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VOL. 49 NO. 3
ISSUE 797
JULY 1973

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

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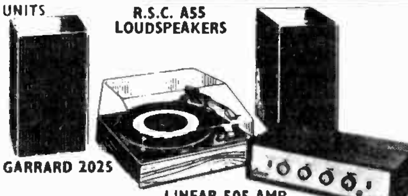

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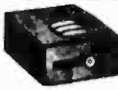

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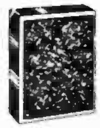

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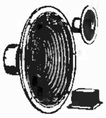

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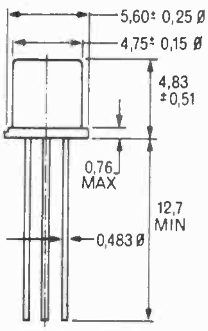

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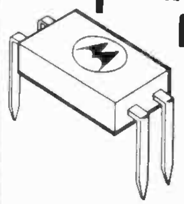

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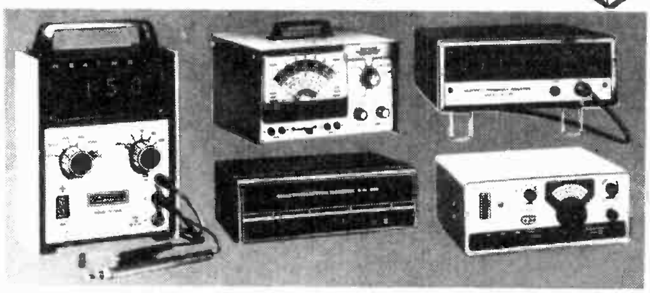

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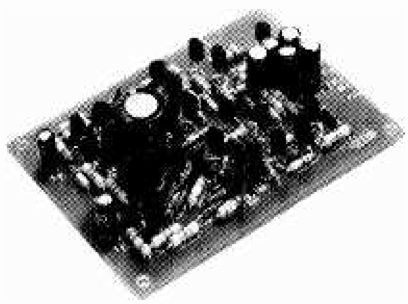

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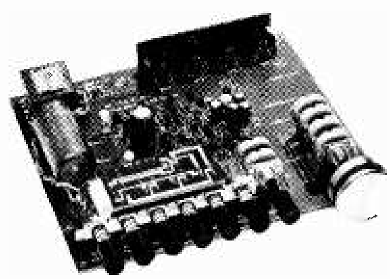

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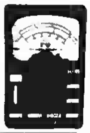
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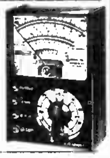
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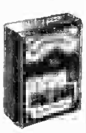
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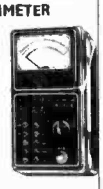
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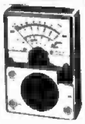
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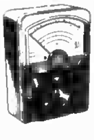
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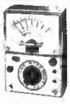
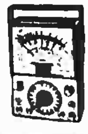
HIOKI MODEL 750X

50,000 o.p.v. 43 ranges 0–0·3 to 1,200v D.C. 0–3 to 1,200v A.C. 0–30µA/300mA. 0–3K/30 meg ohms. − 10 to + 17dB. £8·97. Post 20p.

U4312 MULTIMETER

Extremely sturdy instrument for general electrical use. 667 o.p.v.
0/·3/1·5/7·5/30/60/150/300/600/900 VDC and 75mV.
0/·3/1·5/7·5/30/60/150/300 600/900 VAC.
0/300µA/1·5/6/15/60/150 600MA/1·5/6 AMP. D.C.
0/1·5/6/15/60/150/600MA/1·5/6 AMP. AC.
0/200 Ω/3K/30K Ω.
Accuracy DC 1%. AC 1·5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. £9·50. P. & P. 25p.

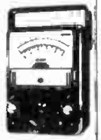
HIOKO MODEL 700X

100,000 O.P.V. Overload protection. Mirror scale. ·3/·6/1·2/1·5/3/6/12/30/60/120/300/600/1200V DC 1·5/3/6/12/30/60/150/300/600 1200 V. A.C. 15/30µA/3/6/30/60/150/300mA 6/12 AMP. DC. 2K/200K/2 Meg/20 Meg ohm −20 to +63dB. £13·50. P. & P. 20p

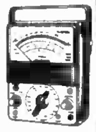
MODEL C-7080 EN

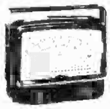
Giant 6" mirror scale. 20,000 o.p.v. 0 / ·25 / 1 / 2·5 / 10 / 50 / 250 / 1000 / 5000V. D.C. 0 / 2·5 / 10 / 50 / 250 / 1000 / 5000V. A.C. 0 / 50µA / 1 / 10 / 100 / 500mA / 10 amp. D.C. 0 / 2K / 200K / 20 meg − 20 to + 50 dB. £13·95. Post 35p.

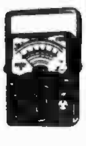
370 WTR MULTI-METER

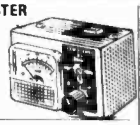
Features A.C. current ranges. 20,000 o.p.v. 0/·5/2·5/10/50/250/500 1000 V. D.C.
0/2·5/10/50/250/500/1000V AC
0/50uA/1/10/100mA/1/10 Amp D.C.
0/100mA/1/10 Amp AC
0/5K/50K/500K/5 MEG/ 50 MEG.
−20 +62db.
£15. P. & P. 25p.

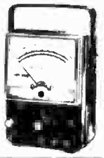
HT100B4 MULTI-METER

Features A.C. current ranges. 100,000 o.p.v. Mirror Scale, Overload protection. 0/·5/2·5/10/50/250/500/1000 V D.C.
0/2·5/10/50/250/1000 V. A.C. 0/10/250µA/2·5/25/250 MA/10 Amp. D.C.
10 Amp A.C. 0/20K/200K/2 MEG/20 MEG. − 20+62dB.
£12·50. P & P. 25p.

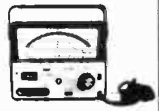
KAMODEN 72.200 MULTITESTER

High sensitivity tester. 200,000 o.p.v. Overload protection. Mirror scale. Ranges: 0 / ·06 / ·3 / 3 / 30 / 120 / 600 / 1200V. D.C.
0 / 3 / 12 / 60 / 300 / 11,200V. A.C.
0 / 6µA / 1·2mA / 120mA / 600mA / 12A. D.C.
0 / 12A. A.C.
−20 to +63dB. 0 / 2K / 200K / 2 meg / 200 meg ohms. £16·95. Post 30p.

TMK LAB TESTER.

100,000 O.P.V. 6½in. Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K/Volt A.C. D.C. Volts: ·5, 2·5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 25, 50, 250, 500, 1,000V. D.C. Current: 10, 100µA, 10, 100, 500mA, 2·5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG, 100MEG Ω. Decibels: −10 to +49 db. Plastic Case with Carrying Handle. Size: 7½in. × 6¾in. × 3½in. £18·95. P. & P. 25p.

Model S-100TR MULTIMETER TRANSISTOR TESTER

100,000 o.p.v. mirror scale/overload protection. 0/·12/·6/3/12/30/120/600 V DC. 0/6/30/120/600. V AC. 0/12/600µA/ 12/300mA/12 AMP DC. 0/10 K/1 MEG/100MEG. −20 to +50db. 0·01–·2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. £13·50. P/P 25p.

LB3 TRANSISTOR TESTER

Tests ICO and B. PNP / NPN. Operates from 9v battery. Complete with all instructions, etc. £3·95. P. & P. 20p.

KAMODEN HM.350 TRANSISTOR TESTER

High quality instrument to test Reverse Leak current and DC current. Amplification factor of NPN, PNP, transistors, diodes, SCR's etc. 4" × 4½" clear scale meter. Operates from internal batteries. Complete with instructions, leads and carrying handle. £12·50. Post 30p.

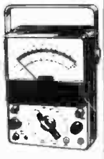
MODEL 449A IN CIRCUIT TRANSISTOR TESTER

Checks true A.C. beta in / out. Checks Icbo. Checks diodes in / out. Checks SCR, etc. Beta HI 10 – 500, LO 2 – 50. Icbo 0–5000µA. 220/240 V A.C. operation £17·50. Post 25p.

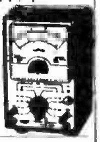
MODEL U4311 SUB-STANDARD MULTI-RANGE VOLT AMMETER

Sensitivity 330 ohms/Volt AC and DC. Accuracy 5% D.C. 1% AC. Scale length 165mm. 0/300/750µA / 1·5 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 / 750mA / 1·5 / 3 / 7·5AMP DC 0 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 / 750mA / 1·5 / 3 / 7·5 AMP AC 0 / 75 / 150 / 300 / 750mV / 1·5 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 / 750V DC 0/750mV / 1·5 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 /750V AC. Automatic cut out. Supplied complete with test leads, manual and test certificates. £49·00. Post 50p.

TE-65 VALVE VOLTMETER

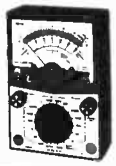
28 ranges. D.C. volts 1·5–1,500v. A.C. volts 1·5–1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation. Complete with probe and instructions.
£17·50. P. & P. 30p.
Additional probes available: R.F. £2·12½; H.V. £2·50.

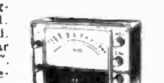
KAMODEN HM 720B F.E.T. V.O.M.

Input Impedance 10 meg ohms.
Ranges:
0 / ·25 / 1 / 2·5 / 10 / 50/ 250 / 1000V. D.C.
0 / 2·5 / 10 / 50 / 250 / 1000V. A.C.
0 / 25µA / 2·5 / 25 / 250 MA D.C.
− 20 to + 62dB
0 / 5K / 50K / 500K / 5meg 500meg ohms.
£14·95. Post 30p

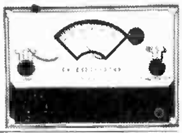
TE-40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: 01/·003/·1/·3/1/3/10/30/100/300V. R.M.S. 4cps.-1·2 Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17·50. Carr. 25p.

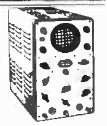
TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER

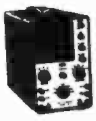
Battery operated, 11 meg input, 26 ranges. Large 4½" mirror scale. Size 5¾" × 4¾" × 2¾". DC VOLTS 0·3–1200V AC VOLTS 3–300V RMS. 8·0–800V P-P. DC CURRENT ·12–12MA. Resistance up to 2000M ohm. Decibels −20 to + 51dB. Complete with leads/instructions. £17·50. P. & P. 20p.

MODEL L-55 FET V.O.M.

Input impedance 10 meg ohms. 0 / ·3 / 1·2 / 6 / 30 / 120 / 600V. D.C. 0 / 3 / 12 / 60 / 120 / 600V. A.C. 0 / 120µA / 120mA D.C. 0 / 1K / 100K / 10 meg /100 meg ohms
£15·97. Post 15p.

KAMODEN HMG-500 INSULATION RESISTANCE TESTER

Range 0–1000 Megohms, 500 Volt. Battery operated. Wide range clear meter 4½" × 4". Complete with de-luxe carrying case, batteries, instructions. £19·95. Post 30p

BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR
Sine 18 × 200,000 Hz: Square 18 × 50,000 Hz

Output max. + 10 dB. (10 K ohms) Operation internal batteries Attractive 2-tone case 7½" × 5" × 2". Price £17·50. Carr. 17½p.

CI-5 PULSE OSCILLOSCOPE

For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth 10MHz. Sensitivity at 100KHz VRMS/mm. ·1·25; HOR. AMP. Bandwidth 500KHz. Sensitivity at 100KHz, V RMS/mm. ·3·25; Preset triggered sweep 1·3,000usec.; free running 20-200,000Hz in nine ranges. Calibrator pips. 220 × 360 × 430mm. 115-230V. AC operation. £39·00. Carr. paid.

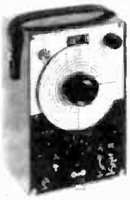
TO-3 PORTABLE OSCILLOSCOPE

3in. tube, Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v p-p/CM. Bandwidth 1·5cps–800kHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps 300 kHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½lb. 220/240V. A.C. Supplied brand new with handbook. £47·50. Carr. 50p.

RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE

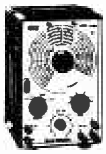
5 mc/s Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in. × 4in. C.R.T. Calibrated triggered sweep from ·2 u/sec. to 100 milli-sec. per cm. Free running time base 50 c/s-1 mc/s. Built-in time base calibrator and amplitude calibrator. Supplied complete with all accessories and instruction manual £87. Carr. Paid.

MODEL AT201 DECADE ATTENUATOR

Frequency range 0 200KHz. Attenuator 0–111db, 0·1db step. Impedance 600 ohms. Max. Input power 30dbm. Size 180 × 90 × 55mm. £12·50. Post 37p.

ARF-300 AF/RF SIGNAL GENERATOR

All transistorised, compact, fully portable. AF sine wave 18 Hz to 220 KHz. AF square wave 18 Hz to 100 KHz. Output sine / square 10v. P-P. RF 100 KHz to 200 MHz. Output 1v maximum. Operation 220/240v. AC. Complete with instructions and leads. £29·95. Post 50p.

TE-20D RF SIGNAL GENERATOR



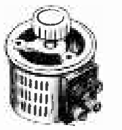
Accurate wide range signal generator covering 120 Kc/s 500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions £15. Carr. 37½p. Size 140 × 215 × 170 mm.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms. 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. £17·50. Carr. 37½p.

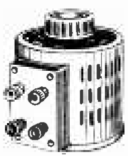
"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality at low cost. All models – Input 230V. 50/60 c/s. Variable output 0–260V.



MODEL S-260 GENERAL PURPOSE BENCH MOUNTING

1 Amp	£7·00
2·5 Amp	£8·05
5 Amp	£11·75
8 Amp	£15·90
10 Amp	£22·50
12 Amp	£23·60
20 Amp	£49·00
25 Amp	£58·00
40 Amp	£82·50



MODEL S-260B

Panel Mounting.

1 Amp	£7·00
2·5 Amp	£8·05

Carriage and Packing Extra

AUTO TRANSFORMERS

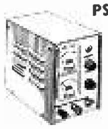
0/115/250V. Step up or step down. Fully shrouded.

80 W	£2·10	P. & P. 18p
150 W	£2·70	P. & P. 18p
300 W	£3·60	P. & P. 23p
500 W	£5·25	P. & P. 33p
1000 W	£7·50	P. & P. 38p
1500 W	£10·20	P. & P. 43p
2250 W	£17·25	P. & P. 50p
5000 W	£35·00	P. & P. £1

MCA. 220 AUTOMATIC VOLTAGE STABILISER

Input 98 125 VAC or 176, 250VAC. Output 120VAC or 240VAC. 200VA rating. £11·97. Carr. 50p.

PS.200 REGULATED P.S.U.



Solid state. Variable output 5-20 volt D.C. up to 2 amp. Independent meters to monitor voltage and current. Output 220/240 V. A.C. Size 7½" × 5½" × 3½". £19·95. P. & P. 25p.

PS.1000B REGULATED POWER SUPPLY

Solid state. Output 6, 9 or 12 volt DC up to 3 amps. Meter to monitor current. Input 220/240v AC. Size 4" × 3½" × 6½". £11·97. P. & P. 25p.

230V/240V SMITHS SYNCHRONOUS GEARED MOTORS

Built in gearbox. All brand new and boxed. 30 RPH CW; 2 RPH CW; 20 RPH CW; 2 RPH ACW; 30 RRH CW;

p each Post 12p.

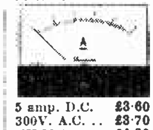
50

SEW CLEAR PLASTIC PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVT. DEPTS., EDUCATIONAL AUTHORITIES, ETC.

Over 200 ranges in stock—other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

Type SW.100 100 x 80 mm.



50μA	£4·15		
50–0–50μA	£3·95		
100μA	£3·95		
100–0–100μA	£3·90		
500μA	£3·70		
1mA	£3·60		
20V. D.C.	£3·60		
50V. D.C.	£3·60	5 amp. D.C.	£3·60
300V. D.C.	£3·60	300V. A.C.	£3·70
1 amp. D.C.	£3·60	VU Meter	£4·30

Type SD.830 82.5mm x 110mm Fronts

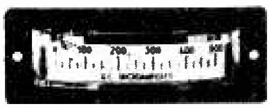
		10mA	£3·10
		50mA	£3·10
		100mA	£3·10
		500mA	£3·10
		1 amp.	£3·10
		5 amp.	£3·10
		10 amp.	£3·10
50μA	£3·40	5V. D.C.	£3·10
50–0–50μA	£3·40	10V. D.C.	£3·10
100μA	£3·35	20V. D.C.	£3·10
100–0–100μA	£3·35	50V. D.C.	£3·10
200μA	£3·30	300V. D.C.	£3·10
500μA	£3·15	15V. A.C.	£3·30
1mA	£3·10	300V. A.C.	£3·30
5mA	£3·10	VU Meter	£3·50

Type SD.640 63.5mm x 85mm Fronts

50uA	£3·05	500mA	£2·90
50–0–50μA	£3·05	1 amp.	£2·90
100μA	£3·00	5 amp.	£2·90
100–0–100μA	£3·00	10 amp	£2·90
200μA	£3·00	5V. D.C.	£2·90
500μA	£2·95	20V. D.C.	£2·90
1mA	£2·90	50V. D.C.	£2·90
5mA	£2·90	300V. D.C.	£2·90
10mA	£2·90	15V. A.C.	£3·00
50mA	£2·90	300V. A.C.	£3·00
100mA	£2·90	VU Meter	£3·15

Type SD.460 46mm x 59.5mm Fronts

50μA	£2·80	1 amp.	£2·60
50–0–50μA	£2·80	5 amp.	£2·60
100μA	£2·75	10 amp.	£2·60
100–0–100μA	£2·75	5V. D.C.	£2·60
200μA	£2·70	10V. D.C.	£2·60
500μA	£2·55	20V. D.C.	£2·60
1mA	£2·60	50V. D.C.	£2·60
5mA	£2·60	300V. D.C.	£2·60
10mA	£2·60	15V. A.C.	£2·70
50mA	£2·60	300V. A.C.	£2·70
100mA	£2·60		
500mA	£2·60	VU Meter	£2·90



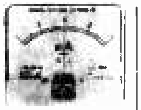
"SEW" EDGWISE METERS

Type PE.70. 3 17/32in. x 1 15/32in. x 2¼in. deep

50μA	£3·15	500μA	£3·20
50–0–50μA	£3·60	1mA	£3·20
100μA	£3·60	300V. A.C.	£3·25
100–0–100μA	£3·50	VU Meter	£3·35
200μA	£3·40		

***MOVING IRON—**
ALL OTHERS MOVING COIL
Please add postage

Type MR.85P. 4¼in. x 4¼in. fronts



		50mA	£3·10
		100mA	£3·10
		500mA	£3·10
		1 amp.	£3·10
		5 amp.	£3·10
		15 amp.	£3·10
		30 amp	£3·20
		20V. D.C.	£3·10
		50V. D.C.	£3·10
50μA	£3·95	150V. D.C.	£3·10
50–0–50μA	£3·40	300V. D.C.	£3·10
100μA	£3·40	15V. A.C.	£3·10
100–0–100μA	£3·30	300V. A.C.	£3·10
200μA	£3·30	S Meter 1mA	£3·15
500μA	£3·20	VU Meter	£3·95
500–0–500μA	£3·10	1 amp. A.C.*	£3·10
1mA	£3·10	5 amp A.C.*	£3·10
1–0–1mA	£3·10	10 amp. A.C.*	£3·10
5mA	£3·10	20 amp. A.C.*	£3·10
10mA	£3·10	30 amp. A.C.*	£3·10

Type MR.52P. 2¼in. square fronts

50μA	£3·50	10V. D.C.	£2·50
50–0–50μA	£3·05	20V. D.C.	£2·50
100μA	£3·00	50V. D.C.	£2·50
100–0–100μA	£2·95	300V. D.C.	£2·50
500μA	£2·65	15V. A.C.	£2·60
1mA	£2·50	300V. A.C.	£2·60
5mA	£2·50	S Meter 1mA	£2·60
10mA	£2·50	VU Meter	£3·60
50mA	£2·50	1 amp. A.C.*	£2·50
100mA	£2·50	5 amp. A.C.*	£2·50
500mA	£2·50	10 amp. A.C.*	£2·50
1 amp	£2·50	20 amp. A.C.*	£2·50
5 amp	£2·50	30 amp. A.C.*	£2·50

Type MR.65P. 3½in. x 3½in. fronts

50μA	£3·70	10V. D.C.	£2·60
50–0–50μA	£3·15	20V. D.C.	£2·60
100μA	£3·15	50V. D.C.	£2·60
100–0–100μA	£3·10	150V. D.C.	£2·60
200μA	£3·05	300V. D.C.	£2·60
500μA	£2·75	15V. A.C.	£2·80
500–0–500μA	£2·60	50V. A.C.	£2·80
1mA	£2·60	150V. A.C.	£2·80
5mA	£2·60	300V. A.C.	£2·80
10mA	£2·60	500V. A.C.	£2·80
50mA	£2·60	S Meter 1mA	£2·85
100mA	£2·60	VU Meter	£3·70
500mA	£2·60	50mA A.C.*	£2·60
1 amp.	£2·60	100mA A.C.*	£2·60
5 amp.	£2·60	200mA A.C.*	£2·60
10 amp.	£2·60	500mA A.C.*	£2·60
15 amp.	£2·60	1 amp. A.C.*	£2·60
20 amp.	£2·60	5 amp. A.C.*	£2·60
30 amp.	£2·80	10 amp. A.C.*	£2·60
50 amp.	£2·90	20 amp. A.C.*	£2·60
5V. D.C.	£2·60	30 amp. A.C.*	£2·60

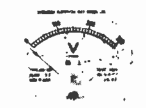
"SEW" EDUCATIONAL METERS

Type ED.107. Size overall 100mm x 90mm x 108mm

A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50μA	£5·50	20V. d.c.	£4·85
100μA	£5·10	50V. d.c.	£4·85
1mA	£4·85	300V. d.c.	£4·85
50–0–50μA	£5·10		
1–0–1mA	£4·85	Dual range	
1A d.c.	£4·85	500mA/5A d.c.	£5·10
5A d.c.	£4·85	5V/50V d.c.	£5·10
10V d.c.	£4·85		

Type MR.38P. 1 21/32in. square fronts



		200mA	£2·25
		300mA	£2·25
		500mA	£2·25
		750mA	£2·25
		1 amp.	£2·25
		2 amp.	£2·25
		5 amp.	£2·25
		10 amp.	£2·25
		3V. D.C.	£2·25
50μA	£2·55	10V. D.C.	£2·25
50–0–50μA	£2·50	15V. D.C.	£2·25
100μA	£2·45	20V. D.C.	£2·25
100–0–100μA	£2·40	50V. D.C.	£2·25
200μA	£2·25	100V. D.C.	£2·25
500μA	£2·25	150V. D.C.	£2·25
500–0–500μA	£2·25	300V. D.C.	£2·25
1mA	£2·25	500V. D.C.	£2·25
1–0–1mA	£2·25	750V. D.C.	£2·25
2mA	£2·25	15V. A.C.	£2·30
5mA	£2·25	50V. A.C.	£2·30
10mA	£2·25	150V. A.C.	£2·30
20mA	£2·25	300V. A.C.	£2·30
50mA	£2·25	500V. A.C.	£2·30
100mA	£2·25	S Meter 1mA	£2·30
150mA	£2·25	VU Meter	£2·65

Type MR.45P. 2in. square fronts

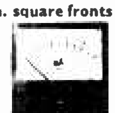
50μA	£2·70	5 amp.	£2·40
50–0–50μA	£2·65	10V. D.C.	£2·40
100μA	£2·60	20V. D.C.	£2·40
100–0–100μA	£2·50	50V. D.C.	£2·40
200μA	£2·50	300V. D.C.	£2·40
500μA	£2·45	15V. A.C.	£2·40
500–0–500μA	£2·40	300V. A.C.	£2·40
1mA	£2·40	S Meter 1mA	£2·50
5mA	£2·40	VU Meter	£2·70
10mA	£2·40	1 amp. A.C.*	£2·40
50mA	£2·40	5 amp. A.C.*	£2·40
100mA	£2·40	10 amp. A.C.*	£2·40
500mA	£2·40	20 amp. A.C.*	£2·40
1 amp.	£2·40	30 amp. A.C.*	£2·40

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts

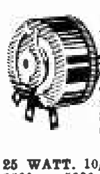
		1 amp.	£2·60
		5 amp.	£2·60
		15 amp.	£2·60
		30 amp.	£2·60
		50 amp.	£2·60
		5V. D.C.	£2·60
		10V. D.C.	£2·60
		20V. D.C.	£2·60
		50V. D.C.	£2·60
		150V. D.C.	£2·60
		300V. D.C.	£2·60
25μA	£4·60	50mV. D.C.	£2·90
50μA	£3·55	100mV. D.C.	£2·90
50–0–50μA	£3·05	30V. A.C.*	£2·65
100μA	£3·00	50V. A.C.*	£2·65
100–0–100μA	£3·00	150V. A.C.*	£2·65
500μA	£2·70	300V. A.C.*	£2·65
500–0–500μA	£2·70	500mA A.C.*	£2·60
1mA	£2·60	1 amp. A.C.*	£2·60
1–0–1mA	£2·80	5 amp. A.C.*	£2·60
5mA	£2·60	10 amp. A.C.*	£2·60
10mA	£2·30	20 amp. A.C.*	£2·60
50mA	£2·60	30 amp. A.C.*	£2·60
100mA	£2·60	50 amp. A.C.*	£2·60
500mA	£2·60	VU Meter	£3·65

Type S-80 80 mm. square fronts



50μA	£3·50		
50–0–50μA	£3·40		
100μA	£3·40		
100–0–100μA	£3·30		
500μA	£3·05		
1mA	£3·00		
20V. D.C.	£3·00		
50V. D.C.	£3·00	5 amp. D.C.	£3·00
300V. D.C.	£3·00	300V. A.C.	£3·00
1 amp. D.C.	£3·00	VU Meter	£3·70

POWER RHEOSTATS



High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. ¼in. dia. shafts. Bulk quantities available.

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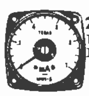
50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms. £1·35. P. & P. 10p.

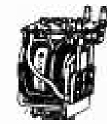
100 WATT. 1/5/10/25/50/100/250/500/1000 or 2500 ohms. £1·95. P. & P. 15p.



240° Wide Angle 1mA Meters

MW 1-6	60mm square	£3·97
MW 1-8	80mm square	£4·97

P. & P. extra



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ALL PRICES ARE SUBJECT TO 10% VAT

GWS

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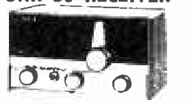
GWS G.W.SMITH & CO (RADIO) LTD

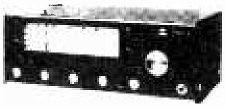
UNR 30 RECEIVER



4 Bands covering 550 kc/s-30 mc/s B.F.O. Built-in Speaker 220/240 v. A.C. Brand new with instructions.

Our Price £15·75 Carr. 37p

UR-1A RECEIVER



4 Bands covering 550 kc/s-30 mc/s. FET, S Meter. Variable BFO for SSB. Built-in Speaker, Bandspread, Sensitivity Control. 220/240 v. A.C. or 12 v. D.C. 12¼in. × 4¼in. × 7in. Brand new with instructions.

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Solid state, 5 bands covering 200-420 KHz and ·55 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning. BFO, AVC, ANL, "S" meter, AM/CW/SS B. Integrated speaker and phone socket. 220/240 v. A.C. or 12 v. D.C. Size 325 × 266 × 150 mm. Complete with instructions and circuit.

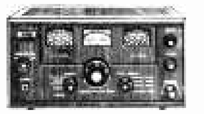
Our Price £32·50 Carr. 50p

LAFAYETTE HA-600 RECEIVER

General coverage 150-400 kc/s, 550 kc/s-30 mc/s, FET front end, 2 mech. filters, product detector, variable B.F.O., noise limiter, S Meter Bandspread. RF Gain. 15in. × 9¼in. × 8¼in. 18 lb. 220/240 v. A.C. or 12 v. D.C. Brand new with instructions.

Our Price £50·00 Carr. 50p

TRIO 9R59DS RECEIVER



4 bands 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 frequency 445 kc/s, audio output 1·5w. Variable RF and AF gain controls 115/250 v. A.C. Size: 7in. × 13in. × 10in. with instruction manual.

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FULL RANGE OF TRIO STOCKED

GWS

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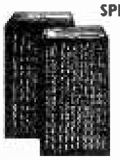
Model 350. 13" × 8" with single tweeter/crossover. 20-20,000 Hz. 15 watt RMS. Available 8 or 15 ohms. £7·25 each. P. & P. 37p.
Model 450. 13" × 8" with twin tweeter/crossover. 55-13,000 Hz. 8 watt RMS. Available 8 or 15 ohms. £3·62 each. P. & P. 25p.

SPECIAL OFFER! STEREO SPEAKERS



Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size 14½" × 9" × 7½". 8 ohms. 8 watt RMS. 16 watt peak. Complete with DIN lead.

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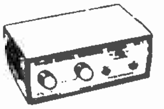
HA-10 STEREO HEADPHONE AMPLIFIER

All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5MU/100MU. Output 50MW.

Our Price £5·97 P. & P. 15p

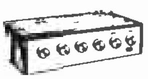
1021 STEREO LISTENING STATION



For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. 2 gain controls, speaker on-off slide switch, stereo headphone sockets. 6" × 4" × 2½".

Our Price £2·25 P. & P. 15p

MP7 MIXER PREAMPLIFIER



5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9½" × 5" × 3". Inputs Mics: 3×3mV 50K; 2× 3mV 600 ohm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.

Our Price £8·97 P. & P. 20p

HAND HELD 2-WAY WALKIE TALKIES

Industrial quality in robust metal cases. Battery operation. Volume and squelch controls. Call button and press to talk button. Telescopic aerial. Complete carrying cases.

2 channel 300mW **£52·50** Pair. Post 50p.
3 channel 2 watt **£79·50** Pair. Post 50p.

Licence required for operation in U.K.

HOMER INTERCOMS

Ideal for home, office, stores, factories, etc. Supplied complete with batteries, cable and free instructions.
2 Station £2·97, P. & P. 15p.
3 Station £5·25, P. & P. 15p.
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6 TRANSISTOR HIGH QUALITY TUNER. SIZE ONLY 6 × 4 × 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88-108Mc/s. Ready built ready for use. Fantastic value for money.

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Stereo multiplex adaptors £4·97.

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Outstanding value. Soft ear-pads, adjustable headband. 8-16 ohms. 20-20,000 Hz. Complete with lead and stereo plug.

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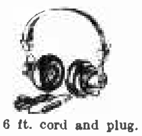
TE1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET

Sensitive magnetic headset with soft earpads. Impedance 2,600 ohms (d.c. 600 ohms). Frequency response 200-4,000 Hz.

Our Price £1·97 P. & P. 30p

LHO2S STEREO HEADPHONES



Lightweight headphones with padded earpieces. 4-16 ohms. 20-20,000 Hz. Complete with 6 ft. cord and plug.

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Moving Coil. Ideal for language teaching, communications. Headphone imp. 16 ohms. Microphone imp. 200 ohms.

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DH-08S DE-LUXE STEREO HEADPHONES

Features unique mechanical 2 way units and fitted adjustable lever controls. 8 ohm impedance 20-20,000 cps. Complete with spring lead & stereo jack plug.

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4-CHANNEL STEREO HEADPHONES

TTC G3600. Soft vinyl covered head cushion and earphones. Each earpiece incorporates two 2" speaker units. Fitted 2/4 channel changeover switch. Impedance 4-16 ohm. Frequency response 20-20,000 Hz. Complete with 15 ft. coiled lead fitted two stereo plugs.

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ROTEL BARGAIN!

RH700 STEREO PHONES

Soft leather ear cushions. Impedance 8-16 ohms. 20-20,000 Hz. 15ft coiled lead. Brand new and boxed (List £9·95.)

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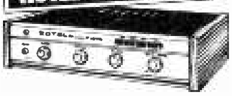
ROTEL BARGAINS!



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RA310	15 + 15 watt	£34·95
RA610	32 + 32 watt	£51·95
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SPEAKERS	
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Covers FM 88-108 MHz. Five push button tuning scales. 8+8 watts rms. Inputs for stereo ceramic cartridge and tape etc. Separate bass treble, balance and volume controls.

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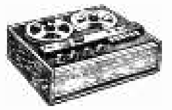

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4 track. 7½, 3¾, 1⅞ i.p.s. Stereo/mono record/play. 7" reels. Inputs for dynamic mikes, radio, gram. Complete with cover.

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SAVE UP TO 33⅓% OR MORE! GWS

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Complete units with Stereo cartridge ready wired in plinth cover.

