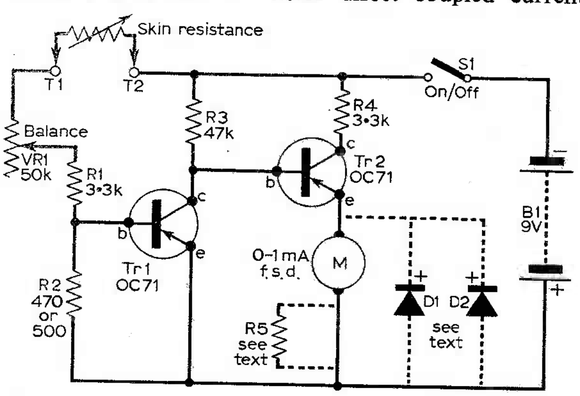


Fig. 1: The lie detector circuit. D1, D2 and R5 are meter protection components.

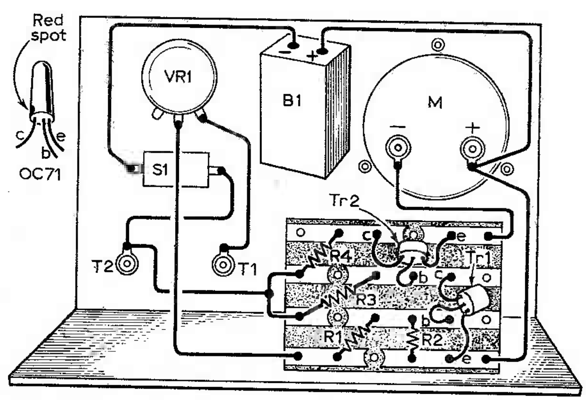


Fig. 2: Wiring of the lie detector and transistor lead identification.

★ components list

Resistors:
R1 3·3kΩ ¼W
R2 470Ω or 500 ¼W
R3 47kΩ ¼W
R4 3·3kΩ ¼W
R5 100 or 150Ω ¼W (see text)

Transistors:
Tr1 OC71
Tr2 OC71

Miscellaneous:
1mA f.s.d. meter; S1 Toggle switch; B1 9V battery (PP3); T1, T2 Insulated terminals; D1, D2 Germanium diodes (see text); Skin resistance electrodes (see Fig. 4); Cabinet; wire; solder etc.

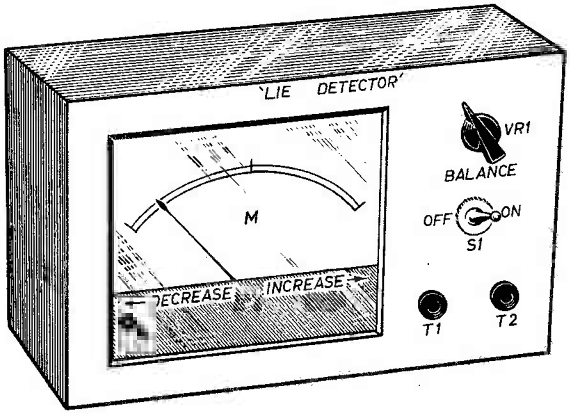


Fig. 3: Appearance of the instrument.

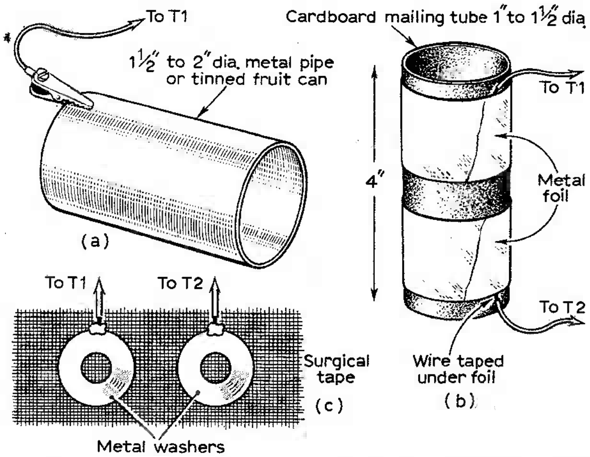


Fig. 4: Skin resistance electrodes; (a) for holding in each hand, (b) for holding in one hand and (c) for taping to wrist.

sensitive will be the instrument to small skin resistance changes. M is a 1mA d.c. moving coil unit and should be as large as possible to show up small deflections, but the calibration is unimportant and any surplus type is suitable. If the instrument is switched on without the electrodes connected a current of almost 3mA flows through M. This causes the meter needle to bang against the pin alarmingly but should not harm the movement. However, a meter required for other accurate measurements should not be used. A little protection can be provided for the meter by wiring one or two germanium diodes, or the junction of a germanium transistor, across it in the forward direction. If M has an internal resistance of 100 Ω the current through it will be limited to about 2mA, but if this is still considered excessive an additional 100 to 150 Ω resistor (R5) in series will give further limiting of the maximum meter current but causes some loss of sensitivity. Note that the red or positive (cathode) ends of the diodes are connected to the negative terminal of M.

Suitable skin resistance electrodes for connection to terminals T1 and T2 are shown in Fig. 4. The hand-held electrodes give best results provided they are not gripped too tightly, and given a chance to warm up to body temperature so that the skin resistance stabilises. As the voltages in the instrument are low there is no danger of shock.

It is not possible to give any hard-and-fast rules for positive "lie detection". This is an experimental instrument. Some people show little or no change in skin resistance, while others show a constantly changing resistance which is possibly triggered by the presence of the meter! Some give a sudden change whenever they answer "yes" to a question and no change for answer "no" (whether true or false) or vice versa. Sometimes the meter indicates random disturbances and the cause is hard to detect. Provided one does not expect the instrument to be usable for prying into private affairs it can be used for many interesting experiments. ■

SIMPLE ELECTRONIC KEYER

—*continued from page 329*

remember that if a licence is aspired to, the GPO will require the test to be taken using a conventional Morse key. A relay with more contacts could be used, of course, if other outputs are required; for receiver muting, for example.

Construction of the key should be reasonably self-explanatory from Fig. 2. The whole assembly is mounted on a wooden block measuring 4in. × 2in. × ¾in. Three brackets about 1in. high with a ½in. lip for securing them to the base should be cut from a sheet of 18s.w.g. aluminium, the widths of two being about ½in. and the rear support, which needs two screws in line, should be about 1in. wide. The "paddle" is easily made from a 5in. metal nail file, drilled with a couple of holes at the narrow end for securing it to the rear bracket. Adjustable contacts are merely screws in the front brackets, each locked with a couple of nuts. Wires can be taken from the bracket mounting screws to the electronic circuitry. Any conventional form of construction is suitable for the electronics, such as Veroboard, Cir-Kit, pin-board or tagstrips. Details have not been given because the wiring is really quite simple.

This unit does demand care when switching from dot to dash and vice versa, to maintain correct element spacing. Nevertheless, with some practice it will be easier to progress to high-speed sending than with a straight Morse key. It is, incidentally, useful to remember that one dash equals three consecutive dots, the space between characters should equal one dot, the space between letters equals three dots, and the space between words is five to seven dots.

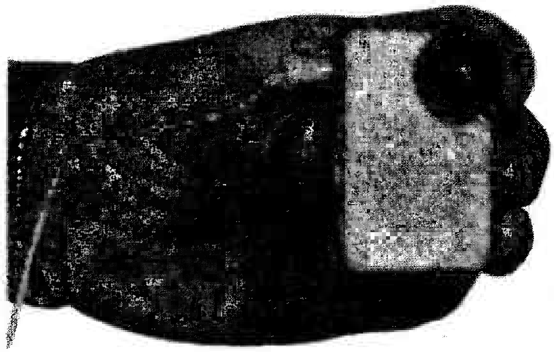
★ components list

Resistors:
- R1, 2, 3, 4 1kΩ
- R5 3·3kΩ
- R6, 9 1·2kΩ
- R7, 8 15kΩ
- VR1, VR3 5kΩ lin.
- VR2, VR4 5kΩ lin.

Capacitors:
- C1, 2 8μF, 12V
- C3, 4 16μF, 12V
- C5, 6 1000pF
- C7 0·1μF

Semiconductors:
- Tr1, 2, 3, 4, 5, 6, 7 OC81
- D1 OA81

Miscellaneous:
RLA relay with 200Ω coil and 2 make contacts (see text), BY1, 9V battery, headphones, nail file, 18s.w.g. aluminium, screws and nuts, wood block 4 x 2 x ¾in., Veroboard, etc., battery connector.



THE mini-two

M. WALLIS

A MINIATURE T.R.F. RADIO COVERING THE M.W. BAND WHICH CAN BE BUILT FOR LESS THAN 25s. AND ITS SIMPLICITY MAKES IT AN IDEAL PROJECT FOR THE BEGINNER.

EVER since transistors first became available on the amateur market constructors have been building radio sets smaller and smaller and these never lose their fascination to a large proportion of both new and established constructors.

The author is not claiming that the one described here is the smallest yet but it uses readily available components and case (always a problem for such sets) and should cost under 25s. to build. Even though the set is very small things are not so tight that building it is a problem. None of the component valves are critical, which is a common fault with many designs of this type and also the circuit is very stable, very important since the effects of handling some simple designs can send them way off tune.

Choice of transistors

Since the physical size of the set is small, obviously the aerial must be very small and consequently a very high gain is required from the transistors used; also, if very high gain transistors are used it will mean fewer stages are needed. There are on the market several transistors with very high gains but amongst the cheapest and highest gain is the BC109, now being replaced by the BC169 which is identical apart from being plastic encapsulated and cheaper. The BC169 costs under 2s. 6d. each and two of these are used in the circuit.

In the prototype very cheap near-equivalents were tried with a large measure of success, these being the transistors sold in the 10s. packs, but the component values had sometimes to be altered slightly and consequently such substitutions are not recommended for those building the set straight up without first bread-boarding.

The circuit

Among designs of this type reflexing is very popular, that is, making the r.f. transistor do two jobs, but this was rejected since closer tolerance component values are needed and problems with stability are often encountered.

It is also common practise to bias one of the transistors in such a way that it will detect, but here again a straightforward detector diode is used, as accurate and individually chosen components would be required.

The basic circuit that we are left with is a high gain r.f. amplifier with a limited amount of regeneration provided by VC2 consisting of two lengths of wire twisted together followed by a detector and a high gain a.f. amplifier. The detailed circuit operation is described separately for those interested, the circuit is shown in Fig. 1. It is common to use a high impedance magnetic earpiece acting as the collector load of the second transistor but these cost two or three times the price of crystal types and the performance between the two types was identical.

Choice of components

About the smallest and cheapest method of tuning a coil is by means of a 250pF trimmer costing about 2s. and one is used here. Batteries are a problem and for sets of this sort there is a limited choice. The one chosen was the Ever Ready B154, a 15V battery costing 2s. 9d. This is available from Boots' or other chemists and is used for hearing aids among other things. The current consumption of the radio is only 1·5mA and will power the radio for months.

Since space is limited, a 2·5mm rather than 3·5mm jack and socket are used and the crystal earpiece should be bought with this size. As far as the author is aware, ready wound coils of the size used in the set are not available but it is a relatively easy matter to wind one's own on a 1¼in., ¼in. diameter ferrite rod. Details of this are shown in Fig. 2.

The majority of the components are mounted on 0·1in. matrix Veroboard, 13 × 9 holes. To save sawing it to this size, this matrix is easily broken to the correct size along the holes.

The detector diode, OA81, is available in a miniature size and one of these should be used as the larger version will be a tight fit.

cost of miniature radio

	s	d
VC1	2	0
L1, L2	1	6
Two BC169Bs	4	6
D1—OA81	1	6
Four resistors	1	0
Two 0·01μFs	1	0
Crystal earpiece	4	6
Battery—B154	2	9
Case	1	6
Earphone jack	1	0
Veroboard	2	0
	23	3

Prices are only a guide

circuit operation

The radio waves are picked up on the aerial coil, L1, which has its own inductance and signal pickup qualities greatly increased by the ferrite rod. In combination with VC1, L1 forms a tuned circuit at a particular frequency depending on the position of VC1. The overwind on the coil, L2, considerably transforms the very high impedance of the tuned circuit thus preventing Tr1 from damping the tuned circuit; C1 is a d.c. blocking capacitor. Tr1 greatly amplifies the r.f. signal and part of this is fed back to the tuned circuit through VC2 providing a regenerative action.

The remainder of the signal is passed through C2 and is detected by D1 which is connected directly to the base of Tr2 which further amplifies the audio signal and applies it across the crystal earpiece. R1 and R3 provide the correct bias current for the transistors and R2 and R4 provide the loads across which the r.f. and a.f. signals are developed. As there is always a certain amount of detection in the first transistor, C2 is made large to feed this to Tr2. If it was necessary only to pass an r.f. signal C2 could be considerably reduced.

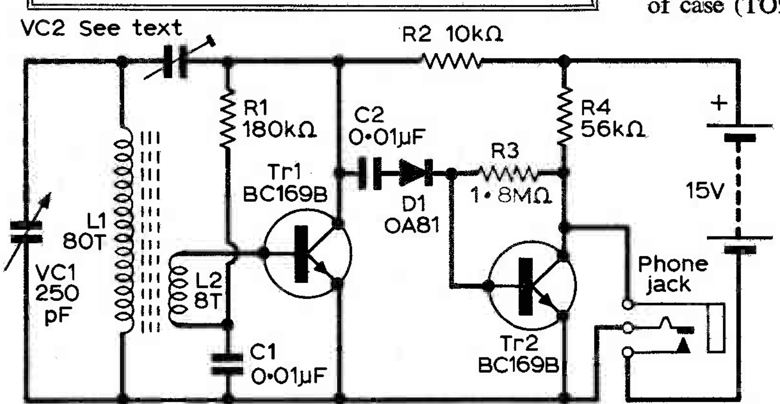


Fig. 1: The circuit of the Mini-two.

★ components list

Resistors:

R1	180kΩ	R3	1·8MΩ
R2	10kΩ	R4	56kΩ

All miniature ¼ watt, 10% tolerance

Capacitors:

C1 0·01µF, C2 0·01µF — miniature disc types, 12V
VC1 250pF trimmer (Radiospares, available from most component suppliers)
VC2 See text

Semiconductors:

Tr1 BC169B, Tr2 BC169B — Electrovalue Ltd.
D1 OA81, subminiature type

Miscellaneous:

L1, L2—see text: Crystal earpiece with 2·5mm jack plug; 2·5mm socket; B154, 15V battery; Veroboard, see text for size; Plastic case—see text; Tuning knob (Henry's Radio).

Construction

The aerial coil should be wound first using 80 turns of 34 s.w.g. enamelled copper wire. A narrow band of adhesive tape should be wound around one end trapping the end of the wire in this. Eight turns of similar wire should be wound on top of the original windings approximately in the middle.

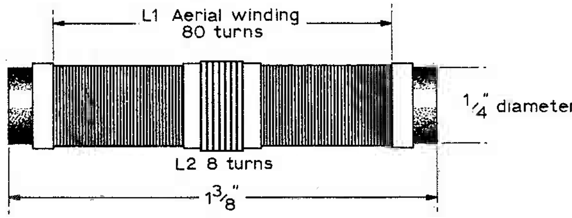


Fig. 2: Details of the aerial windings.

Only one break is needed in the Veroboard strip and this can be made using a ¼in. drill. The components should then be mounted on the Veroboard as shown, taking note of the transistor connections, note that the lead arrangements on this type of case (TO92) positions the collector in the middle.

After mounting the components on the board, solder in the wires which will lead to the battery, the earphone socket and the tuning capacitor; finally feed the aerial wires through the appropriate holes, pull tight and solder. The aerial should be pulled close to the board as there is no other means of supporting it.

The tuning capacitor should next be modified. Remove the screw used for compressing the "vanes", screw the fixing nut underneath up tight and saw off the surplus thread. Remove the fixing nut and place the trimmer in position inside the box pressing to mark the positioning for the hole. Using a ¼in. drill make the hole for the trimmer, fitting it in right into the corner. A ⅜in. 6BA round-headed screw should next be fitted through the tuning knob and locked with a nut. This can now be screwed through the trimmer and, allowing for the correct amount of movement, fix two locking nuts on the screw. The tuning knob is available as a replacement for some Japanese miniature volume controls.

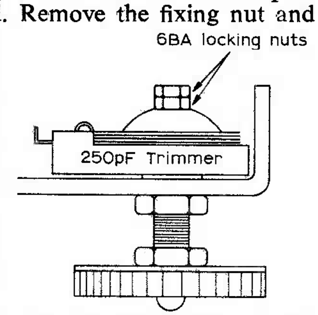


Fig. 3: Modification of the tuning trimmer.

The battery connections should be soldered, for, although spring contacts could be used these are not as reliable and the battery will have to be changed so rarely that it will be no chore.

The on/off switch is incorporated in the earphone socket by bending the switch section so that instead of being normally on it will be normally off. The jack, when inserted will automatically switch the set on. A ¼in. hole should be drilled in the side of

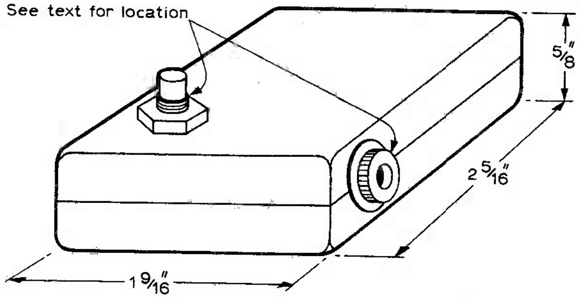


Fig. 4: The plastic case for the Mini-two.

the case to take the earphone socket, this fits inside the case beside the trimmer.

The actual case used is widely available, sold holding 30 hairgrips (which may be of use to our longer haired friends to avoid singeing whilst soldering or for the closer cropped section to give to their good ladies!) "Kirbigrips" are the manufacturers of these hair grips and box, and they cost 1s. 6d.

The only setting-up necessary in this radio is adjusting VC2 which is made up by twisting 2in. lengths of insulated wire together. If the set fails to break into oscillation reverse the connections of the overwind. This design, together with the transistors used makes for an "overlap" in oscillation, that is, once oscillation starts it is necessary to reduce VC2 (by untwisting the wires) quite a bit before stability is achieved again. Because of this only a limited amount of regen is possible but

An inside view of the completed receiver.

it is sufficient to increase sensitivity and selectivity appreciably.