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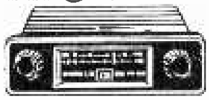

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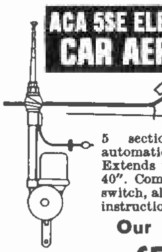

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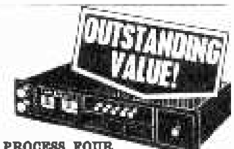

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6AC7	.15	6F28	.60	10F18	.35	30FL14	.66	DF96	.34	ECF804	
6AG5	.25	6F32	.15	10LD11	.53	30L15	.55	DH76	.28		2.10
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6AV6	.28	6K7G	.12	12BE6	.30	35D5	.70	E80F	1.20	ECL85	.54
6AW8A	.54	6K8G	.33	12BH7	.27	35L6GT	.42	E83F	1.20	ECL86	.33
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6BA6	.19	6L7	.38	12K7GT	.34	35Z5GT	.30	E180F	.90	EF41	.58
6BC8	.50	6L18	.44	12Q7GT	.28	50C5	.32	E182CC	1.00	EF42	.33
6BE6	.20	6L19	1.38	12SC7	.35	50CD6G		E1148	.53	EF73	.75
6BH6	.43	6LD20	.48	12SG7	.23		2.17	EA50	.27	EF80	.21

EF83	.54	KT2	.25	PL81A	.48	UY41	.38
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EY51	.35	PCL82	.29	UBF80	.33	2N1756	.55
EY81	.35	PCL83	.54	UBF89	.33	2N2147	.94
EY83	.54	PCL84	.32	UBL21	.55	2N2297	.25
EY84	.50	PCL805/85		UC92	.35	2N2369	.24
EY87/6	.27		.37	UCC84	.33	2N2613	.43
EY88	.40	PCL86	.36	UCC85	.33	2N3053	.36
EZ40	.40	PD500	1.44	UCF80	.31	2N3121	2.75
EZ41	.42	PEN4DD		UCH21	.60	2N3703	.21
EZ80	.19		1.38	UCH42	.57	2N3709	.22
EZ81	.20	PEN45	.40	UCH81	.29	2N3988	.55
GY501	.75	PEN45DD		UCL82	.30	2S323	.55
GZ32	.39		.75	UCL83	.54	AA119	.17
GZ33	.70	PEN46	.20	UF41	.50	AA120	.17
GZ34	.47	PEN453DD		UF42	.60	AA129	.17
GZ37	.67		.98	UF80	.35	AAZ13	.20
HABC80	.44	PENDD-		UF85	.34	AC107	.17
HL23DD	.40	4020	.88	UF86	.63	AC113	.28
HL41DD	.98	PFL200	.50	UF89	.27	AC126	.14
HL42DD	.50	PL33	.38	UL41	.54	AC127	.19
HN309	1.40	PL36	.46	UL84	.28	AC128	.22
HVR2	.53	PL81	.42	UM80	.33	AC132	.22
HVR2A	.53						

AC154	.28	BCY12	.55	OA79	.10
AC156	.22	BCY33	.22	OA81	.10
AC157	.28	BCY34	.25	OA85	.09
AC165	.28	BCY38	.25	OA90	.14
AC166	.28	BCY39	.28	OA91	.10
AC168	.48	BCZ11	.42	OA95	.10
AC176	.61	BF158	.22	OA200	.10
AC177	.31	BF159	.28	OA202	.11
ACY17	.28	BF163	.22	OC22	.42
ACY18	.22	BF173	.42	OC23	.42
ACY19	.21	BF180	.33	OC24	.42
ACY20	.20	BF181	.44	OC25	.42
ACY21	.21	BF185	.44	OC28	.66
ACY22	.17	BF194	.17	OC29	.69
ACY28	.20	BFY50	.25	OC35	.35
AD140	.40	BFY51	.21	OC36	.47
AD149	.55	BFY52	.22	OC44	.11
AD161	.50	BY100	.20	OC45	.12
AD162	.50	BY105	.20	OC46	.17
ADT140	.69	BY114	.20	OC70	.14
AF106	.55	BY126	.17	OC71	.12
AF114	.28	BY127	.20	OC72	.12
AF115	.17	BYZ10	.28	OC74	.25
AF117	.21	BYZ11	.28	OC75	.12
AF121	.33	BYZ12	.28	OC76	.17
AF124	.28	BYZ13	.28	OC77	.30
AF125	.19	CG12E	.22	OC78	.17
AF126	.20	FSY11A	.25	OC78D	.17
AF139	.72	FSY41A	.25	OC81	.12
AF178	.75	GD9	.22	OC81D	.12
AF180	.53	GET113	.22	OC82	.12
AF186	.61	GET118	.22	OC82D	.12
AF239	.48	GET119	.27	OC83	.22
BA102	.50	GET573	.42	OC84	.26
BA115	.15	GET587	.47	OC123	.25
BA116	.28	GET873	.17	OC139	.25
BA129	.14	GET887	.25	OC169	.25
BA130	.11	GET897	.25	OC172	.39
BA153	.17	GET898	.25	OC200	.24
BC107	.14	MI	.17	OC201	.42
BC108	.14	OA5	.31	OC203	.33
BC113	.28	OA9	.14	OC204	.33
BC115	.17	OA10	.47	OC205	.47
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BC118	.25	OA70	.17		
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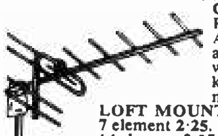

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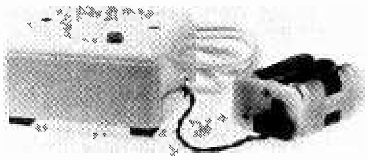

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SN7404	0·20	0·18	0·16	SN7460	0·20	0·18	0·16	SN74154	2·00	1·75	1·55
SN7405	0·20	0·18	0·16	SN7470	0·30	0·27	0·25	SN74155	1·55	1·47	1·35
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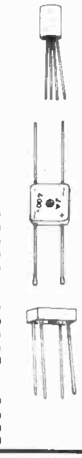

Type	Volts P.I.V.	Price 1-11
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BO5/05	50	20p
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B1/05	50	25p
B1/10	100	25p
B1/20	200	30p
B1/60	600	35p
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W005	50	30p
W01	100	35p
W02	200	40p
W06	600	45p
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B2/100	100	40p
B2/200	200	45p
B2/600	600	50p
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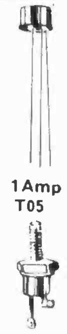

Type	Volts P.I.V.	Price 1-11
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CRS 1/10	100	30p
CRS 1/20	200	30p
CRS 1/40	400	35p
CRS 1/60	600	45p
THREE AMP (TO48)		
CRS 3/05	50	30p
CRS 3/10	100	30p
CRS 3/20	200	35p
CRS 3/40	400	45p
CRS 3/60	600	55p
FIVE AMP (TO66)		
CRS 5/400	400	60p
SEVEN AMP (TO48)		
CRS 7/100	100	60p
CRS 7/200	200	65p
CRS 7/400	400	70p
CRS 7/600	600	95p
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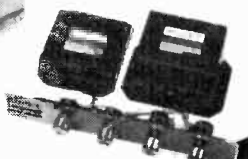

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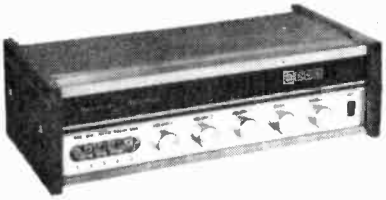

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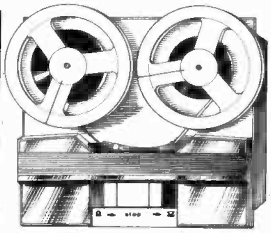

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PRICES: SYSTEM 1

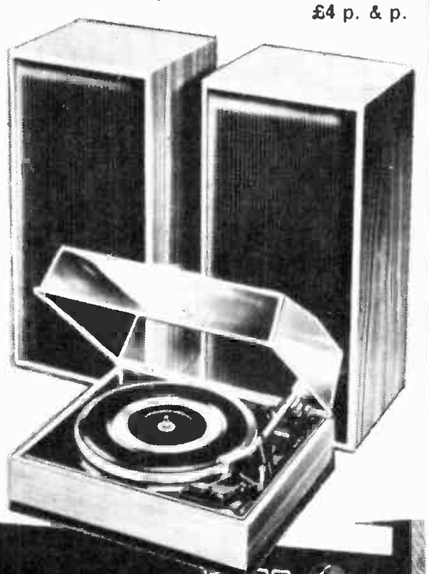
Viscount III R 102 amplifier	£24·20 + £1 p & p
2 Duo Type II speakers	£14·00 + £2·20 p & p
Garrard SP25 Mk.III with MAG. cartridge plinth & cover	£18·00 + £1·75 p & p
total	£56·20

Available complete for only **£49** + **£3·50** p. & p.

PRICES: SYSTEM 2

Vicount R 102 amplifier	£24·20 + £1 p & p
2 Duo Type III speakers	£32·00 + £3·30 p & p
Garrard SP25 Mk. III with MAG. cartridge plinth & cover	£18·00 + £1·75 p & p
total	£74·20

Available complete for **£65** + **£4** p. & p.



20 + 20w. r.m.s. 40Hz to 40kHz ± 3dB. Total distortion at 10w. at 1kHz – 0·1%. This is real value for money! We have designed 2 systems and the heart of them both is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. FET's (Field effect, transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder.

For both systems we have chosen the famous Garrard SP25 Mk. III deck, with fitted magnetic cartridge, which comes complete with simulated teak plinth and tinted acrylic cover.

The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo II's for the smaller room or the big Duo III's for real bass response.

SPEAKERS: Duo Type II Size approx. 17in. × 10¾in. × 6¾in. Drive unit 13in. × 8in. with parasitic tweeter. Max. power 10 watts 8 ohms. Simulated Teak cabinet. £15·40 a pair (inc. VAT), £2·20 p. and p. Duo Type III Size approx. 23½in. × 11½in. × 9½in. Drive unit 13½in. × 8½in. with H.F. speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20KHz. Teak veneer cabinet. £35·20 a pair (inc. VAT) + £3·30 p. & p.
SPECIFICATION R102 : 20 watts per channel into 8 ohms (suitable 8–16 ohms.) Total distortion @ 10W @ 1kHz 0·1%. P.U.1 (for ceramic cartridges) 180mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K equalised within 1dB R.I.A.A. *Radio* 180mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. Signal-to-noise ratio: (all controls at max.) –58dB. Cross talk better than –40dB on all inputs. Size approx. 13¾in. × 9in. × 3¾in. Send S.A.E. for fully illustrated brochure. 12 month's written guarantee.

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Above motor board 3¼in.
Below motor board 2½in.
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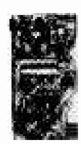

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Module kit, 30-17,000 c.p.s. with tweeter crossover, baffle and instructions. **£12·50**
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'Group 25'	'Group 35'	'Group 50'
12 inch 25 watt **£8·80**	12 inch 35 watt **£9·90**	15" inch 50 watt **£22**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

TEAK VENEERED HI-FI SPEAKER CABINETS
For 12in. or 10in. dia. speaker 20 × 13 × 9in. £9·90 Post 25p
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For 6in. and tweeter 12 × 8 × 6in. £4 Post 25p
LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft.

GOODMANS 6½in. HI-FI WOOFER £4

8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30-12,000 cps. Ideal P.A. Columns. Hi-Fi Enclosures Systems, etc.
Suitable Cabinet 12 × 8 × 6, £4·00.
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ELAC CONE TWEETER

The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3¼ × 3¼ × 2in. deep. Rating 10 watts, 3 ohm or 15 ohm models. **£1·90** Post 10p
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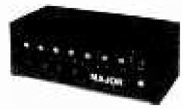

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BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **£3·95**

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COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18p. OUTLET BOXES, SURFACE OR FLUSH, 25p.
BALANCED TWIN RIBBON FEEDER 300 ohms 5p yard.
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Dual-in-line or Zig-Zag (Quil). 14 and 16 pin
Our Price 1p per pin

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CZ13A	13p			VA1034	10p
CZ19	13p			VA1039	15p
GL16	£1·00			VA1040	10p
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R53	£1·32			VA1055S	10p
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5KΩ	50KΩ	500KΩ
10KΩ	100KΩ	1MΩ
25KΩ	250KΩ	2MΩ

log or lin less switch (& 1KΩ lin)	12p
log or lin with switch	24p
dual less switch	40p
dual with switch 10K, 100K & 1M log only	52p
10K log / 10K antilog less switch	40p

Capacitors

dise ceramic
- ·01μF 18v 5p
- ·022μF 18v 5p
- ·047μF 12v 5p

low voltage
- 0·1μF 30v 5p
- 0·22μF 6v 5p
- 0·47μF 3v 5p

ceramic plate
- 1000pf 10p
- 2200pf 10p

30V
- 4700pf 10p
- 10,000pf 10p

Ceramic – plate **63V (C333)**

1·8pf	8·2pf	33pf	120pf
2·2pf	10pf	39pf	150pf
3·3pf	12pf	47pf	180pf
3·9pf	15pf	56pf	220pf
4·7pf	18pf	68pf	270pf
5·6pf	22pf	82pf	330pf
6·8pf	27pf	100pf	

all 5p. each

mylar film **100V**

1000pf	2p	·01μF	3p	·068μF	4p
2000pf	2p	·02μF	3p	·1μF	4p
5000pf	2p	·04μF	3p	·2μF	5p
		·05μF	3p		

polystyrene **160V**
10pf to 10,000pf in multiples of 10, 15, 22, 33, 47 & 68. **3p each**

metallised polyester **250V (C280)**

·01μF	3p	·068μF	3½p	·47μF	8p
·015μF	3p	·1μF	4p	·68μF	11p
·022μF	3p	·15μF	4p	1μF	13p
·033μF	3p	·22μF	5p	1·5μF	20p
·047μF	3p	·33μF	6½p	2·2μF	24p

metallised polyester **400V (C281)**

·01μF	4½p	·047μF	6p	·22μF	10p
·015μF	4½p	·068μF	6p	·33μF	14p
·022μF	4½p	·1μF	7p	·47μF	15p
·033μF	5½p	·15μF	8p		

silvered mica 1% (>50pf) 500V

2·2pf—820pf	7p	4·7nF—5600pf	19p
1nF—2·2nf	9p	6800pf—·01μF	29p
2·7nF—3·6nF	16p		

mixed dielectric **600V**

·01μF	7p	·047μF	7p	·22μF	16p
·022μF	7p	·068μF	8p	·47μF	24p
·033μF	7p	·1μF	8p	1μF	33p

Slider Pots

Single	Dual	log
10K	10 + 10K	or
25K	25 + 25K	lin
50K	50 + 50K	
100K	100 + 100K	Knobs
30p	50p	10p

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LOUDSPEAKERS No. 4
COILS AND INDUCTORS No. 5
TRANSFORMERS No. 6
(postage 5p)

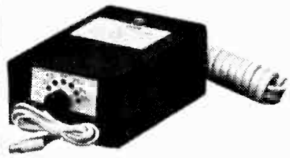
Resistors

½ watt 5% Carbon Film – low noise Hi-Stabs
All E24 values **1p** each plus p. & p. 7p for up to 50 Resistors and a further 2p for each additional 50. Deduct **33⅓%** for 100 of one type or **25%** for mixed orders over £1 in value.

1 W	10%	Carbon Composition	3p each
2 W	10%	Carbon Composition	6p each
2½ W	5%	Wire wound	9p each
5 W		Wire wound	9p each
10 W		Wire wound	10p each

plus p. & p. 7p for up to 25 resistors plus 1p for each additional 25.

Eliminators



6 volt @ 50mA	£1.50
9 volt @ 50mA	£1.50
6 + 6 volt, 50mA	£2.50
9 + 9 volt, 50mA	£2.50
7½ volt for cassette recorders	£2.00
6, 7½ or 9 volt	£3.00
3, 4½, 6, 7½, 9, 12 @ 500mA (illus.)	£3.99
Car Battery Converter fully stabilised to provide 6, 7½ or 9 volts	£4.99

(p. & p. 15p on all types)

Diodes & Rectifiers

AA119	9p	BA156	15p	BY176	£1·50
AA120	9p	BA243	56p	BY182	£1·50
AA129	9p	OA47	10p	BY250	23p
BA102	25p	OA79	9p	IN4001	6p
BA115	17p	OA90	7p	IN4002	7p
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BA145	20p	OA200	10p	IN4004	8p
BA148	20p	BY100	15p	IN4005	10p
BA154	13p	BY126	15p	IN4006	12p
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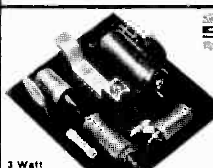
BZY88 ZENER SERIES 10p each

SGS

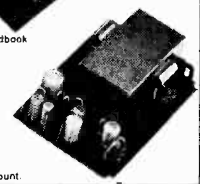
EA1000



3 Watt Audio Amplifier

Our Price inc. handbook £2·49

10+ less 15%
25+ less 25%
100+ less 33⅓%



5 Watt Audio Amplifier

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Matching stereo decoder £4·97
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Presets

Vertical or Horizontal

0·1 watt 5p		0·25 watt 7p		
100	1KΩ	10KΩ	100KΩ	1MΩ
250	2·5KΩ	25KΩ	250KΩ	2·5MΩ
500	5KΩ	50KΩ	500KΩ	5MΩ

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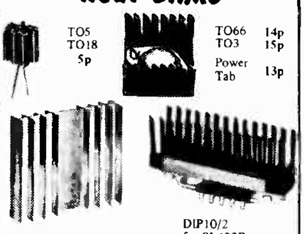

TO5 / TO18 5p
TO66 14p
TO3 15p
Power Tab 13p
10D 50p
DIP10/2 for SL403D 15p

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AC107	25p	BC147	10p	BF196	15p	OC81	19p	2N1304	22p	2N5172	15p
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AC128	15p	BC157	12p	BFY50	24p	OC171	38p	2N2926 all	10p	LO37TI	£1·50
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AF139	28p	BF184	25p	OC45	15p	ZTX531	25p	2N3903	15p	μA723C	95p
BC107	10p	BF185	25p	OC71	11p	2N697	18p	2N3904	17p	μA741C	47p
BC108	10p	BF194	15p	OC72	17p	2N706	12p	2N3905	21p	μA748C	60p
BC109	10p	BF195	15p	OC76	15p	2N708	15p	2N3906	12p		

mixed dielectric **1000V**

1000pf	6p	6800pf	9p	·1μF	12p
2200pf	6p	·01μF	9p	·22μF	22p
3300pf	6p	·022μF	9p	·47μF	30p
4700pf	6p	·047μF	12p		

Ceramic

12KV.d.c.		8KV.d.c.		HI-K 750V.	
10pf	9p	200pf	9p	1000pf	5p
15pf	9p	220pf	9p	1500pf	5p
22pf	9p	250pf	9p	2000pf	5p
68pf	9p	270pf	9p	3000pf	5p
82pf	9p	300pf	9p	5000pf	5p
100pf	9p	750V DISC		10,000pf	5p
120pf	9p	470pf	5p	feed-through	
140pf	9p	1000pf	5p		
150pf	9p	5000pf	5p		
180pf	9p	10,000pf	5p	1000pf	5p

Veroboard

	Copperclad 0.1"	Copperclad 0.15"	Plain 0.15"
2½" x 1"	6p	6p	–
2½" x 3¾"	20p	16p (9)	10p
2½" x 5"	24p	21p (7)	12p
3¾" x 3¾"	24p	21p (8)	–
3¾" x 5"	27p	27p (10)	17p
17" x 2½"	67p	50p	37p
17" x 3¾"	90p	70p	52p
17" x 5"	–	–	75p

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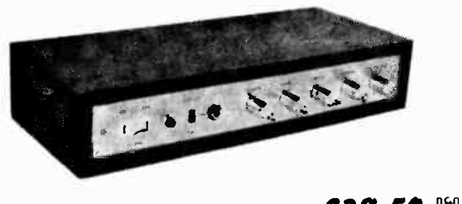
(10)	4"	x 5¼"	x 1½"	40p	8p
11	4"	x 2½"	x 2"	35p	8p
12	3"	x 2"	x 1"	32p	9p
13	6"	x 4"	x 2"	50p	10p
14	7"	x 5"	x 2½"	58p	12p
15	8"	x 6"	x 3"	75p	18p
16	10"	x 7"	x 3"	85p	20p

THE TEXAN



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20 Watts per channel integrated stereo amplifier developed by engineers of Texas Instruments Ltd. This designer approved kit, has a state-of-the-art specification, including distortion of only 0.09% at 20 Watts into 8 ohms and a bandwidth of 5 – 35,000 at –3db. The semiconductor compliment of this superb kit includes no less than 6 integrated circuits, 10 Silicon transistors, 4 rectifiers and 2 zeners. Controls include: bass; treble; volume; balance; on/off; 'on' indicator; headphone sockets; scratch filter; rumble filter; inputs for magnetic phono; tuner; aux or tape; tape head etc; input; selector; mono/stereo switch. The construction of this kit was featured in 'Practical Wireless' May - Aug. 1972.

Mullard & Siemens Electrolytics

CAP μF	VOLTAGE 4	6.3	10	16	25	40	63
1	—	—	—	—	—	—	6p
1.5	—	—	—	—	—	—	6p
2.2	—	—	—	—	—	—	6p
3.3	—	—	—	—	—	—	6p
4.7	—	—	—	—	—	—	6p
6.8	—	—	—	—	—	6p	6p
10	—	—	—	—	6p	—	6p
15	—	—	—	6p	—	6p	6p
22	—	—	6p	—	6p	—	6p
33	—	6p	—	6p	—	6p	—
47	6p	—	6p	—	6p	6p	8p
68	—	6p	—	6p	—	—	10p
100	6p	—	6p	—	6p	6p	12p
150	—	6p	—	6p	6p	10p	12p
220	6p	—	6p	6p	10p	12p	18p
330	6p	—	6p	10p	—	—	21p
470	—	6p	10p	—	12p	18p	40p
680	—	10p	—	12p	18p	21p	—
1000	10p	—	12p	18p	21p	40p	60p
1500	—	12p	18p	21p	—	—	—
2200	—	18p	21p	40p	45p	55p	93p
3300	—	21p	—	—	—	—	—
4700	21p	—	—	60p	75p	93p	—

CAP μF	VOLTAGE 16	25	40	64
500			33p	40p
1250			50p	—
1600			—	75p
2000	40p	50p	—	—
2500	—	—	75p	93p
3200	50p	—	—	—
4000		75p	93p	—
6400	75p	93p	—	—

Quantity Prices on application.

Hi-Volt Electrolytics

1, 2, 4, 8μF 450V	14p	32μF 450V	20p
16μF 450V	15p	50μF 350V	20p
8 + 8μF; 450 V.W	18p	32 + 32μF; 350 V.W	25p
8 + 16μF; 450 V.W	20p	32 + 32μF; 450 V.W	43p
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GARRARD WB1 Base	3·56	2·70
GARRARD WB4 Base	5·28	3·90
GARRARD SPC1 Cover	3·47	2·60
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Cover for 85P	7·26	5·00
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McDONALD Cover for 710/810	4·40	2·95
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*DULCI FMT 7 FM	23·16	14·90
JVC Nivico MCT V5E/VT500 AM/FM	82·50	65·95
VT 700	126·50	101·50
MCT V7E AM/FM	115·25	94·95
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LEAK Delta AM/FM	83·79	62·25
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3000	42·44	28·95

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KOSS KO-727B	18·15	13·75
KOSS 747	22·00	16·50
KOSS K-711	11·00	8·50
KOSS K6	13·75	10·50
KOSS K6/LC (with volume control)	15·40	11·60
KOSS K6/LCQ Quadrafone	22·00	18·75
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PIONEER SE 30A	13·86	9·25
PIONEER SEL 20A	8·67	5·50
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	Rec. Retail Price £ p	Comet Price £ p
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	Rec. Retail Price £ p	Comet Price £ p
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FORMATIVE HABITS

DURING the first 18 years of human life a great many natural developments take place which perhaps we take for granted. One of these is the shrugging off of juvenile behaviour characteristics and the adoption of a mature outlook to face the rigours of a competitive world.

When applied to a technical art such as broadcast entertainment, not only do programme standards alter, but also the medium by which they are conveyed. The obvious examples that spring to mind are the progressions through 405-line, 625-line, and colour television for one; acoustic gramophones, mono discs, 2-channel stereo and quadraphonic sound for another. In spite of a mixture of pessimism, cautiousness, apathy, or just plain rejection, developments in the methods and standards of technical achievement still win through.

But there is still a very interesting factor; that is a great reluctance, especially in the U.K., to shake off some of those formative habits. We still have 405-lines, mono discs (often forced to undergo processing to stereo status), and of more topical concern, medium wave broadcasting. Why? Or equally, why not? The very organisation that has been trying to convert us to v.h.f./f.m. for the past 18 years is still promoting broadcasting on m.w./l.w. Even more interesting—the IBA are now doing likewise. Why?

Have you bought or built an f.m.-only tuner in the light of the advice about improved reception of BBC programmes, only to find that you cannot receive the programmes that go out on a.m. only? Do you also find that reception in cars via f.m. is very difficult because of interference? Are you finding station separation on the medium wave more difficult? It is truly amazing that in spite of "progress" our broadcasting system is still bugged on occasions by major reception problems. (See letters on page 261.)

It is interesting to note that the BBC are experimenting with concurrent television and stereo radio programme material. Let's have more! Experiments are also going ahead on broadcasting quadraphonic sound, but we have not heard them yet.

In the meantime we will go on promoting v.h.f./f.m., especially for constructors. Mr. Ainslie's recent article was typically a popular project. Mr. Rayer describes a special receiver in this issue, that enables the experimenter to extend reception outside the usual 88–108MHz limits of a conventional dial. Future issues will provide state-of-the-art circuits of f.m. stereo. But we will not forget a.m. On the contrary we shall do all we can to provide constructors with limited experience some simple circuits to build, and at low cost too; more details about this next month.

M. A. COLWELL—*Editor*

The August issue on sale 6th July, will include our new all-transistor oscilloscope specially designed for students, experimenters and constructors who want reliable performance coupled with simple construction. We shall also have a communications receiver and details of a new Datacard scheme commencing in the autumn. Our autumn issues are being planned as the best yet for new projects and ideas on home entertainment. We would hate the idea of you missing them, so order your regular copies of *Practical Wireless* now. Further details on page 239.

NEWS...

Mobile rally diary

June 17—Amateur Radio Mobile Society Rally, R.A.F. Cosford, Shropshire. Details from W. S. Barwick, 34 Malvern Rd., London, N.8.

June 24—West of England (Bristol City and County RSGB Group) Mobile Rally at Longleat. Further details of this popular rally can be obtained by dropping a line to A. H. Williams, G8CKJ, 58 Britannia Road, Kingswood, Bristol.

July 1—South Shields and District Amateur Radio Club's rally will be at Redwell School, Prince Edward Road, South Shields.

July 8—Cornish Rally at Treviglass County Secondary School, Newquay, Cornwall.

July 8—The Worcester and District Amateur Radio Club are organising the Upton-on-Severn Mobile Rally and further details can be obtained from B. A. Jones, G8ASO, 12 Woodside Road, Larkhill, Worcester, WR5 2EG.

July 22—Anglian Mobile Rally will be held at the Suffolk Showground Bucklesham Road, Ipswich. Readers can obtain further information by contacting C. J. Wantling, G3TNE, 15 Melplash Road, Ipswich, Suffolk, IP3 8QJ. Telephone Ipswich 75241.

July 22—Southdown Rally at Polegate, Wilmington.

August 5—Radio Society of Great Britain Mobile Rally at Woburn Abbey, Beds.

August 12—The Derby and District Amateur Radio Society are holding their 1973 rally at the usual venue i.e. Rykneld School, Bedford Street, Derby. There's ample inside accommodation if it rains and plenty of parking space for cars. In addition, there will be plenty of attractions for the XYL's and harmonics. If you want to know more, send a s.a.e. to Fred Ward, G2CVV, 5 Uplands Avenue, Littleover, Derby, DE3 7GE.

August 12—Torbay Annual Mobile Rally will be held at Newton Abbot Rugby Club ground. There will be talk-in stations, the usual stands and various competitions. The contact for further gen is L. H. Webber, G3GDW, 43 Lime Tree Walk, Newton Abbot, Devon.

NEWS... NEWS... NEWS...

MOS i.c.'s and their Applications

THE latest book published by Mullard Ltd. is entitled "MOS Integrated Circuits and their Applications". It provides the reader with an introduction to these devices and should be ideal reading for designers unfamiliar with them and for electronic engineering students.

The construction, manufacture and characteristics of MOS i.c.'s are covered and the ways in which they can be used are fully explained.

A short description of the operation of the devices is followed by the explanation of the manufacturing processes of the various types of MOS i.c.'s. The static characteristics of the MOS transistor are examined and a description given of the static inverter which forms the basis of the gating elements used in MOS logic devices.

Switching characteristics are discussed and the main MOS static and dynamic logic circuits are examined.

Interface circuits are given and input/output protection devices described.

The final chapter deals with typical logic applications in which MOS i.c.'s can be used advantageously.

The book, cloth bound with 176 pages costs £2 and is obtainable from leading booksellers.

An Aussie 'First'

RON Wilkinson, VK3AKC is the first man in Australia to send a radio signal to America via the moon. He used the frequency of 1296MHz and the signal was received by the Crawford Hills UHF Group U.S.A.

The aerial used: a 20ft. parabolic dish.

Interface '73

TEXAS Instruments will again be holding their annual Seminar at the 'Talk of the Town' in London. It will be entitled "Interface 73" and will run for 3 days—June 12, 13 and 14. The same programme will be repeated each day.

In addition to presentations on Optoelectronics, Memories and Power Devices etc. Texas Instruments are expecting to make important policy statements on the Digital I.C. market.

Audio Fair '73

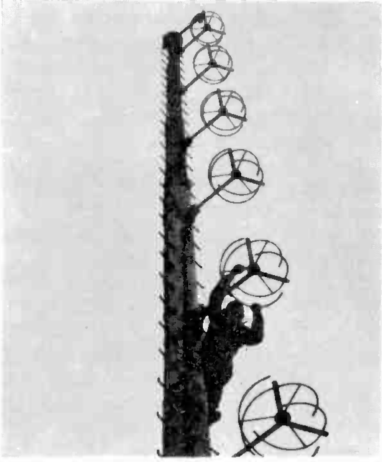
DATES are announced for the 1973 International Audio Festival and Fair and, for the first time since the exhibition moved to Olympia in 1969, it is to be open on a Sunday. Dates are October 23 to 28.

Circular aerials for VHF

EMI has been awarded contracts to provide the Independent Broadcasting Authority with transmitting aerial systems for Britain's first commercial radio stations.

Altogether six systems are being supplied and they will cover five major cities throughout the country including London, Birmingham, Glasgow and Manchester. Transmissions from the new stations are expected to commence towards the end of 1973.

Two v.h.f. aerials have been specified for London and Birmingham, which will be the first of their type in this country, utilising circular polarisation techniques. These techniques are used extensively in the United States to give improved reception for transistor and car radios.

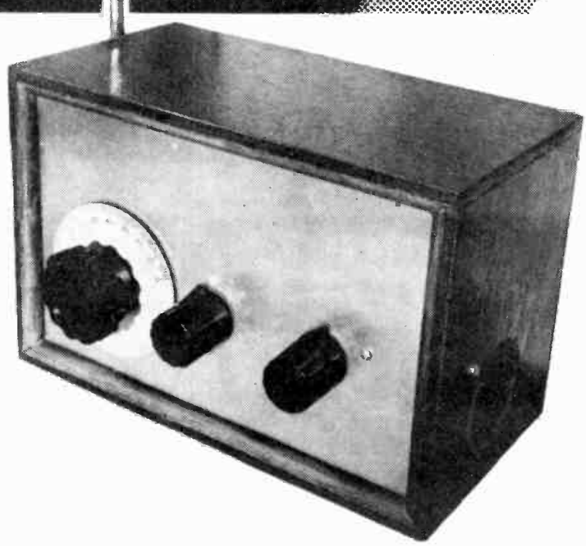


The aerial system for London, which is 60ft. high, will be installed on the top of the 500ft. television tower at the IBA Croydon transmitting station. This aerial will transmit two programmes to the London area. The second v.h.f. system will be mounted on the 1000ft. mast at the Lichfield transmitting station, near Birmingham.

extra bands

fm receiver

F. G. RAYER



The usual VHF receiver has a single VHF band covering those frequencies used for VHF broadcasting. The actual band varies with different receivers, but is often about 88-108MHz or so. This is usually obtained with fixed coils and a small ganged variable capacitor in conjunction with fixed capacitors and trimmers.

Experiments with a view to increasing coverage beyond that of popular VHF receivers show that the range can be extended in the HF direction by eliminating the parallel fixed capacitors and trimmers in the tuning circuits, as would be expected. For a reasonable inductance to capacitance ratio, tuning values of about 25pF are about the largest useable, but it is found that provided the layout gives the shortest possible leads, miniature plug-in coils are satisfactory, allowing extended coverage.

As trimmers would curtail coverage in the HF direction, and interchangeable coils are envisaged, separate tuning capacitors become almost essential. This eliminates ganging or alignment difficulties in this part of the receiver and works out quite satisfactorily because only the oscillator requires a reduction drive. The second tuning control is merely peaked for best results.

To facilitate alignment only two tuned circuits are used and since a single pair of plug-in coils will cover a band larger than the usual VHF range there is no need to fit other coils if not wanted.

The receiver intermediate frequency is 10·7MHz, so the second channel occurs at 21·4MHz from the wanted tuning frequency. As the tuned circuits have separate controls, some signals can thus be received at two positions of the oscillator tuning, depending on whether the oscillator frequency is 10·7MHz above or below the wanted signal. This is an effect which is unavoidable, if the advantage of separate tuning capacitors is to be retained, but it is not too important provided it is understood that this effect can arise.

In view of this, the bands given below are those of the oscillator coverage:

Band 1 34— 55MHz
Band 2 45— 72MHz
Band 3 82—140MHz
Band 4 110—180MHz

For general VHF use, Band 3 coils will be most suitable, the reception coverage then being approximately 72-130MHz, with the oscillator HF of the signal frequency.

CIRCUIT

Fig. 1 is the circuit of the receiver, the rod aerial or feeder being taken to the primary of L1, which is tuned by VC1. L2 is the oscillator coil, capacitor VC2 having a ball drive and dial for tuning. L1 and L2 are miniature plug-in coils, for changing bands.

Tr1 is the dual-gate FET mixer, output from the drain going to IFT1. Transistors Tr3, Tr4 and Tr5 are the three 10·7MHz IF amplifiers, with double-tuned IF transformers. C8 and C11 are necessary to neutralise these stages. IFT4 is a ratio discriminator transformer with the matched diodes D1 and D2 the audio output being taken via R19 from the tertiary winding.

VR1 is the audio volume control feeding a 3-stage amplifier. A $2\frac{1}{2}$in. speaker is incorporated for portable use, but the output jack allows a larger speaker or headphones to be plugged in.

The mixer and oscillator stages, with associated components, are built on a metal chassis but the IF and AF amplifiers are built as separate units on insulated boards.

CHASSIS AND PANEL

The chassis is 8 x 4in. and is a universal chassis flanged member. For the case described, the panel is flat aluminium, 8 x 5in. Fig. 2 shows the underside of the chassis.

VC1 is mounted centrally and $\frac{1}{4}$in. clear of the chassis. The holder for L1 is placed so that the leads from pins 1 and 6 are as short as possible, as shown.

VC2 is mounted on a metal bracket and is set back to accommodate the ball drive. The holder for L2 must also be placed to allow very short leads to VC2. The ball drive requires a $\frac{3}{4}$in. or 1in. hole in the panel and its lug is fixed with a 6BA bolt. VC2 and the drive need to be lined up to give a smooth free movement. The listed drive has a flange and

★ components list

Resistors

R1	100kΩ	R13	680Ω	R25	47kΩ
R2	2·2kΩ	R14	1kΩ	R26	3·3kΩ
R3	100kΩ	R15	33kΩ	R27	47kΩ
R4	1kΩ	R16	5·6kΩ	R28	12kΩ
R5	10kΩ	R17	1kΩ	R29	2·7kΩ
R6	10kΩ	R18	680Ω	R30	680Ω
R7	33kΩ	R19	100Ω	R31	2·2kΩ 5%
R8	5·6kΩ	R20	680Ω	R32	39Ω 5%
R9	680Ω	R21	680Ω	R33	5·6kΩ
R10	1kΩ	R22	4·7kΩ	R34	470kΩ
R11	33kΩ	R23	4·7kΩ	VR1	22kΩ log.
R12	5·6kΩ	R24	5·6kΩ		pot. with switch S1

All 10% ¼W except R31 and R32, 5%

Capacitors

C1	22pF	C11	5pF	C21	2μF 6V
C2	1000pF	C12	5000pF	C22	0·01μF
C3	5pF	C13	5000pF	C23	2μF 6V
C4	5pF	C14	5000pF	C24	100μF 12V
C5	5000pF	C15	5000pF	C25	2μF 6V
C6	0·01μF	C16	5000pF	C26	60μF 6V
C7	5000pF	C17	5000pF	C27	100μF 12V
C8	5pF	C18	330pF		
C9	5000pF	C19	330pF		
C10	5000pF	C20	0·01μF		

VC1 and VC2 25pF variable (Jackson C804)

Semiconductors

Tr1	3N141	Tr4	OC170	Tr7	OC81D
Tr2	BF200	Tr5	OC170	Tr8/9	OC81
Tr3	OC170	Tr6	OC71	D1/2	OA79

Miscellaneous

IFT1/2/3, (Denco IFT15). IFT4, (Denco RDT2). T1, (Home Radio TR64). T2, (Home Radio TR55A). Chassis, 8 x 4in. Universal chassis flanged member, panel 8 x 5in. (Home Radio). Valveholders B9A(2). Ball drive, (Jackson 4511/F). Dial 2¾in. dia. (Bulgin). Veroboard 0·15in. matrix, and pins. Knobs. Coaxial socket. Speaker 3Ω, 2½in. dia. Jack socket (switched). L1/2, see text.

ALIGNMENT GENERATOR

R1	22kΩ	R3	1kΩ	R5	5·6kΩ
R2	5·6kΩ	R4	22kΩ		

C1	5000pF	C3	0·01μF	C5	22pF
C2	1000pF	C4	47pF		

Miscellaneous

Tr1, OC71. Tr2, AF117. T1, (Home Radio TR64). L1, (Denco 'Blue' Range 4, **Valve type**). S1/2 toggle, on/off. Chassis, 5 x 2in. universal chassis flanged member (Home Radio). Veroboard, pins.

the metal dial can be fixed with two very short 8BA bolts run into the tapped holes.

Wiring for Tr2 is shown in Fig. 2. Very short leads are essential to C4 and C5. The shield lead Sh is **not** connected. The oscillator may be tested by connecting a 9V battery to chassis and negative lead (observe the polarity shown). If this stage is oscillating, battery current, as indicated by a meter in one battery lead, will change when VC2 is shorted. If this stage does not oscillate, the receiver cannot work at all. A transistor of doubtful efficiency may oscillate at the lower frequencies but not in the 150-180MHz region. So the test can be made with all coils, and for all positions of VC2.