On two prototypes Radios 1, 3, and 4 were received well and under favourable conditions Radio Luxembourg and one or two other continental stations were heard with good volume. ■

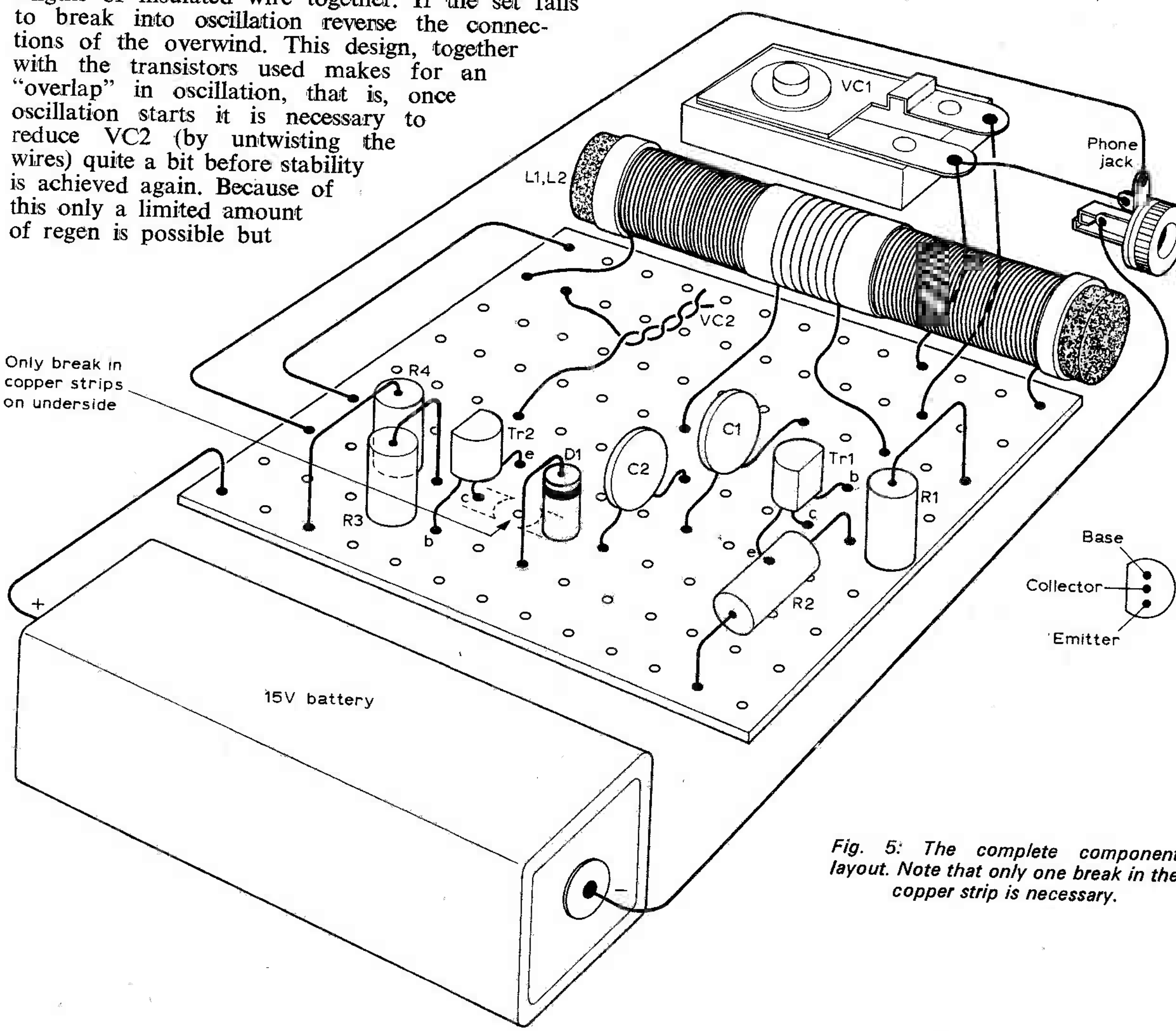


Fig. 5: The complete component layout. Note that only one break in the copper strip is necessary.

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents.

No one knows

I was extremely pleased at first, to read B. R. Meredith's letter (March 1969) on the subject of those elusive fictional holes. I thought that at last people were beginning to understand the work of the theoretical physicist, but I was shattered by the next paragraph, which showed that he had not got the point at all—for he still believes in the fantasy world of the electron. I might even venture to suppose that he regards an atom as consisting of solid spheres of negative charge flying through space round a fixed set of positive and neutral spheres. I dare say many readers believe this as well—but this is where a fundamental misapprehension arises and this belief, I am sorry to say, is fostered by even the best text-books.

The atomic model and the electron-hole theory are not supposed to be, and were never intended to be taken as literal representations. In each case, what the physicists said was: "We can understand how an atom works and we can do our sums on it, by *pretending* that it consists of particles having mass, charge, momentum etc., in certain fixed relations. The model, for such it is, is only useful for us in so far as it enables us to explain the results we observe." In a similar way, the physicists have never said that the positive hole exists—all they have said is that we can explain semiconductor action most effectively by pretending that such holes exist and that they move like electrons but in the opposite senses.

If Mr. Meredith knew anything of the results of Quantum Mechanics, he would be utterly confused to say the least. Using this system it is easier to explain atomic spectra and other effects by considering the electron as a smeared-out spherical charge distribution around a hypothetical nucleus. But even this is only a model, for the quantum mechanical electron is in fact a wave in space. However the wave is not a wave as we understand it! So you can see how confusing it gets!

The main point of my argument is that the scientist invents a model which will explain his results and gradually, mainly through the influence of badly written beginners' books, people begin to associate the model with the real thing. I would like to state categorically, here and now, no one knows, or will ever know, exactly what an atom or electron looks like. The nearest we can ever get is to invent a model system which explains all known phenomena.

I must admit, Mr. Meredith's remarks about current flow in paragraph 5, puzzled me somewhat until I realized that he apparently has not yet sorted out the difference between electron flow and conventional current flow. For his benefit and that of his students, I might just point out that for historical reasons the conventional current flow is directly opposite to that of electron flow. I find that authors and "experts" tend to deal in either convention to about an equal extent, depending on which system they were educated in. The advice he gives his students ("What are the electrons doing") is very sound but then it is always very useful if one can appreciate the other point of view.

Incidentally, I believe that it is impossible to explain p-n-p action without the use of "hole theory" and I should be very interested to hear how Mr. Meredith does this.

Finally, as for Hiatitis Pungens, I don't think it ever existed, except perhaps in a confused mind.—**K. H. J. Rainbow** *(Surbiton, Surrey)*.

Rhodian mod.

With reference to the "Rhodian Tape Recorder" design by Julian Anderson (P.W. March-April 1968), I have a suggestion which may be of help to other constructors of this unit.

In an otherwise excellent design giving very good results, I have found two difficulties, and after some experimenting I have improved one of these—the record level indication. I found the DM70 indicator was not giving any indication until the level, was so high as considerably to overmodulate the tape.

To make the "line" on the DM70 shorten appreciably, the grid must be several volts negative with respect to the cathode. I therefore decided to amplify the bias signal before it was applied to the grid, and for simplicity and small size. I used transistors, powered by a ½ wave voltage doubler from the heater line—only 7 components are involved. A super-alpha pair is used to match the impedance of the bias signal.

With this arrangement, a short line shows with no signal, and lengthens with increasing amplitude. The only precaution necessary is to keep the unit away from heat, as this alters the d.c. characteristics of the transistors. R1 can be chosen to give a full-length line when recording level is optimum.

This circuit gives a good indication of level, but I should be interested to know whether other constructors have had this problem, and how they have tackled it: also any comments on my other problems, whistles on recording from an a.m. radio, due to radiation from the oscillator coil. Perhaps this is due to building the unit on a printed circuit rather than a metal chassis? I would be glad to hear from other constructors "in any case!"—**W. Wright** *(Muirpark House, Tranent, East Lothian, Scotland)*.

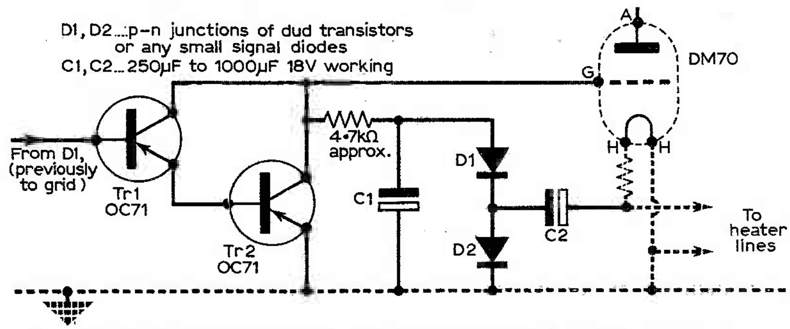


Fig. 1: The "Rhodian" modification. The original circuitry is shown in dotted form.

A VERSATILE INTERCOM SYSTEM

PART 2 J.E.BARRETT

IT was desired at one stage to add an extension from the shed to the main unit in the kitchen but to provide such an extension would have proved expensive using a three-wire connection. Consequently a two-wire extension was devised but having the disadvantage that only one such extension may be parented on to a main unit, see Fig. 6. The operation of the extension is somewhat different from usual in that receiving a call at the main from the extension (announced by a bell) requires that the extension selector on the main unit be operated before communication can be established. A call to the extension from the main unit is made in the normal way. The original extension unit consisted of a GPO type non-dial telephone with a press-button switch added just in front of the receiver rest for *ringing* purposes.

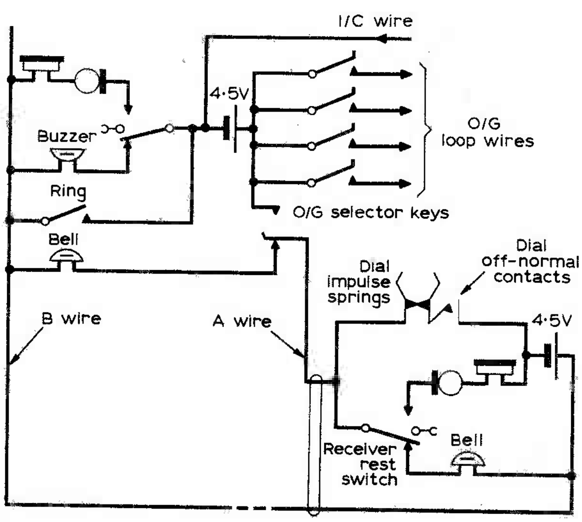


Fig. 6: Wiring of the two-wire connected extension.

Night Extension of Two-Wire Unit

It was found that if the two-wire extension parent was unattended, calls to it were fruitless and since the extension has no outgoing selector keys, no connection could be made to the basic network. To overcome this problem, a night extension facility was added to the parent unit so that calls to it could be re-directed to any unit present on the main unit.

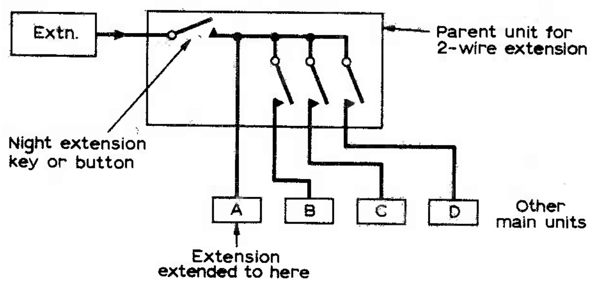


Fig. 7: Block diagram of two-wire night extension.

This arrangement is shown more clearly in the block diagram in Fig. 7 and the circuit in Fig. 8. The setting-up operation is to lift the receiver, operate the three keys or buttons simultaneously for "night extension", "shed extension" and the selector switch for the unit to which it is desired to extend the call. A call incoming from the extension to the parent will cause the buzzer to ring at the extended unit

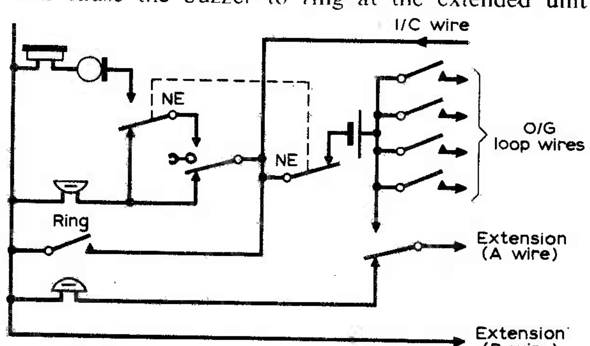


Fig. 8: Wiring of the two-wire night extension.

which can receive the call in the usual way. Note that outgoing calls cannot be made from the extended unit to the extension and the parent cannot be used to receive incoming calls (which will be announced by a buzzer in the usual way) unless the night extension facilities are first cancelled by momentarily depressing the receiver. rest switch. Note also that the receiver must be left off the parent unit so that the keys or buttons hold locked. The unit used by the author to parent the two-wire extension was a seven key unit and it was thus a simple matter to use one of the spare keys for the night extension facility.

Auto-Transfer of Two-Wire Extension

It will be seen from the description of the night extension that if a call originating from the extension cannot be dealt with at the parent unit, it can be extended to any of the other units by setting up a "temporary night extension" arrangement. The procedure is as follows: On hearing the bell (announcing a call from the extension) lift the receiver, operate the extension key or button and speak to caller. If the caller wishes to be connected to another unit, release the caller by temporarily depressing the receiver rest key and call the desired unit. On answering, the extension key and night extension key must be operated whilst holding the selected station key so that all three lock down. Since the receiver of the main unit is cut out of circuit, it will be difficult for the operator of the main unit to know when the conversation is over, hence an automatic transfer arrangement was devised having the following facilities:

(i) A call from the extension to the parent operates the bell.

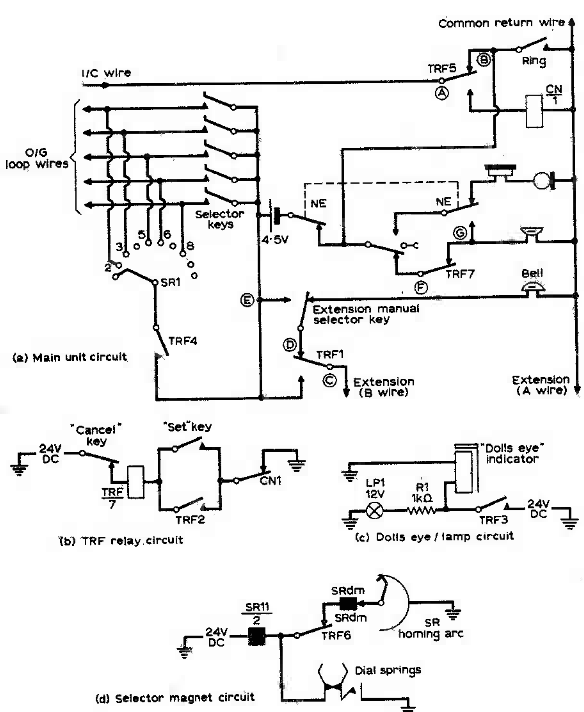


Fig. 9: Wiring of the auto-transfer facility.

(ii) The operator answering is then asked to transfer the call to another unit.

(iii) The auto-transfer key or button is operated (biased off) and the unit required is dialled (1 to 0 for up to ten extensions) and the ring key operated a few times to call the dialled unit.

(iv) The receiver is replaced and a "doll's-eye" indicator remains held whilst the transfer is in operation.

(v) At the termination of the call, the called unit rings the parent in the usual way. This causes the doll's-eye to drop out and the equipment to reset to normal without the intervention of anyone at the parent.

The circuit diagram is shown in Fig. 9.

Auto-Transfer Circuit

After ascertaining the unit required, the "transfer set" key or button is operated. This applies the earth at CN1 to the relay TRF, which latches via TRF2 and CN1. The doll's-eye indicator operates and the indicator lamp lights from the 24V supply via TRF3. The selector magnet, SR is now disconnected from its self-interrupt springs and homing arc by TRF6. The speech path is set up via TRF1 and TRF4. The incoming wire is switched to the 4·5V relay CN by TRF5 in preparation for cancelling the transfer. It is necessary to isolate the main unit buzzer as this will otherwise interfere with transmission being coupled in parallel to the extension receiver, this is achieved by TRF7. Dialling now steps the selector to the required outlet. On completion of dialling the *ring* key or button is operated which applies 4·5V battery voltage to the dialled unit via TRF4 and SR1 returning via the common return wire. When the dialled unit answers, the call is announced and the receiver is replaced. At the termination of the call, the called unit rings to the parent and in so doing applies 4·5V across the relay CN via TRF5, CN1 operates to disconnect the earth from TRF which releases. TRF6 deoperates, connecting the selector magnet to the earth on the homing bank via the self-interrupt contacts, SRdm, the magnet now steps successively to home. All other TRF contacts restore to normal causing the doll's-eye to release and the indicator lamp to extinguish. Calls may now be made to and from the parent unit without the further operation of any keys or buttons.

The power supply for the transfer unit is derived from a 20V transformer (or any other suitable voltage so long as it is sufficient to operate the relay, selector and doll's-eye indicator) and a silicon rectifier to give approximately 18V r.m.s.

All the apparatus can be housed in a wooden box containing the dial and doll's-eye indicator or the equipment may be housed with the transformer/rectifier separately from the dial and doll's-eye indicator. No details are given for the construction of the auto-transfer equipment since these will vary with the apparatus of the constructor.

A normally made "transfer cancel" key is connected in series with the relay should it be necessary to cancel a call from the parent unit (e.g. if there is no reply from the call deunit). This takes the form of a key switch (in practice the other "side" of the "transfer set" key).

TO BE CONTINUED

P.W. GUIDE TO COMPONENTS

PART 9

M. K. TITMAN, B.Sc. (Eng)

TRANSDUCERS are components which convert physical effects such as temperature, light intensity, mechanical movement, pressure etc. into electrical quantities. Since a number of types of transducer can be used for each physical parameter it will be convenient to consider each group separately.

Temperature

Most electronic components are affected by temperature variation and consequently a wide variety of transducers are available for temperature measurement. Among the most popular are thermostats, thermistors, thermocouples and temperature dependent resistors.

Thermostats

Thermostats are widely used for temperature control where critical operation is not required. The basic construction of a thermostat is illustrated in Fig. 1. Essentially it consists of a bimetal element formed by laminating two metals together. The metals used have radically different coefficients of

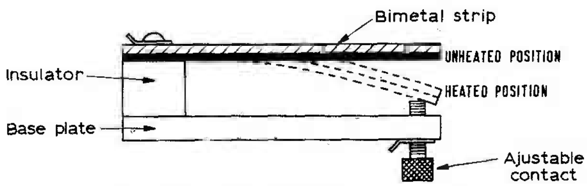


Fig. 1: Basic thermostat construction.

linear expansion with temperature and consequently when the temperature is changed one element expands more than the other, which results in the strip bending to accommodate the separate requirements of each material. When the strip is heated or cooled the bending occurs and is used to make or break a contact.

The actual temperature at which this occurs is determined by the contact to strip spacing and can be adjusted by moving the contact position. Because of the variation in strip characteristics and the relatively small movement there is a large variation from one unit to another and individual setting of each thermostat is often required.

Thermostats are effective devices for sensing one particular temperature value within a margin of error of 2-5°C and can only be used for a single temperature due to the ON-OFF characteristic of their operation. Consequently they are widely used as control elements in domestic and industrial temperature control applications but are not generally used for temperature measurement and indication.

Applications

In electronic circuits thermostats are used as delay elements and for miniature circuit breaker applications. Components with delay times of 10-100secs are available and are used for valve applications where the application of h.t. potentials are delayed until after the heaters have warmed up. Both normally-open and normally-closed contact configurations are available and generally the bimetal strip is indirectly heated with a coil. The heating coil is wound around the bimetal strip and is electrically isolated from the contact. The coils are generally wound to match heater voltage ratings of 4, 6 and 27V and require current levels of 200-750mA. Contact ratings vary from 0·5A to 2A and depend largely upon size and construction. A typical low cost delay element is shown in Fig. 2; such devices vary in price from 5s. to 15s. Valve configurations are also available to suit many standard valve bases at prices from £1 to £3.

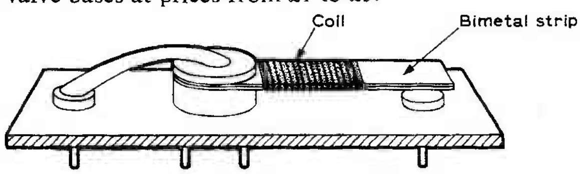


Fig. 2: Miniature thermostat delay element.

Miniature thermostat circuit breakers are used for over current and over power protection. Because of the time-lag inherent in the device due to thermal delay they are insensitive to transient conditions. The operation is similar to the delay elements except that the contact is normally closed. The current at which the contact opens is determined by the thermostat and a delay of 5-20secs is inherent. It should be noted that the maximum coil current for operation is dependent upon ambient temperature and reduces as the ambient increases; consequently these devices cannot be regarded as accurate for over current protection applications. They have the advantages of positive switching action and automatic restarting (as the coil cools) and are very cheap at prices from 3s. to 25s.