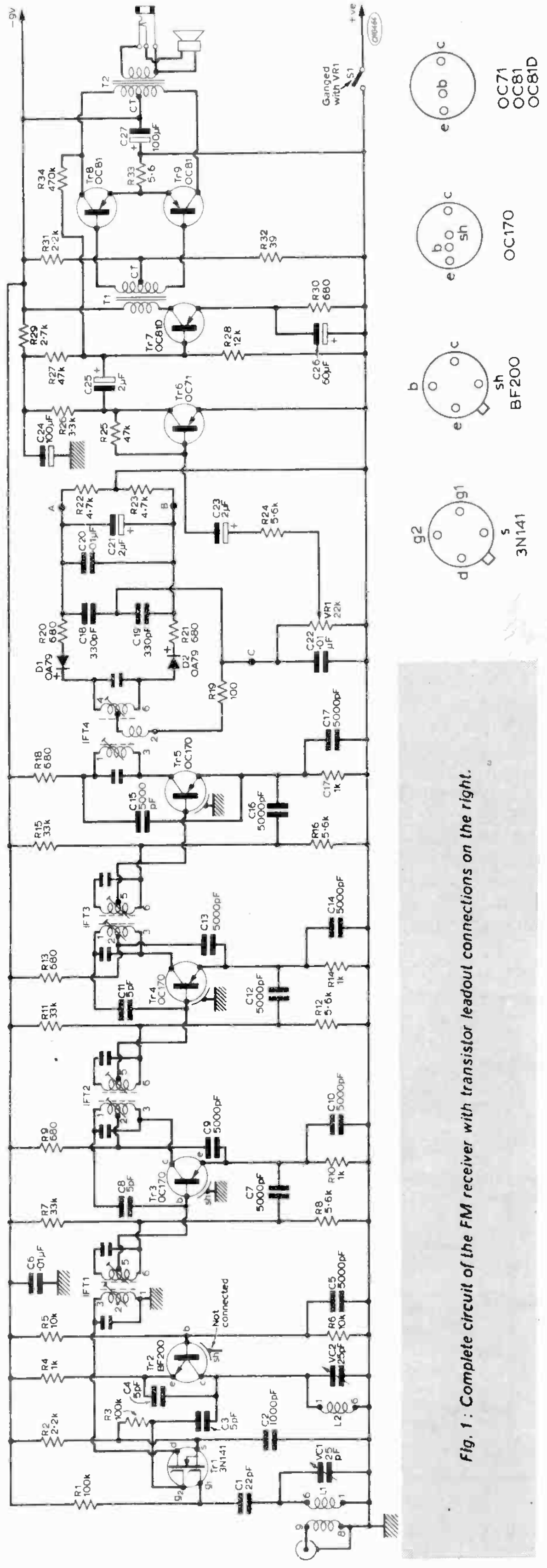


Fig. 1: Complete circuit of the FM receiver with transistor leadout connections on the right.

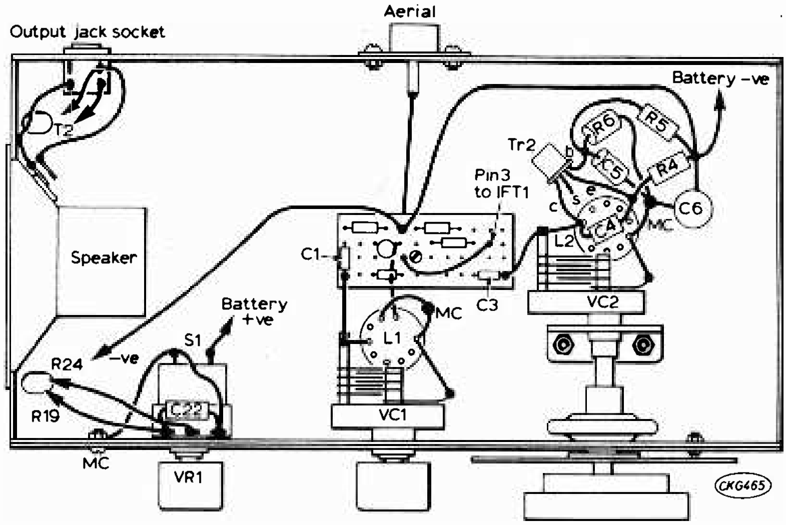


Fig. 2: Layout underneath the chassis with the tuned oscillator stage at the right. The mixer stage board (Fig. 3) is in the centre with its associated tuned circuit. The speaker is interconnected with the headphone jack socket mounted on the rear apron of the chassis.

MIXER BOARD

This board is $1\frac{7}{8}$ x $\frac{3}{4}$in. of 0·15in. matrix plain Veroboard, wired as in Fig. 3. A 6BA bolt, with extra nuts, allows the board to be locked to the metal chassis, with enough clearance to avoid any short circuits. This bolt forms the earth return.

The leads of C1 and C3 can be left projecting, to solder to VC1 and VC2. Also fit a pin or projecting lead for the negative connection, and a wire which can pass down through the board and chassis, to reach pin 3 of IFT1 on the IF amplifier.

Transistor Tr1 should be supplied with a shorting clip on its leads, and this **must not be removed** until the transistor has been soldered in place. First wire the board as in Fig. 3, omitting Tr1. Solder on the wires which will go to gate 1, gate 2, source and drain, and cut them to length and tin them. Tr1 is then inserted with its wires as shown. The leads can be spread with a sharpened matchstick, but should not be touched with a metal or plastic tool, or the fingers. Solder source and drain leads. Then while holding iron and solder in contact with the lead from C1/R1, solder g1. In the same way, hold the iron and solder against the lead from R3, and solder g2. When the resistors are soldered to provide an external circuit from g1 and g2 to the source, the transistor is protected and the wire clip is removed. If g1 or g2 have to be unsoldered from R1 or R3, or these resistors have to be unsoldered, the transistor leads should first be bound with thin wire.

The board is fixed as in Fig. 2, and external connections are made. The co-axial aerial socket and output socket are fixed to the rear flange of the chassis so that the receiver can be tested out of its case.

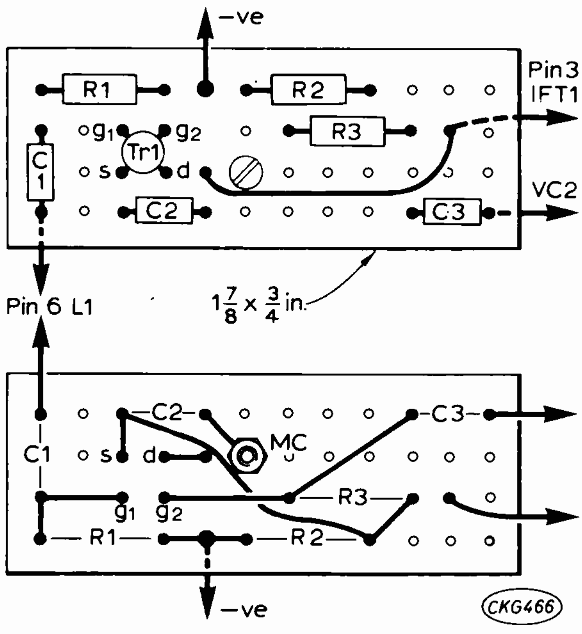


Fig. 3: Both sides of the mixer stage board.

IF AMPLIFIER

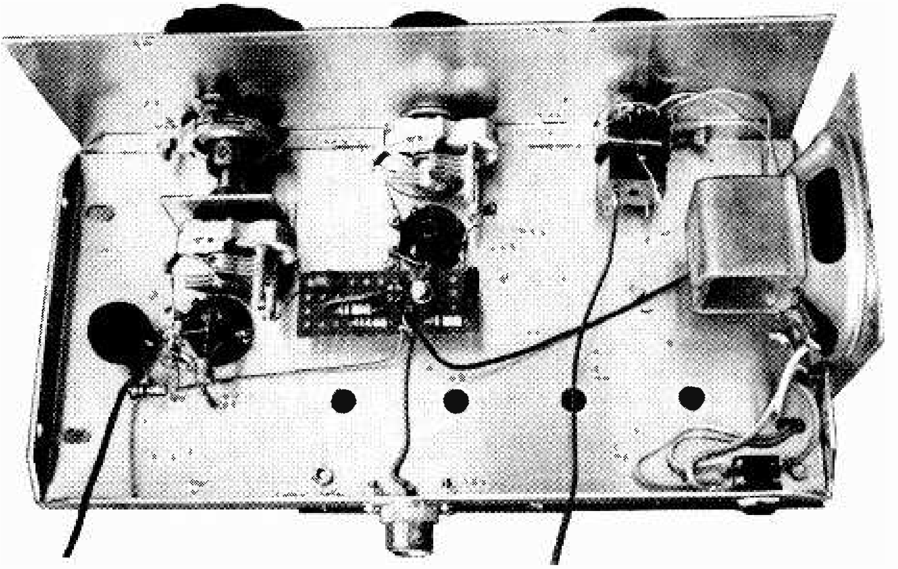
This is assembled on a $5\frac{1}{2}$ x $1\frac{3}{4}$in. board as in Fig. 4. First mark and drill holes for the IFT's and for the two $\frac{1}{2}$in. 6BA bolts. These, with additional nuts, form the chassis return and hold the board the metal chassis.

Leads should be short and direct, and insulated sleeving is put on where necessary. If $\frac{1}{4}$in. lengths of small diameter sleeving are put on the transistor leads this will prevent shorts and hold the transistors at a suitable height, while also identifying the wires.

Note that all the IFT screening cans are earthed. As the IFT's are prealigned, unnecessary disturbance of the cores is better avoided. When wiring D1 and D2, note that these may have a *black* ring to show positive. Polarity must be correct as a DC voltage is produced across C21.

Run a lead from pin 3 of IFT1 to a pin or wire, so that the wire from Tr1 can be soldered on later. A black lead, to go to battery negative, is soldered to R18, Fig. 4. A lead from R19 is provided, and will pass through the chassis to VR1.

If this section is tested with the board separate from the receiver, do not run a signal generator or other lead from pin 3 of IFT1 near the other IFT's or circuits, or instability may be caused which would not be present when the amplifier is fixed to the chassis.



View of the underside of the FM receiver which should be compared with Fig. 2.

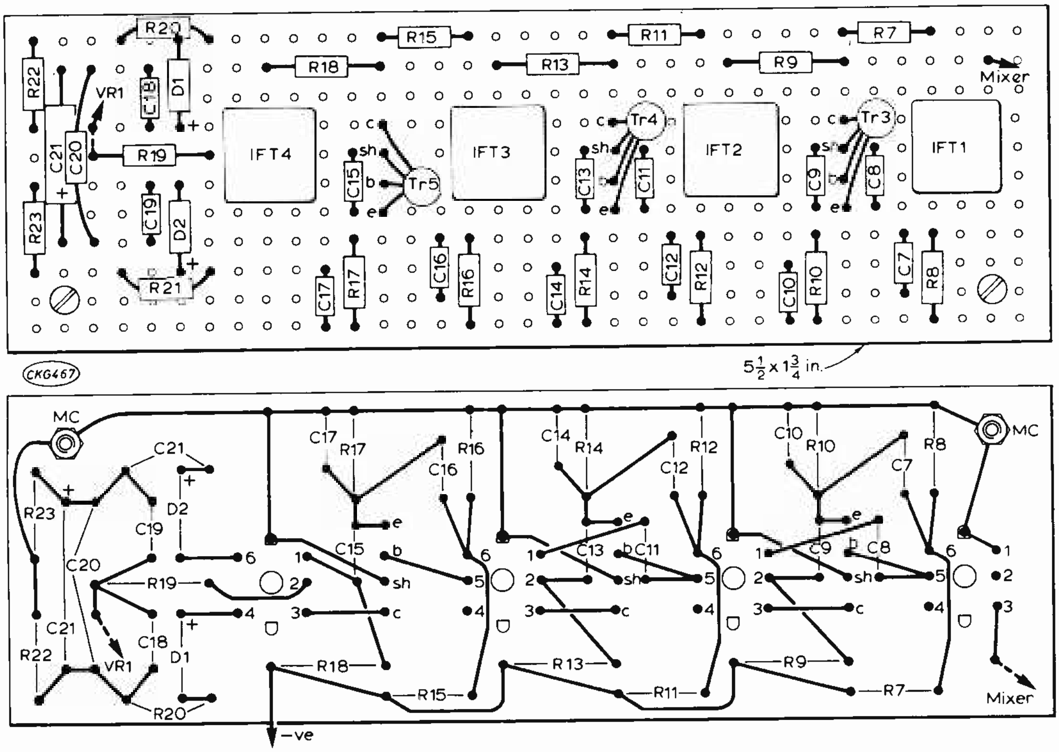


Fig. 4: The two sides of the IF amplifier board, shown actual size, illustrating component layout and wiring.

IF ALIGNMENT

This can be carried out with the aid of a high-resistance voltmeter, or the 2·5V range of the usual type of multi-range meter, preferably with a resistance of 10kΩ/volt or better. It is assumed that if alignment equipment for FM receivers is available the means of employing this will be known, so the method of alignment described here is an alternate method.

Three test points are shown on the circuit, Fig. 1, and the multi-range meter is clipped to these for aligning the IF amplifier by this method. Initially, meter negative is clipped to A and meter positive to B. Maximum signal strength at the diodes will then produce maximum voltage from A to B, as shown by the meter. All the IFT cores are adjusted for maximum meter reading and each core should have quite a sharp tuning peak, seen by observing the meter while slowly turning the core.

For the second stage of adjustment, the meter is clipped from point C to chassis, the polarity being unimportant. The bottom core of IFT4 is then adjusted for minimum reading on the meter. In addition to the usual upwards movement of the meter pointer, some backwards movement can normally be seen. By rotating the lower core one way or the other, it should be possible to make the meter pointer move backwards or forwards from its minimum position. Set the core so that the meter shows this "zero". This completes the IF strip adjustment.

When making these adjustments, a properly fitting plastic trimming tool should be used. It is helpful to have a signal generator of the usual type employed with AM receivers and to tune this to 10·7MHz. A lead from the generator is placed near the receiver mixer, to secure sufficient input to allow an indication on the voltmeter as described. When the generator output is amplitude modulated, this will be heard in the speaker, but the adjustments described are made with the generator giving a CW output.

Unnecessary adjustment to the cores before obtaining results is best avoided, as they are approximately adjusted when the IFT's are manufactured. Should IFT's be used which are so far out of adjustment that no signal can pass through the IF strip, couple the signal generator to the base of the last IF amplifier and adjust the last IFT. Then transfer the generator input to the previous amplifier base and adjust the third IFT. After taking the input to the first IF amplifier base and adjusting the second IFT transfer the input to the mixer in the way described, and carefully check all the IFT's.

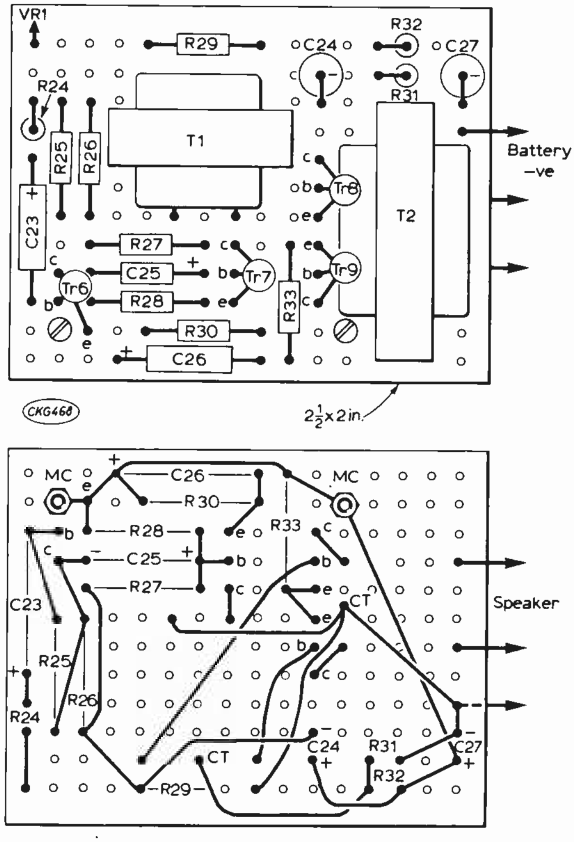


Fig. 5: Details of the audio amplifier board, full size.

Where no signal generator is available, the only method is to tune the receiver until some signal is obtained, and to work on this by ear, adjusting all cores for best volume and the bottom core for best results with an FM transmission. This can prove reasonably satisfactory, unless the IF circuits are so far off tune that the strongest transmission available cannot be heard.

INSTABILITY

With three IF stages and double-tuned transformers it is quite possible for IF instability to arise. This depends on the individual transistors, position and length of leads and similar factors. It is heard as whistling or hissing accompanying signals, or as oscillation liable to start when the IFT's are aligned, but which ceases when some cores are slightly staggered.

Where a small adjustment of some cores prevent this, and results are good, no modification is necessary. Otherwise, the trouble can be cured by placing a resistor between pin 5 of one or more IFT's and the corresponding base lead. This is most easily done by disconnecting the base wire from the pin, so that the resistor can be soldered directly to the pin, under the board. A similar result is achieved by placing a resistor in the lead from collector to pin 3 of the following IFT.

The values of the resistors are not very critical, except that unnecessarily large values will reduce gain. A number of small resistors from about 22Ω to 220Ω or so can readily be tried. In the original IF strip a value of 100Ω was used in the first stage, with 39Ω resistors for each of the following stages.

Though the amplifier can be tested and roughly aligned when clear of the receiver, final adjustments should be made with it fixed in its normal position. Four holes are required in the metal chassis, so that the lower cores can be reached. Final slight readjustment of IFT4 can be made by ear, when a transmission is tuned in. A simple 10·7MHz alignment generator is described later.

COILS

Band 3 was covered with Denco miniature plug-in coils Range 7. A "Yellow" coil is used for L1 and "Red" coil for L2. This is the most generally useful band. Band 2 is covered by using a similar pair of coils, Range 6. The Range 5 coils, which have cores, cover Band 1. All these coils are the valve type. For Band 4, coils were wound using Denco plug-in formers. Place the former in a valve holder before soldering to the pins. L1 is 2½ turns spaced ⅛in. and tapped at 1 turn from pin 1, for pin 9. L2 is 1½ turns, spaced ⅛in. Both are 22swg or similar wire.

AF AMPLIFIER

This is assembled on 0·15in. matrix Veroboard, in a similar way to the IF amplifier. The board is 2½in. x 2in. and both sides are shown in Fig. 5.

Transformer T2 has lugs which pass through slots, which can be made by drilling small holes closely together, and the lugs are twisted to hold the transformer to the board. Two ½in. 6BA bolts secure tags which form the chassis (positive) return.

The wiring of this unit should prove to be quite straightforward. Observe the polarity of electrolytic capacitors and put sleeving on any leads where this is necessary to avoid short-circuits. Two thin flexible leads are soldered to the secondary tags of T2, for the speaker connections. A Veropin or projecting wire is provided for the connection to VR1 and another for fixing a black flexible lead for battery negative.

A great advantage of this circuit is that it provides quite high gain while the DC operating conditions of each stage are isolated from those of other stages. The specified transistors are readily available, but if similar types are to hand it is quite likely that they could be used. In some cases, the value of one or more resistors might have to be changed to suit the transistors. This is especially so in the output stage, where unsuitable values may cause high battery drain on the one hand, or very low drain with distortion, on the other.

It is quite a good plan to test the AF amplifier by itself, when it is completed. This is done by taking an AF input to the volume control VR1, which may be left in circuit to avoid overloading. The speaker and battery are connected when the amplifier should draw about 10mA, rising to 25-50mA or so with ample volume.

The parts are assembled with glue and panel pins. Four ¼in. strips are glued flush with the front edges, inside. The receiver can then be inserted as a complete unit from the back.

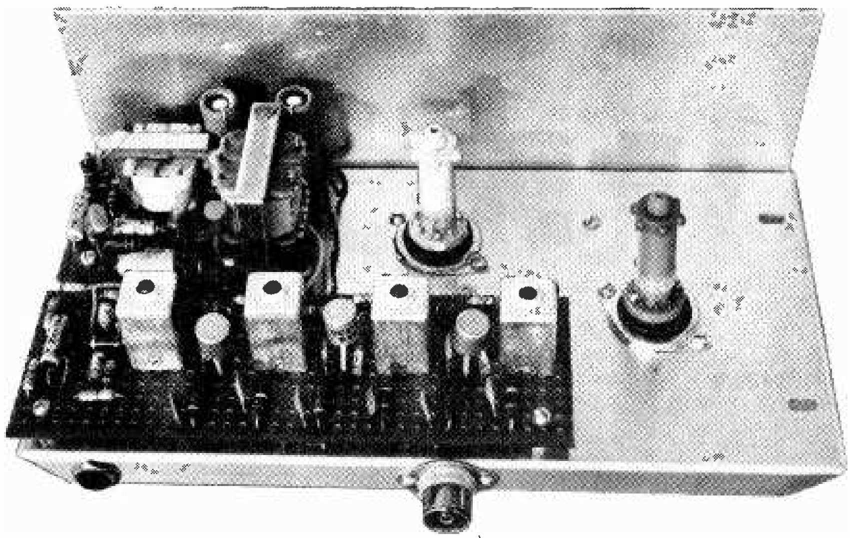
Bolts through the holes which are punched in the chassis flanges hold the receiver in the case. The back is thin plywood or paxolin, held by small woodscrews.

An extending telescopic rod aerial can be fixed to the left-hand side and connected by a short flexible lead to the co-axial socket. The latter can also be used for an external aerial.

AERIALS

In those areas where VHF transmissions are normally well received a telescopic aerial or short wire should be quite adequate. The wire can be 2ft. to 6ft. or so long. The position of the receiver and aerial can influence volume, even with a vertical aerial.

It is also easy to try wires which are very long in terms of wavelength and part of the aerial system can then be out of doors. But with rather long wires the chances of 10·7MHz breakthrough are increased.



This photograph shows the position of the IF and AF boards on top of the chassis.

The negative feedback is not essential and R34 may be omitted or changed to between 470 and 680kΩ. If used, connect it from driver base to one output transistor collector at T2 primary. If volume falls slightly, this is correct. Should oscillation begin, transfer the connection to the other collector.

As the first AF stage is followed by two stages of amplification, a noisy transistor here will cause a hiss in the speaker. This was so in the amplifier shown and was traced to the use of a noisy, cheap surplus OC71 in the first stage. When this transistor was replaced, the noisy background ceased.

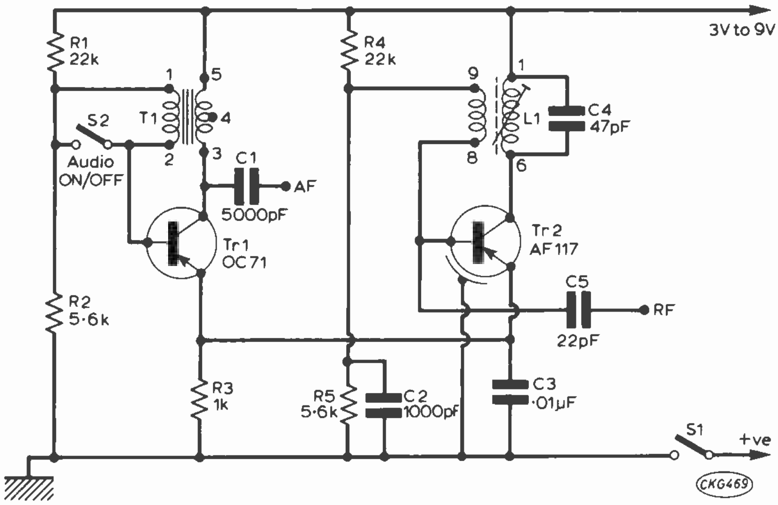
CABINET

The cabinet is made from ¼in. plywood. Each side is 5¼ x 4½in. and the top and bottom are 8⅝ x 4½in. An aperture to match the small internal speaker is cut in the right-hand side and covered with speaker gauze or similar material.

Best possible results are obtained by making a VHF type aerial of suitable dimensions for a chosen band. The aerial can then be high and in the clear outside, a co-axial down-lead going to the receiver. This can give a very great increase in signal strength.

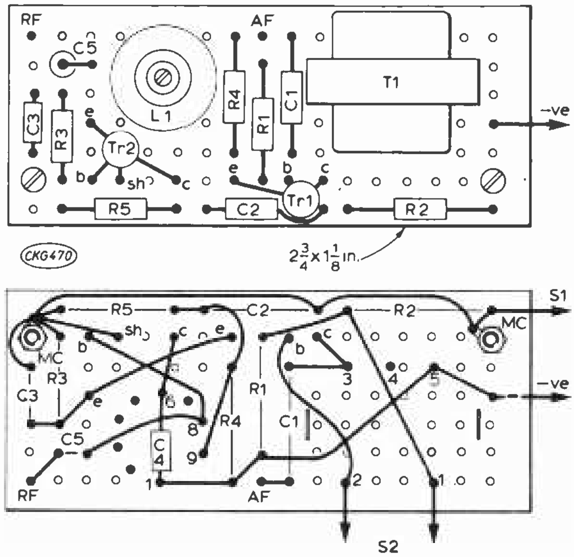
ALIGNMENT GENERATOR

If necessary, a simple 10·7MHz alignment generator can be built using the circuit shown in Fig. 6. Tr1 is an audio oscillator and output from this may be taken, via the isolating capacitor C1, from the "AF" pin. This output may be useful for checking the AF circuits as well as providing amplitude modulation (and a certain amount of FM also) of the RF oscillator Tr2. The RF oscillator is tuned by means of the core of L1 and output can be had via C5 at the "RF" pin. Enough input to the IF strip may be obtained by just placing the generator near the circuits of IFT1.



◀ *Fig. 6: Circuit diagram of the simple alignment oscillator providing RF or modulated RF at 10·7MHz.*

▼ *Fig. 7: Most of the components for the oscillator are mounted on the circuit board shown below.*



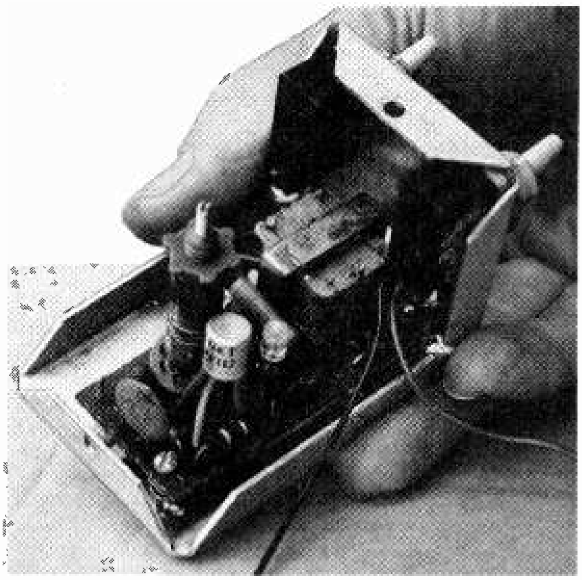
Constructing this generator is straightforward. A 5in. x 2in. flanged "universal chassis" member has its flanges cut 2in. from one end, so that a 2 x 2in. section can be bent at right angles. Two toggle switches (S1 and S2) are mounted on this part, near the top and edges to clear the transformer T1.

The generator is assembled on a small piece of Veroboard, as in Fig. 7. Drill the board for the pins of L1 and T1 and for two ½in. 6BA bolts, which with extra nuts will provide the chassis return and allow the wired board to be mounted in the small chassis described. Two Veropins are inserted, at the points "AF" and "RF" so that leads can be clipped or soldered on, if wanted. If preferred, two small sockets could be mounted between the switches and be wired to these pins.

The circuit was found to operate with any battery from 3V to 9V. When S2 is open, an audio tone accompanies the signal, when this is tuned in. With S2 closed, no modulation is present. The modulated signal is more easily found on a receiver or obtained through the IF amplifier, but the unmodulated signal is used for final alignment, in the way explained.

If an accurately calibrated receiver is available set this to 10·7MHz and rotate the core of L1 to tune the generator accurately to this, with S2 closed for final adjustment. If an accurately calibrated signal generator can be borrowed (but will not be available later) set the generator to 10·7MHz, tune this in on another receiver, and adjust L1 (with S2 closed) for zero beat.

With an FM receiver with 10·7MHz IF, place the alignment generator near this and adjust L1 to the correct frequency. If no such receiver is available, open S2 and place an insulated lead from the "RF" pin near the 1st IFT of the IF amplifier, which should give a strong enough signal for the core of L1 to be adjusted. Subsequently, reduce the coupling as much as possible, so that the IFT cores can be peaked as described, with S2 closed. There is no need for the IFT's to be exactly on 10·7MHz provided all the cores can be peaked and are still free to be moved either way. ■



As can be seen here the oscillator is very small and is easy to construct.

MAGNETIC AMPLIFIERS

PART 1

I. R. SINCLAIR

AMPLIFICATION of d.c. and very low frequencies with very high gain, no valves or transistors, high output power capabilities—these are some of the advantages of magnetic amplifiers. Despite all these advantages, magnetic amplifiers are hardly ever used outside industrial electronics, yet they could be of great use in many amateur applications calling for low frequency amplification; applications such as motor speed control, photoelectric amplification; temperature control, or servo systems.

Probably the strongest reason for this is the lack of complete information on the working of a magnetic amplifier, textbooks either describing the amplifier as if magnetic theory were well known to the reader, or ignoring them altogether. This article sets out to fill the information gap.

MAGNETIC CIRCUITS

One of the causes of the information gap is the way in which magnetism is taught in schools. We learn about magnetic poles and the simple "laws" of magnets as they were known 150 years ago, but nothing of the later developments in magnetic theory which made the solution of magnetic problems so much easier. We cannot, in this space, even attempt to outline the whole of modern magnetic theory, but we can take a look at the part of magnetism regarding magnetic materials and magnetic circuits which forms the basis of magnetic amplifiers.

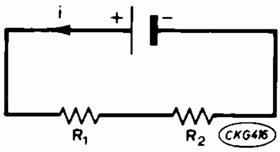


Fig.1 : Simple circuit to demonstrate Kirchoff's Second Law.

Figure 1 shows an electric circuit with a cell producing a current through two resistors in series. Now the voltage (electromotive force) across the cell is equal to the sum of the products of current times resistance for each resistance, or to use the mathematical form, $V=R1\times i+R2\times i$, which is Kirchoff's Second Law. This electrical circuit is simple to deal with because the flow of current is exclusively in the circuit with no current flowing in the air around.

We can draw a very close comparison between the electric circuit of Fig. 1 and the electric magnetic circuit of Fig. 2, but with the exception that magnetic effects can be detected in the air around a magnet and do not confine themselves to the metal portion of the magnet. Designing magnetic circuits is rather like trying to design electric circuits to work in salt water; though the surroundings do not conduct so well as the wires, they have a considerable effect, and current will flow even if there is a gap in a circuit.

If we imagine a magnet as a "cell", having two terminals and a **magneto-motive** force corresponding to the electromotive force of a cell, and the magnetic effect as a flow of magnetic current, or **flux**, then the similarity is obvious. Add to this the idea of **magnetic resistance** or **reluctance** for each piece of the magnetic circuit and we can make a Kirchoff's Law for the magnetic circuit.

$$MMF=R1\times N1+R2\times N2$$

where R is **reluctance** (magnetic resistance) and N is **magnetic flux.**

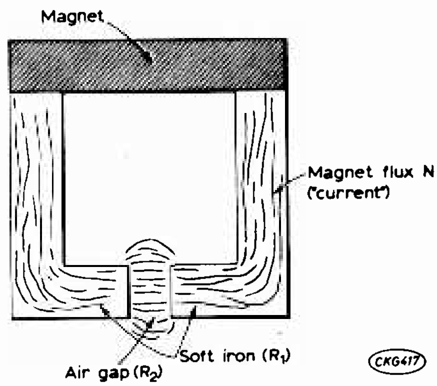


Fig. 2: The magnetic equivalent circuit of Fig. 1.

This idea is useful in the design of transformer cores, relays, and other electromagnetic devices but cannot be used as simply as Kirchoff's Law, because the reluctance is not as constant as the simple resistance of Kirchoff's Second Law, but varies with the flux. Despite this complication, however, the idea of a magnetic circuit is useful, especially since the greatest reluctance in most magnetic circuits is the air-gap (or any other gap not closed by magnetic materials) which is constant at any value of magnetic flux.

It is rather like the case of a circuit of several resistances in series, all about 100Ω but varying with current (as thermistors do) except for one which is about 15KΩ and which "swamps" the others. In the same way, the large reluctance of an air-gap in a transformer core makes design easier because it makes it unnecessary to bother too much about the precise reluctance of other portions of the circuit.

Incidentally, the idea of MMF is used mainly with electromagnets. When permanent magnets are incorporated in a magnetic circuit, as in polarised relays, they are treated as a "negative reluctance" which contributes flux, rather than as a source of m.m.f.

MAGNETIC FIELD STRENGTH AND FLUX DENSITY

If we wind a solenoid and pass a measured current through it, we find that the magnetic effect, provided that no iron or other magnetic material is present, depends only on the current i, and the number of turns of the coil per unit length. For a very long coil, the magnetic field strength is simply $H = N \times i$, and H is measured in units of amperes/metre. As far as we are concerned this is a measure of the force which this solenoid would exert on a compass needle at a distance.

If a core of iron or any magnetic alloy is now placed inside the coil, the effect on a compass needle is greatly increased. The magnetic field has magnetised the iron, and the two different effects are adding together. We can measure this in the same way, but several old and confusing mistakes can be avoided if we measure this new effect by using **induction.** When a current changes in a coil which is wound on the same core as another, there is a voltage induced in both coils which is proportional to the number of turns and the rate at which current is changing. The quantity which changes the iron core is the **magnetic flux** which we met earlier and is measured in Webers or volt-seconds.

We find that the effect of a solenoid with an iron core can be measured by dividing the flux in the core by the area of cross-section of the core; this unit is called **flux-density**, and it is measured in Teslas ($T = 1$ Weber/m^2) and given the symbol **B**.

RELATION BETWEEN B AND H

If we set up the solenoid of the first example with an ammeter for measuring current, so that we can calculate H and a search coil close by connected to a flux meter so that we can measure B, we can place a magnetic material in the core of the solenoid and measure both B and H over a range of values. When we do so, we get a graph of the kind shown in Fig. 3. Starting from $H = 0$ and slowly increasing, the curve rises sharply and then flattens off until the rate of rise is equal to the rate of rise of H. When H is decreased again, the value of B does not take the same values as it did on the way up.

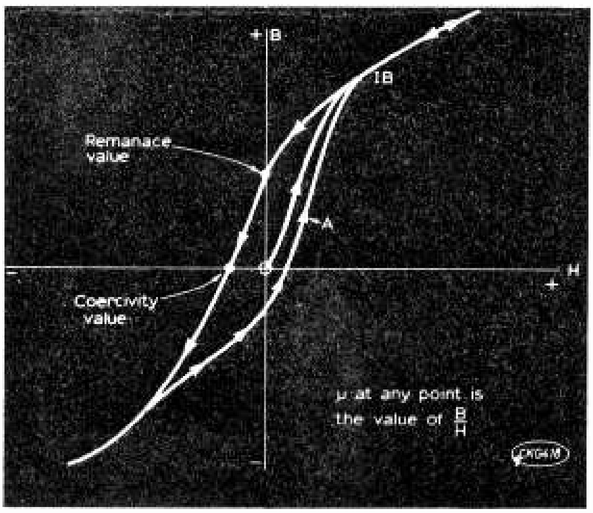


Fig. 3: Graph showing relation between 'B' and 'H'. (Note: For 'remanace' read 'remanance'.)