Thermistors

Thermistors are temperature sensitive resistors and the circuit symbol is shown in Fig. 3. They are

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32	25	16	10	6·4	4	2·5	1/2	10/6	23/–	80/3
64	50	32	20	12·5	8	5	1/2	10/4	22/6	77/9
125	100	64	40	25	16	10	1/–	8/9	18/9	63/6
250	200	125	80	50	32	20	1/1	9/6	20/9	70/9
400	320	200	125	80	50	32	1/2	10/4	22/6	77/9
800	640	400	250	160	100	64	1/6	13/4	29/6	102/9
1250	1000	640	400	250	160	100	2/–	18/10	37/9	134/4
2000	1600	1000	640	400	250	160	2/6	22/3	44/3	165/6
3200	2500	1600	1000	640	400	250	3/–	26/9	59/–	204/3
				800	500	320	5/3	46/6	101/–	343/9
				1250	800	500	6/6	57/6	125/4	427/–
				2000	1250	800	8/–	71/4	157/–	541/8
				4000	2500	1600	12/6	91/6	194/9	843/9
				6400	4000	2500	15/–	133/4	291/8	1000/–

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½W; 10×4·3
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5% ranges; 4·7 Ohms to 1 Megohm (E24 Renard Series).
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¼W	5%	2½d.	1/9	3/8	11/8
½W	10%	2½d.	1/9	3/8	11/7
½W	5%	3d.	2/–	4/–	12/10

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±10% tolerance. 100 Volt Working.
Prices—per Capacitance value (µF)

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0·05	8d.	6/–	12/6	41/8
0·1	10d.	7/1	15/6	51/–
0·2	1/2	10/–	20/10	68/6
0·5	2/–	17/6	37/6	125/–

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Prices—per Capacitance value (µµF)

	each	10 off	25 off	100 off
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470, 560, 680, 820, 1,000, 1,500	6d.	4/–	8/8	26/8
2,200, 3,300, 4,700, 5,600 ..	7d.	5/–	10/10	33/4
6,800, 8,200, 10,000, 15,000	8d.	6/–	13/–	40/–
22,000	9d.	6/9	18/–	45/4

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Prices—per ohmic value	each	10 off	25 off	100 off
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½W at 70°C. Long Spindle.
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Prices—per ohmic value	each	10 off	25 off	100 off
Miniature (0·3W)	1/–	8/9	18/9	66/8
Subminiature (0·1W) ..	10d.	7/1	14/7	46/8

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400V: 1,000, 1,500, 2,200, 3,300, 4,700pF, **6d.** 6,800pF, 0·01, 0·015, 0·022µF, **7d.** 0·033µF, **8d.** 0·047µF, **9d.** 0·068, 0·1µF, **11d.** 0·15µF, **1/2.** 0·22µF, **1/6.** 0·33µF, **2/3.** 0·47µF, **2/8.**
Modular, metalised, P.C. mounting, 20%, 250V: 0·01, 0·015, 0·022µF, **7d.** 0·033, 0·047µF, **8d.** 0·068, 0·1µF, **9d.** 0·15µF, **11d.** 0·22µF, **1/–.** 0·33µF, **1/5.** 0·47µF, **1/8.** 0·68µF, **2/3.** 1µF, **2/9.**

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3·5mm. Type P6. Standard. Unscreened. Unbreakable moulded cover.

Prices	each	10 off	25 off	100 off
P1	3/–	26/8	62/6	233/4
SE/P1	3/6	30/10	66/8	280/–
P2	2/6	23/4	54/2	200/–
P3	6/6	60/–	137/6	500/–
P4	6/2	59/6	127/6	455/–
P5	2/2	19/2	43/9	158/4
P6	1/8	15/–	33/4	116/8

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S5	2/9	25/–	56/8	216/8
S6	1/6	13/4	33/4	100/–

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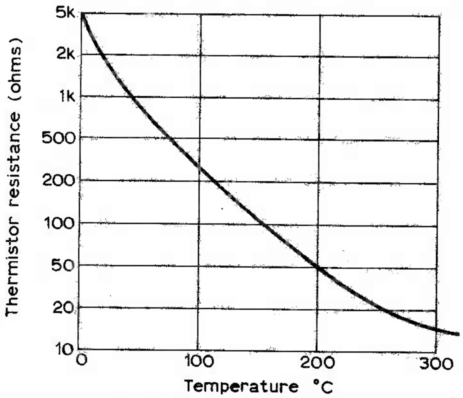
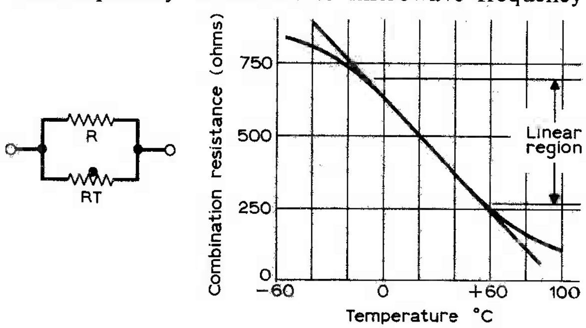


Fig. 3 (right): Thermistor circuit symbol.
Fig. 4 (left): Thermistor logarithmic characteristic.

The resistance falls logarithmically with increase in temperature and a typical thermistor characteristic is shown in Fig. 4. Since the characteristic is continuous they can be used both for control and indication and are particularly useful for power measurement especially in the r.f. to microwave frequency range. Where a linear characteristic is required this can be achieved by shunting the thermistor with a resistor as shown in Fig. 5(a). This results in the modified characteristic shown in Fig. 5(b).

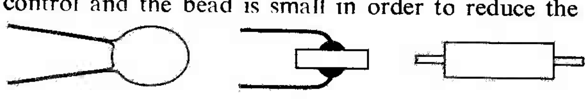


(a) Linearisation circuit (b) Linear characteristic

Fig. 5: Linearising the thermistor characteristic.

Applications

In electronic circuits thermistors are used for automatic gain and amplitude control and for surge suppression whilst as transducers they are used for measurement, indication and control. Three basic forms of construction are used to suit the varied design requirements and these forms are illustrated in Fig. 6. Bead thermistors are used for amplitude control and the bead is small in order to reduce the thermal delay. Consequently they are fast acting and suitable for direct control. Indirectly heated types in evacuated or gas filled glass encapsulations are also available. Disc thermistors are larger but are not protected except by the end connections. They are therefore more useful for power applications in control and compensation. Rod thermistors have a large surface area for heat dissipation and are particularly useful for surge suppression.



(a) Bead thermistor (b) Disc thermistor (c) Rod thermistor

Fig. 6: Types of thermistor construction.

Parameters

Thermistor operating temperatures are wide but generally between 0-300°C. Resistance values vary considerably and are available from 100kΩ to 0·5MΩ at 20°C ambient temperature. The tolerance on thermistors of a particular type is usually ±20% of the ambient 20°C level. At maximum temperature or dissipation the resistance value is usually between 10Ω and 1kΩ depending on type. Disc and rod thermistors have lower ambient resistance values and are supplied to closer tolerances, usually ±10% or ±5%. Power dissipation levels vary from 20-100mW for bead thermistors to 1-5W for disc thermistors.

Prices vary between 7s. and 20s. for disc thermistors of wide tolerance to 15s. to 35s. for close tolerance devices, whilst bead thermistors vary from 10s. to 50s. depending on tolerance and construction. Generally directly heated bead devices are available in the range 10s. to 25s. for general purpose application. Whilst these prices apply for standard thermistors specialist r.f. and microwave power measurement devices are considerably more expensive.

Thermistors have a number of advantages when compared with thermostats for control purposes. These include the ability to both measure and control, and also non-mechanical operation which results in reduced size and increased reliability and stability. They are also robust and unaffected by high vibration levels. However they do require additional circuitry for control applications and generally are destroyed by high overload values. This is a particular problem in power measurement at v.h.f. and u.h.f. frequencies.

Thermocouples

Thermocouples are widely used for temperature measurement and control but rarely as components in electronic equipment. Thermocouples are junctions of dissimilar metals and many combinations are used including cromel/alumel, copper/constantan, iron/constantan, and platinum/rhodium to cover the various temperature ranges. They operate by generating a small voltage in the region of mV when the temperature of the junction is raised but have very low source resistances. However when used in conjunction with high input impedance amplifiers rather than galvanometers the lead conditions are not critical.

Temperature ranges vary with the type of metals used for the junction. Commonly copper/constantan (Cu/Con) is used for temperatures from −200°C to +300°C since these are generally available in wire form, whilst cromel/alumel (Cr/Al) is widely used for more critical applications to 1000°C. Platinum/platinum rhodium is used for the range 0-1800°C where exceptional accuracy and stability are required.

—*continued on page 347*

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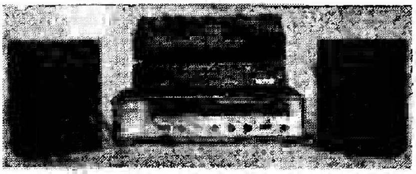

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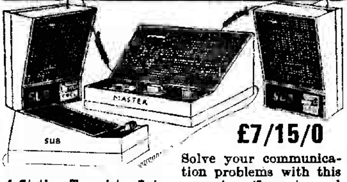

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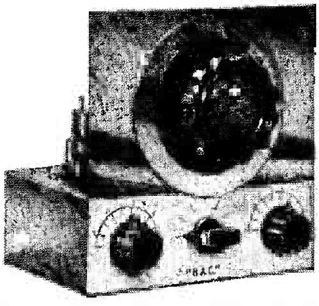

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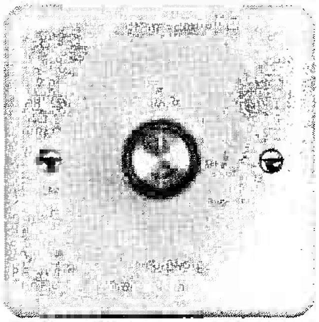

This is an attractive dimmer unit which fits in place of the normal wall light switch. The mounting plate is ivory to match modern fittings and the control knob is in bright chrome. An ON/OFF switch is incorporated to control up to 500 watts at mains voltages from 200-250 volts, 50 Hz.

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A MINIATURE POWER SUPPLY

I. J. KAMPEL

A MINIATURE STABILISED SUPPLY WHICH CAN BE BUILT TO GIVE AN OUTPUT BETWEEN 6V AND 18V. PROTECTION AGAINST ACCIDENTAL SHORT CIRCUIT IS INCORPORATED IN THE DESIGN.

IN this modern age of the transistor, there is a wide range of small, portable equipment designed to operate from batteries, and modern power packs offer a very reasonable life. Considered long term, however, there are many cases where the economy of running this same equipment from a mains supply would be a great advantage.

Due to its small size, $4\frac{3}{8} \times 2\frac{5}{8} \times 1\frac{1}{4}$in., the supply to be described is small enough to mount inside such equipment where the addition of a switch gives the versatility of mains/battery operation.

The supply has a current limit to protect against accidental short-circuit of the output, or overload, and in the form described has a nominal 18V stabilised output. A continuously variable output would not enable the circuit to keep its present advantage of simplicity. The 18V line may be used directly with decoupled line dropping resistors, or even further zeners if very accurate lower voltage lines are required. Alternatively the actual output may be reduced to any desired lower level by small component modifications.

As an example of the economy of such a unit, compare, for instance, the requirement for an 18V line and a load current of 30mA. The most convenient method of obtaining this with batteries would be two series PP9's. Assuming a 12 hour/day operation, and allowing the supply to drop to 13V with the PP9's, lifetime would be about 80 hours for 7s. 6d. The cost of the miniature mains unit for the same period is less than two-tenths of a penny!

The circuit, including a sub-miniature mains transformer, is constructed on a piece of Veroboard, and this may be mounted inside the smallest of the Eddystone boxes. The supply can be used floating or with earth connected to either polarity. Output is taken from solder pins, and the supply box designed for use as a general purpose bench unit or for mounting inside equipment.

Regulation is better than could be achieved with a simple zener since zener current variation with load current variation has been minimised, thus achieving a 1% regulation.

Figure 1 shows typical output voltage against load current. It is pointed out that the absolute value of output voltage is dependent upon the spread of zener voltage, and will be about 0·7V less than a given zener voltage. For the BZY94 the spread is 16·9V to 19·1V.

CIRCUIT DESCRIPTION

A miniature mains transformer, T1, provides from a 240V mains supply a secondary of 24V r.m.s. This a.c. voltage is fed to a bridge rectifier formed by diodes D1, D2, D3 and D4. C1 is an initial reservoir capacitor tending to lift the full-wave rectified waveform to its peak value, and R1 and C2 provide further smoothing and ripple filtering. C1 and C2 should be capacitors suitable for this purpose, and capable of handling large ripple currents.

Resistor R3 provides zener bias current for D6, and the zener holds the base of Tr2 at a stabilised level, approximately 0·7V higher than the output voltage. The output is taken as an emitter follower and must therefore be tied to the zener voltage by the V_{be} of Tr2.

R4 provides a small bleed current to keep Tr2 just on when the supply is on open-circuit, and to further ensure that current variation in Tr2 base is minimised. The current through D6 should be kept as constant as possible to maintain accurate regulation of the output.

As shown in Fig. 1, the current limit comes into operation just above the working range of 40mA. This is necessary to ensure that the supply is not overloaded, and means that should an accidental short-circuit be applied to the output, the supply will be protected.

The current limit is provided as follows. The whole of the load current passes through R2, thus the voltage developed across it is proportional to the load current. In fact the circuit biasing current is also passed through R2, and this assists the switching-on action of Tr2, the current limiting transistor. When the voltage reaches a pre-determined level across R2, Tr2 is biased on. The voltage required to do this is the forward voltage across D5 plus the V_{be} of Tr1. This will be approximately 1·4V, but will vary slightly according to diode and transistor spreads. Because of this, slight adjustment of

SPECIFICATION

Output voltage	18V nominal (16·2V–18·4V due to zener spread)
Voltage regulation	± 1% (measured on prototype)
Ripple voltage	<1mV r.m.s. at 40mA (considerably less at lower levels)
Current range	0–40mA
Current limit	40–60mA

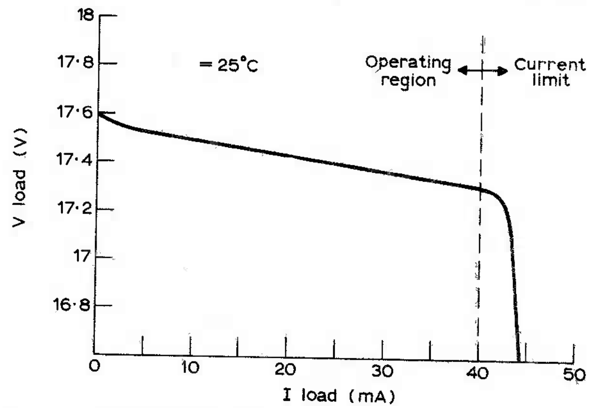

Fig. 1: Typical output voltage plotted against load current.

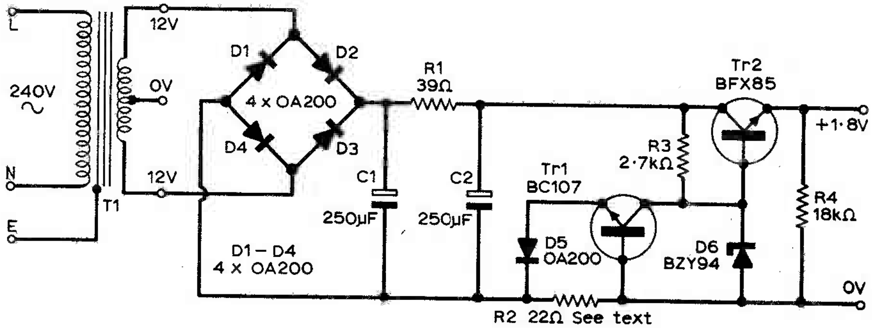

Fig. 2: The circuit of the power supply.

R2 may be necessary to ensure that the circuit limits at the correct current. It should not be necessary to get to a lower or a higher resistance value than the next preferred values.

When the current increases to limiting value, the voltage across R2 brings on Tr1 which, on short-circuit at the output, goes into saturation. The voltage at Tr1 collector is thus made to fall, collapsing the reference voltage provided by the zener diode, and hence the output voltage. V_{be} of Tr2 must not exceed 0·7V or thereabouts or this transistor will be destroyed. Obviously a short circuit output reduces the emitter to 0V, and hence the necessity to reduce the base voltage to something less than 0·7V relative to the 0V output.

After construction, a test should be made with a current meter and a variable load, such as a potentiometer. If the output voltage, which should also be monitored, does not start to drop just after 40mA is reached, R2 should be increased slightly. If the voltage falls suddenly before reaching 40mA decrease R2 slightly. (If two parallel resistors are required for good limiting at the right value, the second resistor may be inserted in the Veroboard layout between holes H11 and H12.)

For further smoothing a capacitor may be placed across the output. There is room for a moderately sized capacitor on the Veroboard between W4 and W11. The higher the capacitance (at appropriate voltage working) the lower the ripple.

Note that whilst a tempting place to put a smoothing capacitor is across the zener diode, this is not to be recommended. If this is done there is a danger of burning out Tr2 if a short is applied to the output; since this capacitor will then discharge directly through the emitter-base of this transistor unchecked.

COMPONENT NOTES

All the transistors used are silicon types, and since germanium types behave very different thermally to silicon, and since V_{be}'s differ considerably, germanium components should not be substituted. It is also stressed that when alternative silicon components are used in the regulatory or limiting sections, the specification may not be achieved.

Small size, low cost silicon diodes may be employed throughout the circuit, including the bridge rectifier, since the supply is only providing limited power. Silicon alternatives to the OA200's may be freely employed.

With regard to the zener diode, the quality used relates to the degree of regulation with varying load current. Whilst zeners of the OAZ series may be used here, for a better regulation the newer BZY types give a superior performance with their sharper knees and smaller zener voltage variation with zener current.

If the constructor has any of the BZY88 range of silicon zener diodes, two of these might be used in series to give approximately 18V, for example, two BZY88 C9V1, giving a nominal voltage of 18·2V. If two such diodes are used in series, however, zener voltages under about 5·1V are not recommended since for lower voltages slope resistances generally are not as good and regulation will deteriorate. Of the transistors, any 800mW, 30V transistor will be suitable for Tr2 with a reasonable gain, preferably greater than 60 (at 1mA). A wide variety of silicon transistors may be used for Tr1 with a reasonable gain and V_{ce} of about 30V. The BC107 is recommended for availability and low cost, with the ZTX302 or BC167 as alternatives in plastic encapsulation.

The BFX85 or BFX86 are excellent transistors to use as Tr2 for free-air mounting.

Note: if it is desired to use two zener diodes in series to provide the 18V reference, these may be mounted on the Veroboard as follows, where the zener shown between U1 and U11 is removed. Connect the cathode of the uppermost to U1 and the anode to U8. Connect the lower diode cathode to V8 and its anode to V11.

OTHER OUTPUT VOLTAGES

It is possible to modify the circuit to give output voltages from anything between about 6V and 18V. For simplicity in the circuit, because output voltage is not variable, the power dissipated by Tr2 may be predicted accurately. It will be appreciated that with a variable control, when the power is not dissipated by the load at a high load voltage, the regulating transistor is required to take over on power dissipation. With a fixed output, this may be conveniently limited to a low value, and hence a free-air mounting used. For a lower line voltage, it must be ensured that Tr2 does not dissipate more than its rated power. With no heatsink, the BFX85 may dissipate 800mW up to 30°C, and this should be reduced to a maximum of 600mW at 70°C.