The value of B left when $H = 0$ again is called the **remanance** and measures the ability of the material to be permanently magnetised. To reduce B to zero, an opposite value of H (called the coercivity) must be applied. As the values of H in the opposite direction are increased, the curve traced out becomes the opposite of the one previously traced, but the first portion of the graph is never traced again unless the iron can be completely demagnetised (by heating, for example) and the experiment repeated.

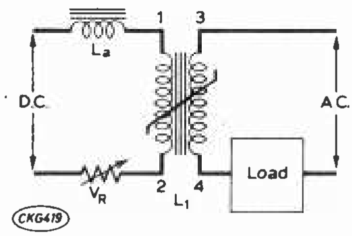


Fig. 4: Simple magnetic amplifier. The DC input to the 'primary' is not a mistake! See text.

The interesting portions of this curve, called a hysteresis curve, for our purposes are the steep sides and the flattened top. When the current in the coil is at a value corresponding to point A on the curve, the flux density changes considerably with a change of current, a condition which is ideal for a transformer or choke since it means the greatest possible reverse voltage, and so the maximum inductance. When the current in the coil is at a value above point B, the change of flux density is *very* much less, and the material of the core is said to be **saturated.** In this condition, an increase of current in the coil causes very little increase of flux density, very small induced voltage, and so very little opposition to change of current (low inductance) so that large currents can flow. A core which includes an air gap limits the flux density because of the reluctance of the air gap and so reduces the possibility of saturation, which can have serious effects in transformers. A core which consists of a circle of magnetic material will saturate easily because of its low reluctance.

Many text books quote the permeability of a magnetic material μ as if it were a constant. As can be seen from the curve of Fig. 3, it is not a constant, but varies with the magnetic field strength, so that the only value which has any real meaning is the maximum permeability, the value of μ at point A on our curve, because this indicates the usefulness of the material for a transformer core.

A SIMPLE MAGNETIC AMPLIFIER

Figure 4 shows the circuit of the simplest form of magnetic amplifier. This consists of the choke L1 which is provided with two windings on a core of material which saturates easily (no air gap) and which has a very small area enclosed by the forward and return paths, meaning that the energy spent in magnetising and de-magnetising the core is not too large. Such a multiple winding choke (it is *not* a transformer, despite the similarity of the symbol) is termed a **reactor.** The winding marked 3, 4 is used as a choke in an a.c. secondary circuit, and the winding marked 1, 2 is used to apply magnetic flux to the core by passing a steady current. The winding 1, 2 is usually known as the **control winding,** and a

choke La is wired in series with this winding to prevent a.c. being fed to the control voltage source through transformer action in the reactor.

Imagine that no d.c. is applied to the control winding. The winding 3, 4 then acts as a choke (providing that the current through it is not too large) so that only a fraction of the alternating voltage applied to the secondary circuit can appear across the load resistor. If now some current flows in the control winding, the condition can be reached where the sum of flux due to the control winding and flux due to current in the secondary winding cause the core to saturate. At saturation, the inductance of the secondary winding is very low and a high current flows in the load, so that the average current through the load increases. This is equivalent to shifting the bias conditions of the amplifier, and this shift in the operating point is shown by the curves of Fig. 5.

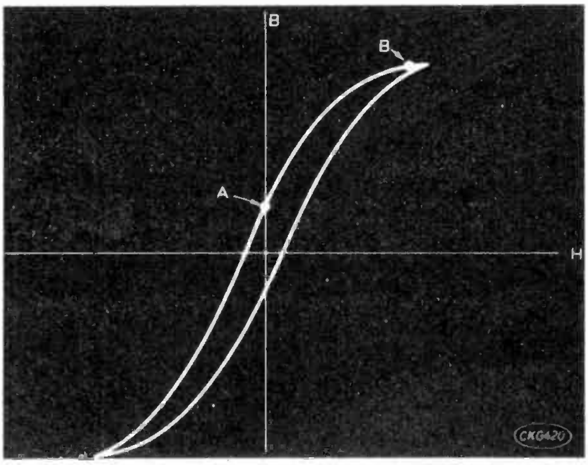


Fig. 5: At A, $\mu = \frac{B}{H}$ is high, and the inductance of the coil (proportional to μ) is high. At B the reverse obtains.

This type of magnetic amplifier is known as a straight-saturating amplifier and is seldom used because the sensitivity is low and the waveform across the load is distorted. It does, however, illustrate well the principles involved in magnetic amplifiers, and is easy to construct. The current amplification produced is equal to the ratio of turns of the control winding to the turns of the secondary winding (that is, the same as the ratio of a conventional transformer); note that the step up is from d.c. in the control winding to a.c. in the secondary winding so that this offers a method of controlling a.c. by means of a d.c. source.

SELF SATURATING MAGNETIC AMPLIFIERS

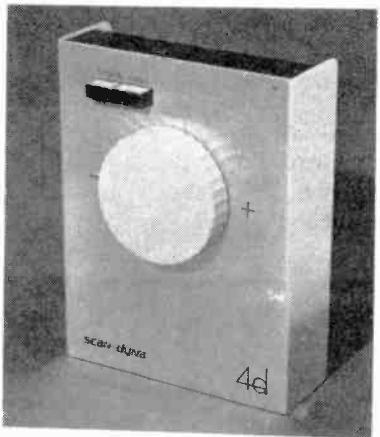
For many purposes, greater sensitivity and a better waveshape are required and these requirements have resulted in the self saturating magnetic amplifier, which uses the secondary current to contribute more to the saturation of the core. This is achieved by making the secondary current travel only in one direction in the core. If the core is already saturated by the control current the inductance is very low and the secondary current is unimpeded.

TO BE CONTINUED NEXT MONTH

PRODUCTION LINES

colin riches

4D STEREO



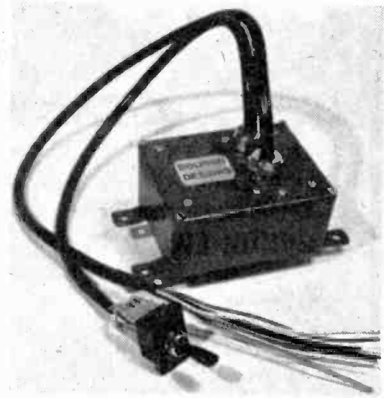
This is a Scan-Dyna 4d stereo unit. Used in conjunction with a stereo amplifier and 4 speakers, it damps the direct signals to two back speakers, permitting the reflected sounds from the back to be made separate from the direct sound of the front two speakers.

The outputs from the amplifier channels are fed to the 4d unit. The four speakers are then plugged into DIN speaker sockets on the unit and the large knob can be rotated to control the volume of the back two speakers.

By use of the 4d unit, a 4-channel effect is produced which gives a very pleasing sound. In the unit (shown) the push-button marked "front" disconnects the back two speakers so that the stereo amplifier can operate as a normal 2-channel system. The push-button "test" is used to adjust correct balance between the two front speakers. One point of warning, however, it is essential that a correct phase connection is made between the amplifier and the 4d unit. Price is £12·90 plus VAT and your local hi-fi dealer should have 4d units in stock.

ELECTRONIC IGNITION

A recently announced transistorised ignition system from Dolphin Designs has its casing made from diecast aluminium with a special epoxy finish. All metal parts are cadmium plated and connections are through watertight glands. All metals are plated to prevent electrolytic corrosion and the circuit is built on a fibreglass board with a double thickness of copper. The unit is designed for 12V cars with either positive or negative chassis.



A dash-mounted switch will revert the car to conventional ignition whilst driving either for comparison or the unlikely event of failure. The ignition system is priced at £12·95, plus 30p postage, plus VAT, and is available from: *Dolphin Designs, 59 Leighton Avenue, Leigh-on-Sea, Essex.*

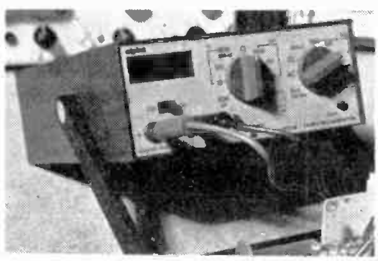
PEAK PROGRAMME METER

The PPM concept was developed by the BBC for checking modulation depths at transmitters, and the modern derivative (BS 4297) is used in the broadcasting and sound recording fields. The standards define attack and decay times and logarithmic meter scaling, with positive and negative peak detection as some sounds have + and − levels differing by up to 8dB. The drive circuit, produced by Surrey Electronics is for 1mA L.H. zero meters and is available as a kit at £8 or built and aligned at £12.

The attack time is 2·5mS, decay rate 1dB per 100mS and detection + and − peaks within 0·5dB. Display is a log. meter scale of 6 with 4dB divisions (−22 to +4) or BBC style 1 to 7. Accuracy is within 0·3dB and frequency response −0·5dB (20Hz–20kHz) −1·0dB (12Hz–30kHz). Input impedance is 100kΩ and supply is from +24V to 50V. Consumption is 25mA.

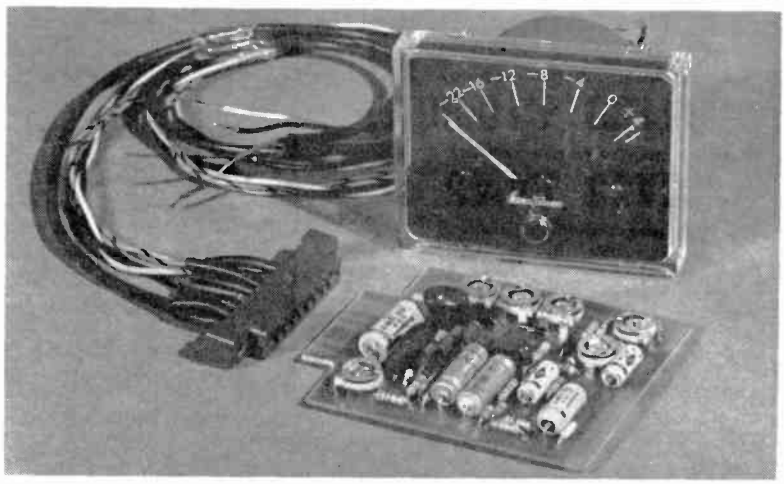
Ernest Turner special "ballistics" meters type 642 cost £9 and 643 £10·70. Further information from: *Surrey Electronics, 24 The High Street, Merstham, Redhill, RH1 3EA, Surrey.*

ADVANCE ALPHA



This digital multimeter from Advance costs £55. A total of 24 ranges indicate d.c. voltages from 1mV to 1kV, a.c. voltages from 1mV to 500V, d.c. and a.c. current from 0·1μA to 1A and resistance from 0·1Ω to 10MΩ.

Two other instruments in the Advance "pipeline" are the TC17 timer counter and DVM44 digital voltmeter. *Advance Electronics Ltd., Instrument Division, Raynham Road, Bishops Stortford, Herts.*



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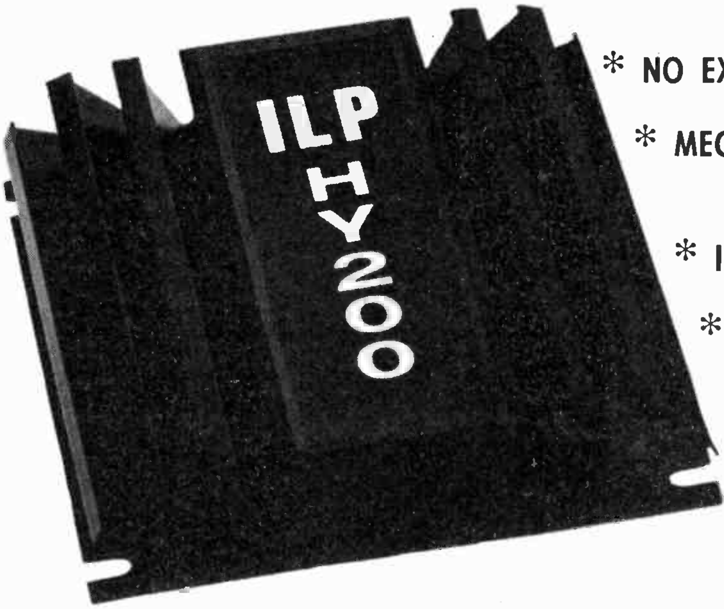
100 WATTS!



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Only 5 connections are provided, input, output, power lines and earth.

OUTPUT POWER: 100 watts RMS; 200 watts peak music power. **INPUT IMPEDANCE:** 10kΩ. **INPUT SENSITIVITY:** 0Dbm (0·775volt RMS). **LOAD IMPEDANCE:** 4–16Ω. **TOTAL HARMONIC DISTORTION:** less than 0·1% at 100 watts, typically 0·05%. **SIGNAL : NOISE:** better than 75Db relative to 100 watts. **FREQUENCY RESPONSE:** 10Hz–50KHz ±1Db. **SUPPLY VOLTAGE:** ±45volts. **APPLICATIONS:** P.A., Disco, Groups, Hi-Fi, Industrial. **PRICE: £14·90** inc. VAT & P&P. Trade applications welcomed.

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I.C. OF THE MONTH

L.A.J. IRELAND

Number 39 SGS TBA435 VOLTAGE REGULATOR

STANDARD portable transistorised equipment commonly operates from a 9 volt battery supply. When the occasion arises for such devices to be operated from a 12 volt supply, for example on a car battery, it is clearly necessary to provide some form of voltage dropper. This is not as simple as at first appears, due to the common use, for example, of class B output stages in portable equipment. Since it is not a constant current load, therefore, it is impossible to insert a simple resistor to provide the reduced supply voltage.

Neither is a potentiometer arrangement adequate, since it requires a standing current greater than the drain of the device in use. Zener diodes face a similar objection, and the integrated circuits available to date have generally required complex interconnections and several discrete components to set the required output voltage. Hence the advantages of the TBA 435, a simple three terminal device specifically designed to provide a fixed output voltage of 8·5 volts when operated from any power source between 10·5 and 20 volts. Its applicability to the problem of operating 9 volt transistorised equipment from automobile power supplies is obvious.

Performance

The device is capable of supplying continuously a current of over 100mA. at the rated output voltage, representing an internal power dissipation of 0·75 watts, increasing to 4 watts if mounted on an adequate heat sink. The circuit is, of course, fully protected against overload and even short-circuit conditions, while maintaining the rated output voltage to within 1% over the design range.

The operation of the protection equipment is fully illustrated in Fig. 1, which clearly displays the drop in output voltage if an attempt is made to exceed a safe current. When in automobile use, it may be found advantageous to precede the regulator with an RF choke, to prevent ignition interference entering the system through the power supply lines. However, the IC itself has a capacity to reject ripple and high frequency noise by a factor of some 50dB, a property which is highly significant both for mobile and mains-driven equipment.

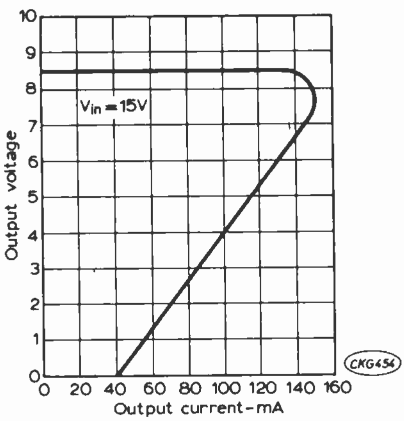


Fig. 1: Output regulation curve. Note action of protection circuit as rated current is exceeded.

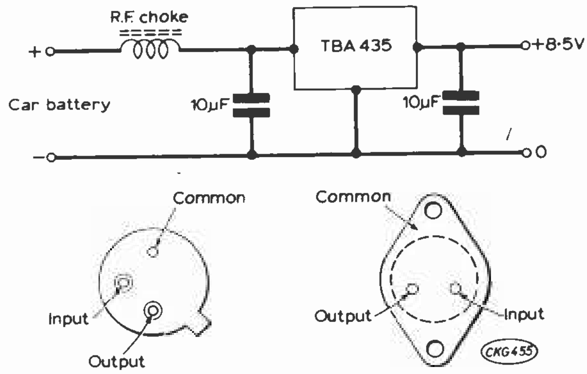


Fig. 2: Practical application of TBA435 and connections for 100mA and 600mA types.

It might be of interest to point out that the TBA 435 is merely one of a series of similar three-terminal integrated circuit voltage regulators with analogous operating parameters but with a range of output voltages. In any case where a power supply must provide a well regulated protected output at a fixed voltage, the appropriate unit from this series should certainly be evaluated for the application.

Type	TBA 625A	L 005	TBA 435	TBA 625B	L 036	TBA 625C	L 037
Output voltage	5	5	8·5	12	12	15	15
Rated current mA	100	600	100	100	600	100	600

Note: The NE555 reviewed in the May issue is made by Signetics and not SGS.

practically wireless commentary by HENRY

No. 100 Ton Up

NOT until one of my colleagues and regular readers reminded me of the passage of time was I aware that this contribution is the hundredth Old Henry has made to PW. Have you really endured me that long?

Anniversaries are a time for recall and for resolution. Recall is a facet of Henry's waffling that may at times have seemed to take precedence. Resolution should be

Brimming over with human kindness

saved for innovatory dates, the Chinese New Year, the day after the annual holiday, any Monday morning . . .

Instead, if you'll bear with me, I would like to blast off about a couple of subjects that have recently roused my ire—and which, according to my critics, seem to exemplify Henry's approach to radio design, construction, and marketing.

First, the last. And I mean the retailer; your local friendly dealer, as the Radio & Television Retailers' Association would have us believe. Brimming over with the milk of human kindness, intent on social justice and the welfare of his customers, ineffably altruistic . . .

Believe me, the radio retailer who really cares; who came up from bright emitters and the days of the catswhisker; who will spend his precious spare time finding better ways of providing P.A. for the nearby Old Folks Club; whose advice is geared to needs and not mere profit: that chap is as rare as a fridge in an Eskimo's igloo!

Monthly, one reads glowing tributes in the enthusiast magazines from readers who, despairing of help from local dealers, took their gear to the manufacturer, and had satisfaction. I feel a bit wry about that—better that the manufacturer should give his local agent good backing.

I have even read examples of 'turn-around' repairs being done on equipment for which I have had outstanding parts orders for months, and can only think, with typical Henryesque cynicism, that the manufacturer was really thinking of his 'public image'. But that's another story.

As good an example as any of the way 'the trade' does not care was to be seen at Sonex, where Donald Aldous wore himself into the ground in organising a series of lectures. During the two trade days, attendance at the lectures was abysmally small.

Practically the only interest was shown when a quadraphonic demonstration was given, when the lecture theatre became half-filled.

I don't want to enter the surround-sound arena just now, but would agree that discrete four-channel is the only truly 'hi-fi' way of doing things: that, just as with gramophone records, mono/stereo, f.m. broadcasting, commercial radio, colour TV and any other technical innovation, compromise has resulted from the needs of compatibility, and we shall probably have some inadequate system ultimately foisted upon us.

The slogan seems to be: 'Never mind what's best. What can we get away with?'

Very few dealers are today happy to take in repairs. They will tell you that their service department is already stretched to the limit to service the stuff they sell. which, when you think about it, argues that either their workshop is under-staffed or the stuff they sell continually goes wrong.

The truth is that there is little profit in service. The retailer does not regard good service as necessarily fostering goodwill. In our own establishment, the 'Boss' is fond of saying: 'One second complaint outweighs twenty well-done jobs.'

Which brings me to my second grievance . . . . It *is* possible to make service pay, but only if it is run as a strictly economic business. And that, friends, entails *our* paying the true price for what we have done.

Take the case of the ordinary interconnecting lead. You can buy made-up packs of practically any plug or socket to any other for round about a pound, often less. But if you want a 'special' lead made by an otherwise busy engineer, you must expect to pay half as much again.

He has to fit this between other jobs, sort out matching more often than not, forage among the rubble for plugs and disentangle cable, set up his mini-vice and lick the end of his soldering iron, muttering incantations the while.

In a workshop like ours, where one of my colleagues waits till I am looking the other way, then 're-organises' all the drawers of

muttering incantations the while

small parts, it is lead-making that is most sick-making, and wildly uneconomic.

Perhaps that is why the small dealer no longer exists, and the package-seller who has taken his place shuns service: because we, you and I, are unwilling to pay our whack!

0-99 seconds PROCESS TIMER

G.H. WOODS

ENLARGER timers generally rely mainly on charging or discharging capacitors through variable resistors and an appropriate switching circuit. These timers can give a good repeat accuracy of $\pm 0{\cdot}25$ seconds but actual settings can only be as accurate as can be manually calibrated, using a stop watch, in most cases no better than $\pm\frac{1}{2}$ second mid-range.

This IC Timer relies for its accuracy on the mains supply frequency; it has a very high repeat accuracy, requires no calibration and is switchable from 0-9·9 seconds in 0·1 second steps and 0-99 seconds in 1·0 second steps—the accuracy directly proportional to that of the mains. It has been my experience that the 0-9·9 second range is useful when printing in colour when filter changes dictate exposures of seconds and fractions of a second.

CIRCUIT DESIGN

The circuit uses nine TTL i.c.'s. The timing is derived from 50Hz mains supply frequency which is obtained from the secondary of T1 Fig. 1 and fed via a capacitor C1 to a two transistor Schmitt trigger circuit the output of which goes to a control gate. The output from this gate goes to an SN7490, IC4 in Fig. 2, used as a divide by five. The 10Hz output from this goes to a divide by ten, IC5, to give 1Hz. Two more SN7490's, IC6 and 7, are used as divide by ten circuits; the BCD outputs of each one being decoded by an SN7442. The ten outputs of the SN7442's pass to the single pole twelve way wafer switches S2 and 3.

To start the timing sequence S1 is depressed which causes a logic pulse to be fed to the input of a flip-flop of an SN7472, IC3, one output of which goes to the control gate G1 so that 50Hz is applied to the driving circuit; and to gate G2 which is connected to gate G8 controlling the driving circuit. The other output of IC3 goes to the zero reset of the dividers IC4-7.

If, for instance, S2 is on position 4 and S3 on position 5 then when 45 seconds have elapsed the outputs from the wafer switches are at logic 0 instead of logic 1 as they would have been before the beginning of the timing sequence. These two outputs are inverted using two nand gates G3 and 4 the outputs of which are applied to another nand gate G5 whose output will be at logic 0, when the 45 seconds have elapsed and at logic 1 at any other time.

The output is used to clear the flip-flop IC3 so causing it to revert to its original state which blocks the 50Hz clock pulses, clears the dividers IC4-7 and

★ components list

Resistors

R1	47kΩ	R5	47Ω
R2	2·2kΩ	R6	4·7kΩ
R3	2·2kΩ	R7	27Ω
R4	3·3kΩ	R8	150Ω

All ¼W 10%

Capacitors

C1 0·68μF C2 1000μF C3 10μF

All 12VW

Integrated Circuits

IC1	SN7442	IC4	SN7490	IC7	SN7490
IC2	SN7442	IC5	SN7490	IC8	SN7400
IC3	SN7472	IC6	SN7490	IC9	SN7400

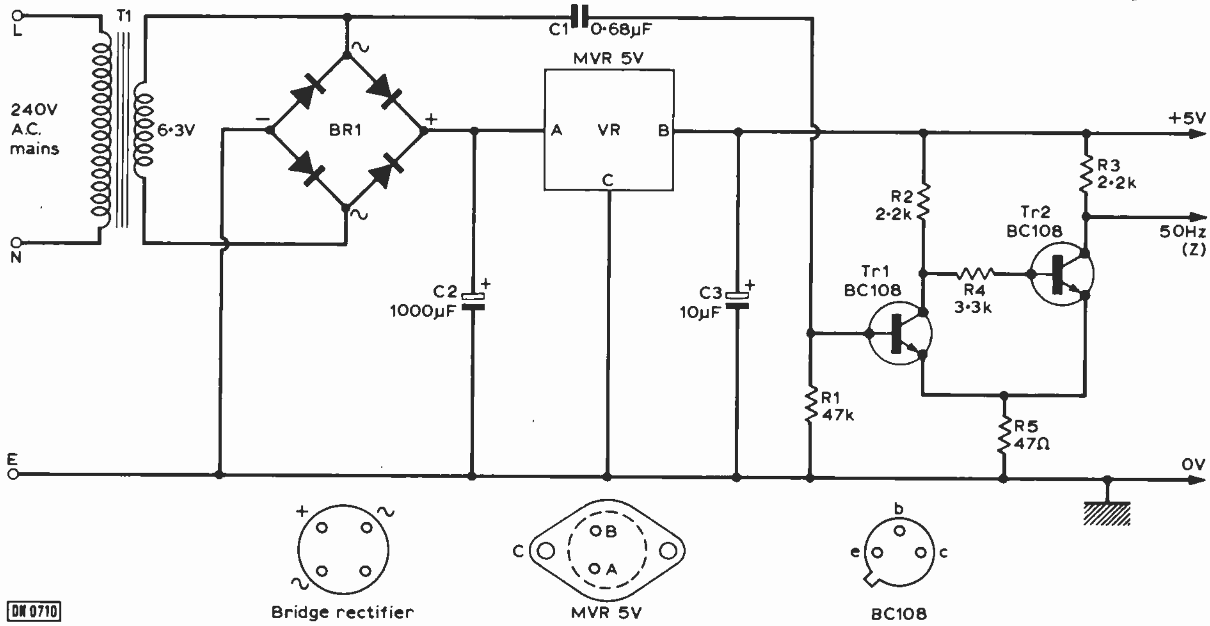
Semiconductors

Tr1	BC108	Tr3	2N2926	D1	40430
Tr2	BC108	VR	MVR5V (RS)		(400V 6A)

BR1 50V 1A bridge rectifier

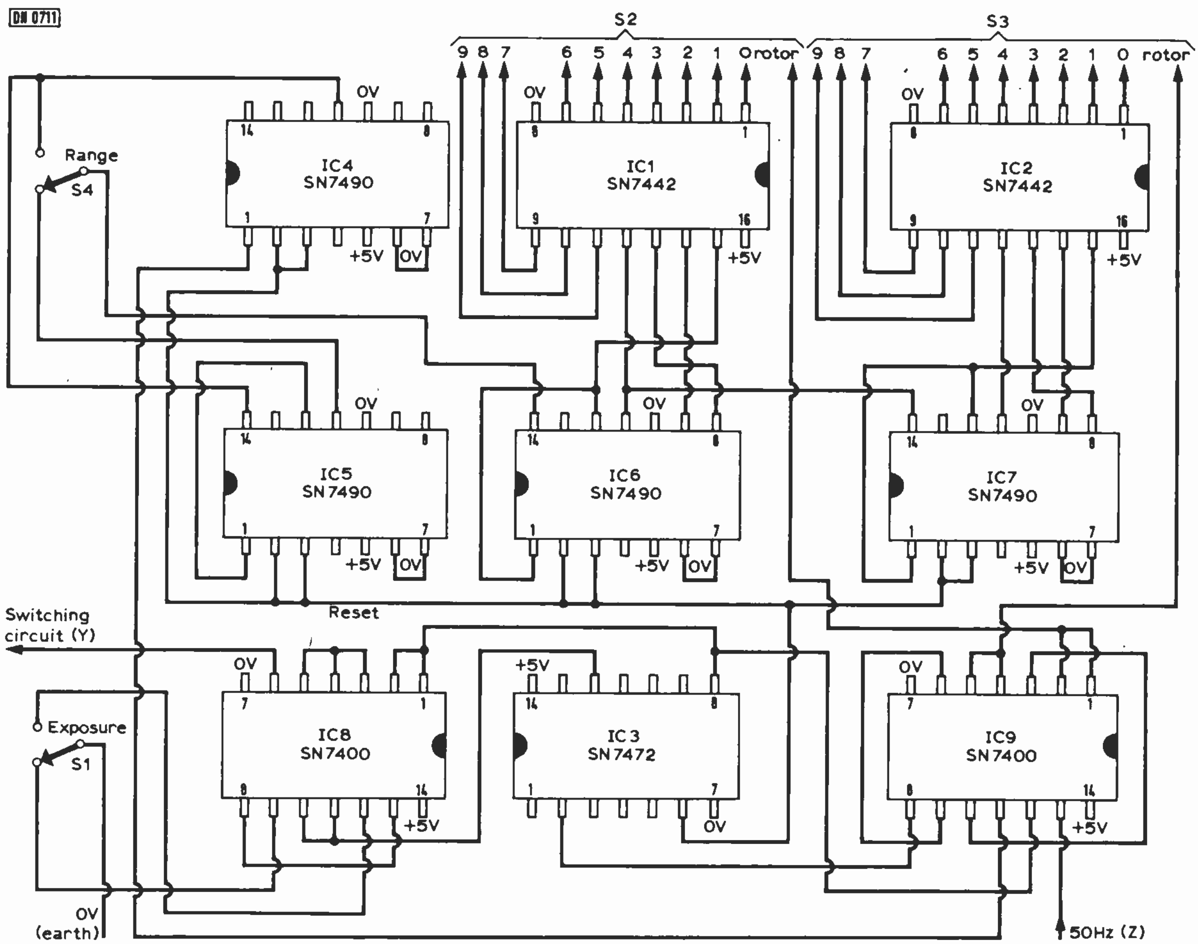
Miscellaneous

T1, transformer 230/6·3V 1A .S1, SP biased toggle switch. S2 and S3, 2 x SP 12 way wafer switch. S4, SP changeover toggle switch. Veroboards, 3¾ x 3¾in. 0·1in. matrix, 3¾ x 2½in. 0·1in. matrix. Veropins, knobs. Case 8 x 6 x 3in. with lid. Reed coil and switch for 3-5V operation.



▲ *Fig. 1: Circuit of 5V stabilised power supply and two transistor Schmitt trigger arrangement.*

▼ *Fig. 2: Diagram of interconnections and supply leads for the nine integrated circuits.*



switches the triac off via the reed switch. Two nand gates are connected so as to eliminate contact bounce at S1 (gates G6 and 7).

Switch S4 is an added facility which allows the circuit to count to ten seconds in 0·1 second steps and this is achieved by merely short-circuiting one of the divide-by-ten i.c.'s IC5 causing 10Hz to be applied to IC6 instead of 1Hz. When either or both wafer switches are set on positions 11 and 12, closing S1 switches the triac on which is held on until S1 is closed again; this facility allows the enlarger to be on for focusing.

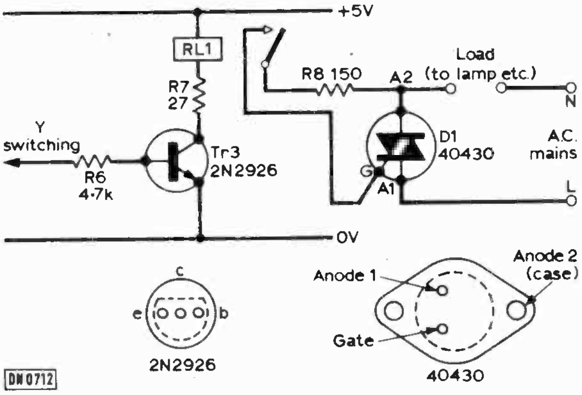
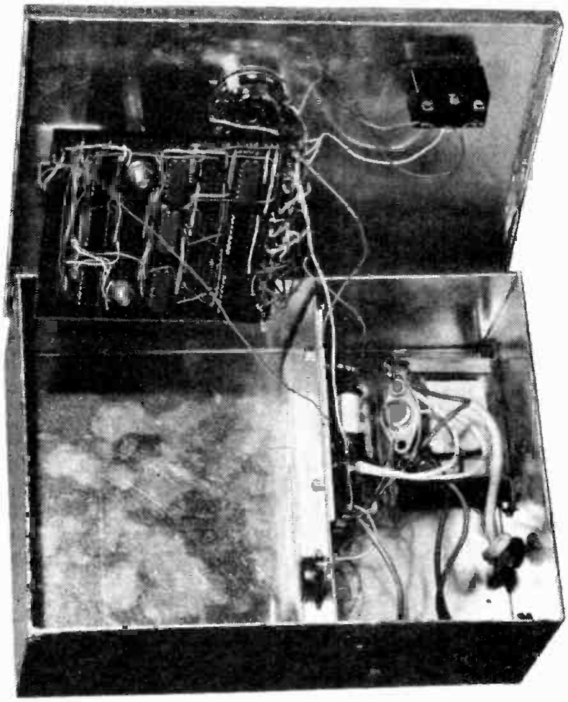


Fig. 3: Isolating stage using a reed relay to control the triac switch.



The IC board is mounted in the lid of the box on spacers to minimise the length of the wiring to the switches.

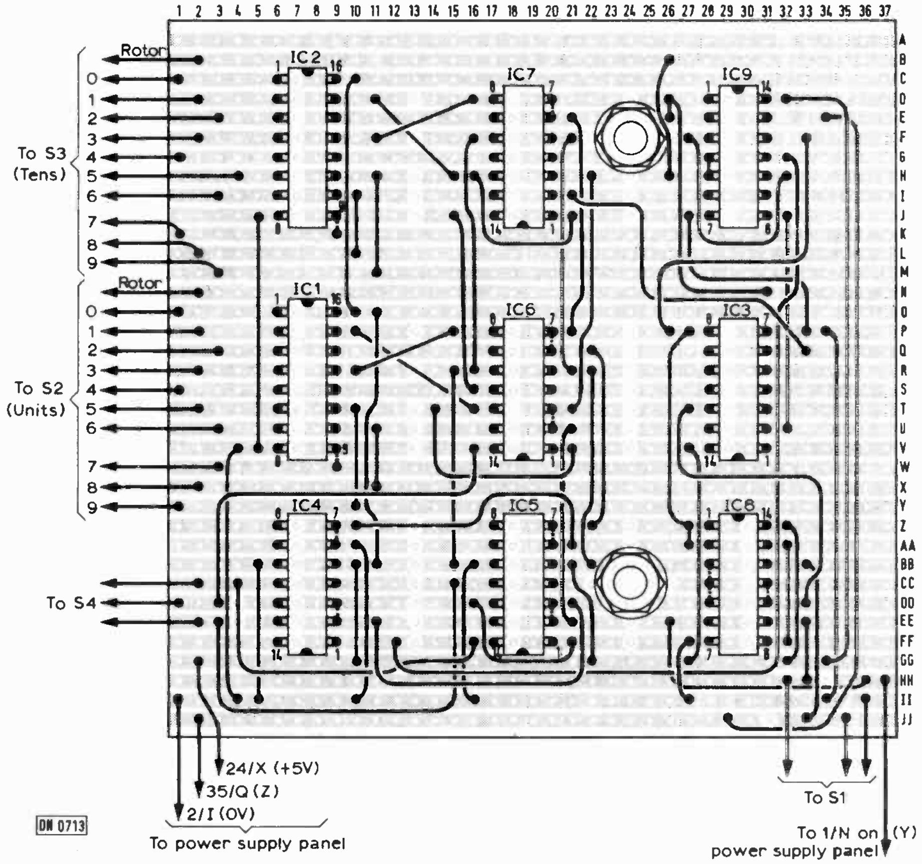


Fig. 4: Placement and wiring of the IC's on the veroboard panel. Note carefully all breaks in copper rails.

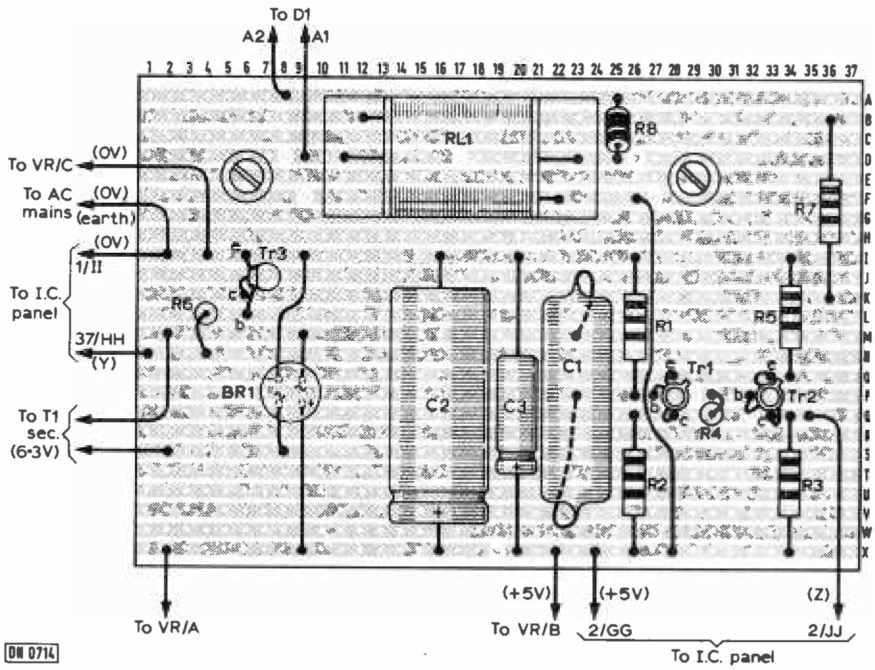
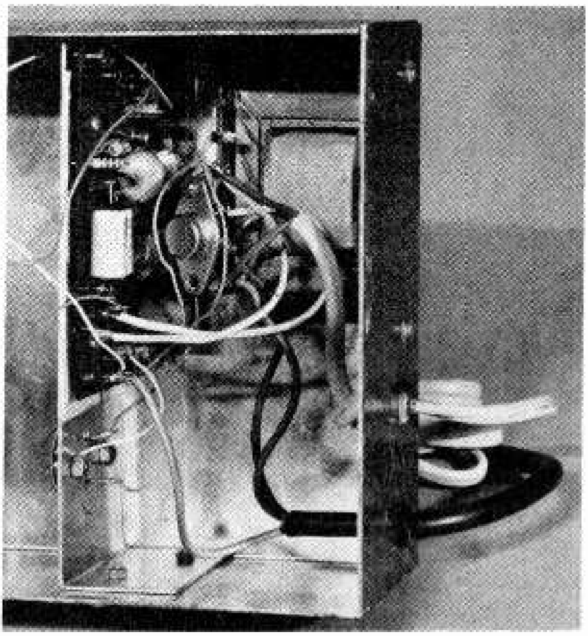


Fig. 5: Layout of panel carrying the power supply, Schmitt trigger circuit and reed relay.

Although the output of the final i.c. (IC8) to the switching circuit is compatible with the gate current required for the triac, the triac cannot be driven directly as it would mean that all the i.c.'s would be live and could not be earthed. In order to overcome this problem a reed relay is driven from IC8 and the triac switched from that. Unfortunately the reed relay used is not TTL compatible so an interface circuit consisting of a 2N2926 is used between IC8 and the reed relay, Fig. 3.



The panel of Fig. 5 is mounted on insulating spacers on the aluminium partition as well as the 5V regulator. The triac is mounted on a tag strip, part of the mains transformer.

Unfortunately, due to the high cost of i.c. holders (as much as twice the cost of some i.c.'s) they have not been used in the construction of this circuit. The i.c.'s have been mounted directly on to the 0·1in. matrix Veroboard, Fig. 4, care being taken not to allow the i.c.'s to get too hot although that is not much of a problem providing one solders them quickly and in rotation. The wiring between all components should be as short as possible (never any longer than 10in.) so as to prevent spurious triggering of the i.c.'s.

The construction is fairly straightforward, the whole unit being mounted in an aluminium box. The switches S1-4 are mounted on the lid as is the IC board, held by 2in. long 2BA nuts and bolts with spacers to provide a stand off so that the wires from S2 and S3 to the pins on the i.c. board are as short as possible. For convenience the triac was mounted on the transformer which was bolted to the case.

The power supply reed relay and interface circuit for the triac are mounted on Veroboard, Fig. 5, which is fixed to a piece of aluminium fixed across the inside of the box.

When the wiring has been completed and checked *thoroughly* (without the triac connected) it is possible to test the timing.

The switches S2 and S3 should be set to each of their positions and the timing tested: if it is not correct then one should look for faulty connections, missing drilled holes in Veroboard and solder bridges. When testing the timing it is important that the triac is not connected. Use a meter on the reed switch.

Because of the fact that the triac cannot be driven directly from the i.c.'s it is necessary to use an interface circuit. The i.c. board output goes to a resistor and transistor which switches hard-on when it receives a logic 1 voltage and a reed relay is energised which provides the gate current for the triac to turn on. Using a reed relay in this way the i.c.'s are completely isolated from the mains. ■

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Tremolo gene

THE use of electronic devices to modify the sound of an electric guitar has become very popular in recent years, and the equipment of a guitarist often includes such devices as echo chambers, 'fuzz" boxes and 'wah-wah' pedals. This article describes a tremolo generator which can be used not only with electric guitars but also with most other electronic instruments.

REQUIREMENTS

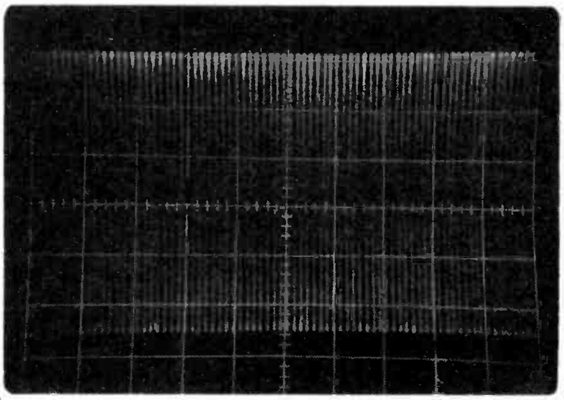
To add tremolo to a musical sound it is necessary to vary the loudness of the sound repeatedly at a very low frequency. In the terminology of electronics, this process is called *amplitude modulation.*

Figure 1 shows a block diagram of the tremolo generator. The input signal coming from the guitar has a more or less constant amplitude. The tremolo signal is generated by a low-frequency oscillator, whose output frequency and amplitude can be varied by means of foot pedals. The input and tremolo signals are fed into an amplitude modulator, whose output consists of the input signal with an amplitude which varies at the frequency of the tremolo signal.

Figure 2 shows oscilloscope traces of the signals involved. The input signal (a) is, in this case a, 400Hz wave generated by an audio signal generator. The tremolo signal (b) is a signal of much lower frequency, about 8Hz. The output signal (c) consists of the 400Hz input modulated at 8Hz.

CIRCUIT DESCRIPTION

The circuit diagram is shown in Fig. 3. It is easier to understand the circuit if the various sections are considered separately.



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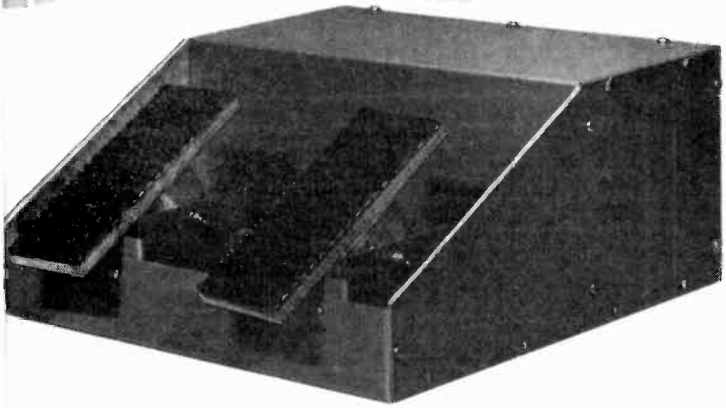


R. MORGAN

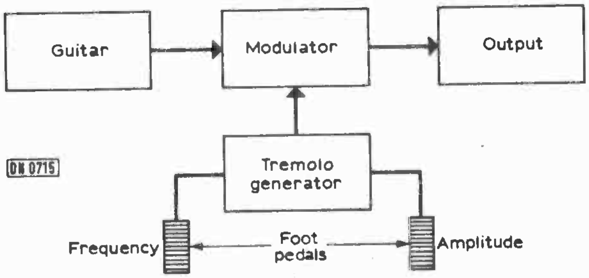


Fig. 1. Block diagram of the stages comprising the tremolo generator.

Fig. 2(a) left, shows an input signal of 400Hz from a signal generator while 2(b), centre, is a much lower frequency signal from the oscillator in the tremolo generator. The two signals are fed to a modulator stage producing the signal shown in 2(c), right.

Oscillator

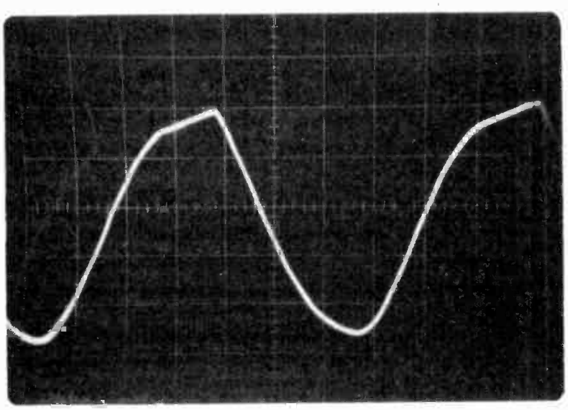
The oscillator is required to produce a reasonably sinusoidal output at very low frequencies, from about 1Hz to 10Hz, and the usual circuit for this purpose is the Wien bridge oscillator. In Fig. 3 transistors Tr1 and Tr2 form a Wien bridge oscillator whose frequency is determined by resistors VR1+R3, VR2+R4, and capacitors C2, C3. The frequency can be varied over the required range by varying VR1 and VR2, which are ganged.

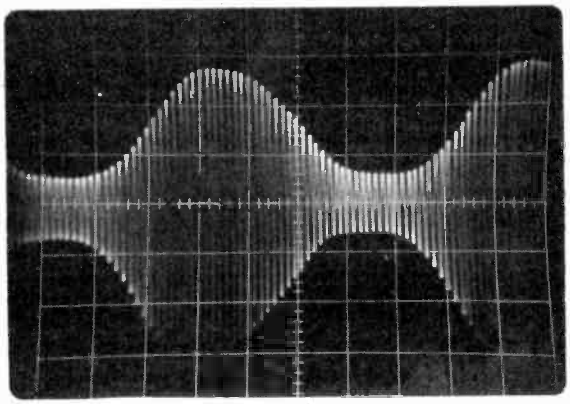
This type of circuit requires an amplitude controlling device to keep the output amplitude at a level low enough to avoid saturation of the transistors; without this the output increases to a point where severe distortion occurs. The usual amplitude control device is a thermistor, which can be expensive, but by suitable modification of the circuit it is possible to use a much cheaper device, namely a 6V bulb LP1.

The output of the oscillator is fed into a potentiometer, VR4, the setting of which determines how much of the oscillator output is fed into the next stage. Consequently VR4 acts as a modulation depth control.

Modulator

The musical signal from the guitar is fed into Tr3 and amplified. The degree of amplification depends on the current through Tr3 and if this current is varied the amplitude of the output from Tr3 is also varied. The current through Tr3 is controlled by Tr4, so that when the oscillator signal is fed into Tr4, the current through Tr3 varies at the same frequency as the oscillator signal. Consequently the amplitude of the output from Tr3 also varies at the frequency of the oscillator signal. The output from Tr3 is therefore the musical signal modulated at the frequency of the oscillator.





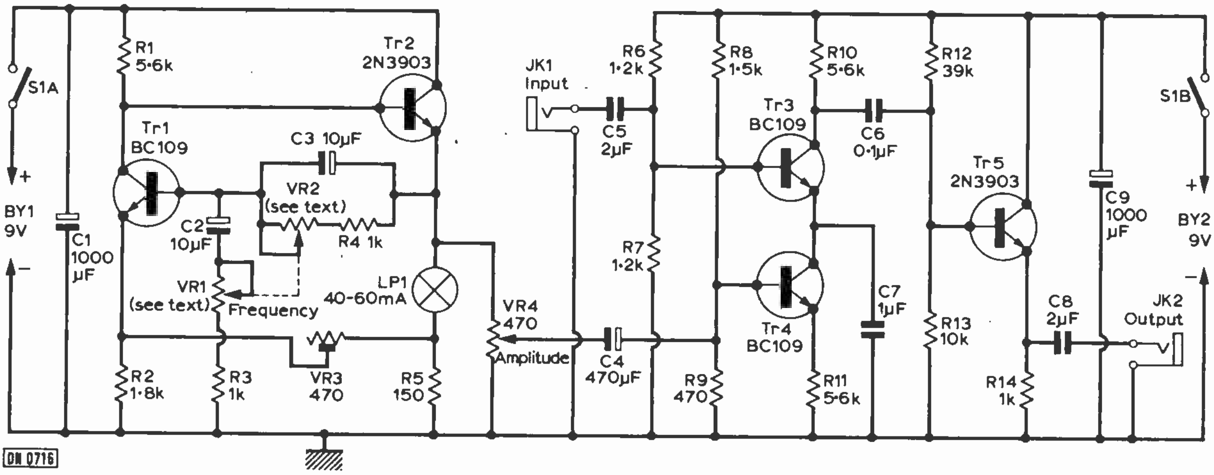


Fig. 3. Complete circuit diagram of the tremolo generator. Note that separate batteries are employed to avoid using expensive decoupling components.

★ components list

Resistors

R1	5·6kΩ	R6	1·2kΩ	R11	5·6kΩ
R2	1·8kΩ	R7	1·2kΩ	R12	39kΩ
R3	1kΩ	R8	1·5kΩ	R13	10kΩ
R4	1kΩ	R9	470Ω	R14	1kΩ
R5	150Ω	R10	5·6kΩ		

All resistors ¼W 10%

VR1 50kΩ linear VR3 470Ω pre-set

VR2 50kΩ linear VR4 470Ω linear

See text for further information on potentiometers

Capacitors

C1	1000μF	C4	470μF	C7	1μF (poly)
C2	10μF	C5	2μF (poly)	C8	2μF (poly)
C3	10μF	C6	0·1μF	C9	1000μF

All 12V or more working voltage

Semiconductors

Tr1	BC109	Tr3	BC109	Tr5	2N3903
Tr2	2N3903	Tr4	BC109		

Miscellaneous

Switch S1, double pole on/off. Jacks (2). Lamp LP1, 6V 40-60mA, with holder. Batteries PP9 or similar (2). Veroboard 12 x 2½ in. (minimum) 0·1 in. matrix, and pins. Metal for casework.

Meccano Parts

Name	Part No.	No. Off
Axle Rod 4 in.	15b	3
Axle Rod 3 in.	16b	1
Axle Rod 2 in.	17	1
Pinion ¾ x ¼ in.	25	2
Gear wheel 1½ in.	27	2
Nuts and bolts	37	1 pkt.
Double angle strip 2½ x ½ in.	48a	4
Slotted strip 5½ in.	55	4
Collar and screw	59	7
Couplings	63	3
Plates 5½ x 2½ in.	70	2
Sprocket chain	94	1
Sprocket wheel ¾ in.	96a	2
Bellcranks	128	4

Output stage

The modulator output is at a high impedance and suitable for feeding directly into amplifiers with a high impedance input, i.e. all valve amplifiers and most transistor amplifiers. However, some transistor amplifiers have low-impedance inputs and if the modulator is used with such an amplifier an impedance-conversion stage is needed. The addition of such a stage makes the output suitable for all amplifiers, whether of high or low impedance, and there are certain other advantages such as a reduced level of mains hum. The output stage in the present design is an emitter-follower formed by Tr5.

Power supply

If several parts of a circuit are fed from one power supply, there is a danger of unwanted interaction between one part of the circuit and another, due to voltage variations, unless the supply is de-coupled by means of a resistor and capacitor. When a circuit is designed to run at very low frequencies, as is the case here, the de-coupling capacitor has to be very large and therefore very expensive. A much cheaper solution is to use separate batteries for each part of the circuit. In the present design two batteries are used, one for the oscillator and the other for the rest of the circuit.

CONSTRUCTION

The electronics are built on a piece of 0·1in. matrix Veroboard, $11\frac{3}{8} \times 3\frac{3}{4}$in. A suggested layout is shown in Fig. 4, but the layout is by no means critical and can be altered if necessary to suit components of different sizes and shapes. Constructors who are not used to building on 0·1in. Veroboard should, take care to avoid bridging between the copper strips, by avoiding the use of too much solder.

The two sections of the circuit are almost completely separated electrically by severing all the copper strips where indicated, **except for the negative rail,** using a Vero spot cutter or a $\frac{1}{8}$in drill, or alternatively, with a sharp knife. The transistor leads are rather short and constructors who are inexperienced in soldering are advised to hold the leads with a pair of fine-nosed pliers during soldering, at a point between the solder joint and the body of the transistor.

Care should be taken to connect the input and output jack sockets correctly, with the negative rail to

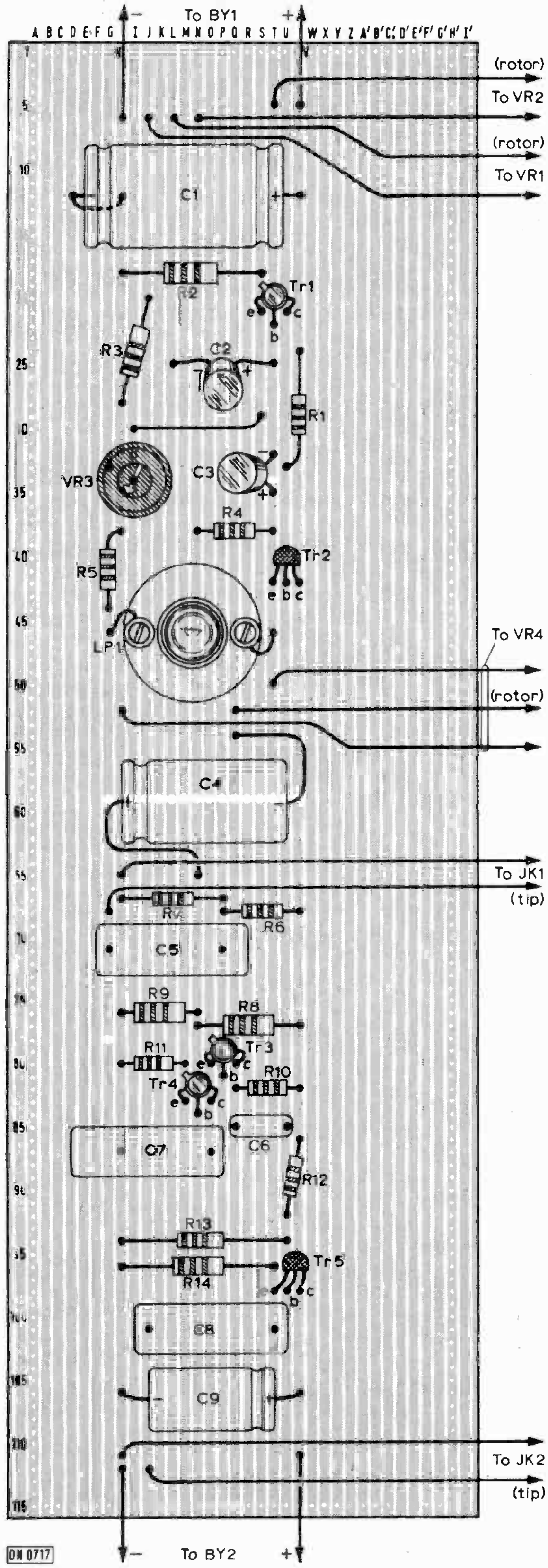


Fig. 4: Layout of the circuit board. Breaks in copper rails are best made before fitting components.

the socket contact which touches the outer conductor of the jack plug. If a mistake is made in this, an embarrassing amount of hum may be induced.

Potentiometers VR1 and VR2 are ganged linear controls. While ordinary carbon potentiometers are satisfactory, it is preferable to use wire-wound potentiometers because they have a much longer life and are less liable to noise. Ganged wire-wound controls are not easy to obtain, and for that reason the present design uses two ordinary single potentiometers with their spindles connected together. The mechanical details of this linkage using Meccano parts are shown in Fig. 5a. Because the two controls are "back to back", the connections may appear to be a little unusual, but if Fig. 5a is followed there should be no difficulty.

The mechanical linkages between the foot pedals and the controls are worth considering is some detail.

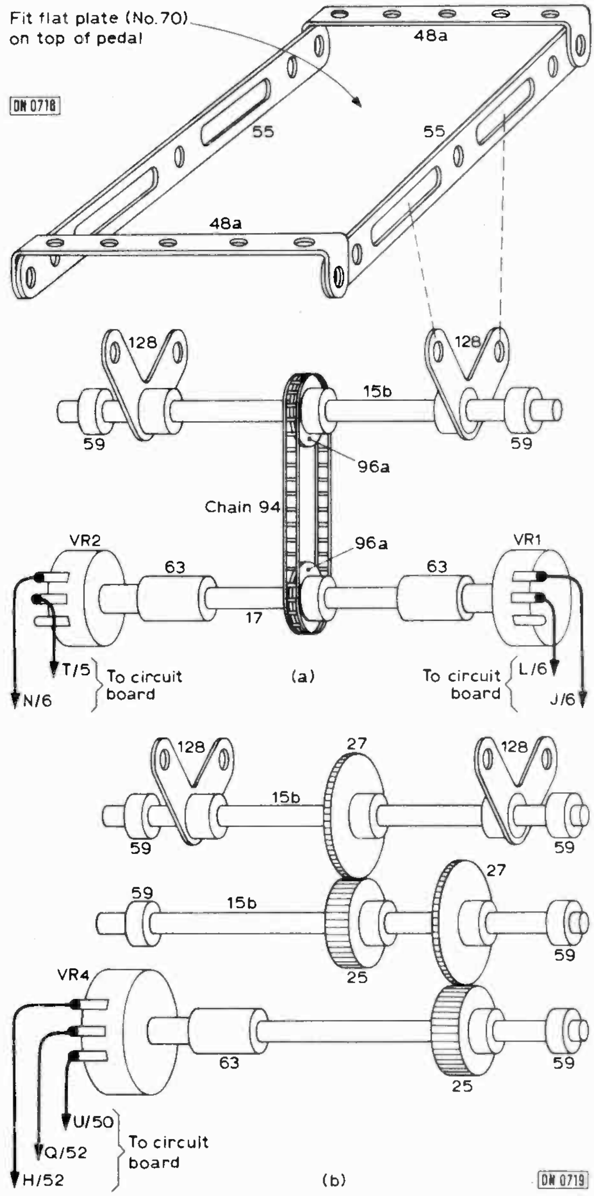


Fig. (5a), top, shows the assembly of the Meccano parts and potentiometers comprising the tremolo frequency pedal.
Fig. (5b), bottom, is the pedal assembly for the tremolo depth control.

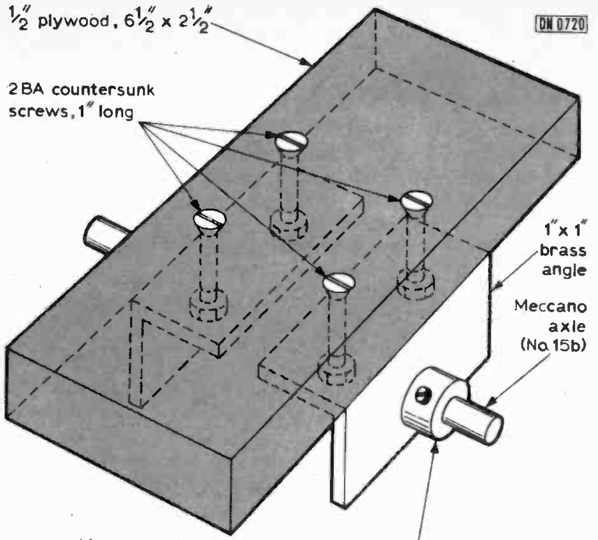


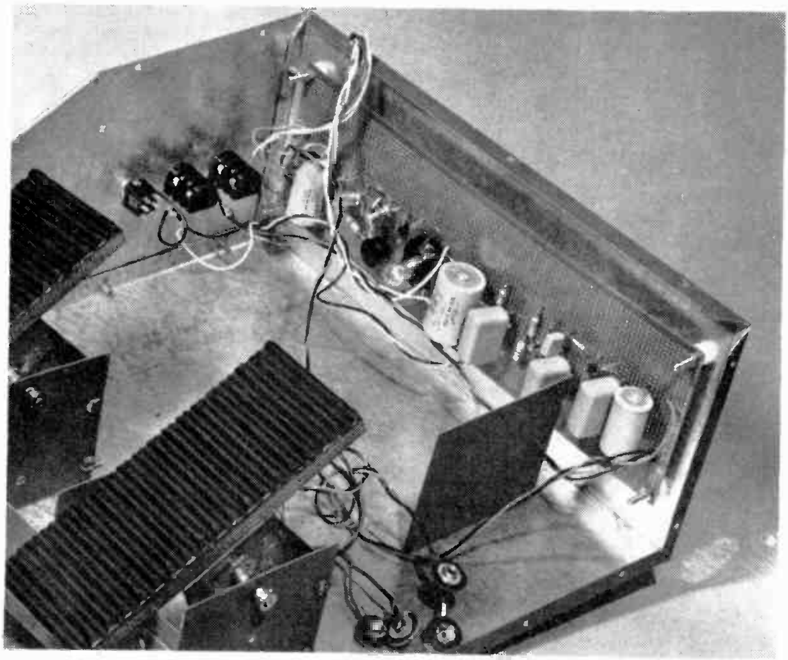
Fig. 6: Details of the foot pedals which were eventually fitted to the prototype unit.

It is not possible to rotate one's foot through more than about 60° without discomfort, while an ordinary potentiometer can rotate through about 300°. In the case of VR1 and VR2 a variation in resistance from zero to about 10kΩ is required and this can be achieved simply by using one end of the track of a 50kΩ potentiometer. In the case of VR4 it is necessary to use almost all the available rotation of the potentiometer so a 4 to 1 gear ratio is needed between the pedal and the control spindle. Meccano provides a simple and cheap way of building the linkage, and a suggested arrangement is shown in Fig. 5b.

From experience it was found that a sturdier pedal assembly was desirable and two were constructed, as in Fig. 6. They were each covered with corrugated rubber sheet.

A piece of equipment of this sort is subjected to a certain amount of rough treatment, and it is important to build a strong framework capable of withstanding abuse. A suggested design of framework is shown in Fig. 7.

The circuit board can be fixed with spacers to the back of the case. The on/off switch and the input and output sockets are fixed to the left-hand side panel. The two batteries are held in place by a metal bracket.



A view of the partially assembled casework showing the circuit board mounted along the back with input and output jacks and on/off switch at the lefthand side. The two batteries are located by the partition at the right. Pedal movement is restricted by the pedal housing, if constructed as in Fig. 7.

TESTING AND ADJUSTMENT

When the construction has been completed, and the circuit checked carefully, the unit is ready for testing and adjustment. It is useful to have an oscilloscope for this purpose, but it is not essential. Because of the use of two batteries, each part of the circuit can be tested separately.

Oscillator

The first job is to set the position of the frequency pedal. Slacken off the grub-screws holding the short axle between VR1 and VR2 and turn the spindles of the potentiometers VR1 and VR2 to the **minimum** resistance position. Push the foot pedal to the extreme end of its movement, and tighten up the grub screws. Check that the potentiometers rotate smoothly when the pedal is moved. Leave the pedal near the middle of its travel.

The next adjustment is to set the position of the modulation depth pedal. Slacken off the grub-screw of the cogwheel which drives the spindle of VR4. Rotate the spindle to bring the slider to the **earthed** end of the track. Push the foot pedal to the extreme end of its movement, and tighten up the grub screw. Check the rotation of the potentiometer when the pedal is moved and once again leave the pedal near the middle of its travel.

Connect the oscillator battery (not the modulator ends of VR4. Set the timebase of the oscilloscope to a slow scan (about one trace per second if possible) and the input sensitivity to about 1 volt for full deflection. If an oscilloscope is not available, put the unit in a partially darkened room in a position where the lamp LP1 can be seen easily.

Connect the oscillator battery (not the modulator battery) and switch on. Adjust the preset potentiometer VR3 until the circuit starts oscillating, as evidenced by the trace on the oscilloscope or by a dull pulsating glow in the lamp LP1. Move the frequency pedal to bring VR1 and VR2 to a high-resistance position. The frequency should drop to about 1Hz or less. If the circuit stops oscillating,

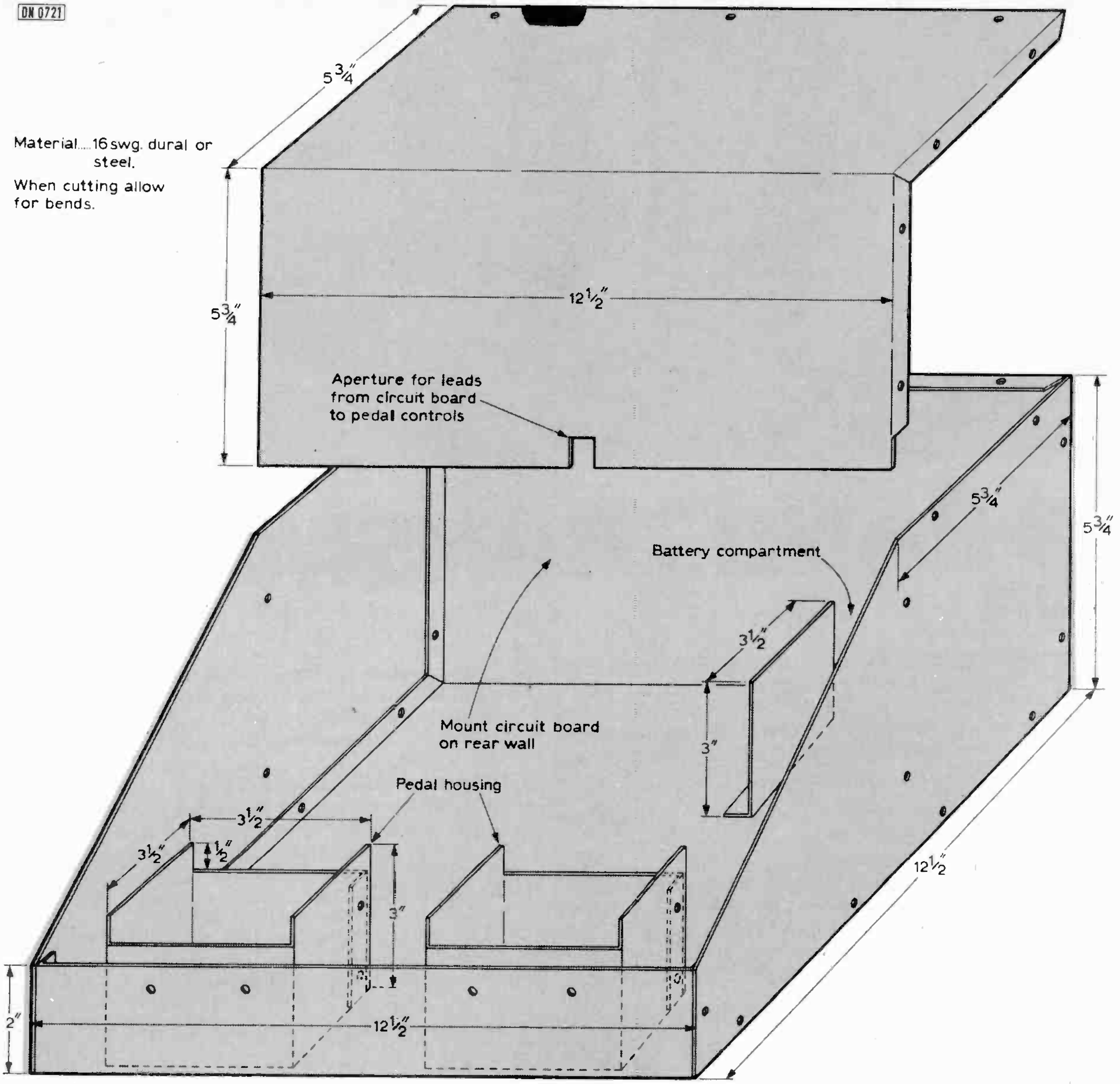


Fig. 7: Details of the casework housing the tremolo generator.

re-adjust VR3. Gradually raise the frequency by means of the frequency pedal and check that the oscillator works correctly over the required range of frequency; if it shows any sign of stopping, re-adjust VR3. The ideal position for VR3 is one in which the oscillation is just able to continue over the whole range of frequency, but the setting is not very critical. Finally, switch off.

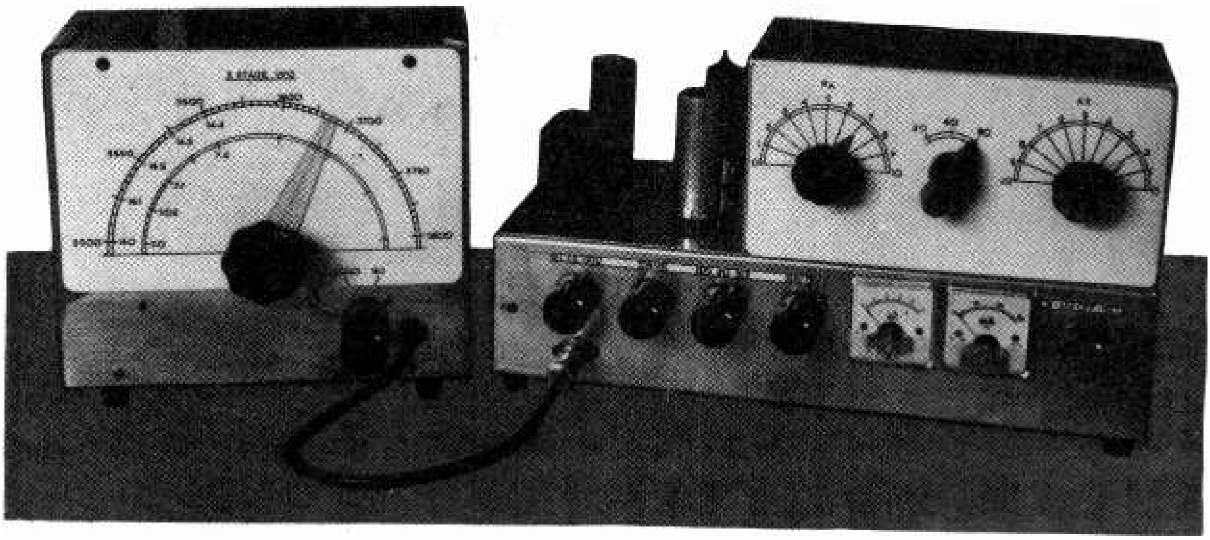
Modulator

Disconnect the oscillator battery and connect the modulator battery. Plug the guitar lead into the input socket and plug the output into the guitar amplifier. Switch on and check that the volume is satisfactory and that there is no distortion of the sound. If all is well, no further adjustment is needed. If there is noticeable distortion, it is probably due to overloading of the modulator, and this can most easily be prevented by connecting a resistor of a few kilohms in series with the input, between the input jack and C5.

OPERATION

Connect both batteries, the guitar and the amplifier. Switch on and adjust the positions of the pedals while playing long chords. The effect of the tremolo generator on the sound should now be apparent.

The guitarist may like to try the tremolo effect in conjunction with other devices. It appears to be particularly effective when used with a 'fuzz' box. It seems that better results are obtained when the 'fuzz' box is placed between the guitar and the tremolo generator, rather than between the tremolo generator and the amplifier, but this is a matter for experiment. ■



3-BAND TRANSMITTER

PART 2

F. G. RAYER G3OGR

THOUGH this VFO is particularly intended for use with the transmitter described last month it can be employed for the frequency control of any similar transmitter. The VFO has a straightforward circuit which can give reliable and excellent results.

CIRCUIT

Fig. 1 is the circuit which uses a 6C4 as a Clapp oscillator, the HT to this stage being regulated by the OA2 voltage regulator. The valve capacitances are shunted by the large value capacitors C2, C3, and C4, so this type of circuit proves to be stable and trouble-free.