For a lower voltage, select the most suitable zener, then realising that V_{e2} will be about 0·7V less than the zener voltage, considering a maximum current of about 50mA, the maximum V_{ce} may be calculated where $P_{max} \simeq V_{ce} . I_e$. This gives 12V for up to 70°C ambient, but if enclosed in a small metal box, even with the

★ components list

Resistors:

R1	39Ω 10%	R3	2·7kΩ 10%
R2	22Ω 5%	R4	18kΩ 10%

All ¼w miniature types

Transistors and Diodes:

Tr1 BC 107, ZTX 302, BC 167, etc
Tr2 BFX 85, BFX 86 etc
D1 to D5 OA 200, OA 202
D6 BZY 94 C18

Miscellaneous:

Transformer, Radiospares sub-miniature 12V type, Veroboard 12 x 24 holes, 0·15in. matrix.

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J1009	7"	Double Play Poly	2400ft.	25/-	P. & P. 2/6.
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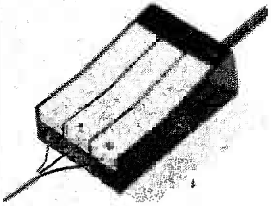

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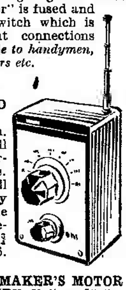

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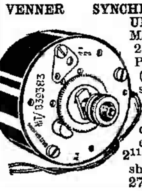

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MT4	150W	Size $3\frac{1}{2} \times 2\frac{3}{4} \times 3$in.	Wgt 3 lb	Price 33/-	P&P 6/-
MT65	200W	Size $3\frac{1}{2} \times 4\frac{1}{4} \times 4$in.	Wgt 4 lb	Price 39/6	P&P 6/-
MT66	300W	Size $4 \times 4 \times 3\frac{3}{4}$in.	Wgt 6 lb 7 oz	Price 59/4	P&P 9/-
MT110	400W	Size $4\frac{3}{4} \times 4\frac{1}{2} \times 4$in.	Wgt 11 lb	Price 85/-	P&P 10/-
MT67	500W	Size $5\frac{1}{2} \times 4 \times 4\frac{1}{2}$in.	Wgt 12 lb 8oz	Price 89/-	P&P 10/6
MT83	750W	Size $4\frac{1}{2} \times 5\frac{1}{2} \times 5\frac{1}{2}$in.	Wgt 13 lb 4oz	Price 95/7	P&P 10/6
MT84	1000W	Size $4\frac{1}{2} \times 5\frac{3}{4} \times 5\frac{1}{2}$in.	Wgt 16 lb	Price 142/2	Carr. ex.
MT93	1500W	Size $5\frac{5}{16} \times 5\frac{7}{8} \times 6\frac{1}{2}$in.	Wgt 28 lb 9oz	Price 170/6	Carr. ex.
MT94	1750W	Size $5\frac{5}{16} \times 6\frac{3}{8} \times 6\frac{1}{2}$in.	Wgt 31 lb	Price 195/-	Carr. ex.
MT95	2000W	Size $7 \times 6\frac{1}{2} \times 8\frac{1}{2}$in.	Wgt 40 lb	Price 211/2	Carr. ex.
MT73	3000W	Size $6\frac{7}{8} \times 7\frac{1}{8} \times 8\frac{3}{8}$	Wgt 45 lb 8oz	Price 300/-	Carr. ex.

LOW VOLTAGE 12 VOLT RANGE

Primary 200–250v—Secondary 12v

MT111	0·5 Amp	Size $3 \times 2\frac{1}{4} \times 1\frac{3}{4}$in.	Wgt 12oz	Price 15/3	P&P 2/6
MT71	2 Amp	Size $2\frac{3}{4} \times 2\frac{1}{2} \times 2\frac{1}{4}$in.	Wgt 1 lb	Price 19/-	P&P 3/9
MT69	4 Amp	Size $3\frac{1}{4} \times 2\frac{3}{4} \times 2\frac{3}{4}$in.	Wgt 2 lb 4oz	Price 28/-	P&P 6/-
MT70	6 Amp	Size $4 \times 3 \times 3\frac{7}{8}$in.	Wgt 3 lb 12oz	Price 39/-	P&P 6/-
MT72	10 Amp	Size $3\frac{1}{2} \times 4\frac{1}{4} \times 4$in.	Wgt 6 lb 3oz	Price 51/-	P&P 9/-
MT105	20 Amp	Size $4\frac{3}{4} \times 4\frac{1}{2} \times 4$in.	Wgt 11 lb 13oz	Price 95/-	P&P 9/-
MT187	30 Amp	Size $5\frac{1}{4} \times 4\frac{3}{4} \times 4\frac{3}{4}$in.	Wgt 16 lb 12oz	Price 180/-	P&P 13/6

LOW VOLTAGE 24 VOLT RANGE

Primary 200/250v. Secondary 24v

MT58	1 Amp	Size $2\frac{3}{4} \times 2\frac{3}{8} \times 2\frac{1}{4}$in.	Wgt 1 lb 7oz	Price 23/9	P&P 4/6
MT114	3 Amp	Size $2\frac{1}{2} \times 3 \times 3$in.	Wgt 3 lb 6oz	Price 38/-	P&P 6/-
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MT17	8 Amp	Size $4\frac{3}{4} \times 3\frac{3}{4} \times 4$in.	Wgt 7 lb 8oz	Price 72/7	P&P 9/-
MT115	10 Amp	Size $4\frac{3}{4} \times 4\frac{1}{2} \times 4$in.	Wgt 11 lb 13oz	Price 95/-	P&P 11/-

LOW VOLTAGE 30 VOLT RANGE

Primary 200/250v Secondary Tapped 12–15–20–24–30

MT112	0·5 Amp	Size $3\frac{1}{4} \times 2\frac{7}{16} \times 1\frac{15}{16}$in.	Wgt 1 lb 4oz	Price 17/4	P&P 3/9
MT79	1 Amp	Size $2\frac{3}{4} \times 2\frac{1}{2} \times 2\frac{3}{8}$in.	Wgt 2 lb	Price 23/-	P&P 6/-
MT20	3 Amp	Size $4 \times 3\frac{1}{2} \times 3\frac{3}{8}$in.	Wgt 4 lb 6oz	Price 46/2	P&P 6/-
MT51	5 Amp	Size $4\frac{3}{4} \times 3\frac{1}{4} \times 4$in.	Wgt 6 lb 8oz	Price 60/9	P&P 9/-
MT88	8 Amp	Size $5\frac{1}{2} \times 3\frac{3}{4} \times 4\frac{1}{2}$in.	Wgt 9 lb 6oz	Price 92/4	P&P 11/-
MT89	10 Amp	Size $5\frac{1}{2} \times 4 \times 4\frac{1}{2}$in.	Wgt 12 lb 2oz	Price 103/6	P&P 11/-

LOW VOLTAGE 50 VOLT RANGE

Primary 200–250v SECONDARY TAPPED 19–25–33–40–50v

MT102	0·5 Amp	Size $2\frac{3}{4} \times 2\frac{3}{4} \times 2\frac{1}{4}$in.	Wgt 1 lb 11oz	Price 21/3	P&P 6/-
MT104	2 Amp	Size $4 \times 3\frac{1}{2} \times 3\frac{3}{8}$in.	Wgt 5 lb	Price 45/8	P&P 6/-
MT106	4 Amp	Size $4\frac{3}{4} \times 4\frac{1}{4} \times 4$in.	Wgt 9 lb 4oz	Price 77/-	P&P 9/-
MT118	8 Amp	Size $5\frac{1}{4} \times 5\frac{1}{4} \times 4\frac{3}{4}$in.	Wgt 18 lb 9oz	Price 132/-	P&P 13/6
MT119	10 Amp	Size $6\frac{1}{2} \times 4\frac{1}{2} \times 6\frac{1}{4}$in.	Wgt 19 lb 12oz	Price 165/-	P&P 15/6

LOW VOLTAGE 60 VOLT RANGE

Primary 200/250v. Secondary Tapped 24–30–40–48–60

MT124	0·5 Amp	Size $3\frac{1}{4} \times 2\frac{3}{4} \times 2\frac{3}{8}$in.	Wgt 2 lb 4oz	Price 24/-	P&P 6/-
MT127	2 Amp	Size $4 \times 3\frac{1}{2} \times 3\frac{3}{8}$in.	Wgt 5 lb 6oz	Price 52/10	P&P 6/-
MT123	4 Amp	Size $4\frac{1}{2} \times 3\frac{3}{4} \times 4\frac{1}{2}$in.	Wgt 10 lb 6oz	Price 99/-	P&P 11/-
MT122	10 Amp	Size $6\frac{1}{2} \times 5 \times 6\frac{1}{2}$in.	Wgt 23 lb 2oz	Price 152/-	Carr. ex.

MAINS H.T. RANGE

							Size	Price	P&P,
MT1AT	250–0–250v	80MA	6·3v	3·5A	5/6·3v	1A	$3\frac{1}{2} \times 3 \times 3$in.	33/-	6/-
MT6AT	250–0–250v	100MA	6·3v	3·5A	5/6·3v	1A	$4 \times 3\frac{1}{2} \times 3\frac{1}{4}$in.	38/3	6/-
MT110	250–0–250v	120MA	6·3v	3·5A	5/6·3v	1A	$4 \times 4 \times 3\frac{1}{4}$in.	44/9	6/-
MT11AT	300–0–300v	100MA	6·3v	3·5A	5/6·3v	1A	$4 \times 3\frac{1}{4} \times 3\frac{7}{8}$in.	37/9	6/-
MT12AT	300–0–300v	120MA	6·3v	4A	5/6·3v	1A	$4 \times 3\frac{3}{4} \times 3\frac{3}{8}$in.	46/2	9/-
MT33AT	300–0–300v	150MA	6·3v	4A	5/6·3v	1A	$4 \times 4 \times 3\frac{1}{2}$in.	59/4	9/-
MT2AT	350–0–350v	80MA	6·3v	3·5A	5/6v	1A	$4 \times 3\frac{1}{8} \times 3\frac{3}{8}$in.	38/6	6/-
MT7	350–0–350v	100MA	6·3v	3·5A	5/6·3v	1A	$4 \times 3\frac{1}{2} \times 3\frac{3}{8}$in.	42/4	6/-
MT8	350–0–350	120MA	6·3v	3·5A	5/6·3v	1A	$4 \times 3\frac{3}{4} \times 3\frac{3}{8}$in.	50/-	6/-

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Primary Voltage 200–250v. Secondary 6–12v.

M77	1 Amp	Size $2\frac{3}{4} \times 2\frac{1}{2} \times 2\frac{3}{8}$in.	Wgt 1 lb 6oz	Price 15/-	P&P 4/6
MT45	1·5 Amp	Size $2\frac{3}{4} \times 2\frac{3}{8} \times 2\frac{3}{8}$in.	Wgt 1 lb 9oz	Price 21/9	P&P 4/6
MT46	2 Amp	Size $3\frac{1}{4} \times 2\frac{3}{8} \times 2\frac{3}{8}$in.	Wgt 2 lb 4oz	Price 25/4	P&P 6/-
MT47	3 Amp	Size $4 \times 3 \times 3\frac{7}{8}$in.	Wgt 3 lb 8oz	Price 28/4	P&P 6/-
MT5	4 Amp	Size $4 \times 2\frac{3}{4} \times 3\frac{1}{4}$in.	Wgt 3 lb 11oz	Price 33/-	P&P 6/-
MT78	5 Amp	Size $4 \times 3\frac{1}{2} \times 3\frac{3}{8}$in.	Wgt 5 lb 4oz	Price 42/-	P&P 6/-
MT86	6 Amp	Size $4 \times 3\frac{1}{2} \times 3\frac{7}{8}$in.	Wgt 5 lb 12oz	Price 48/-	P&P 6/-
MT48	7 Amp	Size $4 \times 4 \times 3\frac{3}{8}$in.	Wgt 6 lb	Price 56/7	P&P 9/-
MT146	8 Amp	Size $3\frac{1}{2} \times 4 \times 4$in.	Wgt 6 lb 4oz	Price 75/-	P&P 9/-
MT49	9 Amp	Size $4\frac{3}{4} \times 3\frac{3}{4} \times 4$in.	Wgt 7 lb 8oz	Price 99/-	P&P 9/-
MT147	10 Amp	Size $4\frac{3}{4} \times 3\frac{1}{2} \times 4$in.	Wgt 9 lb 3oz	Price 105/-	P&P 9/-
MT50	12·5 Amp	Size $5\frac{1}{4} \times 4\frac{1}{4} \times 4\frac{3}{4}$in.	Wgt 11 lb 14oz	Price 125/-	P&P 11/-

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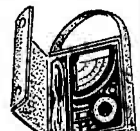
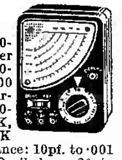


20,000 opv. AC volts 10, 50, 250, 1,000v. DC volts 5-25, 125, 500, 2500v. D.C. Current 0-50μA, 0-250mA Resistance 0-60K, 0-6 Megohm. Decibels –20 to +22dB. Size of meter $4\frac{1}{2} \times 3\frac{1}{4} \times 1$in. **85/-.** P. & P. 3/6.



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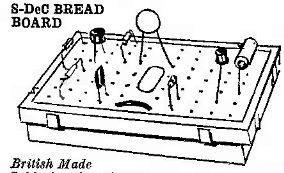

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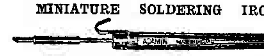

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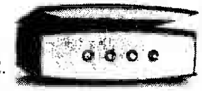

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ventilation holes, design on this point should be conservative. Thus go for a V_{ce} smaller than 12V, in fact as small as practically possible whilst still allowing for spreads. R1 may then be increased to ensure that at this current the V_{ce} selected is not exceeded. A zener current of 1–2mA is satisfactory. It may be necessary to reduce R3 when the lowest voltage at Tr2 collector is considered (i.e. at say 45mA load current). select R4 to take about 1mA at the rated output voltage.

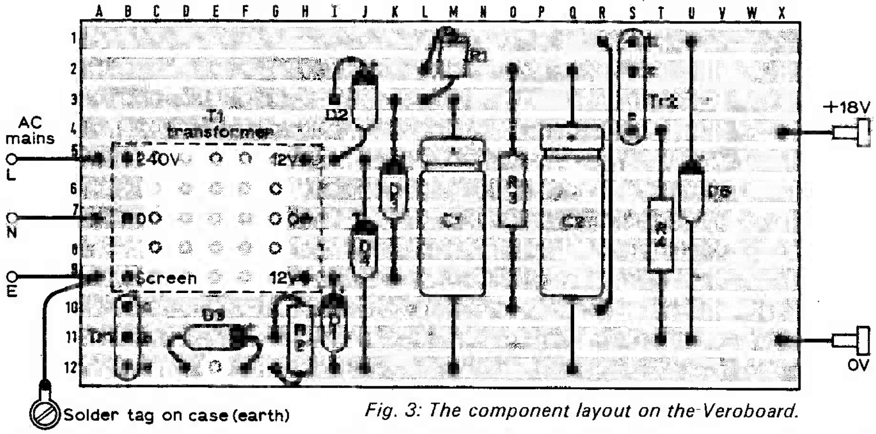


Fig. 3: The component layout on the Veroboard.

Other components will remain the same. For very low output voltages, the centre tap of the transformer may be employed to give full-wave rectification of 12V r.m.s. with two diodes, in the normal manner.

CONSTRUCTION NOTES

The Veroboard layout for the circuit is shown in Fig. 3. For safety reasons, the copper strips are removed over the whole area in the close vicinity of the mains ideally all the appropriate section of strip removed with a razor blade. Apart from clearing the copper tracks here, only one other break is made in the tracks, this being at hole E12.

Resistors R1 and R2 are vertically mounted; resistors R3 and R4 horizontally mounted. Since the capacitors are rather bulky, they should be the last components to be mounted, after a thorough check of the rest of the circuit has been made. Do not overlook the jumper bar between R2 and R10.

The complete unit may be mounted in the smallest Eddystone diecast boxes size $2\frac{5}{8} \times 4\frac{3}{8} \times 1\frac{1}{4}$ins. but great care must be taken to ensure that the box has plenty of ventilation holes and that, since mains is being applied to the unit, the insulation of the input is adequate. The box itself should be earthed.

No mains switch is provided as in many applications this would not be required since when mounted in equipment, this switch would be remote from the box itself. If desired, there are miniature toggle switches which might be fitted near the output sockets.

Needless to say, every care should be taken to ensure correct circuitry and insulation before switching on since this is a mains unit.

OTHER NOTES

The screen contact of the transformer should be wired to the mains earth lead.

Note that the supply is not intended for use as a constant current generator in the limiting mode as prolonged running on the limiting slope means excessive transformer dissipation. The current limit is intended solely as a protective device. ■

PW GUIDE TO COMPONENTS

—continued from page 340

Great care is required when using thermocouples since the low voltage level requires sensitive sensing devices. Consequently they require calibration for a given length of lead and location and when used in remote positions special compensating cable is required.

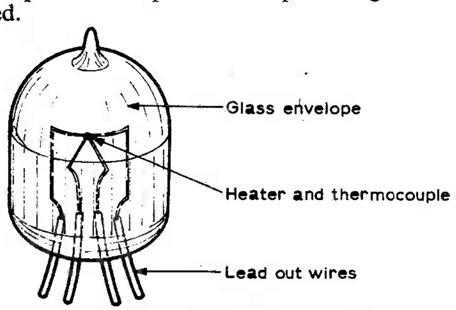


Fig. 7: Vacuum v.h.f. thermocouple.

Glass encapsulated and indirectly heated thermocouples are used for v.h.f. power measurement with standard output voltages of 7mV and 12-15mV, and a typical device is shown in Fig. 7. Prices vary but for this application are between 20s. and 60s.

TO BE CONTINUED

CQ! CQ! CQ! CQ! CQ! CQ! CQ!

INFORMATION WANTED

. . . using the R1355 and indicator type 6 as a TV unit and circuits for both units. This idea was in radio magazines about 1949.—N. Page, 108 Haden Hill Road, Halesowen, Worcestershire.

. . . circuit diagram of a Grundig radio type 2068 WE.—H. Jones, 41 Sundorne Crescent, Harlescott, Shrewsbury, Shropshire.

. . . mods on the 19 set, especially the b.f.o., further bandspread and any method of increasing the Tx range.—J. Yates, 6 Dufton Walk, Langley, Middleton, Nr. Manchester, Lancashire.

. . . the circuit, manual, or any details of the Bird electronic organ, 1959 model, C7 type and the Neosonic tone generator.—S. F. White, 87 Dyas Avenue, Birmingham, 22A.

. . . mods to the 19 set Mk 3.—F. Shepherd, 16 Frames Road, Purbrook, Portsmouth, Hampshire.

. . . hire or borrow the manufacturer's instruction book for Cossor oscilloscope model 339A.—W. Chew, 26 Stallards, Pixie Lane, Braunton, Devon.

. . . circuit or handbook—buy or loan—for Jason Mercury 2.—A. F. Sephton, 16 Bloemfontein Avenue, Shepherd's Bush, London, W.12.

. . . information on re-alignment of Admiralty B40 receiver. Also manual.—A. Parry, Fron Deg, Pistyll, Nr. Pwllheli, Caerns., North Wales.

. . . circuits and information on modifying the R1155.—W. Wallingford, 1550 Stratford Road, Hall Green, Birmingham, 28.