Components in the VFO stage are enclosed in a metal box on the chassis and this complete screening avoids any difficulties from stray feedback. The whole VFO is in turn enclosed in a metal box or case.

A 6BH6, V2, is a buffer-amplifier which also frequency doubles for working on 7MHz and 14MHz. On 3·5MHz resistor R6 forms the anode load. Output to the transmitter is by a co-axial lead plugged into the socket which is provided on the transmitter. The latter also supplies power for the VFO. When working on 14MHz, the crystal oscillator stage of the transmitter acts as a second doubler.

Coil L1 and capacitor VC1 tune 3500-3800kHz and output frequencies are fundamental or doubled which makes the VFO calibration easy.

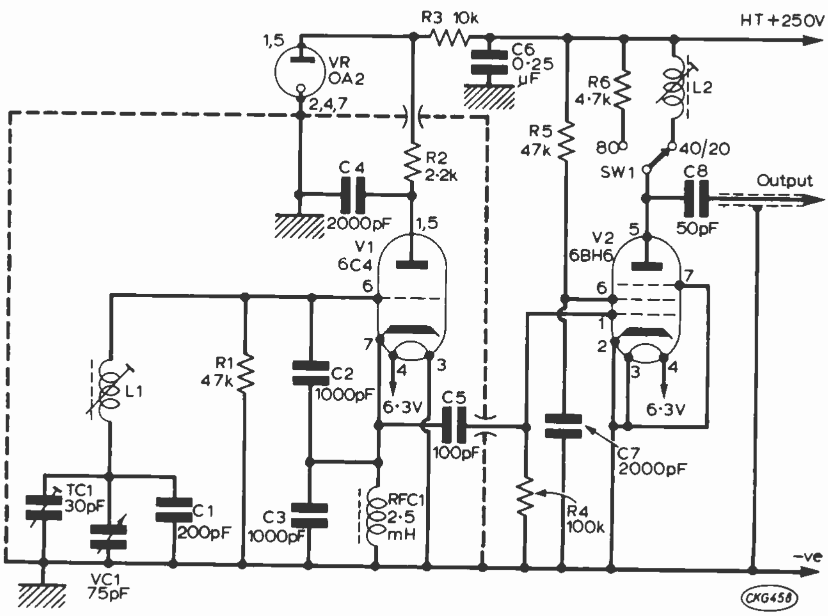


Fig. 1: Circuit of the two valve variable frequency oscillator. The power for the VFO is taken from the main transmitter, described last month. Components associated with the 6C4 oscillator valve are shown within the dotted enclosure.

VFO BOX

The variable frequency oscillator coil L1 and associated components are completely enclosed in a box, Fig. 2 which is very easily made from "universal chassis" members. A flanged member 8 x 3in. is taken and a V-shaped notch is cut in each flange 2in. from the end. A right-angled bend can now be made 2in. from each end. A sharp bend is best obtained by holding the member firmly on a piece of wood just large enough to rest between the flanges, and with one edge level with the bending line. This gives a U-shaped piece 2in. high and 4in. wide. The front is closed by attaching a 4 x 2in. flanged plate with four bolts. After all assembly is finished, a flat back plate 4 x 2in. is fixed on with self-tapping screws.

Tuning capacitor VC1 is mounted on the front flanged plate as in Fig. 2 and the ball drive is put on. Its lug is held with a long bolt with spacer, or extra nuts.

Trimmer TC1 is fixed on a small bracket under a hole, so that it can be adjusted from above with a screwdriver. Tag-strips are used to anchor R2, C5 and RFC1. The coil L1 is positioned as shown, with its core adjusting screw projecting from the top of the box.

Wiring and components in the box should all be rigid.

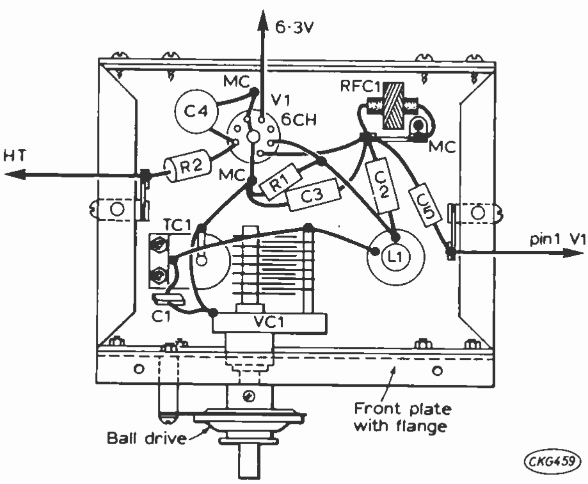


Fig. 2: Layout and wiring of components within the separate oscillator box.

Coil L1 is wound on a cored former, ½in. in diameter and 1¼in. long, with 30 turns of 26swg enamelled wire, closewound. The winding is started as near to the top or pin end of the former as possible. The former can be lightly smeared with a suitable adhesive (Denfix) before winding. The end is secured with cotton and adhesive.

The VFO can be tested by applying heater and HT voltages (about 150V) and adjusting TC1 and L1 for suitable coverage. With VC1 almost fully closed, L1 core is rotated to obtain 3·5MHz. VC1 is then set almost fully open, and TC1 is adjusted for 3·8MHz. One adjustment modifies the other, so this needs to be repeated several times. Sufficient coupling to a receiver is obtained by placing the aerial lead near the VFO.

Final calibration should be with the aid of a 100kHz crystal marker or equally accurate frequency standard. This will give calibration marks at 3·5, 3·6, 3·7 and 3·8MHz. Tuning the receiver to the second harmonic of the VFO will give 3·55MHz (at 7·1MHz) and so on, while the fourth harmonic will give calibration for the 20m band. When the VFO is being calibrated, or is in use with a transmitter, the higher frequency bands are direct multiples of the 3·5MHz band frequencies, so working with and marking the scales is very straightforward.

★ components list

Resistors

R1 47kΩ ½W	R3 10kΩ 3W	R5 47kΩ 1W
R2 2·2kΩ ½W	R4 100kΩ ½W	R6 4·7kΩ 1W

Capacitors

C1 200pF 1% SM	C6 0·25μF 350V
C2 1000pF 1% SM	C7 2000pF disc
C3 1000pF 1% SM	C8 50pF SM
C4 2000pF disc	TC1 30pF trimmer
C5 100pF SM	VC1 75pF variable

Valves

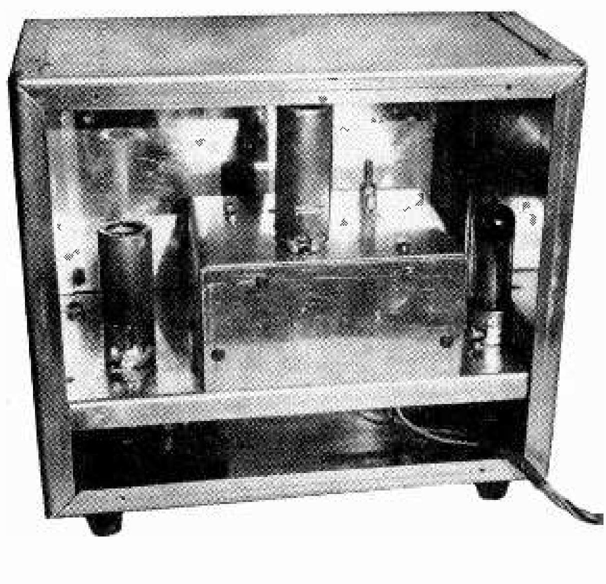
V1 6C4	V2 6BH6	VR OA2

Miscellaneous

Valveholders B7G (3) with screens (2). Ball drive, knobs. Single pole 2 way switch. Formers, ½in. dia. with cores, (2) (Denco). RFC 1, miniature choke 2·5mH. VFO box: Universal chassis member, 8 x 3in., flat plate 4 x 2in., flanged plate 4 x 2in. Panel: plate 8 x 7in. Chassis: plate 8 x 4in. Case: flanged plates 8 x 4in. (2) 7 x 4in. (2) Home Radio.

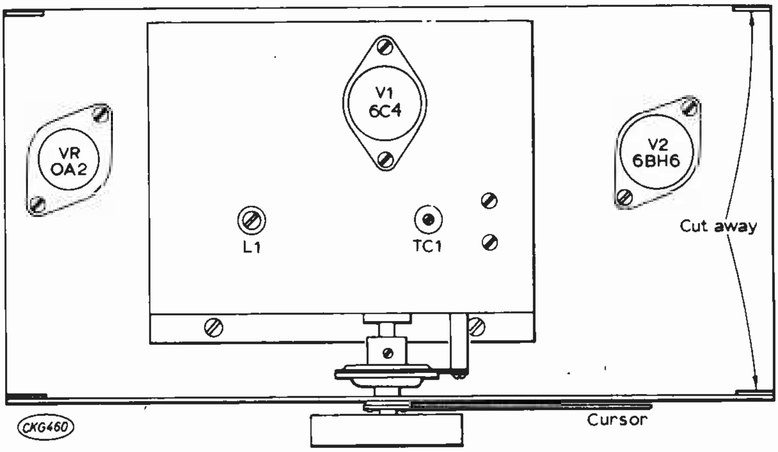
CHASSIS AND CASE

The main chassis is a universal chassis flanged member 8 x 4in. This allows similar members to be used for the top and bottom of the VFO case, with 7 x 4in. flanged members for the sides. The front is a flat plate 8 x 7in.



Rear view of VFO shows position of oscillator stage on main chassis.

Fig. 3: Details of layout on top of main chassis. The oscillator can be checked and roughly calibrated before the box is fitted to the top of the chassis. RF output and power supply wires pass down through a hole in the chassis.



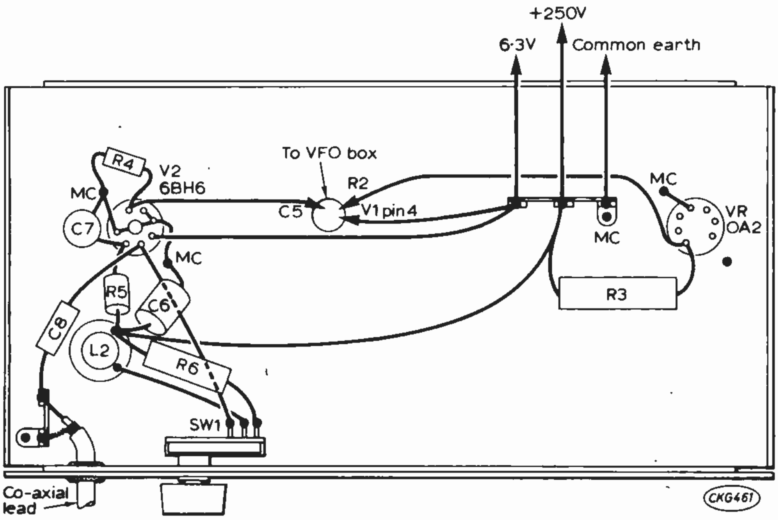


Fig. 4: Underneath the chassis showing the wiring of the buffer/multiplier stage and voltage regulator for the oscillator stage. The co-axial lead, bottom left, to the transmitter must be as short as possible. Power supply leads are taken to a 3-pin plug matching the socket on the transmitter.

The long flanges of the chassis member are first cut away at each corner just sufficiently to allow this item to fit *inside* the flanges of the members which form the sides of the case. The chassis is bolted so that its top surface is 2in. above the bottom edge of the 8 x 7in. panel plate. Voltage regulator VR and V2 are placed as in Fig. 3, and the wired VFO box is bolted in this position and its back closed with the 4 x 2in. plate.

WIRING

Fig. 4 shows components and wiring under the chassis, with leads passing through a hole for heater, regulated HT and the connection from C5 to the grid of V2.

A tag strip holds flexible leads for 6·3V, 250V and common chassis return. These three leads can be about 18in. long and they are soldered to the pins of the 3-way plug, which fits the transmitter power outlet. Power switching of the VFO is controlled by the CW/AM/OFF/NET switch on the transmitter.

The VFO output lead is about 9in. of low-loss co-axial cable, passing through a grommet in the front panel and anchored at a tag strip. The VFO output position is adjacent to the transmitter VFO input socket, so a long co-axial lead is not required or desirable. A long lead here may cause difficulty in resonating L2, or in securing adequate drive, due to its capacitance and possibly losses in the high impedance anode and grid circuits.

L2 has 38 turns of 32swg enamelled wire close-wound on a ½in. diameter former with adjustable core. The winding should begin as near to the tagged end of the former as possible.

The VFO should be tested before completing the case. It was found stable when used without the case, but the latter improves screening and rigidity. When the case is assembled, a short screwdriver is necessary to reach L1, L2 and TC1.

To assemble the case, put the side members with their flanges in the slots provided. The bottom and top can then be put into place, and are bolted to the sides. The case is checked for squareness, and the panel is correctly positioned. Holes for self-tapping screws are then drilled through the panel and side flanges, so that the panel can be secured. It is best to drill both panel and flange with a bit suitable for the self-tapping screws to hold, then use a larger bit, on the panel holes only for clearance.

The flanges of the member forming the chassis are bolted to the sides of the case.

USING THE VFO

For operation on 80m, VFO, driver and PA switches are all set to the 80m position. With the transmitter control switch at "Net" grid current should be shown by the transmitter meter and the carrier should be found on a receiver at the VFO frequency. The transmitter driver stage screen grid potentiometer will need to be turned back considerably to keep grid current down to the correct level.

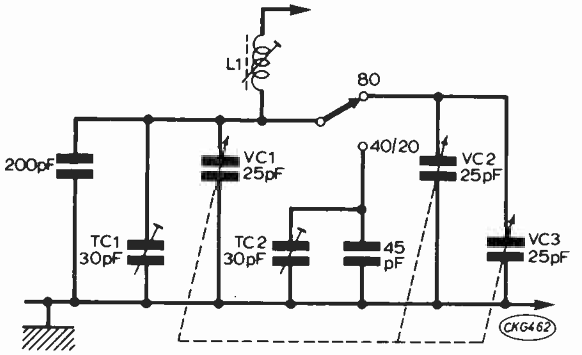


Fig. 5: Modified oscillator circuit to improve bandspread coverage on the higher frequency bands.

For working on 40m, place the VFO switch at 40/20m and the transmitter switches at 40m. L2 may need adjusting as mentioned for 20m.

When first testing the VFO on 20m, tune to about 14·2MHz. Set the VFO switch at 40/20m and both transmitter switches at 20m. With the control switch at "Net" rotate the core of L2 for maximum grid current as shown by the transmitter meter. On all bands tune the PA grid for maximum grid current, adjusting this to a suitable level with the drive potentiometer.

CALIBRATION

The scales are marked so that the higher frequency bands are direct multiples of the low frequency band. So 3·5MHz is also 7·0MHz and 14·0MHz. As mentioned this greatly simplifies calibration.

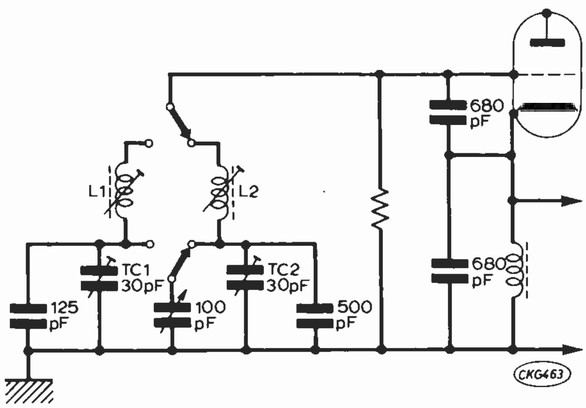


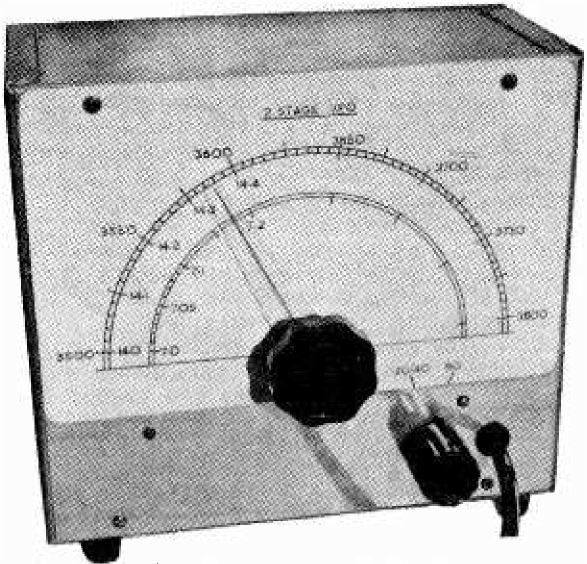
Fig. 6: Suggested circuit to give full scale coverage on all bands, 1·8—28MHz.

With this method of covering higher frequency bands only a smaller part of the tuning spread is used for 40m and 20m. During experimental use of the VFO, two methods were employed to spread the tuning on the HF bands. These may be of interest, though they were not used in the completed VFO.

The method shown in Fig. 5 gives coverage of 3·5-3·8MHz on one range for 80m. On the other range the VFO tunes from 3·5-3·6MHz, giving coverage of 7·0-7·2MHz and 14·0-14·4MHz with almost the full 180-degrees rotation of the tuning capacitor.

With the switch at 80m, VC1, VC2 and VC3 are all in parallel, forming a 75pF variable tuning capacitor, with TC1 and the 200pF capacitor as before.

When the switch is on 40/20, TC2 with its parallel fixed capacitor substitute for VC2 and VC3 and coverage is restricted to that of VC1, that is 3·5-3·6MHz, giving actual ranges of 7·0-7·2MHz and 14·0-14·4MHz.



A closer look at the VFO dial calibration.

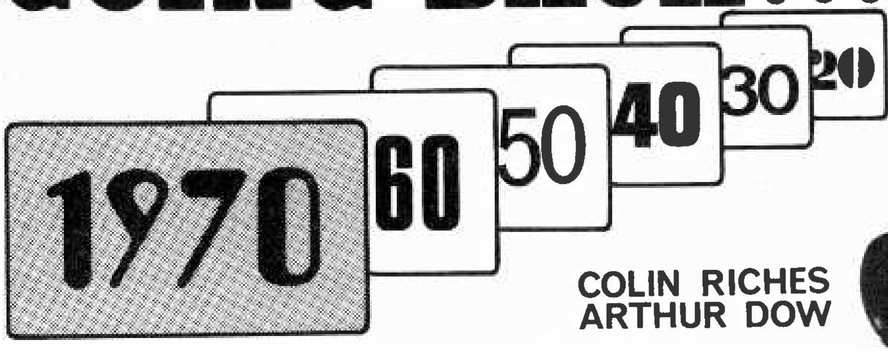
A Jackson miniature 25pF 3-gang capacitor was used. TC2 is adjusted so that 3·5MHz falls on the same tuning position, with the switch at 80m or 40/20m. The 80m range has to be individually calibrated. The 20m range is the second harmonic of the 40m range.

Fig. 6 shows a modification used for some considerable time in conjunction with an all-band transmitter. With the switch placing L1 in circuit, TC1 is adjusted for coverage of 1·75-2·0MHz. This is for Top Band (160m) and 80m, the 1·75-1·9MHz portion of the band being doubled for 3·5-3·8MHz. L1 is 60 turns of 36swg enamelled wire, closewound on a ½in. diameter cored former.

When the switch places L2 in circuit, coverage is from 7·0-7·2MHz. This gives operation at the fundamental frequency of 7·0-7·1MHz for 40m. For 20m, 7·0-7·2MHz covers 14·0-14·4MHz, with doubling. This same VFO band provides 21·0-21·4MHz for 15m and 28·0-28·8MHz for 10m.

Where the transmitter has few frequency multiplying stages this arrangement is very useful indeed. When the transmitter covers all bands with the minimum of circuits, it is helpful to fit a 4-way switch for V2 in the VFO. In addition to the untuned load, coils for 3·5MHz, 7MHz and 14MHz may then be selected, giving a choice of VFO outputs, with only tripling required to reach 21MHz, or doubling for 28MHz. ■

GOING BACK...



COLIN RICHES
ARTHUR DOW

Following our review in the April issue of the extensive collection of vintage wireless equipment belonging to George Weston of Auckland, New Zealand, we received a copy of a letter sent to Mr. Weston by Mr. W. W. Barnes, G2FI, of Wadhurst in Sussex, who began his career in wireless in 1917 when he was with the Royal Flying Corp. He rightly congratulates Mr. Weston for having stuck to his task of gathering together so much ancient gear in a part of the world where the amount of such equipment must be very limited.

Mr. Barnes joined the Philips Company in 1926 and stayed with them for many years, mainly in their Servicing Department, and thus was able to offer some additional information on the 2510 and 2515 receivers that we pictured in the April issue. These sets were made at Eindhoven in Holland but when sent to England were fitted with Mullard valves and the type numbers changed to 2511 and 2516 respectively! Needless confusion does not seem to be the prerogative of the modern society! The 2511 was the first domestic receiver having two HF stages to appear on the English market and, according to Mr. Barnes, was far ahead if its time. It was built 'like a battleship' and reputedly was just as heavy! Obviously the forerunner to the AR88!

Mr. Barnes recalls feeding the output of a 2511 into a pair of PX4's which fed a mains energised 18in. loudspeaker. The speaker and its power supply alone weighed 48lbs.! We understand that the current copy of the Philips News Sheet refers to a letter from a customer saying his 2515 is still in use and functioning perfectly. Mr. Barnes built his own two-HF-stage receiver in 1922 from a design published in the old 'Modern Wireless'. However it was unstable to the extent that the coils had to be wound with resistance wire to 'hold it down'.

Transatlantic DX

Another old-timer from the ranks of the amateur fraternity is George Tagg, G8IX, now of Stoke-on-Trent, who has been good enough to trust us with the original negatives and photographs of the wireless gear that he operated over fifty years ago, in 1919/20 to be precise. He was then a Leading Telegraphist at HM Wireless Telegraphy station at Mount Pearl, St. John's, Newfoundland and the equipment in use included a Model L receiver and a Poulsen Arc transmitter. (If anyone has any information on this receiver we would be glad to hear from them.)

George Tagg seen here at St. John's, Newfoundland, is still active on the air as G8IX.

Remarkably enough the best DX included contacts with the station at Pembroke Dock. George recounts taking photographs of Alcock and Brown before their epoch-making Transatlantic flight and also making special transmissions and test signals for them while they prepared their equipment.

Early Courtesies

Our collection of photographs of 'very ancient stations' has been swelled by a contribution from Mr. S. D. Mason of Torquay whose station was active in 1910! It doesn't take much work on the office slide rule to realise that Mr. Mason is now a proud 80 years of age. In those early days he was located at Forest Gate in London and his call sign was just a simple 5SV. The preamble to his licence ran 'To all whom these presents shall come, the Post Master General the Rt. Hon. Herbert Samuel sends greetings... etc.' ... obviously a unique document one would be very happy to possess.

Morse and telephony were both used at 5SV to work other stations in the Ilford and Barking areas but seemingly the ship's operators in the Royal Albert Docks were not very favourably impressed by the virtually untuned spark gap at 5SV! The aerial was a twin wire inverted L but only 30ft. long which must have been very short compared with the wavelength in use at the time.

At the beginning of the First World War all Mr.

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AF139 pnp germanium UHF 49p
BC 107 13p; BC108 12p; BC109 13p; } npn
BC167 11p; BC168 9p; BC169 11p
BC177 21p; BC178 19p; BC179 21p; } pnp
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Full lists and technical data will be found in Catalogue No. 6. See also amendments list.

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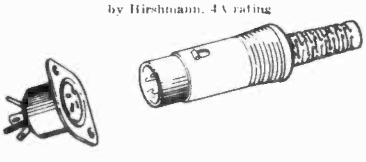
0·8A 400V 65p, 600V 80p
3A 400V 70p, 600V £1·02

ZENER DIODES full range E24 values: 400mW: 2·7V to 36V, 14p each; 1W: 6·8V to 82V, 21p each; 1·5W: 4·7V to 75V, 48p each. Clip to increase 1·5W rating to 3 watts (type 266F) 4p.

DIN PLUGS & SOCKETS

by Hirshmann, 4A rating

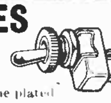


2 way LS socket 10p; plug 12p. 3 way scr. socket 10p; plug 12p. 5 way scr. socket 12p; plug 15p.

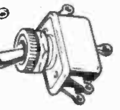
TRANSISTOR ACCESSORIES

To3 cover 7p
Heat sinks 1°C/w, type 6W1, undrilled 60p

SWITCHES



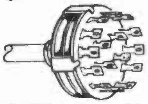
1011C SPST toggle 20p;
409 DPDT toggle 29p. (These are chrome plated 2·5A rating)
7201 Sub-miniature DPDT 250V a.c/2A 48p



ROTARY SWITCHES

Radiospares Miniature Maka-switch (in assembly kit form) Shaft 48p.
Wafers, MBB-2P5W, 1P11W, BBM-1P12W, 2P6W, 3P4W, 4P3W, 6P2W, each, 32p

WAVECHANGE SWITCHES



1P12W, 2P6W, 3P4W, 4P3W, each 24p

ELECTROLYTIC CAPACITORS

AXIAL LEAD Prices subject to amendment by the manufacturer.

Rated voltage: Capacity µF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47							7p	7p
1·0						7p		7p
2·2					7p		7p	7p
4·7				7p		7p	7p	7p
10			7p		7p	7p	7p	7p
22			7p	7p		7p	7p	8p
47	7p		7p	7p	7p	7p	8p	12p
100	7p	7p	7p	7p	7p	8p	12p	18p
220	7p	7p	7p	8p	9p	10p	17p	26p
470	7p	8p	9p	9p	12p	17p	24p	41p
1000	9p	12p	12p	17p	20p	23p	40p	
2200	14p	16p	22p	25p	36p	40p		
4700	23p	26p	37p	40p				
10,000	37p	40p						

Polycarbonate —5% Tolerance

250V up to 0·1µF: 100V/0·1µF and above.
0·01; 0·012; 0·015; 0·018; 0·022; 0·027; 0·033; 0·047; 0·056; each 4p.
0·068; 0·082; 0·1; 0·12; 0·15 each 4p.
0·18; 0·22; each 5p.
0·27; 0·33; 6p. 0·39 7p. 0·47 8p. 0·56 10p. 0·68 11p. 1µF 13p.
Prices subject to amendment by the manufacturer.

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Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99 (see note below)	100 up
C	1/20W	5%	82 Ω–220K Ω	E12	9	8	7·5
C	1/8W	5%	4·7 Ω–470K Ω	E24	1	0·9	0·75
C	1/4W	10%	4·7 Ω–10M Ω	E12	1	0·9	0·75
C	1/2W	5%	4·7 Ω–10M Ω	E24	1·2	1	0·8
C	1W	10%	4·7 Ω–10M Ω	E12	2·5	2	1·6
MO	1/2W	2%	10 Ω–1M Ω	E24	4	3	2 nett
WW	1W	10% ± 1/20 Ω	0·22 Ω–3·9 Ω	E12	7	7	6
WW	3W	5%	1 Ω–10K Ω	E12	7	7	6
WW	7W	5%	1 Ω–10K Ω	E12	9	9	8

Codes: C—carbon film, high stability, low noise.
MO—metal oxide, Electrosil TR5, ultra low noise.
WW—wire wound, Plessey.

Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions on total value of resistor order).

Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

★ Please remember to add V.A.T. to your order.

IMPORTANT. *We regret that where substantial price increases have occurred in some items these are due to the increased costs of imported lines. S.A.E. brings amended list.*

KNOBS

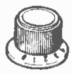
All grub screw fitting for ¼" shafts. Black. For other types—see Catalogue No. 6, P.54

F14.

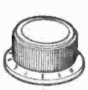
F13.

F12.

F19.



F18.



F17.

KB4

K30/3

F.14 (20mm) pack of 2 32p
F.13 (26mm) pack of 2 38p
F.12 (33mm) pack of 2 40p
F.19 (20mm) pack of 2 32p
F.18 (26mm) pack of 2 38p
F.17 (38mm) pack of 2 40p
KB.4 (20mm) pack of 4 40p
K.30/3 (17mm) aluminium, each 24p

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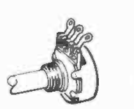
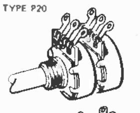


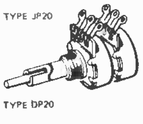
TYPE P20

Rotary carbon track, double wiper SINGLE P20 lin 100 Ω to 2·2M Ω 12p, P20 log 4·7K Ω to 2·2 meg. 12p JP20 Log, 4·7K Ω to 2·2M Ω 12p, Dual gang lin 4·7K Ω to 2·2m Ω, 42p; Dual log, 4·7K Ω to 2·2m Ω 42p; Log/antilog, 10K, 22K, 47K, 1M Ω only 42p; Dual antilog, 10K only, 42p. Any type with 2A D.P. mains switch, 12p extra.
Only decades of 10, 22 & 47 available in ranges quoted.



TYPE JP20

DUAL CONCENTRIC DP20 in any combination of P20 values, 60p; with switch, 72p.



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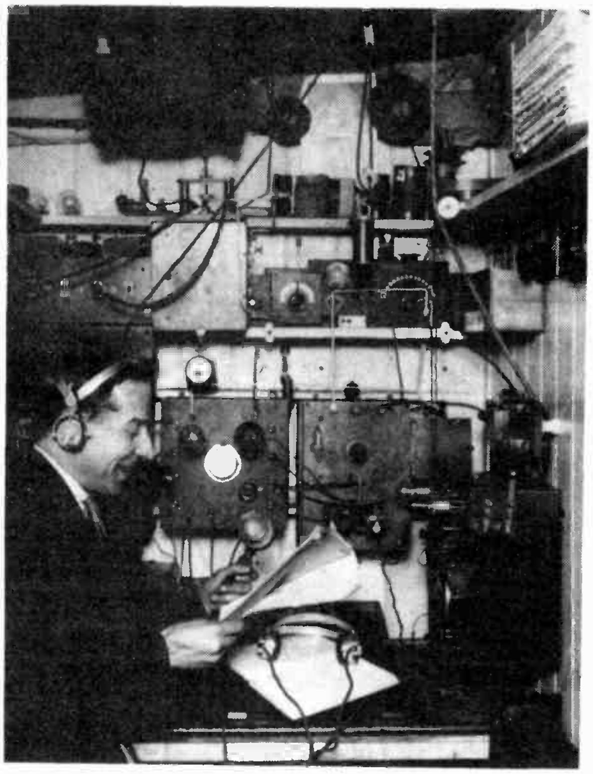


The spark gap at 5SV can be seen on the top shelf under the copper strip helix coil which 'tuned' the transmitter. Below is the 2-valve transmitter consisting of an oscillator and modulator.

Mason's equipment was impounded and he found himself with the Royal Naval Air Service at the White City in London, very close to the present site of the BBC TV service. After operating WT equipment from airships based at near-by Wormwood Scrubbs (another famous name!) 5SV passed to Manston for flying training and finished up with No. 3 Wing in France. Unfortunately Mr. Mason is no longer on the air, which is rather unusual. Generally the bug, having bitten, doesn't let go! At least not for long! ■

ON THE AIR

BROADCAST BANDS

SHORT WAVE DX
by MALCOLM CONNAH

APART from the gems of information which can be gleaned from this monthly page, the best sources of DX information and station news are the DX programmes broadcast by many stations throughout the World.

The following list shows the times at which some of the more popular programmes are broadcast. In all cases the broadcasts are in English.

Australia "DXers Calling" is broadcast during the English transmissions on Saturday at 2130; Sunday at 0430, 0730, 1300 and 1530 and on Monday at 0215.

Ecuador HCJB in Quito broadcasts its "DX Party Line" programme on Monday at 0030, Tuesday at 0300 and 1930 and on Wednesday at 0900.

Great Britain The BBC's "World Radio Club" programme is broadcast over the normal World Service outlets at the following times: Sunday at 0815, Wednesday at 1330, Thursday at 2030 and Friday at 2345.

Portugal Adventist World Radio transmit a programme of DX News compiled by our own World DX Club at 0935 on Sundays on 9670kHz.

Sweden The "Sweden Calling DXers" programme is 25 years old this year but can be referred to as the "grandaddy" of DX programmes. The programme is broadcast every Tuesday and takes up half an hour of the normal English programmes.

Switzerland "Swiss Shortwave Merry-go-Round" is broadcast in all the English transmissions of the Swiss B.C. on the 2nd and 4th Saturdays of the month.

Readers' Logs

The first item in this section this month comes from **John Godwin** of Rugeley in Staffordshire. John reports hearing *Radio New Zealand* between 0600 and 0800 on 11780kHz on his pre-war HRO receiver and "Joystick" antenna.

The transmitter power of *Radio New Zealand* is only 7½kW and reception in this country is fairly difficult. Well done John!

Alexander Morton of Framlingham in Suffolk has two receivers, a Bush AC2, 5 valve domestic and a VEF-204 10 transistor portable. His log included:

5920 *R. Kiev,* in English at 1930.
9023 *Voice of Iran* in English at 2000.
9690 *R. Pakistan* with news in English at 1815.
9745 *HCJB, Quito,* Ecuador, DX Partyline at 0900.
10040 *Voice of Vietnam,* Hanoi, news in English.
15415 *R. Kuwait* in English at 1630.
17895 *R. Portugal* in English at 1345.

Ian Gordon of Rubery, Birmingham has managed to extract signals from the following stations out of the central heating radiator which he use as an aerial and coax them into his Codar CR70A receiver:

9005 *R. Iran* in English at 2015.
9570 *R. Australia* at 0730.
9655 *R. Damascus,* Syria in English at 2050.
9670 *Adventist World Radio* at 0940.
9745 *R. Baghdad,* Iraq in English at 1950.
11675 *R. Pakistan* in English at 2035.
11710 *RAE, Argentina,* s/on at 2300.
11765 *R. Australia,* DXers Calling (Sun.), 0730.
15012 *Voice of Vietnam,* Hanoi in English at 1815.
17885 *R. Japan,* s/on at 0800 in English.

Shaun O' Sullivan of Keynsham (yes that's K-E-Y-N-S-H-A-M of Radio Luxemburg fame), Bristol, has a one valve 'H.A.C.' t.r.f. receiver and a two transistor amplifier connected to a 100 foot long-wire antenna. This combination enabled him to hear:

5930 *Radio Prague,* Czechoslovakia in English at 2135.
5995 *Voice of America* in English at 2040.
6160 *Radio Sofia,* Bulgaria in English at 2135.
6190 *Vatican Radio* in English at 2100.
7090 *Radio Tirana,* Albania in English at 2040.
7100 *Radio Moscow,* USSR at 2110.

Dave Gregory of Plymouth in Devon has a Bendix RA-1 aircraft receiver and an 80 foot long-wire antenna, his log for the month included:

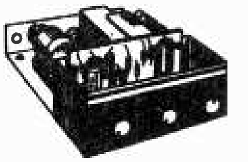
7100 *R. Pakistan* in English at 2200.
9125 Test transmission from *Panama City* at 0035.
9535 *Swiss B.C.,* Berne in English at 1530.
9725 *Kol Israel* noted at 2140.
9770 *R. Baghdad,* Iraq at 2045.
11640 *R. Bangladesh* in English at 1800.
11755 *AIR, Delhi* in English at 2230.
11805 *Radio Finland* noted at 1910.
11880 *Radio Sweden* in English at 1230.
11900 *RSA, South Africa* in English at 1115.
15175 *Radio Norway* noted at 2200.

DX Clubs

The Youth DX Club International (YDXCI) which was mentioned in this column last month has announced that the maximum age of its members will be 17 years. The membership fee is £1·20 which includes the cost of sending the magazine to any country. The address for membership enquiries is YDXCI, Bartletts, Culmstock, Cullompton, Devon.

PRICES NOW INCLUDE VAT

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohm. Frequency response 12Hz—30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7½" deep. AC 200/250V.
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A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **PRICE £9·90 P.&P. 45p.**

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Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3¾" × 2¼". Suitable for Transistor Radios, Tape Recorders, Amplifiers etc. etc. Ready built and tested. **PRICE £5·00 P. & P. 35p.**

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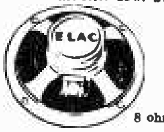

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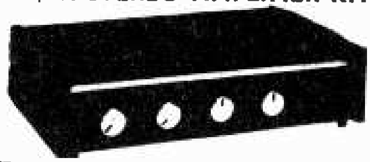

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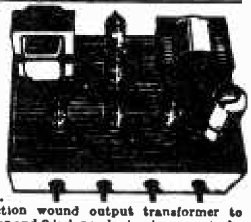

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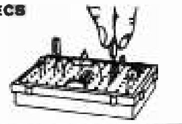

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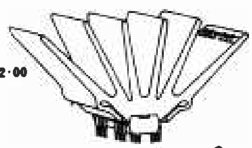

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ON THE AIR

MEDIUM WAVE BROADCASTS
by CHARLES MOLLOY

BILL JARVIS (Luton) has received direct from the BBC "20 BBC Local Radio Stations" which gives details of locations and power.

R. Howard (East Runton) has sent the following log of BBC Local Radio Stations heard at his QTH in Norfolk—Radio Blackburn on 854kHz; Radio Sheffield 1034kHz; Leeds 1106kHz; Newcastle-on-Tyne 1457kHz; Teeside (Stockton) 1594kHz. He also reports hearing La Coruna, Spain on 638kHz; AFN Bremerhaven 1142kHz and Radio Sud, Andorra on 818kHz. Andorra is a small independent state situated in the Pyrenees between France and Spain. Its other medium wave outlet is Radio Andorra on 701kHz and both stations will verify a correct reception report written in English, with a colourful QSL card. It appears that Andorra no longer broadcasts on the short waves and it is only on the medium waves that the DXers can hear broadcasts from this mini-republic. Reception reports should be sent to Radio Andorra, B.P.I, 66720 Andorra-la-Vieille, Andorra for the transmissions on 701kHz and to Sud Radio, B.P.7 Andorra-la-Vieille, Andorra for those on 818kHz. Remember to include an International Reply Coupon (obtainable from main Post Offices) to cover return postage and to ensure a reply.

D. O. French (Stroud Green, London) is unable to hear the religious broadcasts from Trans World Radio Monte Carlo on 1466kHz because of interference from the BBC Radio London station on 1457kHz which transmits from Brookmans Park. He expects TWR to increase power on 1466kHz from 400kW to 1000kW by the end of 1974. TWR will then join the growing list of medium wave broadcasters that use powers of a megawatt or more. Others include Radio Bucharest, Rumania on 1052kHz; El Beida, Libya 1124kHz and Tripoli, Libya 1250kHz both of which are easily heard in the UK after dark; Batra, Egypt 1106kHz; Skopje, Yugoslavia 809kHz; West Germany on 1421kHz and Radio Luxemburg 1439kHz. Other more distant stations that have been heard in the UK include Riyadh, Saudi Arabia on approx. 588kHz; Quazvin, Iran 841kHz (now with 2000kW); Rajkot, India on 1070kHz; Urumchi, China 1525kHz (usually in Russian with jamming) and the Voice of America Thailand 1580kHz in English at 2200hrs GMT. There is also the 1000kW outlet at Calcutta, India on 1130kHz which has been heard by the writer during July at 2200hrs GMT with sign-on at the start of its Chinese programme. It is worth looking for this station between the burble on 1133kHz and Barcelona/Libya on 1124kHz.

VHF/FM DXing
by SIMON DAVID

FIRST of all, my thanks to all those readers who wrote to me; I shall try to pick out interesting points from as many letters as my modest half-page allowance will permit and combine these with any news items that are useful.

Many of you take Band 2 seriously as DXers and this is really the basis on which this feature was started, but there are times when weather conditions, particularly in the summer months, can produce some odd twitterings even on the usual entertainment programmes from local stations.

Mr. **C. Rahn** of Chesterfield has made a study of reception conditions and confirms that humid overcast atmospheres and very warm temperatures bring in some long distant signals. Of course, it is of little help if conditions are cooler en route, so when you have one of those sultry sticky days and the weatherman says that this is spread over the whole country, forget the lawn mower and switch on your f.m. receiver.

It does help to have a multi-element array and if you can arrange for it to be rotated easily, then you are in for a mixed bag of DXing. Mr. Rahn has four aerials: a roof 'H' set to Sutton Coldfield; an indoor 'H' rotatable; a piece of unscreened wire about 1ft. long; and an indoor telescopic. The most fruitful, of course, is the rotatable which brings in most of the BBC local radio stations from afar, plus numerous foreign stations. However, even Caen 95·6MHz was picked up by the telescopic. His tuner is the Omega ST-300C with a stereo decoder A1005M (G. W. Smith). Now with his new "weapon", a 6-element rotatable, he is getting even better results.

There were disturbances on April 1st due to an aurora borealis. Although not visible due to overcast skies, the effects on v.h.f. broadcasting were a "burbling" note on continental stations, detected by Mr. **R. Ham** in Sussex on 42 and 72MHz. These noises also interfered with television on channels 3, 4 and 5.

The target for most DXers is to see how far into Europe one can penetrate on Band 2. Mr. **G. P. Stanbury** tells a fascinating tale involving an Antiference 4-element with two extra directors, a Rigonda "Symphony" radiogram with home made tuning meter in place of the magic eye, the f.e.t. preamplifier from April's *P.W.*, and a rotatable aerial mounted on a cable controlled pulley system. In spite of some backlash, he has heard at his home in Chelmsford, Essex, many BBC stations as far away as North Hessary Tor and Wenvoe.

Continental pick-ups include five Dutch and three Belgian stations on Dutch network RTB-BRT, the latter being Aalter on 90·4, 95·7, 98·6MHz and Veltem on 89·5 and 93·7MHz. West German stations received include Langenberg and BFBS Cologne. There are local disturbances including a 400ft. hill and a police transmitter half a mile away that almost swamps the continentals at times. There is, he says, a local river board authority transmitter which appears to be "ill-matched to its damp string!"

One of the problems of DXing in residential areas is the interfering reflections from neighbouring aerials, and badly aligned tuners without i.f. traps on the aerial can cause trouble. Mr. Stanbury appeals to all users to fit i.f. traps to keep the i.f. on a leash and I would endorse this wholeheartedly.

In the May article I mentioned rejection filters to suppress adjacent channels; the Wolsey Model No 2 covers 40 to 100MHz range with maximum rejection of 45dB. Most good aerial dealers should have these for around a fiver. Finally, the IBA have announced on their medium wave test transmissions on 557kHz that v.h.f. tests start in the autumn on 95·8MHz (entertainment), 97·3MHz (news).

ON THE AIR

AMATEUR BANDS

SHORT WAVES

by DAVID GIBSON, G3JDG

A good month for the persistent listener and some good DX loose on all bands—a fair assessment of the Amateur bands these past few weeks. Eighty metres has yielded such little treasures as ZL2BT and DU1EJ, and even 7MHz has seen fit to part with items like VK5CX and 5R8BD. Good DX on twenty and fifteen but the surprise came from 28MHz which has had spasmodic bursts of life. When this happened the DX was usually 599+ or 5 & 9+. Goodies on 28MHz logged include TU2DD, VP2LI and ZM1HV.

Occasionally one hears of an Amateur station accused of causing interference (QRM) to other receiving equipment, usually television. If this happens, the Amateur involved will take steps to solve the problem and help effect a cure for such QRM.

The boot is now on the other foot. There seems to be a marked increase in the number of intruders into the Amateur bands. Not only this but worse; the interference caused by these illegal intruders is deliberate. Other Hams have reported this also.

John Bagley (Birmingham) comments that we should find out where the QRM is originating from and then refuse to work Amateurs in that country(ies). It might, perhaps, be better to do exactly the reverse—make a point of working these localities and then diplomatically raising the question openly on the air i.e., "Do you suffer from QRM OM there seems to be a strong source somewhere in your area?". The RSGB has set up an Intruder Watch. Perhaps its findings could be published?

A couple of hot tips have arrived. Listen 14250—14300kHz at 1230hrs. at weekends for YA1AH and YA0CDR. There is a net on Friday mornings (14250-14300kHz) called the Arabian Nights (Knights) Net. Stations from VK and ZL frequently call in.

Apparently that XG prefix heard by many mystified souls earlier this year was used by XE1J. Something to do with a 450th anniversary. Another callsign was changed because of the seventh Games held in Panama City. When will G stations get in on this callsign changing act? There are many events in England which merit an instant change of callsign: hearing the first hedgehog; Noddy's birthday.

In the April issue I asked the real G4GJ to "stand up". Well, he has! Operational from Bingley in Yorkshire since 1945 this station has a daily sked (not weekends) with G3CJS on 3680kHz. These stations have been doing some experiments with loop aerials.

Lionel Outridge (Canterbury) read my remarks re 4 metres (70MHz), and promptly built a converter using dual-gate MOSFET's (r.f. and mixer) plus a MPF102 crystal oscillator. Lionel says that a nearby BBC relay on channel 5 puts out a string of 50Hz modulated carriers right across the 70·1—70·3MHz band which makes reception difficult. (Who do you report the BBC to?). Other equipment is a FRDX400 and an indoor dipole. Stations received on 70MHz; G3—AJS, FDW/P, FIJ, FZL, IIR, JEQ/P, LVK, LVP, LVP/M, LVP/P, OHH, OQT, ORH, ORH/M RUA/P, TDM/P, VER/P, VHH, VPK, VPS/P, WMR/P, YCN, YTM, ZFP, ZRH, plus GB3SU, G4BLN, GW4ABR/P, GW4BGG/P and G6SG. So the band isn't morgue. How about a few more of us breathing life into it?

Anyone hear 5GAA, HA25KFZ or O1KA? **Gareth George** (Cheltenham) did and asks what, whom, who or where? (Perhaps someone else heard the first hedgehog?). Receiver is an HRO with a 100ft. long wire. A twiddle on twenty brought: EA3GN, EA5FQ, EA7QG, IT9JC, JA6BEE, JA6NPF, JA6YG, JA7BJA, JX1AK, JX5AZ, JY6UMS, OD5FB, VK3OC, VK3BJB, W7MTL/P, ZL2AAW, ZL2BFU, ZM2KG, ZK2BD all on s.s.b.

Thirteen-year-old **Chris Jones** is alive and well and living in West Bromwich. He also bagged: EA3WZ, IT9FKS, JA3XKJ, W6CYU, all with a CX203 and 70ft. end fed on twenty metres s.s.b.

We stop this 14MHz revelry to bring you a news flash: a two metre log has been received. Guilty party is one **David Noakes** who resides at Cranbrook in Kent. Using an f.e.t. converter (i.f. 28-30MHz), Trio JR310 and a 6-over-6 slot-fed he logged: F1AGY, F1CCP, F6CKU, G3AMF, G3FAB, G3RPZ, G3WKS/P (Rutland), G3YOA, G8BXX/P, G8CIW, G8CLY/P, G8FUF, G8FPR, G8GTD/P.

Derrick Dance (Roxburghshire), CR7OA, PR40 pre-elector, a.t.u. and 264ft. end fed sends in a nice log of stations heard on topband. On c.w.: DJ3CY, GI3YFY, GW3RTR, OH1SJ, OL1AOH, OL1AQL, OL5AQK, plus several GM, OK1 and OK2 stations. On 160 metres s.s.b.: GM4BBL (Shetlands), GW3UCB, GW3ZQN, W4BIF, OE5KE.

At the other end of the scale, Derrick reports these on 28MHz c,w.: DL0IGI (beacon station), F3NB, ZC4CY (new beacon), 3B8MS (beacon), 3D6AX, 4X4SK, 9H1CH. The s.s.b. signals on 28MHz came from: CR6AM, CR6LF, CR7IZ, EA8GZ, EA8IB, LU8AJG, ZC4DS, ZE1AV, 4X4HF, 4X4NJ, 4Z4DZ, 4Z4LI, 9J2AY, 9J2TB and PY5UI on a.m.

Events during June include: June 9-10, four metre open contest; 10, d.f. qualifying round at High Wycombe; 16-17, Microwave Field Day; 17, WAB v.h.f. contest (phone); 23-24, First Topband contest; 24, d.f. qualifying round at Chelmsford. July 7-8, Jubilee v.h.f./u.h.f. contest.

BROADCAST BANDS

Short Wave Reports by 15th of the month to Malcolm Connah, 59 Windrush, Highworth, Swindon, Wiltshire, SN6 7DT.

Medium Waves Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

VHF/FM Reports to Simon David, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

AMATEUR BANDS

Short Wave/VHF

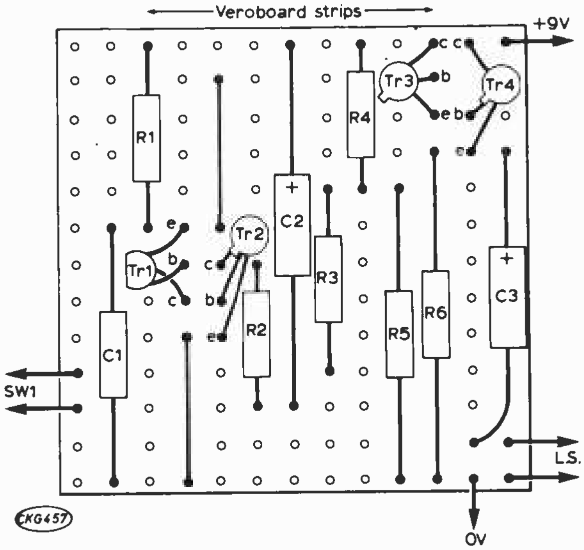
Logs in alphabetical order please by 15th of the month to David Gibson, G3JDG, 12 Cross Way, Harpenden, Hertfordshire.

TAKE 20

DAVID ANDREWS

No. 50
ELECTRONIC SIREN

A series of simple transistor projects, using not more than twenty components.



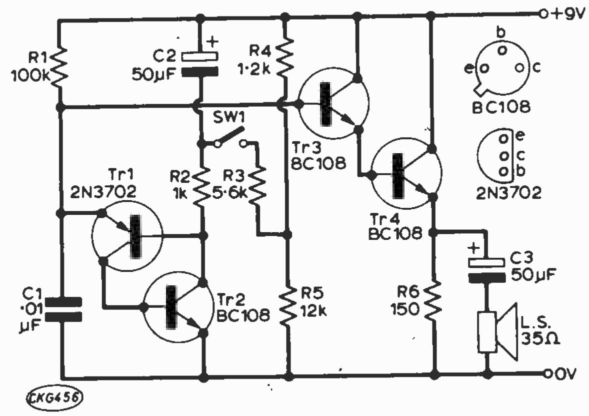
Suggested layout of components on a piece of veroboard.

THIS month's project describes a siren that utilises a voltage controlled relaxation oscillator. The output of the oscillator is fed to a very simple loudspeaker driver stage comprising Tr3 and Tr4 connected as a super-alpha pair. Alternative output stages to provide higher power can be used provided they present a comparatively high input impedance.

Circuit

Tr1 and Tr2 form the active part of the oscillator. They can be almost any type of general purpose pnp and npn transistor respectively; but make sure they are connected the right way round. The frequency of oscillation is set by the values of R1 and C1 together with the potential at the base of Tr1. In this instance the potential is determined by the network of R2, R3, R4 and R5 and is dependent on whether switch SW1 is open or closed. C2 serves to delay the build up and fall of this potential and gives a smooth change of frequency that gives rise to the siren "wail".

Assuming that SW1 is open and that the potential at Tr1's base is low, C1 will charge up through R1 until the base/emitter junction of Tr1 is forward biased. Not much charge is needed on C1 to arrive at this situation and it occurs very early on in the charging cycle. When Tr1 is turned on regenerative feedback occurs between Tr1 and Tr2 and the charge of C1 is shunted to negative through the circuit of Tr1's emitter and collector and Tr2's base and emitter; at the same time the collector of Tr2 is pulled down towards negative. Eventually base current into Tr1 ceases to flow and C1 is free to re-charge through R1 to repeat the cycle; the potential at Tr1's base returns to its original state. If this potential was higher it would take more time for C1 to reach a charge whereby the emitter of Tr1 became more positive than the base and thus the frequency of oscillation is reduced. By closing SW1 we force the potential to increase but this does not happen immediately and the rise is slowed up by the time constant given by C2. The frequency of oscillation reduces slowly to a minimum value set by the potential divider effect of R4 with R5. When the switch is opened the potential reduces slowly as the charge on C2 is bled to negative by the momentary spikes of current drawn by Tr2 through R2. While this happens the frequency of oscillation slowly increases.



The complete circuit of the electronic siren.

★ components list

R1	100kΩ	1p
R2	1kΩ	1p
R3	5·6kΩ	1p
R4	1·2kΩ	1p
R5	12kΩ	1p
R6	150Ω	1p
C1	0·01µF	4p
C2	50µF	10p
C3	50µF	10p
Tr1	2N3702	20p
Tr2	BC108	10p
Tr3	BC108	10p
Tr4	BC108	10p
SW1	Pushbutton switch	15p
		95p

No allowance is made for minimum order costs or for postage and packing and these points should be checked carefully before ordering.

—*continued on page 261*

Dear Sir, letters

Shoreham Transmitters

I was interested to read Mr. Woodward's letter in your March issue. He complains that our transmitters at Shoreham "cause countless harmonics all the way down the medium wave band". The frequencies used at Shoreham are 692kHz (Radio 4), 1214kHz (Radio 1), and 1484kHz (Radio Brighton).

It is true that after the extensive wavelength changes last September a number of intermodulation products were identified but the situation was quickly rectified. **G. H. Sturge** *(BBC Engineering Information Dept).*

Noises

. . . The fact remains that several miles from the transmitters, noises identifiable as Radio 1 can be heard loud and clear on 266 metres, 232 metres, and also on 1100 metres long wave on receivers ranging from small transistor radios to powerful communications receivers. The strength of these signals varies from day to day, and on some occasions I have heard Radio 1 very weak on 247 metres, and very strong on 323 metres.

In addition, Radio Brighton is always clearly audible on approximately 530 and 560 metres medium wave, as well as the intentional 202 metre wavelength.

My complaints have also been supported by the Horsham-based Southern Independent Radio Association, and the Brighton-based Southern .Free Radio Campaign, both of which are responsible organisations, who are trying to improve the standards of broadcasting in this country.

Regarding the possibilities of covering the whole country on medium wave with a few kilowatts, the BBC should try using horizontal long-wire aerials instead of vertical masts. Using this method, the Independent Broadcasting Authority's test broadcasts on 539 metres medium wave cover large parts of the country, with a power of one kilowatt, despite the fact that a powerful Dutch pirate station is on 538 metres, directly underneath.

The IBA's transmitter is also audible in parts of Holland, over the aforementioned Dutch station. I also know for a fact that many on-shore pirate radio stations, notably Radio Jackie of London and Focus 240 of Worthing cover distances of as much as 30 miles, with the 'massive" transmitter power of 7 watts! They also use efficient, long-wire aerials. **P. Woodward** *(Lancing, Sussex).*

Corrective Action

. . . Following Mr. Woodward's further letter, we have carried out some further checks and measurements in the Brighton area. We found two spurious signals spaced about 80kHz above and below the frequency of Radio 1 (1214kHz). These signals were intermittent and of comparatively recent origin, and they were only present when a certain combination of equipment was in use at Shoreham. The necessary corrective action has now been taken, and we are grateful to Mr. Woodward for drawing our attention to these signals.

We did not find any trace of a transmission of Radio 1 on Long Waves, or of Radio Brighton on 530 or 560 metres. But it may be worth pointing out that with a receiver i.f. of around 465kHz, the 'image' appears at approximately the frequencies mentioned, because

$$1484-(2\times 465)=554\text{kHz}$$
(i.e. 542 metres)
$$1214-(2\times 465)=284\text{kHz}$$
(i.e. 1058 metres).

Such 'signals' are of course entirely the product of the superhet receiver, and do not exist as transmissions at all.

There is no point in going into great detail about the problems of medium-wave transmitting aerial design here, which are many and complex. I am afraid that the horizontal long-wire aerial which Mr. Woodward suggests is not suitable for serving very large areas by day and by night.

The IBA test transmissions are not made from such an aerial, and their relatively large coverage is due mainly to the high earth-conductivity of the area adjacent to the River Thames. Nevertheless the station does not serve large areas of the country nor is it intended to do so.

We understand that recordings made in Holland reveal the IBA signal as only just detectable in the presence of the pirate. It should also be remembered that there is a limit to the degree to which the service area of a station can be enlarged by increasing the power or using a different type of aerial, and the power necessary to serve a given area depends on very many factors, not the least of which is the level of interfering signals which must be overridden. **G. H. Sturge** *(BBC Engineering Information Dept).*

TAKE 20—Electronic Siren

—continued from page 260

Operation

On initial switch-on it is possible to get no immediate high frequency oscillation and this problem can be overcome by temporarily shorting out R3 and when the audible tone is heard the shorting link can be removed. Varying the potential divider effect of R4 and R5 will set the minimum lowest frequency. The highest frequency, before complete cut off, is best set by C1. R1 could be adjusted to vary the range of frequency but this is undesirable as it affects the working points of the two transistors.

The output is taken from the junction of R1 with C1 and this is a very high impedance point and if too much current is drawn by an external circuit C1 may never reach a charge at which regenerative triggering can occur. Hence the need for a reasonably high input impedance to the amplifier stage. The output waveform is a sawtooth and its amplitude decreases as the frequency increases which is quite effective in compensating for poor low frequency response of small loudspeakers.

The estimated cost to build this project is 95p, plus cost of the speaker, Veroboard, and VAT. ■

HOTLINES ON RECENT DEVELOPMENTS

COMPUTERS are steadily becoming increasingly involved in our lives. Latest event to highlight this was the official opening of America's first computer-controlled petrol station which also boasts on-line credit checks. The motorist can pay cash or offer a credit card; the mini-computer will accept either. However, just like its human counterpart, man, the computer is happy to accept cash but wary of the credit card. When such a card is offered the computer will immediately check and verify it with the central computer files held in Atlanta. The petrol station is in the suburbs of Los Angeles. If the credit card offered to the computer is out of date, or has been stolen, then the computer will simply "pocket" the card and will refuse to return it. Now there's something you'd scarcely credit.

ONE STEP AHEAD

A quick note to exponents of ESP (extra sensory perception). There is to be an International conference on "Electrical Signals from the Brain". It is to be held at Oxford University, August 28—30, 1973. Anyone got any brain waves?

DEAF-BLIND HELP

In Hanover, there is a Centre for deaf-blind people. How do such unfortunate humans communicate? Feel or touch is an obvious answer. They can, for example, read Braille by feeling the raised dot impressions which make up the Braille alphabet. They cannot, of course, either see or hear television nor can they hear or answer a telephone call.

An ingenious system has been installed at the Hanover Centre which enables deaf-blind people to communicate directly with each other, over great distances—theoretically, anywhere in the world. Key to this system is the Braillomat. This machine produces a strip of paper with Braille alphabet letters or dot characters raised on it. Thus the deaf-blind person has only to run the strip of paper through his/her fingers to "read" the message. The Braillomat has a keyboard rather like a typewriter, but it is extremely simple in that it has only six keys—one key for each of the dots in the Braille alphabet pattern. The idea is that by connecting two of these machines together, two deaf-blind persons can "chat" happily. The tape output, incidentally, is rather like teletype or teleprinter tape.

It doesn't take too much imagination to see the potential here. Each deaf-blind person with a Braillomat could contact other deaf-blind people by using the machines in conjunction with the telephone. But wait; how will they hear the telephone ring? In practice they don't have to because the inventors have thought of this problem. Their answer is a tiny unit which is carried on the person—rather like a radio paging bleeper. Instead of emitting a warning bleep when the telephone rings, the unit simply vibrates. What a wonderful application of electronics this is.

THE "R.O.M."

Big international exhibitions are heavy going but often there are one or two very interesting items which crop up. At this year's Mesucora exhibition in Paris, one company exhibited a digital multimeter which incorporated a digital thermometer. Thus, in addition to the usual multimeter capability of measuring voltage, current and resistance, it offered the measurement of temperature also.

Unfortunately, as temperature rises, the transducer or sensor gives an output which does not follow a linear law and therefore cannot "change" degrees C directly into digital reading.

The solution used was to employ a ROM (read-only memory). This memory can be programmed to take certain correcting actions. For example; if the sensor was measuring 500°C and this, when fed directly to the digital display gave a reading of, say, 537, then the ROM could be programmed to compensate for this. Whenever a 500°C signal came in, the ROM would alter things by subtracting 37 from the answer before it was displayed.

Again, perhaps 600°C might read (fed direct) 671 and thus the ROM's programme would tell it, "If 600 in, subtract 71 to give 600 display". Thus the whole programme takes account of any input and processes it so that the "correct" temperature reading is shown digitally.

INTEREST IN "ERNIE"

In the May article, the story about "ERNIE" might have implied that the name was derived from Ernie Harrison and possibly that Racal Electronics were connected with the Premium Bond selection equipment. We would like to record that the electronic equipment was developed by Plessey and that ERNIE is derived from Electronic Random Number Indicating Equipment, the original version being developed at the Post Office Research Station, Dollis Hill, London. Mr. Harrison is Chairman of the Southern Region Industrial Savings Committee; Racal are not directly connected with ERNIE.

FLAT-SCREEN TV

Last month I reported thin readout devices and suggested flat screen television. I have just come across a flat-screen cathode ray tube (c.r.t.) or, to be more precise, two inches deep. Its function (at present) is to display alpha numeric characters/messages and it does not use either electron guns or deflection plates. It is digitally addressed and the display forms 512 characters in a 5 × 7 matrix of dots. The screen measures 5·4 × 3·8 inches. It has an area cathode which emits a sort of blanket of electrons as opposed to the narrow beam normally associated with the more conventional (and very much longer) c.r.t.

Beam forming is achieved by a plate with some 20,000 holes in it. This "forms" the electron blanket into individual beams. These beams then have to pass through four plates each similar to the beam forming one. These plates are the switching mechanism by which characters are formed. The first two plates (of the four) determine the position of the characters on the screen while the remaining two determine the column and row.

A 75V positive potential will accelerate electrons through the holes in the switching plates, while a 50V negative potential will cut off the beam completely.

After travelling through the switching plates the electron beam(s) now pass through a final plate used for focusing. They then strike the phosphor screen thus creating an illuminated image. The very small thickness of this unique c.r.t. (2in.) has numerous obvious advantages.

Other advantages are also present which may not, at first sight, seem quite so obvious. Because the electron beam has such a very short distance to travel, the display is virtually immune to magnetic interference.

Note: This display, although it has been exhibited and is not an industrial secret, is not yet on the market although its appearance is believed to be imminent.

Ginsberg

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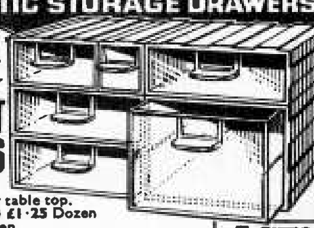

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TRICOLOUR

Mood Lighting System

PART FOUR JUREK BUDEK*

—continued from the June issue

As the load increases, the suppression of radio frequency interference becomes more difficult. Many sophisticated and very effective circuits have been published and are on the market, but very often they are prohibitive to the normal user because of their high cost.

The suppression filter used in this article is very simple, inexpensive and quite effective. It is suitable for total loads up to 900 watts, and consists of one bifilar wound ferrite core filter choke and $0 \cdot 1\mu F$ capacitor as shown in Fig. 23.

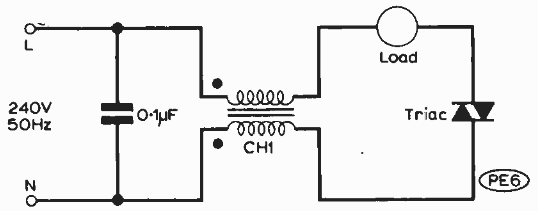

Fig. 23: The suppression circuit used in the mains input supply to the lamp dimming control unit.

The normal symmetrical currents generate magnetic fields which are self cancelling. However, symmetrical currents, caused by radio frequency interference are attenuated.

Assembly

Pay attention to the correct polarity of capacitors, diodes, transistors and triacs. Mount the pulse transformer in correct way, i.e. to avoid sideway fixing.

The three core mains lead enters at the rear of the chassis (Fig. 20, page 54, May issue) and is connected to the junction terminal block.

Thereafter, the connections to the junction terminal block are as indicated in the printed circuit board wiring layout diagrams in this issue. It is pointed out that the mains 'earth' lead (E terminal) should preferably be taken directly to the control unit chassis. In Fig. 20 (May issue) this was shown soldered to the 'earth' side of the printed circuit board layout.

When the printed circuit board is mounted in the chassis metalwork, the 'earthy' side of the foil is connected to the metalwork via the mounting spacers, thus ensuring continuity of the chassis-p.c. foil earth system.

Therefore, the mains earth lead (common) and the earth lead from tag 1 on the lamps output socket SK1 may be conveniently taken to a chassis earth tag which may be mounted under one of the metal bolts that hold socket SK1 in position.

The socket SK1 is wired otherwise as shown in Fig. 20.

The three triacs, CSR3, CSR4 and CSR5, are in all instances bolted directly to the common heat sink

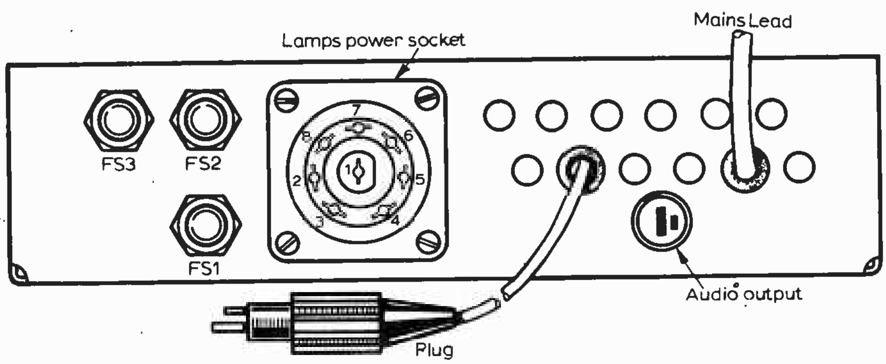

Fig. 24: Rear view of the P.W. Tricolour. The DIN plug and socket are the audio signal feed points—to amplifier output and loudspeaker.

* Texas Instruments Ltd.

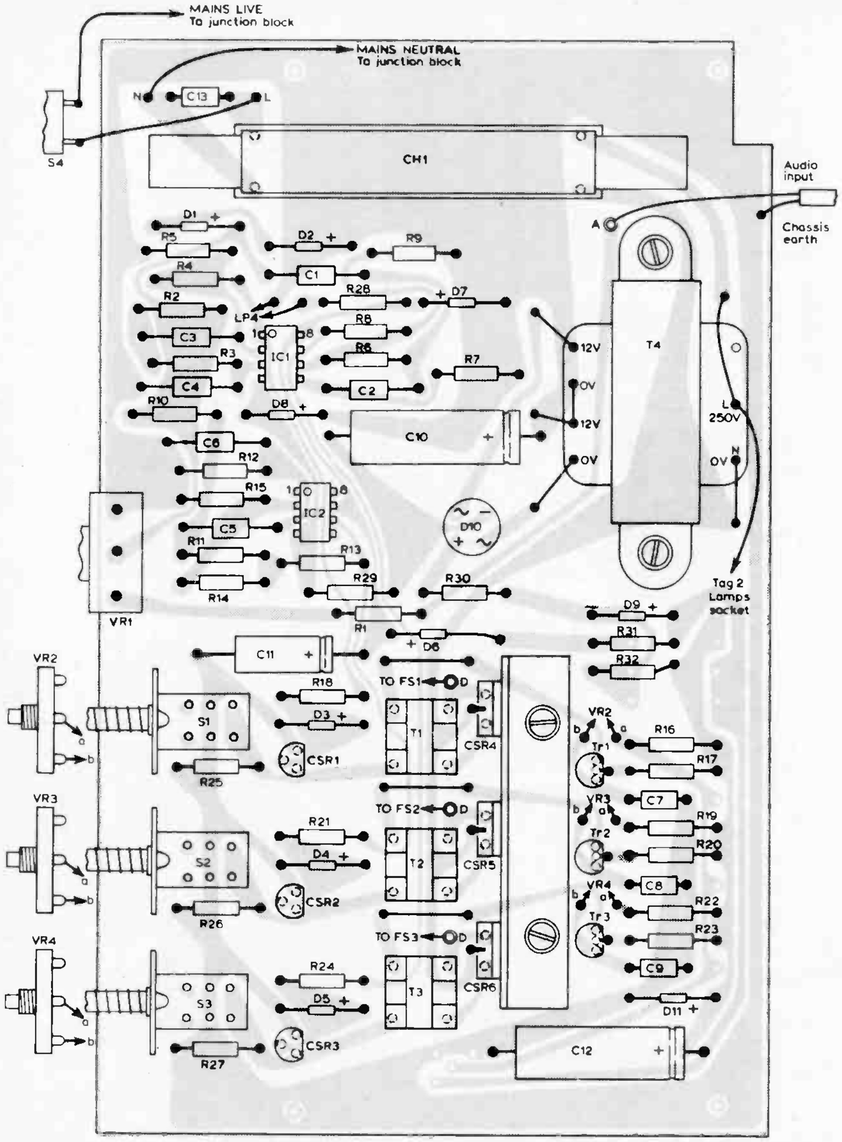

Fig. 25: Component layout for the lamp dimming version of the P.W. Tricolour on the Mk II printed circuit board. Refer to the April and June '73 issues for component details.

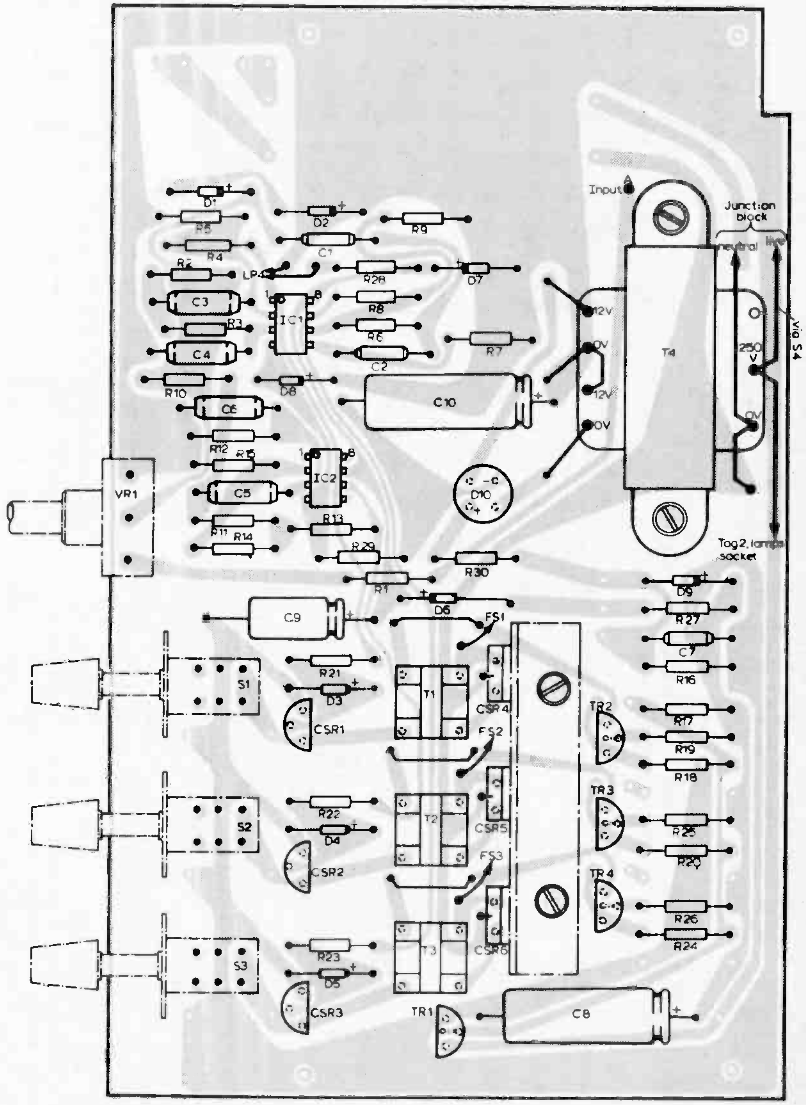

Fig. 26: Component layout for the zero voltage version of the P.W. Tricolour on the Mk II printed circuit board. Refer to the April '73 issue for component details.