. . . gen on the R1475 s.w. receiver and/or the plug units that go with it.—C. Townsend, 77 Yews Hill Road, Huddersfield, Yorkshire.

. . . details of any mods. to a R1155 set or any other information about this set.—B. Dunn, 8 Lancaster Drive, Clayton-le-Moors, Accrington, Lancashire.

. . . the valve line-up and size of mains dropper in 4-valve "Champion" m.w. Rx.—D. Pibworth, 333 The Meadway, Tilehurst, Reading, RG3 4NU.

APPARATUS REQUIRED

. . . line socket for a B28 receiver (W 2835 A) also information on this receiver.—C. A. Downie, 82 Green Street, Eastbourne, Sussex.

. . . Hivac midget 4 and 5-pin valveholders also lin. c.r.t.—J. Bubez, 2 Pen-y-Wain Place, Roath, Cardiff, Wales.

. . . ex-surplus 160m Rx. Will swop for 80m Command receiver and p.s.u.—E. Symonds, 5 John Street, City Road, Cambridge, CB1 1DT.

. . . an inexpensive Garrard battery tape deck.—C. Drewe, 43 Bentinck Avenue, South Shore Blackpool, Lancashire.

. . . head for Walter 101 tape recorder.—J. Barningham, 6 Oxford Meadow, Sibac Hedingham, Halstead, Essex.

INDUCTORS FOR THE PROGRESSIVE SUPERHET

THIS receiver was described in the March 1969 issue of PRACTICAL WIRELESS and since then some difficulty has arisen in obtaining the specified inductors. Details for fitting alternatives are given here.

IF Stages

Denco Maxi-Q IFT11 465kc/s intermediate frequency transformers are suitable for all positions. Pin connections remain the same: 1—HT positive; 3—anode; 6—grid or diode; 4—a.v.c. or diode load. These i.f.t.s have the same base size and fixing.

The address is Denco (Clacton) Ltd., 357/9 Old Road, Clacton-on-Sea, Essex.

Oscillator Coils

These may be Denco "Red" (465kc/s) which have single hole fixing as for the original coils. Ranges are numbered from the l.f. band, and correct padders and pin connections are:

Range 1 (l.w.)	110pF	Pin 5
Range 2 (m.w.)	350pF	Pin 2
Range 3 (s.w.)	1,100pF	Pin 3
Range 4 (s.w.)	3,000pF	Pin 4
Range 5 (s.w.)	None	Pin 6

With the highest frequency band Range 5, pin 6 is wired directly to chassis, no padder being used.

Other pin connections for these coils are: 1—C3; 8—C4; 9—chassis. With Range 1 only, pin 7 is taken to C3 and pin 1 is unused.

Aerial and Mixer Coils

For the receiver with r.f. stage, Denco "Blue" coils are suitable for the aerial circuit and "Yellow" coils for mixer grid. If the receiver is first built without the r.f. stage, but this is to be added later, use "Yellow" coils for the mixer grid (aerial). If the r.f. stage is not to be added "Blue" coils can be fitted here. Ranges and approximate band coverage is as follows:

Range 1 (l.w.)	150-500kc.	2,000-750m.
Range 2 (m.w.)	515-1,545kc.	580-194m.
Range 3 (s.w.)	1·67-5·3Mc.	180-57m.
Range 4 (s.w.)	5·0-15Mc.	60-20m.
Range 5 (s.w.)	10·5-31·5Mc.	28-9·5m.

Pin connections are: Blue, 8—aerial; 1 and 9—chassis; 6—tuning capacitor. Yellow, 9—r.f. stage anode; 8—h.t. positive; 1—chassis; 6—mixer grid.

Constructional Points

The Denco coils are slightly larger in diameter than those originally listed, but can be accommodated in the coil box made as in Fig. 3, p.830, March 1969 issue.

Connections to Range 5 and Range 4 in particular, including padder and chassis returns, must be as short as possible, so these coils are sited close to the wavechange switch.

Trimming

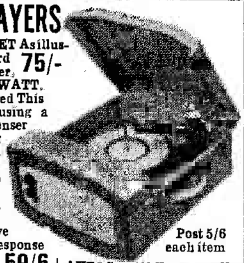
The original coils have trimmers incorporated. The Denco coils are without trimmers. No trimmers are needed in the aerial section because a panel trimmer is fitted.

The easiest way to secure maximum efficiency is to place a single beehive or high-stability trimmer across the oscillator section of the ganged capacitor, and to fit a 50pF variable trimmer for mixer grid. The latter can be operated through an extension shaft so that it occupies the mixer grid section of the coil box. Then no pre-sets are necessary, and no holes for adjusting them are needed in the coil box cover. The mixer grid trimmer is peaked if necessary with very weak signals, in the same manner as the aerial trimmer.

The coil cores are adjusted by threaded rods which project above the chassis, and all normally need unscrewing somewhat as they are fully screwed in for packing. Nuts will lock the coil cores, alignment being as described.

The address of the supplier of the case, chassis, and side brackets is H. L. Smith & Co. Ltd., 287/9 Edgware Road, London, W2. ■

DE LUXE PLAYERS



PORTABLE CABINET As illustrated. To fit standard player or autochanger. **75/-**

RCS AMPLIFIER 3 WATT. Ready made and tested This is a 2-stage unit using a triode pentode condenser coupled valve giving 3 watts output into a 3 ohm loudspeaker. Tone and volume controls mounted on chassis with knobs. Supplied with loudspeaker and valve UCL82. Frequency response 50-12,000 cps. Sensitivity 200mV. **59/6** Post 5/6 each item

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Garrard SRP22	£6.19.6
Garrard SP25 MkII	£13.19.6

AUTOCHANGERS MONO	
Balfour Princess	£5.19.6
BSR Superslim UA25	£6.19.6
MA70 Transcrip'n	£13.19.6
Garrard AT60 Mk. II	£13.19.6

All fitted LP/78 stylii and pickup cartridge complete. Stereo/mono pickup 20/- extra except 3000.

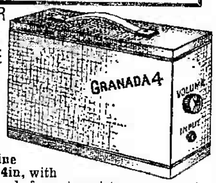
GARRARD TEAKWOOD BASE WB.1. Ready out out for mounting 1025, 3000, SP25, AT60, etc. **65/-**
GARRARD PERSPEX COVER SPC.1 for WB.1 BASE. Durable tinted attractive appearance. **65/-**

E.M.I. PICK-UP ARM Complete with mono cartridge 29/6; Xtal GP67 17/6; Stereo Ceramic 35/-. Powerpoint 56 15/-.

CRYSTAL MIKE INSERTS

1½in. dia. 6/6; ACOS 1⅛in. dia. 9/6. BM3. 1in. dia. 9/6
QUALITY RIBBON MIKE WITH GOOSENECK £11.11.0.

PORTABLE TRANSISTOR AMPLIFIER PLUS DYNAMIC MICROPHONE



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RA2W 6in. Ferrite Aerial with car aerial coil	12/6
Osc. P50/1AC	5/4
I.F. P50/2CC 470 kc/s	5/7
3rd I.F. P50/3CC	6/-
Spare Cores	6d.
Driver Trans. LFDT4.	9/6
Printed Circuit, PCA1	9/6
J.B. Tuning Gang	10/6
Weyrad Booklet	2/-

Telescopic Chrome Aerials 6in. extends to 23in. 5/-.
Ferrite Rods Only. 8 x ⅜in. 4/-; 6 x ⅜in. 5/-.

VOLUME CONTROLS

Long spindles. Midget Size 5K. ohms to 2 Meg. LOG or LIN. L/S 3/-. D.P. 5/-. STEREO L/S 10/6, D.P. 14/6. Edge. 5K. S.P. Transistor 5/-.

80 Ohm Coax 8D yd.
BRITISH AERIALITE AERAXIAL AIR SPACED 40 yd. 20/-; 60 yd. 30/-. FRINGE LOW LOSS Ideal 625 lines **1/6** yd.

WIRE-WOUND 3W POTS. Knurled knob T.V. Type. Values 10Ω to 30K., Carbon 30K to 2 meg. **4/6**

WIRE-WOUND 3-WATT STANDARD SIZE POTS. LONG SPINDLE 50 OHMS to 100 K.. **7/6**

VEROBOARD 0·15 MATRIX
2½ × 5in. 3/8. 2½ × 3¾in. 3/2. 3¾ × 3¾in. 3/8. 3¾ × 5in. 5/2.
EDGE CONNECTORS 16 way 5/-; 24 way 7/6.
PINS 36 per packet 3/4. FACE CUTTERS 7/6.
S.R.B.P. Board 0·15 MATRIX 2½in. wide 6d. per 1in. 3¾in. wide 9d. per 1in.; 5in. wide 1/- per 1in. (up to 17in.).
S.R.B.P. undrilled 1/16in. Board. 10 × 8in. 3/-.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides 7 × 4in., 5/6; 9 × 7in., 6/6; 11 × 3in., 6/6; 11 × 7in. 7/6; 13 × 9in., 9/6; 14 × 11in., 12/6; 15 × 14in., 15/-.
ALUMINIUM PANELS 18 s.w.g. 12 × 12in. 6/6; 14 × 9in. 5/6; 12 × 8 in. 4/6; 10 × 7 in. 3/6; 8 × 8 in. 2/6; 6 × 4 in. 1/6.

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Complete: a die, a punch, an Allen screw and key
⅜in. 16/- ⅝in. 17/6 1⅛in. 19/6 1¼in. 24/- 2³/₃₂in. 44/3
⅝in. 16/- 1in. 19/6 1⅛in. 20/6 1½in. 29/- 2½in. 57/3
⅞in. 16/9 1¹/₁₆in 19/6 1⅝in. 21/6 2in. 39/- 1in. sq. 36/6

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2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 4/6 each.
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Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way, 1 wafer 12/-, 2 wafer 18/-, 3 wafer 24/-, 4 wafer 30/-, 5 wafer 36/-. Extra wafers 6/- each wafer up to 5 max.
TOGGLE SWITCHES, sp. 2/6; sp. dt. 3/6; dp. 3/6; dp dt. 4/6.

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H.R. HEADPHONES 2000 ohms Super Sensitive	35/-
LOW RESISTANCE HEADPHONES 3-5 ohms	39/6
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42/6 Post 2/6.
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Attractive Slim PLAYER CABINET with B.S.R. STEREO Autochanger 4 + 4 AMPLIFIER and TWO matched 6½in. LOUDSPEAKERS Carr. 10/6 (Only 4 pairs of wires to join). **£19.19.6.**

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2/350V	2/3	100/25V	2/-	8/600V	9/6
4/350V	2/3	250/25V	2/6	16/600V	12/6
8/450V	2/3	500/25V	4/-	16+16/500V	7/6
16/450V	3/-	8+8/450V	3/6	32+32/250V	3/6
32/450V	3/9	8+16/450V	3/9	50+50/350V	7/-
25/25V	1/9	16+16/450V	4/3	60+100/350V	11/6
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1,000V-0·001, 0·0022, 0·0047, 0·01, 0·02, 1/6; 0·047, 0·1, 2/6.
SILVER MICA. Close tolerance 1%. 5-500pF 1/-; 560-2,200pF 2/-; 2,700-5,600pF 3/6; 6,800pF-0·01. mfd 6/- each.
TWIN GANG. "0-0" 208pF + 176pF. 10/6; 365pF. miniature 10/-; 500pF standard with trimmers. 12/6; 500pF midget less trimmers. 7/6: 500pF slow motion, standard 9/-; small 3-gang 500pF 19/6. Single "O" 365pF 7/6. Twin 10/6.
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TUNING. Solid dielectric. 100pF, 300pF, 500pF, 7/- each.
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MINIATURE 200v. 20mA., 6.3v. 1a. 2½ × 2 × 1⅝in.	12/6
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2 way crossover for 8 or 15 ohm speakers and tweeters. 3 phono input/output sockets. Made to sell at 42/-. OUR PRICE 22/6. Post 2/6.

Tape Spools 2/6. Tape Splicer 5/-. Leader Tape 4/6. Reuter Tape Heads for Collaro models 2 track 21/- pair.

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10 WATT **55/-** CARR. 5/-

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8½ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The Mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 8 ohm.

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Suitable for all Hi-Fi Systems. Provides rich clear reproduction of the deepest bass and remarkable efficiency in the upper register. Response 20-17,000 cps. "Baker" double cone with special "Ferroba" ceramic magnet. Flux density 16,500 gauss. Bass resonance 22-26 cps. 20 watts rating. Voice coil 8 ohms or 15 ohms.
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LOUDSPEAKER CABINET WADDING 18in. wide, 2/6 ft.

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'Group 25'	'Group 35'	'Group 50'
12in. 25 watt **6 gns.**	12in. 35 watt **8½ gns.**	15in. 50 watt **18 gns.**

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SPECIAL OFFER: 8 ohm, 2½in; 6 × 4in; 80 ohm. 2½in, 2¾in; **15/6** EACH TYPE 25 ohm, 6 × 4in; 35 ohm, 3in; 15 ohm, 10 × 2½in. 7 × 4in.
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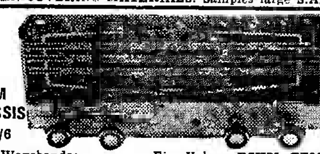
5in. WOOFER. 8 watts max. 20-10,000 cps. 8 or 15 ohm 39/6.
OUTPUT TRANS. EL84 etc. 4/6: MIKE TRANS 50:1, 3/9.
SPEAKER COVERING MATERIALS. Samples large S.A.E.

1969 GRAM CHASSIS



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Three Wavebands: Long, Med.. Short, Gram. Five Valves: ECH81, EF89, EBC81. EL84. EZ80.
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BARGAIN FM TUNER 88-108 Mc/s Six Transistor. Ready built. Printed Circuit. Calibrated slide dial tuning. Size 6 × 4 × 2½in. 9 volt. **£6.19.6.**
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SUPERIOR MOVING COIL MULTIMETER 0-2-500v.D.C. 20,000 ohms per volt, 0-1,000v. A.C. Ohms 0 to 6 meg. 50 Microamps (Full list Meters S.A.E.) **99/6**

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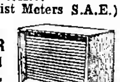

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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT • Frequences in kHz

THE BROADCAST BANDS

Christopher Danpure

THE month of August seems to be the month when all or most of the DX-ers pack up and go on holiday. Many stay in the British Isles, some go abroad. The ones that travel into Europe want to visit the Radio station in that country. The best way to assure an interesting tour of the offices, studios and transmitter building is to write to the station well in advance of departure from this country and put down dates you would like to visit that station, don't just go over and drive up to the station one afternoon and expect them to welcome you with open arms and show you around!

I must thank all readers of this column who have written in so far over my comments in the June issue, they have included some very good points and some very good logs which will be included under our "Heard and Noted" section which now follows.

HEARD and NOTED

Mr. Ray Read has certainly been having a right DX session in Monmouth, Wales, and heard these Latin American stations at fair to good strength between 0330-0400, 4,800 *R. Yaracuy*, 4,890 *R. Diffusora* Venezuela; 4,900 *R. Juventad*, 4,970 *R. Rumbus*, 4,980 *Ecos del Torbes*, 5,020 *R. Nacional*, 5,030 *R. Continente*, all in Venezuela and *Ecos del Torbes* has been heard as late as 0800. From Columbia he heard *Radio Santa Fe* on 4,965, *R. Nacional* on 4,955 and *R. Sutalenza* on 5,075 and 5,095. Another good log has come in from Vaughan P. Smith of Banbury, Oxon. *Voice of Free China* on 9,765 at 1715-1745 SINPO 33242, from Taipei, Formosa. *Radio Diffusion Television Algerienne* is giving good results with SINPO 44433 on 11,835 from 1700-2400. *Radio Amman,* Jordan, gives the best signals round about 1500 on 9,560 with SINPO 33333.

The Voice of Vietnam at Hanoi is being heard regularly on 15,018 with SINPO 45343 up until 2030 in Vietnamese, French and English after 1600.

Now from "Heard and Noted" here are some new summer schedule details just received direct from the stations.

EUROPE

Sweden: *Radio Sweden,* Stockholm is now on the following schedule for its English transmissions. From 1100-1130 on 15,315 and 9,625; 1230-1300 on 21,690 and 15,105. 1400-1430 on 21,585 and 15,315; 1600-1630 on 21,585 and 15,315; 1900-1930 on 15,240 and 11,860; 2045-2115 on 11,705 and 6,065; 2245-2315 on 15,155 and 11,705; 0030-0100 on 11,950; 0200-0230 on 11,950; 0330-0400 on 11,705 and 0515-0545 on 17,840.

CARIBBEAN AREA

Bonaire: *Trans World Radio* has dropped its transmission to Europe from 2000-2215 for the present, but they hope to resume this service in the future.

NORTH AMERICA

Canada: *Radio Canada,* Montreal is now on their Summer Service, here is the latest schedule. 0715-0800 on 11,765 and 9,625; 0830-0930 on 9,625 and 5,970; 1100-1212 on 17,820, 15,325 and 11,720; 1217-1313 on 15,325, 11,720 and 9,625; 1315-1343 on 17,820, 15,325 and 11,720; 1345-1830 on 21,595, 17,820 and 15,325; 1832-2152 on 21,595, 17,820 and 15,320; 2200-2250 on 17,720, 15,190 and 11,720; 2300-0045 on 17,720, 15,190 and 9,625; 0100-0400 15,190, 11,720 and 9,625; 0400-0555 on 11,720 and 9,625; 0555-0630 on 11,765 and 9,625; 0631-0706 on 11,720 and 9,625.

PACIFIC AREA

New Zealand: *Radio New Zealand* is now on its Winter schedule. From 1700-1945 to the Pacific Isles on 9,520 and 6,080; 2000-2145 to Australia and 2000-2400 to Pacific Isles on 15,110 and 11,780; 2200-2400 to Australia on 15,280. From 0015-0545 to Australia on 15,110 and to the Pacific Isles on 15,280; 0600-0800 daily to the Pacific Isles on 9,540 and 6,080; 0800-0845 weekdays only to the Pacific Isles on 9,540 and 6,080; 0800-0845 on Sundays to the Pacific Isles on 9,540 only. On Sundays from 0815-0845 there is a special transmission to the Antarctic on 6,080. Finally from 0900-1145 there is a Daily Service to Australia on 9,520 and 6,080.

Any of our readers who are good writers may be interested in writing a short talk for *Radio New Zealand* as part of their 21st anniversary they are asking listeners to write a talk of up to 400 words about New Zealand, a talk which might be broadcast. If any of you are interested write in to me immediately for details as the closing date is the 30th August 1969.

ASIA

Israel: *Kol Israel* has added a new frequency and transmission to its summer schedule. Now from 2015-2044 to Africa on 9,009 and to Europe on 9,725 and 9,625; 2045-2100 on 9,725, 9,625 and 9,009 to Europe. That was the new schedule for the evening English transmission. There is also a test transmission daily to North America in English from 0400-0415.

Japan: *Radio Japan* now transmits to Europe daily from 0645-0845 on 21,535 and 17,825 and 1930-2100 on 15,195 and 11,960. The English programmes are heard daily from 0800-0830 and 2030-2100.

Due to various problems which arose at the last minute this column could not appear last month, so I hope that this month's column will make up for that. Please note that on September 7th stations will change to their Autumn or Spring schedules, so information in this column will be liable to alteration from that date onwards. Until next month good listening and 73s.

THE AMATEUR BANDS

David Gibson, G3JDG

IT'S been a hard month for the DX enthusiasts. Those goodies have been a bit harder to come by, mainly because conditions were so variable. Going without sleep and meals allowed the really keen types to log the world, but for the less fanatical it's been a case of listening whenever possible and hoping that a nice hole would appear from which our undernourished logs could gain a little sustenance.

Owls and somnambulists (St John's probably) have had quite a time on twenty which has been opening up in the evenings and bubbling away happily, often until long past breakfast time. Generally though, it's been rather unreliable and sometimes more a matter of luck that one managed to listen at the right time.

Similar remarks apply to fifteen which has varied from remarkably good to just plain 'orrible. Oceana has been noticeably absent most of the time while very short skip conditions have had fun with the uninitiated.

If you find the summer months rather heavy going, why not try and plot yourself some propagation maps which you can then compare with those you make next summer? Log all the stations you can hear with as accurate a signal report as you can manage. Log the time too, and by this means you can make up a map of conditions. The final map can take any form you like. You might note the percentage or numbers of stations with, say, reports of 5 & 7 (or better), or you might compare signals from one Continent with those from another.

This is quite a serious task and requires vigilance and concentration. You will need to listen to the QSO in order to hear not only the QTH, but the reports exchanged (compare these with your own report for the stations involved) and you will need to know the power the stations are using. Go on, forget the mini-skirts just this once and become a proper little boffin.

As most readers are aware, these seasonal variations are mainly due to the state of the ionosphere. Interest in the ionosphere is on the increase and enthusiasts will be pleased to hear that a great deal of research is going on. One of the latest methods is to use intensely powerful radar beams to measure the electron density at different heights. I don't suppose this will make the DX any easier to hear, but it may well explain, when all the results are sorted out, why and how the bands do what they do when they do—if you switch on and hear nothing, at least you'll understand why!

LOW HAPPENINGS

Stand smartly to attention with headphones on backwards, we are going to salute the brave few who dared QRX on 7MHz. Persistence, patience plus Palmer, **D. Palmer** of **Lancashire,** to be precise. This combination plus a modified 19 set and a 33ft. ground plane at 20ft. raised this lot on 7MHz s.s.b. — CE3FRR, CN8AW, CP8EN, HP1JC, IS1DMN, OY2A, OY2X, PY1NBF, PY2DL, PY4ABH, PY6VZ, PY7ARJ, TF3TF, TF5TP, UA9EU, UV9KAG, VP9MI, YV1IBI, ZC4HS, ZP3AB, ZP4MO, 4X4UF, 9H1BL, 9M2DQ. Why don't I hear things like that on 7?

Alan Mercer (Lancashire), 9-transistor Ferguson and 71ft. end fed also reckons that 7 is worth a listen. Alan hooked—BY1AQ, EA4JK, F6AGE (running 5W), GW3WEJ/MM (loitering in the Bay of Biscay with 25W), HB9AL, HB9BR, I1ROY, LA6OI, OA8NO, ON4PA (running 800mW), PAØSLR, WØOP.

John Moxham (Somerset), really puts me to shame. His log for 3·5MHz shows just what can be done if you're really determined (and don't mind losing the sleep). The rx is an SR200, the antenna a 140ft. end fed, the ears are standard issue and came with the body. Eighty metre c.w. produced—CN8AW, CR6IK (I'm jealous already), CR6IV, CR6LX, HBØJG, HB9TU/P, HV3SJ, LA2PH/MM (near Ascension Is.), OD5BA, OHØNC, PY1CAD, PY1NBF, PY2DGB, PY7ASQ, VO1FX, VP2AA, VP8FL, VP8HZ, VP8KO, WA1JGO/LA, 4X4MR, 5A1TK, 5A2TR, 5Z4KL, 8P6CC, 9H1I. It's no good, I'll have to get a new cats whisker for the front end.

"Why don't more people listen to topband DX?" writes **Paul Tomes** whose last known address was Swanage, Dorset. A B40 and 165ft. of wire produced —GM3YAC, GW3XRZ, HB9CM, HB9NL, OK1DAG, OK2PCN, OL2AKS, OL6AKP, PAØRTR, W1BB/1, ZB2AY.

HIGH HAPPENINGS

High's the word too. **Paul Knight** built the 2 metre converter described in the November 1967 P.W. His aerial is a dipole built from a pruned "X" Band I TV antenna duly poked out of the bedroom window. This set up produced—F1RR, F1AOY, F4ZK, F6AGF, F8WE, F9PL, PAØCML, PAØCMR, PAØMOT. Paul also logged G2XV (Cambridge) running 500mW to a three ele beam. He also reports hearing F9NJ/T receiving TV transmission from G6ADZ/T on 70 cm.

Down to 21MHz where **J. East** (Worcestershire), has been listening with his 1475 plus RF24B converter and dipole. Signals a la s.s.b. loud and clear from—AP2MR, CN8EM, CR6JA, DU1RH, EA9AQ, WA8HWB/P/HC2, HS1AF, JA1EBF, JA6KCY, JA8DTD, JA9BE, JH1ECQ, KG4DO, KG6ALY, KR6MH, KR8EA, KX6GS, MP4BFO, OX3LP, VE8YI, VK2BNS/MM (Sea of Japan), VK9XI (Christmas Is.), VP2AW, VP8KL, VS6AL, VS9MB, XW8AL, YA1AR, YA1SG, ZS3JJ, 4S7PB, 5A1TL, 5L2BJ, 3LØB/MM (Liberia), 5LØX/MM, 7Q7RN, 9H1R, 9M2BO, 9V1OE, 9N1MM, 9X5AA.

FUTURE HAPPENINGS

Lots and lots of activity in August. August 4th, 144MHz s.s.b. contest; 10th, 432MHz contest; 10th, R.S.G.B. mobile rally at Woburn Abbey; 17th, 70MHz c.w. contest; 17th, Derby mobile rally; 24th, Torbay mobile rally; 24th, ARMS/RSARS mobile rally, Dorset; 24th, Swindon mobile rally; and a rare one—August 9th-23rd, G3JDG/P on 160 metres a.m./c.w. from near Mersea Is. (look it up on the map).

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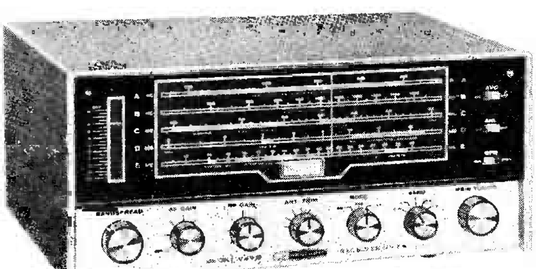

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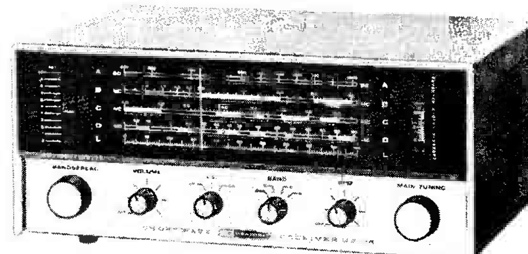

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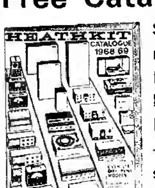

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pulse circuits in operation

I. J. KAMPEL

THE bistable is closely related to both the astable and the monostable circuits but, as its name suggests, the bistable has two stable states. It is incorrect terminology to call the bistable either a multivibrator or a flip-flop, these terms being reserved for astable and monostable circuits respectively. The bistable is sometimes referred to as the Eccles-Jordan Circuit named after the original valve circuit described in 1919 by Eccles and Jordan.

The bistable will rest in either of its two stable states until an external influence causes it to change states. If the output is taken from one collector, therefore, two input pulses are required for every single output pulse at that collector. A series of bistable circuits can thus be used to count input pulses. If there are, for example, four bistable circuits connected such that the output from each feeds the input of the following through to the end of the chain, for every output pulse at the fourth bistable there must be two output pulses from the third bistable, four from the second bistable, and eight from the first bistable. The last bistable will then serve as a counter to a base of 16. By more or less bistables, and by feedback within the chain where necessary via delay lines, counters to bases of 10 or any other number may be designed.

The basic bistable is similar to the multivibrator, where the capacitors are replaced by resistive couplings. This is shown in Fig. 4.1, where the coupling resistors R3 and R4 are shunted by small value speed-up capacitors. Upon switching on, due to unbalance in the circuit, one of the transistors will draw more current than the other, and this transistor will switch on in one of its stable states. We shall assume that Tr1 goes into the ON state. Tr1 bottoms, and under saturation conditions with only about 0·1V at Tr1 collector, Tr2 cannot switch on since the base would have to be supplied with approximately 0·7V, with the extra voltage across R3 also to be taken into account. The circuit will thus stay in this state. If negative pulses are available, a negative pulse at input B will not affect the circuit since as Tr2 is already cut off, the pulse can do no more than drive the base more negative. If, however, the negative pulse is directed to the base of the transistor in the ON state (Tr1) it will cut off this transistor. Tr1 collector will rise towards the positive rail, and as it does so base bias will be provided for Tr2 via R3. C1 provides extra current during the switching transient to drive Tr2 into hard saturation, easing off to just holding it in saturation when the switching has been concluded. As Tr2 goes on, its collector voltage drops down to the saturation level cutting off the supply to Tr1 base. Tr1 can thus not switch on again, and the circuit settles in its second stable state. Only a negative pulse will switch the circuit back to its original state, and this pulse must now be directed to input B. Since there are no large capacitors in this circuit, and the speed-up capacitor may be ignored as far as this is concerned, a fast rise time should be achieved as well as a sharp fall time, unlike the multivibrator, or one side of the monostable.

As in the case of the monostable, it is better to cut the transistor in the OFF state completely off, that is, by reverse bias on the base. Figure 4.2 shows the way to do this by adding a further negative supply rail. If Tr1 is switched on, the potential divider formed by R4 and R6 is adjusted such that the voltage at Tr2 base is

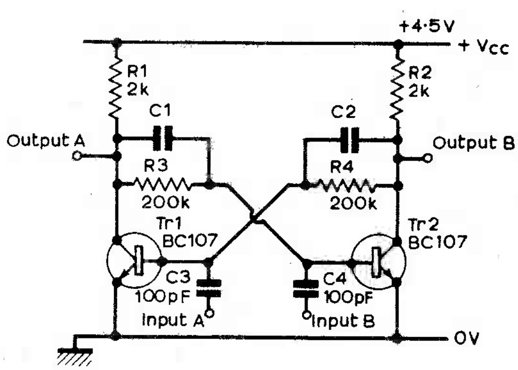

Fig. 4.1: The simplest form of bistable circuit, which rests in either of two stable states, changing only on application of trigger pulses. C1 and C2 are speed-up capacitors for improving switching times.

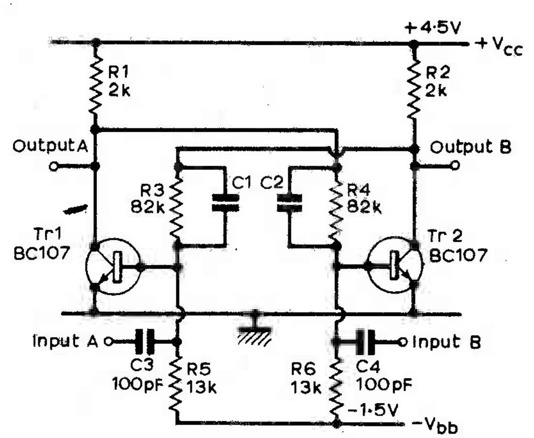

Fig. 4.2: An adaptation of the simple bistable to ensure that the non-conducting transistor is completely cut-off.

PART 4 — THE BISTABLE

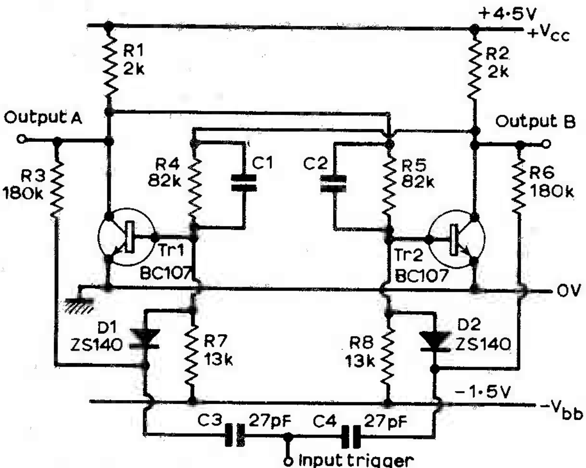

Fig. 4.3: The bistable can be usefully employed in counters, by modifying the circuit as shown here. The input pulses are divided sequentially by the steering circuit consisting of D1/2, R3/6, C3 and C4.

below the earth potential, i.e., a small negative voltage relative to earth. When a negative pulse is supplied to Tr1 base cutting this transistor off, the top end of this potential divider instead of being at the small voltage of V_{ce1}sat now rises to $+V_{cc}$, and the potential divider provides a biasing potential on Tr2 base which switches on Tr2. The potential divider formed by R3 and R5 now takes Tr1 base to a small negative potential which keeps Tr1 off until the circuit is triggered again.

Now it has been shown that the triggering pulse must be steered to the correct input for the bistable to change states, i.e., the input negative pulse must be directed to the transistor in the ON state to have any effect. In most circumstances there is only one trigger source, and in such a case it is necessary to introduce further circuitry to direct the incoming pulses to the correct bases. This circuit is known as the *steering circuit*, and Fig. 4.3 shows this steering circuit added to Fig. 4.2.

The steering circuit operates as follows. Assume initially that Tr1 is bottomed, and Tr2 cut off. Now $V_{c1} = V_{ce}\text{sat} \simeq 0{\cdot}1\text{V}$, and $V_{eb1} \simeq 0{\cdot}7\text{V}$. This means that there is a small voltage across D1 in the forward direction, being $V_{eb1} - V_{ce}\text{sat} = 0{\cdot}7 - 0{\cdot}1 = 0{\cdot}6\text{V}$. The voltage dropped by R3 may be regarded as negligible since it will only slightly reduce the forward voltage across the diode.

Now considering D2, $V_{c2} = +V_{cc}$ and $V_{b2} = -\text{ve}$, i.e. a voltage negative relative to the earth rail. Diode D2 is thus in hard reverse bias and is non-conducting. The steering circuit viewed from the trigger input is thus a low impedance presented through to Tr1 base via the forward biased diode, and a very high impedance through to Tr2 base via the reverse-biased diode. If a negative pulse is applied at the trigger terminal, therefore, the steering circuit guides the pulse to the base of Tr1, the transistor in the ON state, and the pulse thus cuts off Tr1. The pulse has no effect on D2, the negative swing being insufficient to reduce the reverse bias significantly.

Tr1 collector goes to the positive rail, its base goes negative, and diode D1 goes into hard reverse bias. Meanwhile Tr2 has switched on as bias is provided when the base is taken to 0·7V, and with the collector at saturation voltage and base at its more positive voltage, D2 now comes into forward bias. Thus the gate is now open to Tr2 base for the next negative trigger pulse.

Figure 4.4 is a modified version of the bistable with its steering circuit, and here only one supply is used. This uses the sharing emitter resistor, as described in the case of the monostable, to lift the emitters of both transistors to a potential above earth, and thus allow potential dividers to take the base of the transistor in the OFF state slightly negative with respect to the emitter. The saturation current of both transistors should be the same, and with the same current—this saturation current—always provided for one or other of the transistors, the voltage at the top end of R9 should stay substantially constant.

There is another slight addition to this circuit over that of Fig. 4.3, and that is the diodes placed across the steering circuit resistors. The time constant set by the input capacitors and the steering circuit resistors is set such that the diode will always remain conducting until the end of the input pulse, ensuring that the gate to the other transistor does not open too early. The repetition rate of input pulses is limited by the time required for C3 or C4 to return to its initial potential, and for a good triggering action, the time constant should be about

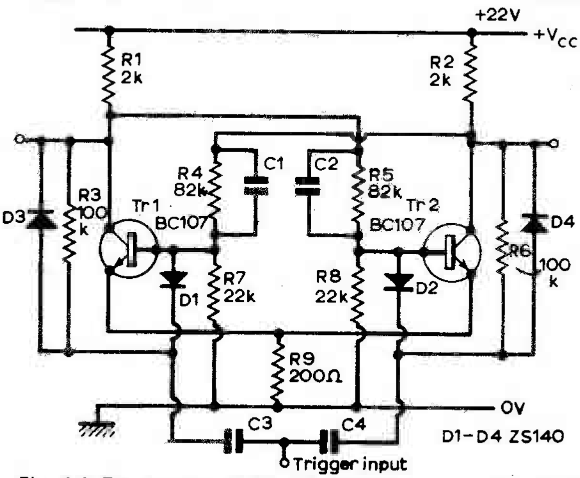

Fig. 4.4: The counter of Fig. 4.3 requires two supply rails. By lifting the bases above ground with R9 in this circuit, only one supply is required.

five times the trigger width. For faster switching rates, the diodes as added in Fig. 4.4 allow the input capacitors to recharge more rapidly through the conducting transistor and its associated conducting diode bypassing the appropriate resistor.

The final instalment, Part 5, will deal with the remaining digital circuits, the Schmitt Trigger and complementary switch, and also the ramp generator.

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COMPUTER MULTI-CORE CABLE

12, 14/0076 copper cores, each one insulated by coloured PVC then separately screened, the 12 metal braided cores laid together and PVC covered overall making a cable just under ½ in. dia. but quite pliable. Price 7/6 per ft. Any length cut.

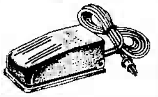
FLEX BARGAINS

Screened 3 Core Flex. Each core 14/0076 Copper PVC insulated and coloured, the 3 cores laid together and metal braided overall. Price £3.15.0 per 100 yds. coil.

15 Amp 3 Core Non-kink Flex. 70/0076 insulated coloured cores, protected by tough rubber sheath, then black cotton braided with white tracer. A normal domestic flex as fitted to 3 Kw. fires. Regular price 3/6 per yd. 50 yd. coil £4.10.0, or cut to your length 2/6 per yard.

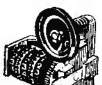
10 Amp 3 Core Non-kink Flex. As above but cores are 28/0076 Copper. Normal price 2/6 per yd. 100 yd. coil £7.10.0, or cut to your length 1/9 per yard.

6 Amp 2 Core Flex. As above, but 2 Cores each 23/0076 as used for Vacuum Cleaners, Electric Blankets, etc., 39/6 100 yd. coil.



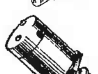
15 Amp FOOT SWITCH

Suitable for Sewing Machine Motor, Drilling Machine or in fact to switch any job where both hands are to be left free. Rated at 13 amps, 250 volts. Price 22/6.



3 DIGIT COUNTER

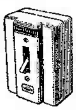
For Tape Recorder or other application, re-settable by depressing button. Price 8/6.



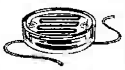
TRANSDUCER

Made by Acos, reference No. I.D.1001. For measuring vibration, etc., to be used in conjunction with "G" Meter. Regular price £5. Our price 49/6. Brand new and unused.

ISOLATION SWITCH



20 Amp D.P. 250 volts. Ideal to control Water Heater or any other appliance. Neon indicator shows when current is on, 4/6. 48/- per dozen.



LIGHT CELL

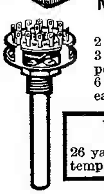
Almost zero resistant in sunlight increases to 10 K. Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in. dia. by ¼in. thick. Rated at 500 MW, wire ended. 8/6 with circuit.

INSTRUMENT BUZZER

6–12 volts, adjustable tone, a very neat metal cased U.S.A. made unit, approx. 1¼in. x 1in. x ¾in. thick. 6/6 each.

12 VOLT SOLENOID

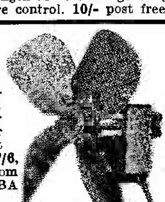
For energizing Reed Switches, etc., size approx. 1⅞in. long by 1⅝in. diameter. Hole through Solenoid approx. ⅜in. 8/6 each.



MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 3/6 each. 36/- dozen, your assortment

WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. 10/- post free.



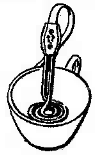
AC FAN

Small but very powerful mains motor with 5½in. blades. Ideal for cooling equipment or as extractor. Silent but very efficient. 17/6, post 4/6. Mounts from back or front with 4BA screws.

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions 19/6, plus 2/6 post and insurance. Or available made up 29/6. Plus 2/6 post.

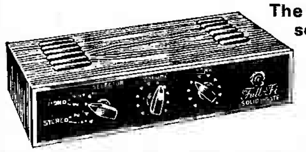
QUICK CUPPA



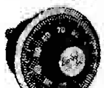
Mini Immersion Heater, 350w. 200/240v. Boils full cups in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. 19/6, post and insurance 1/6. 12v car model also available 19/6.

The Full-Fi STEREO SIX

The amplifier sensation of the year



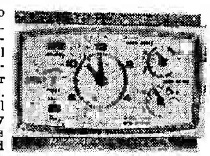
You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled and teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts R.M.S. split over the two channels. The amplifier is ideal for use with normal pickups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. Other controls include "treble lift and cut", "balance" and separate mains on/off switch. Price is £9.9.0, plus 7/6 post and insurance. Speakers (with tweeters) in oiled teak finish cabinets to match amplifier, £8.8.0 per pair.



COMBINATION DIAL SWITCH

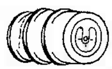
Three separate settings of the dial are necessary before this can be switched on or off. Combinations can be changed as required. A useful Switch for security or novelty. Contacts rated at 1 amp. 35/- each.

ELECTRIC CLOCK WITH 20 AMP SWITCH



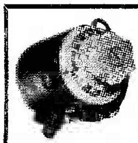
Made by Smith's these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set—also on the left is another timer or alarm—this may be set in minutes up to 4 hours. At the end of the period a bell will sound. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—only 45/-, less than the value of the clock alone—post and insurance 2/9.

NICAD RECHARGEABLE BATTERIES



3·6V 500mA size 1¼ × 1⅝in. dia. type ref. DKZ500 really powerful will deliver 1 amp for ½ hour. Regular price 32/6 our price 17/6 each. New and guaranteed. Other voltages available, single cell 1·2V 6/6. 10 cell 12V 65/-.

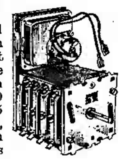
THIS MONTH'S SNIP



Horstmann "Time and Set" Switch

(A 20 amp Switch.) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price 29/6. + 4/6 post.

MOTORISED CAM SWITCH

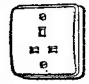


Made by the famous meter company Chamberlain and Hookham, these have a normal mains 200–240V motor which drives a ratchet mechanism so geared to give one ratchet action per minute on a wheel with 60 teeth thus a complete revolution of the cam takes place in one hour. The cam operates 8 switches (6 changeover and 2 on/off thus 480 circuit changes per hour are possible). Contacts, rated at 15 amps have been set for certain switch combinations but can, no doubt, be altered to suit a special job. Also other switch wafers or devices can be attached to the shaft which extends approximately one inch. 47/6, p. & ins. 4/6.

DISTRIBUTION PANELS

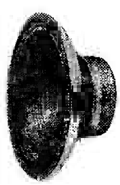
Just what you need for work bench or lab. 4×13 amp sockets in metal box to take standard 13 amp fused plugs. Supplied complete with 6 feet of heavy cable and 13 amp plug. Similar advertised at £5. Our price 39/6, + 4/6 P & I.

G.E.C. 13A SOCKETS



Opportunity to re-equip your house or workshop, or if a contractor, to stock up for future jobs. We offer bakelite 13A sockets for flush or surface mounting made by the famous G.E.C. company and listed from 6/6 each. YOU CAN HAVE A BOX OF 12 flush type 24/-, surface type 29/6, post and ins. 4/6. (Gross or more carriage free.)

HI FI BARGAIN



FULL FI 12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address.

Flux Densitity 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S. Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms—Mains resonance 60 c.p.s.—Chassis Diam. 12in.—12⅜in. over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes —¼in. diam. on pitch circle 11⅝in. diam.—Overall height 5½in. A £6 speaker offered for only £3.9.6 plus 7/6 p. & p. Don't miss this offer. 15in. 30 watt £7.19.6.

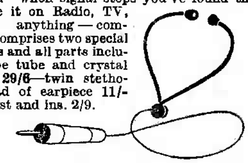
INDICATOR LAMP

Panel mounting consists of neon lamp in red Plastic lens with resistor in leads for mains operation. 2/6 each. 24/- dozen.

12V BLOWER

Heavy duty motor with centrifugal blower coupled to one end. Ideal for car heater. 12/6, plus 4/6 post.

RADIO STETHOSCOPE



Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything — complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. 29/6—twin stethoset instead of earpiece 11/- extra—post and ins. 2/9.

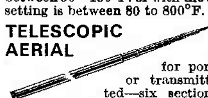
MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (Class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only 16/6, plus 3/6 postage.

PROTECT VALUABLE DEVICES

From thermal runway or overheating. Thyristors, rectifiers, transistors, etc., which use heat-sinks can easily be protected; simply make the contact thermostat part of the heat-sink. Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing. Our contact thermostat has a calibrated dial for setting between 90°–190°F. or with the dial removed range setting is between 80 to 800°F. Price 10/-.

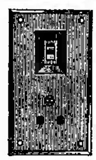
TELESCOPIC AERIAL



for poratable, car radio or transmitter. Chrome plated—six sections, extends from 7½ to 47in. Hole in bottom for 6BA screw. 7/6.

REED SWITCHES

Suitable for dozens of different applications, such as burglar alarms, conveyor belt switching. These are simply glass encased switches which can be operated by a passing permanent magnet coil. A special buy enables us to offer these at 2/6 each, or 24/- dozen. Suitable magnets are 1/- each.

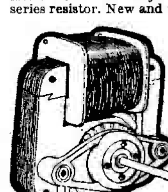


5A, 3 PIN SWITCH SOCKETS

An excellent opportunity to make that bench dis board you have needed or to stock up for future jobs. This month we offer 6 British made (Hicraft) bakelite flush mounting shuttered 5A switch sockets for only 10/- plus 3/6 post and insurance. (20 boxes post free.)

MOVING COIL METER BARGAIN

Panel meters are always being needed and they are jolly costly when you have to buy them in a hurry—so you should take advantage of this offer: 2in. moving coil flush mounting meters only 9/6. These are actually R.F. meters and cost about £3 each but if you don't want them for R.F. then all you have to do is to remove the thermocouple and you will have a 2–3 mA. meter which you can make into almost anything by adding shunts or series resistor. New and unused.



MAINS MOTOR

Precision made — as used in record decks and tape recorders—ideal also for extractor fans, blower, heater, etc. New and perfect, Snip at 9/6. Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

You never need buy another battery for your transistor radio. Stupendous offer this month—a 6-9V Nickel Cadmium battery stack together with a mains operated charger which you mount on the back of your set. The mains flex unplugs so the set remains completely portable. Offered for less than the cost of the batteries alone. ONLY 29/6 plus 3/6 post.

TIMED SWITCH OR MEMORY JOGGER

If you are the forgetful type this can save you embarrassment. Pre-settable up to 12 hours, operated by clockwork motor so can be used in car or anywhere independently of the mains. Switch rated at 15A, 250V can control any type of alarm, 29/6d. less than half the current list price. Brand new and unused.

Where postage is not stated then orders over £3 are post free. Below £3 add 2/9. Semi-conductors add 1/- post. Over £1 post free. S.A.E. with enquiries please

ELECTRONICS (CROYDON) LTD

Dept PW 266 London Road, Croydon CRO-2TH

Also 102/3 Tamworth Road, Croydon


NOW FREELY AVAILABLE
SINCLAIR
IC-10
sinclair

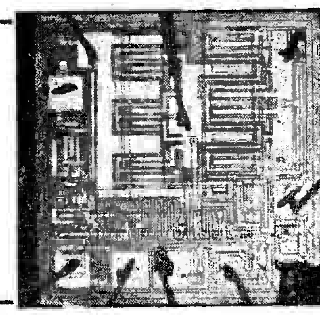
10 WATT MONOLITHIC INTEGRATED CIRCUIT AMPLIFIER

■ Specifications

Power Output	10 Watts peak, 5 Watts R.M.S. continuous.
Frequency response	5 Hz to 100 KHz ±1dB.
Total harmonic distortion	Less than 1% at full output.
Load impedance	3 to 15 ohms.
Power gain	110dB (100,000,000,000 times) total.
Supply voltage	8 to 18 volts.
Size	1 x 0.4 x 0.2 inches.
Sensitivity	5 mV.
Input impedance	Adjustable externally up to 2.5 M ohms for above sensitivity.

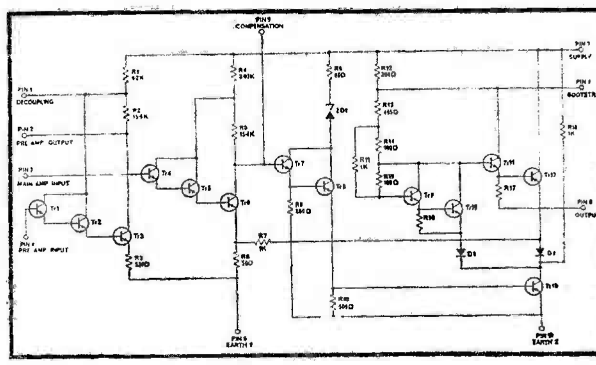
■

ABOVE SHOWS ACTUAL SIZE OF IC-10.
TO RIGHT, VIEW OF AMPLIFIER MAGNIFIED 625 TIMES.



■ Circuit Description

The circuit diagram of the IC-10 is shown on the right. The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. The output stage operates in class AB with closely controlled quiescent current which is independent of temperature. A high level of overall negative feedback is used round both sections and the amplifier is completely free from cross-over distortion at all supply voltages. Thus battery operation is eminently satisfactory.

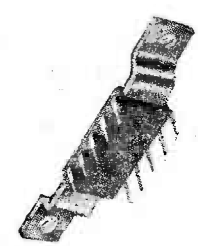


■ Construction

The monolithic I.C. chip is bonded onto a gold plated area on the heat sink bar which runs through the package. Wires are then welded between the I.C. and the tops of the pins which are also gold plated in this region. Finally the complete assembly is encapsulated in solid plastic which completely protects the circuit. The final device is so rugged that it can be dropped thirty feet on to concrete without any effect on performance. The circuit will also work perfectly at all temperatures from well below zero to above the boiling point of water.

■ Applications

Each IC-10 is sold with a very comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity uses. These include public address, loud-hailers, use in cars, inter-com., stabilised power supplies, electronic organs, oscillators, volt meters, tape recorders, solar cell amplifier, radio receivers.
The transistors in the IC-10 have cut off frequencies greater than 500 MHz so the pre-amp section can be used as an R.F. or I.F. amplifier making it possible to build complete radio receivers without any additional transistors.



GUARANTEE

Should you not be completely satisfied with your purchase when you receive it from us, your money will be refunded in full at once and without question. **Full service facilities available to all purchasers.** Goods sent post free in U.K. and Overseas by surface mail. Air-freight charged at cost.

sinclair

SINCLAIR RADIONICS, 22 Newmarket Road, Cambridge
Telephone OCA3 52996

SINCLAIR IC-10

The complete IC-10 with the manual and 5 year guarantee costs

59/6

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1D5 7/6	6BR7 17/-	6K7G 2/-	9BW6 7/-	25A6 5/9	85A2 7/3	DH77 4/9	ECF82 6/6	EM81 8/3	PCC84 6/6	S130 40/-	UL41 12/-
1H5 7/-	6BR8 12/6	6K7GT 4/6	10C1 12/6	25L6GT 7/-	150B2 11/6	DK32 7/9	ECH21 12/6	EM84 7/6	PCC89 10/6	SP4 8/-	UL84 7/-
1LD5 6/-	6BS7 25/-	6K8 2/9	10C2 12/6	25Y5 6/-	150C4 9/6	DK91 6/-	ECH35 11/6	ESU150 20/-	PCC189 10/6	SP41 5/6	UM80 5/6
1N5GT 8/-	6BW6 14/6	6K8M 11/6	10F1 14/9	25Z4 6/3	801 9/6	9K92 9/-	ECH42 11/-	EY51 7/6	PCF80 6/9	SP61 5/-	UU6 21/-
1R5 6/-	6BW7 13/-	6K8G 3/-	10F3 18/-	25Z5 8/-	807 9/-	DK96 7/9	ECH81 5/9	EY86 7/-	PCF82 6/6	STV280/80 95/-	UU7 21/-
1S4 5/6	6C4 5/-	6K8GT 7/-	10F9 10/6	25Z6 8/6	813USA 120/-	DL66 25/-	ECH83 8/6	EZ35 6/-	PCF84 8/-	SU25 19/6	UU8 21/-
1S5 4/6	6C5G 5/-	6K25 15/-	10F18 8/-	28D7 9/3	813 75/-	DL92 6/3	ECL80 5/9	EZ40 8/3	PCF86 9/-	SU2150 12/6	UU9 8/3
1T4 4/-	6C6 3/9	6L1 12/-	10L1 8/-	30C1 6/9	866A 15/-	DL93 4/-	ECL82 7/-	EZ41 9/6	PCF801 9/9	T41 17/6	UY21 9/6
3A4 4/-	6C8G 6/-	6L6G 7/9	10LD11 10/6	30C15 15/-	954 5/3	DL94 6/9	ECL83 10/3	EZ80 5/6	PCF802 9/9	TDD4 8/6	UY41 8/6
3Q4 7/9	6CD6G 24/-	6L18 6/-	10P13 13/6	30C17 16/-	1625 6/6	DL95 7/9	ECL86 9/-	EZ81 5/6	PCF805 15/-	U10 7/6	UY85 8/5
3Q5 7/-	6CH6 7/6	6Q7G 6/-	11E3 70/-	30C18 15/-	4022AR 67/-	DL96 7/6	ECLL800 30/-	GZ30 10/-	PCF806 13/-	U14 7/6	VMP4G 17/-
3S4 6/3	6CW4 12/-	6Q7GT 8/6	12AT6 4/9	30F5 17/-	5763 12/-	DM70 6/-	EF9 20/-	GZ32 10/-	PCF808 15/6	U19 35/-	VP4B 25/-
3V4 6/9	6D6 3/9	6SA7M 7/-	12AT7 6/-	30FL1 16/-	7193 2/-	DY86 6/-	EF37A 7/-	GZ34 11/-	PCL82 7/9	U25 15/6	VR105/30 6/6
5R4GY 10/6	6E5 7/6	6SC7 7/-	12AU6 5/9	30FL12 19/-	7475 14/-	DY87 5/-	EF39 8/-	KT36 18/-	PCL83 10/3	U26 15/6	VR150/30 6/-
5U4G 5/6	6F1 12/6	6SG7 6/-	12AU7 5/9	30FL14 15/6	A61 9/6	E88CC 12/-	EF41 10/-	KT61 17/6	PCL84 8/6	U78 4/6	VT25 15/-
5V4G 8/-	6F5G 8/-	6SH7 3/3	12AX7 6/3	30L15 17/-	ATP4 2/3	EA50 3/6	EF50 5/-	KT66 21/-	PCL85 9/3	U191 13/9	VT31 80/-
5Y3GT 6/-	6F6G 5/-	6SJ7 6/-	12BA6 6/-	30L17 17/-	ATP5 12/-	EABC80 6/6	EF80 4/3	KT81 35/-	PCL86 9/3	U251 16/3	VU111 8/9
5Z4G 7/-	6F8G 5/6	6SK7GT 4/9	12BE6 6/3	30P12 16/-	ATP7 8/6	EAF42 10/-	EF85 7/-	KT81 (7C5) 15/-	PENA4 20/-	U301 12/6	VU120 12/6
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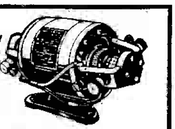

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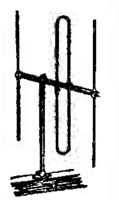

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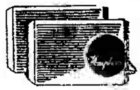

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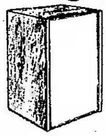

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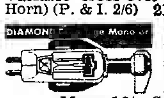

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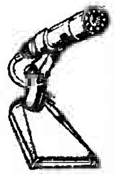

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6T8	6/-
6U4GT	12/-
6U8	6/-
6V6GT	6/-
6X4	4/6
6X5GT	5/-
6X8	11/-
6Y6G	11/6
7C5	14/6
7S7	22/6
7Y4	11/-
7Z4	7/6
9BW6	7/-
9D2	3/6
10C2	10/-
10D2	8/-
10F1	18/-
10F9	10/-
10F18	7/6
10L1	7/6
10LD11	10/-
10P13	10/-
10P14	16/-
12AC6	7/-
12AD6	6/-
12AL5	7/6
12AQ5	7/-
12AT6	4/6
12AT7	6/-
12AU7	5/9
12AV6	5/6
12AX7	5/6
12AY7	13/6
12B4A	9/6
12BA6	6/-
12BA7	6/-
12BE6	6/-
12BH7	6/-
12BT6	4/6
12BY7	10/-
12CU6	12/-
12DQ7	10/-
12E1	20/-

First Quality Fully Guaranteed

AeroX BRAND

ELECTRONIC VALVES

Combined effect of increase in Purchase Tax and S.E.T. and import restrictions forced us to introduce an increase of 1d. per shilling which must be added to the total of each order.

12E14	52/6
12K5	10/-
12K8	8/-
12Q7GT	5/6
12SC7	4/6
12SG7	6/-
12SK7	6/6
12SQ7	7/6
19AQ5	7/6
20CV	62/6
20D1	9/-
20L1	18/-
20P1	10/-
20P3	12/-
20P4	19/-
20P5	19/-
25BQ6GTB	12/-
25C5	9/-
25CU6	12/-
25L6GT	6/6
25Z4G	6/-
25Z5	8/-
25Z6GT	11/-
30A5	7/-
30C15	14/-
30C17	15/-
30C18	14/-
30F5	16/-
30FL1	15/-
30FL12	17/6
30FL13	8/-
30FL14	14/6
30L1	6/-
30L15	16/-
30L17	16/-
30P12	15/-

30P19	14/-
30PL1	15/-
30PL13	17/6
30PL14	17/-
35A5	10/-
35B5	12/-
35C5	6/6
35D5	12/-
35L6GT	8/-
35W4	4/6
35Z3	10/-
35Z4G	4/-
35Z5GT	6/-
50A5	12/-
50B5	12/-
50C5	6/-
50L6GT	8/6
53KU	13/6
75C1	8/-
80	7/-
83A1	12/6
85A2	7/6
85A3	7/6
90AG	46/-
90C1	12/-
90CG	25/-
90CV	25/-
150B2	11/-
150B3	10/-
807	9/-
811A	30/-
812A	60/-
813	75/-
837	15/-
866A	14/-
884	10/-
5670	10/-

5751	11/-
5763	12/-
5886	40/-
6080	27/6
6146	27/6
6146B	47/6
6197	20/-
6360	25/-
6386	75/-
6883	47/6
6939	40/-
7199	15/-
7551	30/-
7581	22/6
7586	22/6
7591A	20/-
7895	22/6
A2293	19/-
AZ1	8/-
AZ31	9/-
CCH35	9/-
CL33	15/-
CY1	8/-
CY31	7/-
DAF96	7/-
DF96	7/-
DH81	10/-
DH101	9/-
DK92	8/3
DK96	7/6
DL68	13/-
DL96	7/-
DM70	6/-
DY86	6/-
DY87	6/6
DY802	9/-
E55L	52/6

E83F	20/-
E88C	23/-
E88CC	12/6
E130L	100/-
E180F	17/6
E810F	57/6
EAF801	10/-
EABC80	6/-
EBC33	8/-
EBC41	9/6
EBC81	6/-
EBF80	7/6
EBF83	8/-
EBF89	6/-
EBL1	12/-
EBL31	24/-
EC86	11/6
EC88	11/-
ECC34	8/-
ECC40	10/-
ECC70	17/-
ECC81	6/-
ECC82	5/9
ECC83	5/-
ECC84	5/6
ECC85	5/-
ECC86	8/-
ECC88	7/6
ECC89	11/-
ECC91	3/6
ECC807	14/-
ECF80	6/6
ECF82	6/6
ECF83	14/-
ECF86	11/6
ECF804	32/-
ECH35	11/-

ECH42	12/-
ECH81	5/3
ECH83	8/-
ECH84	9/-
ECL80	8/6
ECL81	7/6
ECL82	6/-
ECL83	11/6
ECL84	10/-
ECL85	10/6
ECL86	8/-
EF9	8/-
EF39	8/-
EF40	9/-
EF41	11/6
EF42	13/-
EF54	10/-
EF55	12/-
EF80	4/6
EF83	9/6
EF85	6/6
EF86	6/-
EF89	5/-
EF91	4/-
EF92	7/6
EF93	4/-
EF94	5/-
EF95	5/-
EF96	3/6
EF183	6/-
EF184	6/6
EF804	20/-
EH90	7/-
EK90	4/6
EL34	9/6
EL36	8/6
EL38	22/6
EL41	9/6
EL42	10/-
EL81	9/-
EL83	7/6
EL84	4/6
EL85	7/6
EL86	8/-
EL90	6/-
EL95	6/6
EL360	22/-
EL500	17/-
EL821	10/-
EL822	17/-
ELL80	15/-
EM34	16/-
EM71	12/6
EM80	7/-
EM81	7/6

EM84	7/-
EM87	10/-
EN32	30/-
EN91	6/-
EY51	7/6
EY80	8/6
EY81	7/-
EY83	10/-
EY84	9/6
EY86	7/6
EY87	8/-
EY88	8/-
EZ40	8/-
EZ41	8/6
EZ80	5/-
EZ81	5/-
GY501	15/6
GZ32	9/6
GZ33	13/6
GZ34	10/-
HL42DD	8/-
KT66	24/-
KT88	29/-
MH4	7/-
MH41	9/-
ML4	8/-
MSPENT	10/-
N78	19/-
NSP1	66/-
NSP2	66/-
ORP12	8/6
ORP61	5/-
ORP90	22/6
ORP93	22/-
PABC80	7/6
PC86	11/-
PC97	8/-
PC900	9/6
PCC84	6/6
PCC85	7/6
PCC88	11/-
PCC89	9/6
PCC189	10/-
PCC805	16/-
PCC806	16/-
PCE800	15/-
PCF80	6/6
PCF82	6/3
PCF84	8/-
PCF86	9/6
PCF87	15/-
PCF800	14/-
PCF801	9/-
PCF802	9/-

PCF805	14/-
PCF806	12/-
PCF808	14/6
PCL80	15/-
PCL81	9/-
PCL82	7/-
PCL83	12/-
PCL84	8/-
PCL85	8/6
PCL86	8/6
PCL88	17/-
PCL800	17/6
PCL801	15/-
PD500	30/-
PE06-40N	35/-
PEN45	6/6
PEN45DD	12/-
PEN383	9/-
PEN384	9/-
PEN453DD	10/-
PF86	10/-
PF818	14/-
PFL200	13/-
PL33	8/-
PL36	10/-
PL81	9/-
PL83	8/-
PL83	7/-
PL84	6/6
PL500	13/6
PL504	15/-
PL509	30/-
PL802	13/-
PY31	5/-
PY32	10/-
PY33	12/6
PY80	5/6
PY81	5/6
PY82	5/-
PY83	6/6
PY88	7/6
PY500	20/-
PY800	9/-
PY801	9/-
PZ30	7/-
QQV06-40A	105/-
QU37	27/-
SP41	5/6
SP61	5/-
TP22	10/-
TT21	45/-

U19	40/-
U20	12/-
U22	8/-
U25	14/6
U26	14/6
U31	8/-
U33	30/-
U76	4/-
U81	10/-
U281	8/-
U282	8/-
U403	8/-
U404	5/-
UABC80	6/-
UAF42	9/6
UBC41	8/6
UBC81	8/6
UBF80	6/6
UBF89	7/-
UBL1	8/6
UC92	6/-
UCC85	7/-
UCF80	9/6
UCH21	9/6
UCH42	12/-
UCH81	6/6
UCL81	10/-
UCL82	7/-
UCL83	11/-
UF9	10/-
UF41	9/9
UF42	11/-
UF43	10/-
UF80	7/-
UF85	7/3
UF89	7/-
UL41	11/-
UL84	6/6
UM4	10/-
UM84	7/-
UU9	7/6
UY21	9/6
UY41	7/-
UY82	9/6
UY85	6/-
VU39	9/-
VU111	8/6
VU133	8/-
W76	7/-
W107	7/-
W729	10/-
X65	9/-
Z700U	8/-
Z700W	15/-
Z803U	15/-

INTEGRATED CIRCUIT AMPLIFIERS

RCA Type CA3020

Integrated Circuit Audio Amplifier in TO5 encapsulation (size of a small transistor); equivalent to seven n-p-n silicon transistors, 3 diodes and 11 resistors. Power output 550mW. Total harmonic distortion 1%. Will operate on voltage from 3 to 9 volts. **30/-** plus 2/- p.p.

GENERAL ELECTRIC Type PA222

Epoxy moulded in-line package equivalent to six n-p-n transistors, one diode and six resistors. It will provide output of up to 1·2 watts into 15 ohms. Battery operation 22 volts. **40/-** plus 2/- p.p.

The construction of amplifier using the above integrated circuits had been described in March and August issues of P.W. Please note that we only supply the IC's and no other parts are supplied by us.

GENERAL ELECTRIC TYPE PA234

1-watt Audio Amplifier suitable for supply voltage of 9 to 25V and for output loads of 8, 16 or 22 ohms. Only 3 capacitors and 3 resistors are required for making up a complete amplifier delivering 1 watt for an input voltage of 600mW. Epoxy moulded double four-in-line package. **27/6 each**, plus 2/- P. & P.

GENERAL ELECTRIC Type PA237

Similar to PA234, but 2 watts, **40/-**, plus 2/- p.p.

RCA Type CA3036

For Stereo Pre-Amplifiers as described in May issue of PRACTICAL WIRELESS, **19/-**, plus 2/- p.p.

Motorola MC1709CG

Operational Amplifier. Full data supplied on request. **40/-**

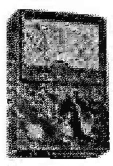
NEW LIST OF TRANSISTORS, INTEGRATED CIRCUITS IS NOW READY.

The List gives full specifications and prices of over 200 types of Semiconductors.

Available free on request.

MULTIMETERS

TYPE MF16



D.C. voltage range: 0-0·5-10-50-250-500V.
A.C. voltage range: 0-10-50-250-500V.
D.C. current range: 500µ-10-100mA.
Resistance ranges: 100MΩ-1MΩ.
The meter is also calibrated for capacity and output level measurements. Sensitivity 2000Ω/V. Accuracy ±2·5% for D.C. and ±4% for A.C. measurements.

Dimensions: 4½ x 3½ x 1⅛in. Price **£4.5.0.**

Type 108-IT: 24 range precision portable meter, 5000 o.p.v. D.C. Volts: 2·5-10-50-250-500-2500V. A.C. Volts: 10-50-100-250-500-2500V; D.C. current 0·5-5-50-500mA. Resistance 2000-20,000 ohms; 2-20 megohms. Power output calibration in A.C. for 600 ohms line. Complete with prods and batteries, **£6.5.0.** P. & P. 5/-.

ZENER DIODES

5 watts Stud Mounted 15% tolerance

22V	D816A	39V	D816G	68V	D817B
27V	D816B	47V	D816D	82V	D817V
33V	D816V	56V	D817A	100V	D817G

8 watts Stud Mounted 15% tolerance

4·7V	D815I	8·2V	D815V	15V	D815E
5·6V	D815A	10V	D815G	18V	D815Z
6·8V	D815B	12V	D815D		

All at 7/6

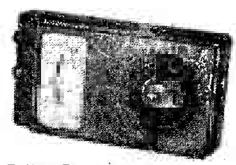
SPECIAL OFFER OF MINIATURE SILICON RECTIFIER

IN5399	1000 piv	1·5 Amps.	Max. range 50A	4/6
IN5408	1000 piv	3 Amps.	Max. range 200A	6/3

For quantities of 20 or over prices are 3/6 and 5/- respectively.

DRY REED INSERTS

Glass dry reed inserts approx. ⅛in. dia. x 1in. long with axial leads. One "make" contact of 100 mA capacity at 50V. Can be operated by permanent magnet or 30-50 Amp-turns relay coils. PRICE **18/-** per doz. post free.



SLIDEWIRE WHEATSTONE BRIDGE

£15.15.0

Battery Powered Portable Resistance Bridge. Range 0·5 to 50 ohms with multiplier settings of 0·1-1-100-1000, providing a measuring range of 0·05 to 50 000 ohms. Accuracy in the middle 3 ranges—0·5% approx. PRICE **£15.15.0.**

TRIACS TYPE 40432

Gated bi-directional Silicon Thyristors with integral trigger. The triac will control up to 1440 watts at 240V mains frequency. Supplied complete with heat sink data sheet and application sheets for motor control and dimmer circuits. **37/6** each.

UNIJUNCTION TRANSISTORS 2N2646

Power dissipation 300mW R.M.S. Base-to-Base voltage 35V max. Peak emitter current 2·0A. Suitable for triggering of thyristors. **12/6.**

D. C. MOVING COIL METERS

ACCURACY 1·5%

SERIES 70 Rectangular flange 80 x 72 mm flush mounted. Body diameter 68mm. Scale length ca 50mm.

60µA	66/-	600µA	49/-	400mA	46/-
100µA	62/-	1mA	46/-	600mA	46/-
250µA	54/-	40mA	46/-	1A	46/-
400µA	52/-	150mA	46/-	2·5A	46/-
6V	82/-	60V	82/-	250V	53/-
40V	82/-	150V	82/-	600V	58/-

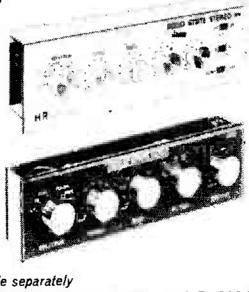
SERIES 120DA. Rectangular flange 120 x 104mm flush mounted. Body diameter 68mm. Scale length ca 95mm.

40µA	82/-	25mA	58/-	15V	62/-
60µA	78/-	60mA	58/-	60V	62/-
100µA	74/-	1A	58/-	100V	62/-
250µA	65/-	1·5A	58/-	250V	65/-
600µA	60/-	10A	60/-	400V	69/-
2·5mA	58/-	40A	64/-	600V	77/-

Illustrated leaflet available on request.

ENGLANDS LEADING COMPONENT & EQUIPMENT CENTRES

SOLID STATE—HIGH FIDELITY
AUDIO EQUIPMENT



Mono or Stereo Audio, Equipment developed from Dinsdale Mk.II—each unit or system will compare favourably with other professional equipment selling at much higher prices.

COMPLETE SYSTEMS FROM £15.5.0

THE FINEST VALUE IN HIGH FIDELITY—CHOOSE A SYSTEM TO SUIT YOUR NEEDS AND SAVE POUNDS

All units available separately

SEND FOR *FREE BROCHURE* (No. 21) *TODAY!*
DEMONSTRATIONS DAILY AT '303' EDGWARE ROAD

ELECTRONIC ORGANS KITS TO BUILD YOURSELF AND COMPLETE UNITS

The MAYFAIR *Acclaimed by everyone*

A completely new development in portable electronic musical instruments and a new field for the home constructor. The 'MAYFAIR' produces a multitude of the most pleasing sounds with a wide range of tone colours suitable for classic or popular music. The organ is fully polyphonic, that is full cords can be played over the entire keyboard. Supplied as a kit of parts which includes 165 transistors, printed circuit panels, special fully sprung and depth of touch adjusted keyboard, attractive vynair covered cabinet with carry handle.

Deferred terms available
COMPLETE KIT
Deposit £29.19.0
12 monthly payments of £7. Total £113.19.0
BUILT AND TESTED
Deposit £36.8.0 and
12 monthly payments of £9. Total £144.8.0

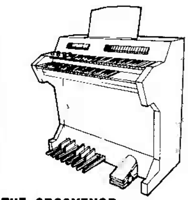
THE MAYFAIR 99 GNS
BROCHURE 9

The GROSVENOR

The Grosvenor is designed for the more ambitious musician and has a much wider range than most commercial organs. It comprises two four-octave (49 note) keyboards and a thirteen-note pedal board. It has four pitches (i.e., 8ft, 4ft, 2ft, 1ft) on the upper or solo keyboard, three pitches (i.e., 16ft, 8ft, 4ft) on the lower or accompaniment keyboard, two pitches (i.e., 16ft, 8ft) on the pedal board. Variable sustain on the solo keyboard and variable vibrato on both keyboards. It has 15 voices in the solo tone-forming unit, 10 voices in accompaniment tone-forming unit and 4 voices in the pedal tone-forming unit. All components and kit sections are available separately including the Oak Console at £65.18.0

A complete detailed and illustrated construction manual is provided with circuits and full parts list. All items may be purchased separately. All parts supplied are fully guaranteed. Full after sales service and advice freely available.

Once built the 'MAYFAIR' or 'GROSVENOR' will then provide years of enjoyable entertainment.
Call in—See them for yourself.



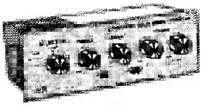
THE GROSVENOR
KITS FROM **£220** terms available
BROCHURE 9B

PRACTICAL ELECTRONICS—ELECTRONIC ORGAN KIT

We are able to supply Parts as described in this series. Details on request

ORGAN COMPONENTS: COMPLETE RANGE IN STOCK • 49 AND 61 NOTE KEYBOARDS • 2 TO 5 PAIR GOLD CONTACTS • COILS AND CHOKES • REVERBERATION SPRINGS AND UNITS • STOP TABS AND ASSEMBLIES • PEDAL BOARDS • RHODIUM AND GOLD CLAD WIRE, ALSO PRINTED CIRCUITS ETC. COMPLETE RANGES FOR TRANSISTORISED ORGANS. ASK FOR NEW PRICE LISTS WITH DETAILS LEAFLET 9B   ALL ENQUIRIES TO: ORGAN DEPT.—MR. ELVINS

INTEGRATED TRANSISTOR AMPLIFIERS



for complete listening satisfaction choose either the—

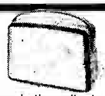
6 WATTS MONO OR 12 WATTS STEREO

We are pleased to offer two new designs with the choice of either mono or stereo systems. These BRITISH DESIGNED UNITS favour the user in so many ways—with fantastic power and quality with far greater adaptability, with freedom for battery or mains operation.

MA7 MONO **£8.10.0** OR STEREO POST PACKING 5/- EITHER MODEL MA66 **£16.10.0** OPTIONAL MAINS UNIT PS20 62/6d pp 4/-

Illustrated leaflets 12 and 14 FREE on request

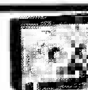
DO IT YOURSELF MW/LW PORTABLE



New printed circuit design with full power output. Fully tunable on both mw/lw bands. 7 transistors plus diode, push-pull circuit. Fitted 5 inch speaker, large ferrite aerial and Mullard transistors. Easy to build with terrific results. All local and Continental stations.

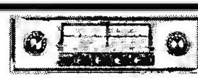
TOTAL COST £6.19.6. P.P. 4/6
TO BUILD Send for Brochure 1

NEW MODELS NOMBREX TRANSISTORISED Test Equipment



MODEL		PRICE £	s.	d.	Leaflet No.
29s	R.F. Generator	21	0	0	—
29x	Xtal R.F. Generator	29	10	0	35
30	Audio Gererator	19	10	0	24
31	R.F. Generator	12	10	0	25
32	C.R. Bridge	10	10	0	26
33	Inductance Bridge	20	0	0	29

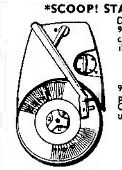
QUALITY CAR RADIOS



A precision engineered car radio that's perfect company for long hours on the road. Has quick push-button operation for immediate station selection and choice of Medium or Long wave frequency. Output of 3½ watts ensures crisp, top quality sound even at high motoring speeds. Includes full accessories and instructions.

POSITIVE/NEGATIVE EARTH PRICE £12.12.6. pp. 4/6
MANUAL as above £8 19.6 but with single MW/LW Push Button

*SCOOP! STAAR RECORD PLAYER



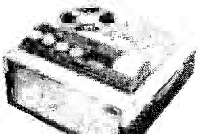
Deck. Plays 33, 45, 78 records 9 volt operated. With mono cartridge. Brand new. As illustrated. **59/6** post 3/6

***MULLARD 1 WATT AMPLIFIER**

9 volt. 5 transistor unit complete with volume control. Output to 3 ohms. Ideal for use with Starr Record Deck. **45/—** post 3/-
Send for leaflet 2

BUILD A QUALITY TAPE RECORDER

To get the best out of your MAGNAVOX DECK, you need a MARTIN RECORDAKIT. This comprises a special high quality 6 valve amplifier and pre-amplifier which comes to you assembled on its printed circuit board—in fact everything needed down to the last screw FOR MAKING A SUPERB TAPE RECORDER, which, when built, will compare favourably with instruments costing twice as much, yet you need no experience or technical skill to bring this about. THE INSTRUCTIONS MANUAL MAKES BUILDING EASY AND SUCCESS ASSURED.

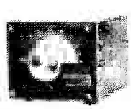


2 Track **36 gns.** 4 Track **39 gns.**
P.P. 22/6 either model
Kit comprises: Deck, Amplifier, Cabinet and speaker, with MICROPHONE 7 in 1,200 ft. tape, spare spool.
ALL UNITS AVAILABLE SEPARATELY   Today's Value £60.
ASK FOR BROCHURE 6.

VHF FM SUPERHET TUNER MKII

5-MULLARD TRANSISTORS & 4 DIODES . 300 Kc/s BANDWIDTH . PRINTED CIRCUIT CONSTRUCTION HIGH FIDELITY REPRODUCTION MONO AND STEREO

A popular VHF FM Tuner now used throughout the country for quality reception of monophonic and, with the decoder stereophonic broadcasts. There is no doubt about it—VHF FM gives the *real sound*. Excellent stability, economically priced.



PARTS TOTAL COST £5.19.6.
DECODER £5 19 6.
(CABINET 20/-) ASK FOR LEAFLET 3

NEW—MALLORY LONG LIFE MERCURY BATTERIES 50% OFF LIST PRICES

*RM12 1.35 volts 3600 m/aH **OUR PRICE 5/- each**
size 2" x ⅝" dia.

* RM625 10.35 volts 350 m/aH
Pack of 8. Size 2¼ x ⅜ dia.
OUR PRICE 10/- each

Easily split into eight 1.35v. cells. These cells are ideal for any application - where SMALL SIZE HIGH CAPACITY and LONG LIFE are required.
QUANTITIES AVAILABLE.

GARRARD RECORD DECKS

ALL BRAND NEW at huge savings

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