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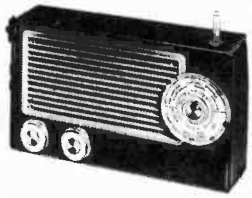

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 Trawler, band plus an extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 25p (FREE with parts).

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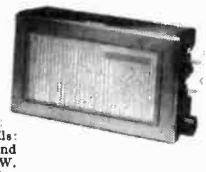

3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ × 1¾ × 3½in. Easy build plans and parts price list 10p (FREE with parts).

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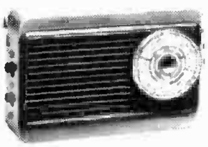

5 TRANSISTORS AND 2 DIODES

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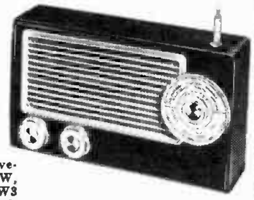

8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts).

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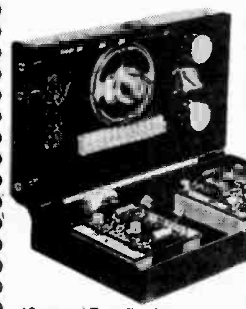

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				7437	65	7480	80	74111	£1·45	74175	£1·35
				7438	65	7482	87	74118	£1·00	74176	£1·60
7400	20	7411	28	7440	20	7483	£1·00	74119	£1·90	74190	£1·95
7401	20	7412	42	7441AN	75	7484	90	74121	60	74191	£1·95
7402	20	7413	30	7442	75	7486	45	74122	£1·35	74192	£2·00
7403	20	7416	30	745Q	20	7490	75	74123	£2·70	74193	£2·00
7404	20	7417	30	7451	20	7491AN	£1·00	74141	£1·00	74194	£2·50
7405	20	7420	20	7453	20	7492	75	74145	£1·50	74195	£1·85
7406	30	7422	48	7454	20	7493	75	74150	£3·35	74196	£1·50
7407	30	7423	48	7460	20	7494	80	74151	£1·10	74197	£1·50
7408	20	7425	48	7470	30	7495	80	74154	£2·00	74198	£4·60
7409	45	7427	42	7472	30	7496	£1·00	74155	£1·55	74199	£4·60
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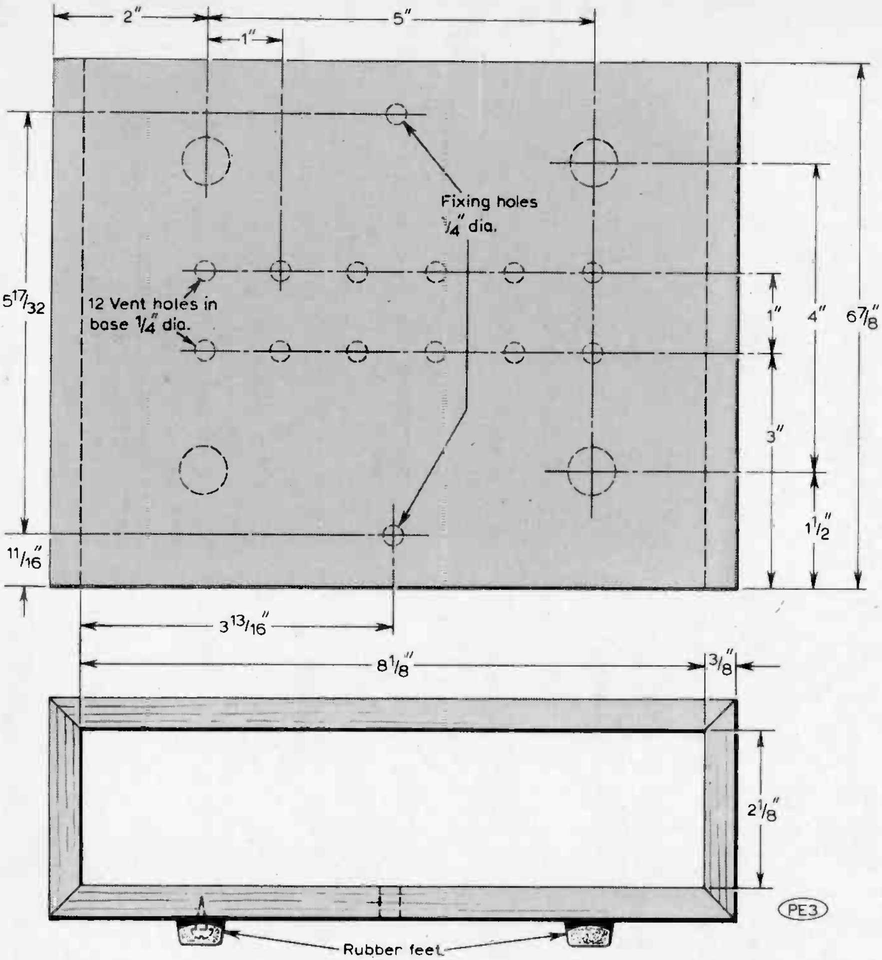


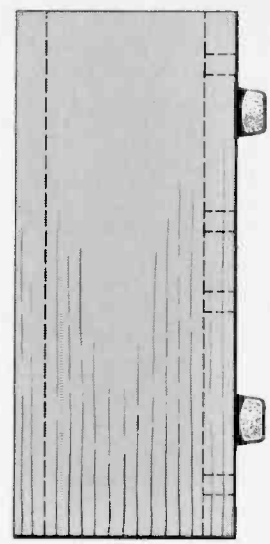
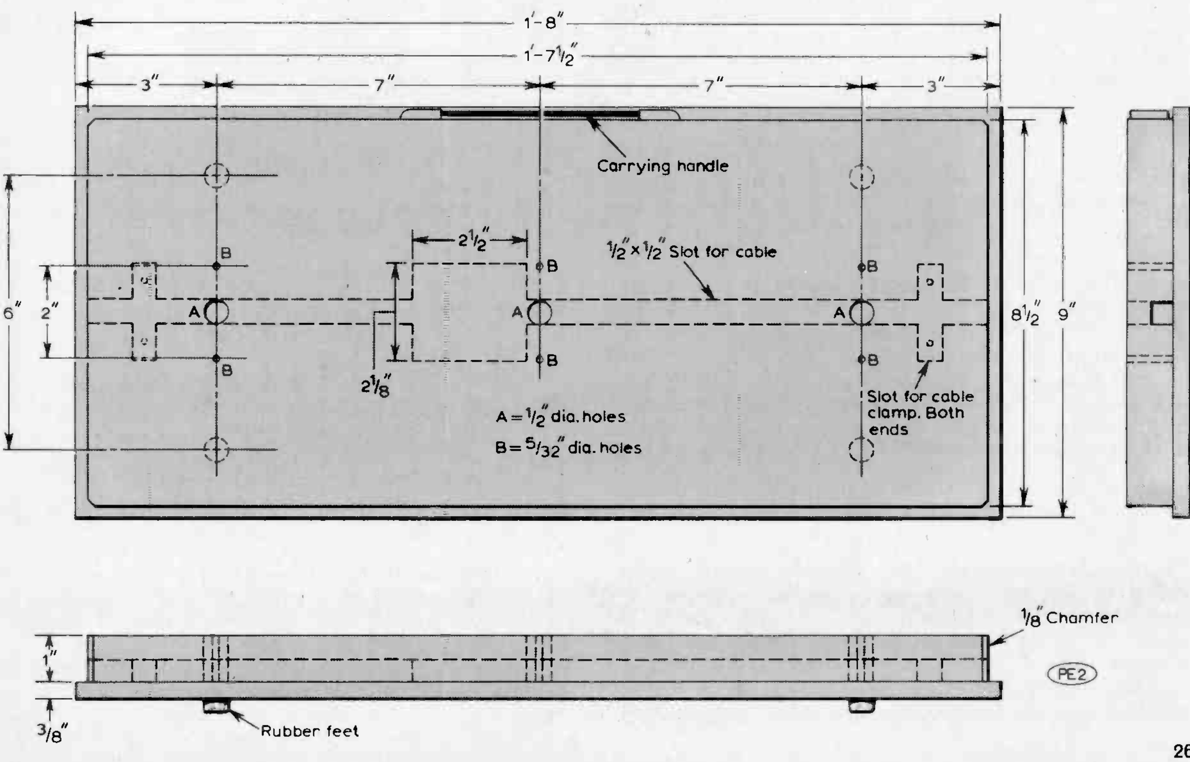


Fig. 27: Cabinet details for the P.W. Tricolour.

Fig. 28: Details of the base unit for the lamps.



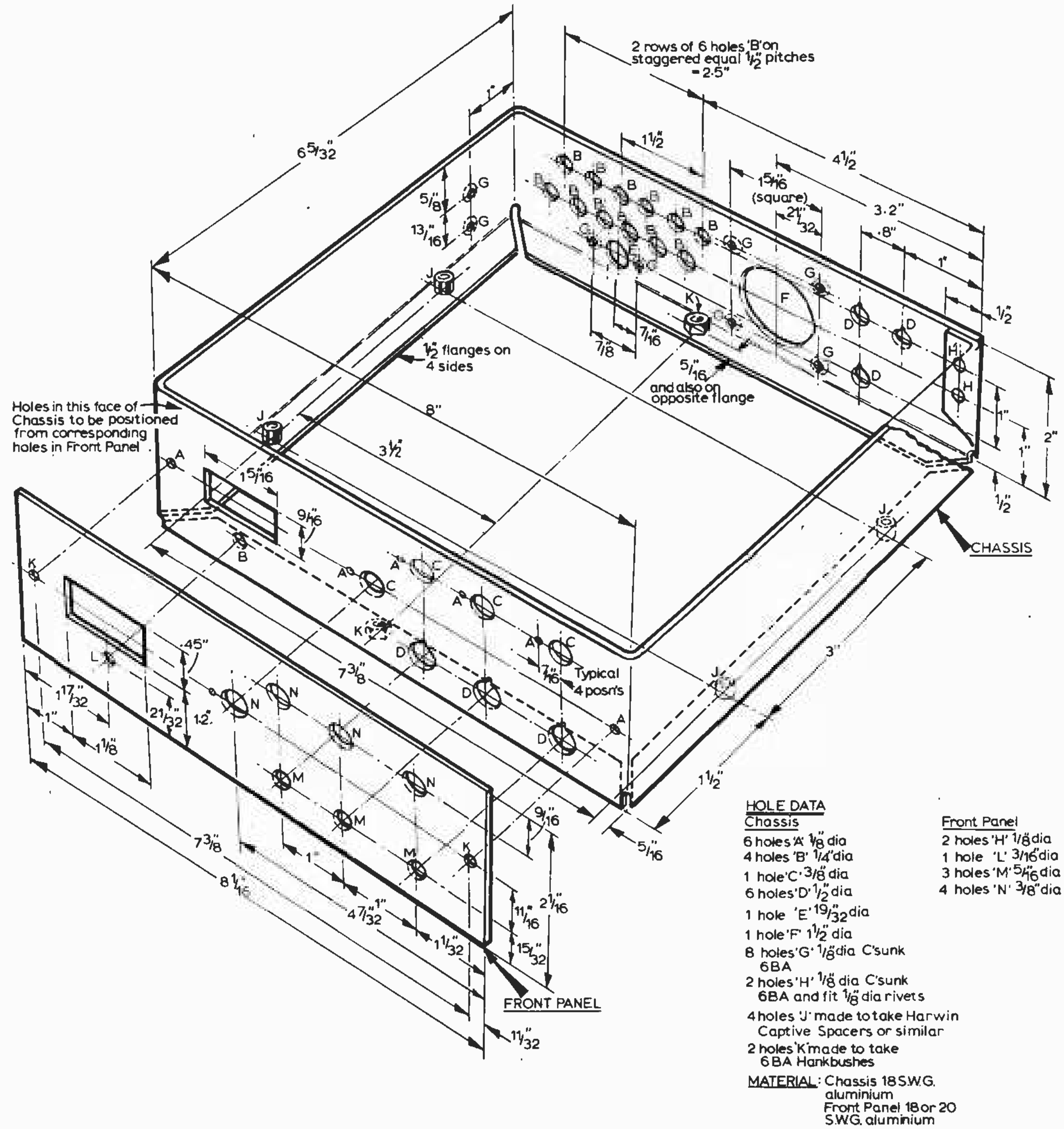


Fig. 29: Front panel and chassis metalwork details for the lamp dimming version. The heat sink is identical to that given in the May issue. Note that the two holes marked 'K' on the front panel should have been given as 'H'.

using 4BAx¼in. bolts and nuts. No insulating washers are used. The heat sink is held in position on the printed circuit board by 4BAx¼in. bolts and nuts.

The lamp dimming controls, VR2, VR3 and VR4 are wired as shown in Fig. 25, the left hand tag on each control is unused. These tags should be carefully positioned so that they do not touch or short to adjacent components.

The Bulgin socket (SK1) and plug (PL1) are numbered on their mouldings to conform with Fig. 20.

Having completed the units and checked the lamp wiring to the multiway lamps socket—1-Earth, 2-Common, 4-Bass, 6-Middle and 8-Treble, check if any of the lamps come on, after the supply has been switched on. If so, there may be a component wrongly positioned in the filter circuit or a solder bridging around the triac or thyristor. If no lamp lights, press on the override switches; the lamps should come on, and if not, change over the lamps, check interconnecting wiring and switching circuits i.e. triac and thyristors.

Finally, play some music. If any of the lamps do not work, check all the components in the relevant filter circuit for dry joints etc.

It should have been pointed out in the captions to Figs 24 and 27 (part 3, last month) that each division of the graticule scale represented 1cm. In the list of components applicable to Fig. 25 the value of R1 (page 184) should have been given as 15kΩ.

It would appear that in some copies of the May issue, one of the I.C. connections (IC1) in Fig. 9 was missing. The missing number is '1'. On the same diagram a figure '13' appears between the middle and treble outputs. This should be ignored. ■

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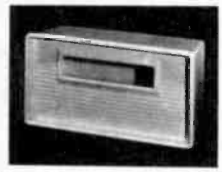

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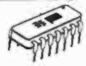

	1	25		1	25		1	25		1	25
SN7400	16p	15p	SN7423	55p	50p	SN7450	16p	15p	SN7489	6·05p	5·85p
SN7401	16p	15p	SN7425	55p	50p	SN7451	16p	15p	SN7490	74p	72p
SN7402	16p	15p	SN7427	49p	46p	SN7453	16p	15p	SN7491	1·10p	1·04p
SN7403	16p	15p	SN7428	77p	72p	SN7454	16p	15p	SN7492	74p	72p
SN7404	16p	15p	SN7430	16p	15p	SN7460	16p	15p	SN7493	74p	72p
SN7405	16p	15p	SN7432	49p	46p	SN7470	33p	29p	SN7494	85p	72p
SN7406	38p	35p	SN7433	94p	82p	SN7472	33p	29p	SN7495	85p	72p
SN7407	38p	35p	SN7437	72p	69p	SN7473	41p	39p	SN7496	95p	92p
SN7408	20p	18p	SN7438	72p	69p	SN7474	41p	38p	SN74100	1·80p	1·75p
SN7409	20p	18p	SN7440	16p	15p	SN7475	50p	47p	SN74104	1·09p	1·06p
SN7410	17p	15p	SN7441	74p	70p	SN7476	44p	43p	SN74105	1·09p	1·06p
SN7411	27p	25p	SN7442	74p	70p	SN7480	73p	70p	SN74107	44p	42p
SN7412	38p	35p	SN7443	1·43p	1·37p	SN7481	1·32p	1·26p	SN74110	61p	59p
SN7413	32p	29p	SN7444	1·43p	1·37p	SN7482	97p	95p	SN74111	1·37p	1·27p
SN7416	47p	43p	SN7445	2·00p	1·92p	SN7403	1·20p	1·15p	SN74118	1·10p	1·05p
SN7417	47p	43p	SN7446	1·07p	1·02p	SN7484	1·10p	1·05p	SN74119	1·47p	1·37p
SN7420	16p	15p	SN7447	1·10p	1·03p	SN7485	3·96p	3·85p	SN74121	44p	41p
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301A	8 PIN DIL	66p	747c	DIL	46p
307	DIL	69p	748c	DIL	39p
307	TO99	69p	748c	TO99	41p
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68µF 6½p
150µF 6½p
470µF 11p
680µF 13p
1500µF 18p
2200µF 18p
3300µF 26p

10 VOLT
22µF 6½p
47µF 6½p
100µF 6½p
220µF 8p
330µF 10p
470µF 10p
1000µF 11p
1500µF 20p
2200µF 24p

16 VOLT
15µF 6½p
33µF 6½p
68µF 6½p
150µF 8p
220µF 9p
680µF 17p
1000µF 17p
1500µF 25p
2000µF 43p

25 VOLT
10µF 6½p
22µF 6½p
47µF 6½p
100µF 8p
150µF 8p
220µF 10p
470µF 13p
680µF 20p
1000µF 22p
2200µF 39p
5000µF 68p

40 VOLT
6·8µF 6½p
15µF 6½p
33µF 6½p

40 VOLT
47µF 6½p
100µF 9p
150µF 10p
220µF 11p
470µF 19p
680µF 25p
1000µF 25p
2200µF 44p

63 VOLT
1µF 6½p
2·2µF 6½p
4·7µF 6½p
6·8µF 6½p
10µF 6½p
22µF 6½p
68µF 10p
100µF 11p
150µF 13p
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330µF 22p
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AC142K	22p	BC145	26p	BFX84	28p	OC72	14p
AC141K	20p	BC147	9p	BFX85	35p	OC81	14p
AC176	15p	BC148	9p	BFX86	22p	OC83	22p
AC187	13p	BC149	9p	BFX87	28p	OC84	28p
AC187K	20p	BC153	16p	BFX88	26p	TIP29A	53p
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AD150	60p	BC212L	11p	MP8121	33p	2N930	23p
AD161	29p	BC213L	11p	MP8122	44p	2N1131	22p
AD162	29p	BC214L	11p	MP8123	50p	2N1132	28p
AD M/P	50p	BC258	9p	NKT211	28p	2N1613	22p
AF114	14p	BC259	9p	NKT212	28p	2N1711	26p
AF115	14p	BC267	14p	NKT214	26p	2N2904	40p
AF116	14p	BC268	15p	NKT217	55p	2N2904A	
AF117	14p	BC300	40p	NKT261	23p		44p
AF118	92p	BC301	32p	NKT271	20p	2N2905	46p
AF124	27p	BC302	30p	NKT274	20p	2N2924	18p
AF139	39p	BC303	50p	NKT275	25p	2N2926	10p
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BC116	16p	BF173	29p	OC23	33p	2N3710	9p
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BC126	25p	BF178	29p	OC28	33p	2N3794	17p
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This Capacitor-Discharge Electronic Ignition System was recently described in Practical Wireless and has proved extremely popular. We are able to offer the kit in two forms; the standard kit containing the electronic components only, enabling the customer to tailor these to his own layout, or the de-luxe version containing a ready-drilled roller-tinned printed-circuit board and fully machined die-cast case with A.M.P Electrical Spade Connector Block. Each kit is supplied with a custom wound transformer, first grade components and full constructional details.

The original circuit employed Germanium Power Transistors for the negative earth version. **WE NOW SUPPLY SILICON P.N.P. POWER DEVICES AT NO EXTRA COST!** All components available separately. Case size 4¾" x 3¼" x 2". Complete assembly and wiring manual **25p**, supplied with de-luxe kit only, refundable on purchase of kit.

Suitable for 12v systems with Pos. or Neg. earth.

Price: Standard Kit ....**£7·97** U.K. Post Free
De-Luxe Kit ....**£9·62** U.K. Post Free

Quantity Discounts:

Trade and Overseas	1–5	Nett	6–9	Less 10%
Enquiries Invited	10–49	Less 15%	50–99	Less 20%
Mail Order Only	100–999	Less 25%	1000 up	Less 30%

PLEASE STATE POS. OR NEG. EARTH WHEN ORDERING.

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LONGLEY LANE, GATLEY, CHEADLE, CHES. SK8 4EE

Selection from our List, sent free for stamped addressed envelope. (Free overseas, and with all orders on request). Cash with order only—No C.O.D. or Caller service. Charges (Min. 7p) in brackets after all items apply to G.B. and Eire only. Regret orders under 30p plus charges unacceptable. S.A.E. please for enquiries or cannot be replied to. Overseas, including Eire and Channel Isles, orders less 10% off prices below, which include V.A.T. **RECORDING TAPE:** Finest quality/value British Mylar available: STANDARD 5" 600ft. 40p. 5¾" 900ft. 55p; 7" 1200ft. 62p; LONG PLAY 5" 900ft. 55p; 5¾" 1200ft. 62p; 7" 1800ft. £1·00 (Charges for 5" and 5¾", singles 9p, two to four 8p each; five and over 33p the lot. For 7", one or two 11p each reel, 3, 4 and 5 reels 33p the lot. 6 reels and over 39p the lot.) Other sizes and accessories in list. **CASSETTES**, Two types, Both in Library Cases, C60 33p, C90 48p, C120 72p. Deluxe Types: C60 55p, C90 72p, C120 99p. (Charges for both types, under 5, 9p each. 5 for 17½p. All quantities over 5, 28p the lot.)
CARTRIDGES all with standard fittings and stylii. Stereo-compatible Mono GP91/SC 98p; STEREO GP93 £1·35, Stereo Ceramic GP94 £1·75. (All at 7p each.) Comparatives shown in List, with more types inc. Sonotone 9TAHC, Stereo Ceramic Diamond £1·70 (7p). **DIAMOND STYLII**: single tip types: Acos GP37, GP59, GP65/67, GP71, BSR TC8/LP/ST: COLLARO O.P. and DC284, GARRARD GC2, GC8, GC810, GCE12, RONETTE BF40, O.P. and T. PHILIPS 3301 (3060, 3066, 3302, 3304), 3010/12/13/16, SONOTONE 19T/20T ALL AT 36p each (7p). SAPPHIRE 16p (7p) DIAMOND DOUBLE TIP TURNOVER TYPES (78 sap. on other side). For ACOS GP73, GP91 (for cartridges GP93, GP94 etc.) GP91SC (for stereo compat. types) GP104 BSR ST4 (ST3, ST5), ST9 (ST8), ST12/14/15, SONOTONE 8TA, 9TA, 9TAHC. PHILIPS 3306 3310, 3224, 3228/22 GP280. GARRARD GCM21, and 22, GC823, GK825 and 26, GCM21T and 22T, GCM24T GC823. GK825T and 26T, GCM31, GC836, GC835, GC838, KS40A, KS41B ETC. ALL AT 68p (7p). SAPPHIRE 32p (7p). **DOUBLE DIAMOND STYLII:** same dia ST/LP tip each side: no 78) All types £1·35 (7p). SAPPHIRE DOUBLE ST/LP, TIPPED 32p (7p). **DIAMOND STYLII GOLDRING REPLACEMENTS:** G800, G800H & G850, £2·25 each. G800E, £3·75 (8p each). **PICK-UP WIRE:** super thin flex screened, sheathed, TWIN 7p per yard, 4-core 13p per yard (either up to 6 yds. 7p). Over, charges paid. **MICROPHONES:** CRYSTAL: LAPEL 1½", clip/hand, lead 3·5mm jack plug 39p (9p). CM20 Cream Plastic hand 58p (9p); "MIC 45". Curved metal hand grip £1·10 (11p) ALL with leads. DYNAMIC: Excellent Mike, 50K Ω, only 3½" long, black/chrome, switched, lead with 2·5 and 3·5 mm jack plugs £1·37 (8p). Cardiod Ball, 50K/600 Ω built in volume control, on/off switch, special 20ft lead, the best value anywhere at £6·60 (33p); Uni-dir mesh ball 50K/600 Ω jack plug cable, adaptor, £5·28 (33p); Omni-dir. Ball mesh, 50K, cable adaptor, jack plug, £4·29 (33p each). **SPEAKERS:** Very popular 12" ROUND, fitted tweeter, 3, 8 or 15 ohms (state which) £2·06 (33p) or pair for stereo £4·65, charges paid. **SMALL** 2½", 3 Ω, 8 Ω or 64 Ω (state which) 41p (9p). More speakers in List. **HEADPHONES:** High resistance 2000 Ω adjustable £1·10 (11p). **EARPIECES:** with lead and min. 2·5mm or 3·5mm (state which) jack plug. MAGNETIC 12p. CRYSTAL (3·5mm plug only) 28p (up to 6 for 9p any size). **SOLDERING IRON:** Slim, modern, British high speed, 8½", all parts replaceable, highest quality, fully guaranteed £1·29 (11p). **TRANSFORMERS:** Sub-min 11 × 11 × 12mm. OUTPUT (3 Ω for OC72, etc.) 16p or DRIVER 17p (Up to 12 for 7p). **CONNECTING WIRE:** Packs of 5 coils, each coil 5yds. Assts. cols. SOLID CORE 16p (7p). FLEXIBLE CORE 18p (9p). **RETRACTABLE FLEXIBLE LEADS** (CURLIES) with phono plug each end, or phono plug one end, phono socket at the other (state which) 6ft, 30p; 12ft, 53p (either 7p). **VIBRATORS:** 12v/4 pin non-synch 12IHD4, 2¾" ex. pins, 33p. SAME but 3½" ex. pins, USA, 16½p. 12v/7 pin synch. (12SR7) 2¾" ex. pins, 72p (9p any type). **MAINS BATTERY ELIMINATORS:** Two models, both 240v A.C. input. Suit most radios and cassette recorders/players with front switch, pilot lights, mains and output leads. Model SC, 3, 6, 7½ and 9v 400mA. stabilised with multi-output adaptor £5·50 (35p). Model N.R. has additional 12v output and 15 500mA £6·00 (35p).

OUR LIST (see heading) has added to the above items Cartridge and Stylii Comparisons Special Non-repeatable Offers, Aerials, Dials, Transistors, Multi-Leads, Plugs, Sockets of many types, Speakers, Vol. Controls, Multi-testers, Mike Inserts, Neons, Indicators, STEREO Headphones, Pocket Screwdriver Testers, Tel. Pick-ups, Wire, Cable, etc., etc.

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THIS IS THE FIRST PAGE OF THE GREAT BI-PAK SECTION

Cut these 3 pages out and keep for reference

BRAND NEW FULLY GUARANTEED DEVICES

Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p
AC107	22	AD161	37	BC145	50	BD133	72	BF182	44
AC113	22	AD162	37	BC147	11	BD135	44	BF183	44
AC115	26	AD161 &		BC148	11	BD136	44	BF184	28
AC117K	22	AD162 (MP)		BC149	13	BD137	50	BF185	33
AC122	13		61	BC150	20	BD138	55	BF188	44
AC125	19	ADT140	55	BC151	22	BD139	61	BF194	13
AC126	19	AF114	27	BC152	19	BD140	66	BF195	13
AC127	19	AF115	27	BC153	31	BD155	88	BF196	16
AC128	19	AF116	27	BC154	33	BD175	66	BF197	16
AC132	16	AF117	27	BC157	20	BD176	66	BF200	50
AC134	16	AF118	39	BC158	13	BD177	72	BF222	1·05
AC137	16	AF124	33	BC159	13	BD178	72	BF257	50
AC141	16	AF125	28	BC160	50	BD179	77	BF258	66
AC141K	19	AF126	31	BC161	55	BD180	77	BF259	94
AC142	16	AF127	31	BC167	13	BD185	72	BF262	61
AC142K	19	AF139	33	BC168	13	BD186	72	BF263	61
AC151	17	AF178	33	BC169	13	BD187	77	BF270	39
AC154	22	AF179	55	BC170	13	BD188	77	BF271	33
AC155	22	AF180	55	BC171	16	BD189	83	BF272	88
AC156	22	AF181	50	BC172	16	BD190	83	BF273	39
AC157	27	AF186	50	BC173	16	BD195	94	BF274	39
AC165	22	AF239	41	BC174	16	BD196	94	BFW10	66
AC166	22	AL102	72	BC175	24	BD197	99	BFX29	30
AC167	22	AL103	72	BC177	21	BD198	99	BFX84	24
AC168	27	ASY26	28	BC178	21	BD199	1·05	BFX85	33
AC169	16	ASY27	33	BC179	21	BD200	1·05	BFX86	24
AC176	22	ASY28	28	BC180	27	BD205	88	BFX87	27
AC177	27	ASY29	28	BC181	27	BD206	88	BFX88	24
AC178	31	ASY50	28	BC182	11	BD207	1·05	BFY50	22
AC179	31	ASY51	28	BC182L	11	BD208	1·05	BFY51	22
AC180	19	ASY52	28	BC183	11	BDY20	1·10	BFY52	22
AC180K	22	ASY54	28	BC183L	11	BF115	27	BFY53	19
AC181	19	ASY55	28	BC184	13	BF117	50	BPX25	94
AC181K	22	ASY56	28	BC184L	13	BF118	77	BSX19	17
AC187	24	ASY57	28	BC186	31	BF119	77	BSX20	17
AC187K	22	ASY58	28	BC187	31	BF121	50	BSY25	17
AC188	24	ASZ21	44	BC207	12	BF123	55	BSY26	17
AC188K	22	BC107	10	BC208	12	BF125	50	BSY27	17
ACY17	28	BC108	10	BC209	13	BF127	55	BSY28	17
ACY18	22	BC109	11	BC212L	12	BF152	61	BSY29	17
ACY19	22	BC113	11	BC213L	12	BF153	50	BSY38	20
ACY20	22	BC114	17	BC214L	16	BF154	50	BSY39	20
ACY21	22	BC115	17	BC225	28	BF155	77	BSY40	31
ACY22	18	BC116	17	BC226	39	BF156	53	BSY41	31
ACY27	20	BC117	17	BCY30	27	BF157	61	BSY95	14
ACY28	21	BC118	11	BCY31	29	BF158	61	BSY95A	14
ACY29	39	BC119	33	BCY32	33	BF159	66	Bu105	2·20
ACY30	31	BC120	88	BCY33	24	BF160	44	C111E	55
ACY31	31	BC125	13	BCY34	28	BF162	44	C400	33
ACY34	23	BC126	20	BCY70	16	BF163	44	C407	28
ACY35	23	BC132	13	BCY71	20	BF164	44	C424	22
ACY36	31	BC134	20	BCY72	16	BF165	44	C425	55
ACY40	19	BC135	13	BCZ10	22	BF167	24	C426	39
ACY41	20	BC136	17	BCZ11	28	BF173	24	C428	22
ACY44	39	BC137	17	BCX12	28	BF176	39	C441	33
AD130	42	BC139	44	BD121	66	BF177	39	C442	33
AD140	53	BC140	33	BD123	72	BF178	33	C444	39
AD142	53	BC141	33	BD124	66	BF179	33	C450	24
AD143	42	BC142	33	BD131	55	BF180	33	MAT100	21
AD149	55	BC143	33	BD132	66	BF181	33	MAT101	22

Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p
MAT120	21	2G308	39	2N2148	63	2N3053	19	2N4059	11
MAT121	22	2G309	39	2N2160	66	2N3054	51	2N4060	13
MPF102	46	2G339	22	2N2192	39	2N3055	55	2N4061	13
MPF104	41	2G339A	18	2N2193	39	2N3391	16	2N4062	13
MPF105	41	2G344	20	2N2194	39	2N3391A	18	2N4284	19
OC19	39	2G345	18	2N2217	24	2N3392	16	2N4285	19
OC20	70	2G371	18	2N2218	22	2N3393	16	2N4286	19
OC22	42	2G371B	13	2N2219	22	2N3394	16	2N4287	19
OC23	46	2G373	19	2N2220	24	2N3395	19	2N4288	19
OC24	62	2G374	19	2N2221	22	2N3402	23	2N4289	19
OC25	42	2G377	33	2N2222	22	2N3403	23	2N4290	19
OC26	28	2G378	18	2N2368	19	2N3404	31	2N4291	19
OC28	55	2G381	18	2N2369	16	2N3405	46	2N4292	19
OC29	55	2G382	18	2N2369A	16	2N3414	17	2N4293	19
OC35	46	2G401	33	2N2411	27	2N3415	17	2N5172	13
OC36	55	2G414	33	2N2412	27	2N3416	31	2N5457	35
OC41	22	2G417	28	2N2646	52	2N3417	31	2N5458	35
OC42	27	2N388	39	2N2711	23	2N3525	83	2N5459	44
OC44	16	2N388A	61	2N2712	23	2N3646	10	2S301	55
OC45	14	2N404	22	2N2714	23	2N3702	11	2S302A	46
OC70	11	2N404A	31	2M2904	19	2N3703	11	2S302	46
OC71	11	2N524	46	2N2904A	23	2N3704	12	2S303	61
OC72	16	2N527	54	2N2905	23	2N3705	11	2S304	77
OC74	16	2N598	46	2N2905A	23	2N3706	10	2S305	93
OC75	17	2N599	50	2N2906	17	2N3707	12	2S306	93
OC76	17	2N696	14	2N2906A	20	2N3708	8	2S307	93
OC77	28	2N697	15	2N2907	22	2N3709	10	2S321	62
OC81	17	2N698	27	2N2907A	24	2N3710	10	2S322	46
OC81D	17	2N699	39	2N2923	16	2N3711	10	2S322A	46
OC82	17	2N706	9	2N2924	16	2N3819	31	2S323	62
OC82D	17	2N706A	10	2N2925	16	2N3820	55	2S324	77
OC83	22	2N708	13	2N2926(G)	14	2N3821	39	2S325	77
OC84	22	2N711	33	2N2926(Y)	12	2N3823	31	2S326	77
OC139	22	2N717	39	2N2926(O)	11	2N3903	31	2S327	77
OC140	22	2N718	27	2N2926(R)	11	2N3904	33	2S701	46
OC169	28	2N718A	55	2N2926(B)	11	2N3905	31	40361	44
OC170	28	2N726	31	2N3010	77	2N3906	30	40362	50
OC171	28	2N727	31	2N3011	16	2N4058	13		
OC200	28	2N743	22						
OC201	31	2N744	22	**DIODES AND RECTIFIERS**					
OC202	31	2N914	16	AA119	9	BY133	23	OA70	8
OC203	28	2N918	33	AA120	9	BY164	55	OA79	8
OC204	28	2N929	23	AA129	9	BYX38/30	46	OA81	8
OC205	39	2N930	23	AAY30	10	BYZ10	39	OA85	10
OC309	44	2N1131	22	AAZ13	11	BYZ11	33	OA90	7
OCP71	48	2N1132	24	BA100	11	BYZ12	33	OA91	7
ORP12	48	2N1302	16	BA116	23	BYZ13	28	OA95	8
ORP60	44	2N1303	16	BA126	24	BYZ16	44	OA200	7
ORP61	44	2N1304	19	BA148	16	BYZ17	39	OA202	8
P346A	22	2N1305	19	BA154	13	BYZ18	39	SD10	6
P397	46	2N1306	23	BA155	16	BYZ19	31	SD19	6
ST140	14	2N1307	23	BA156	15	CG62		1N34	8
ST141	19	2N1308	26	BY100	17	(OA91 Eq.)	6	1N34A	8
TI843	33	2N1309	26	BY101	13	CG651		1N914	7
UT46	30	2N1613	22	BY105	19	(OA70-OA79		1N916	7
2G301	21	2N1711	22	BY114	13	Eq.)	7	1N414B	7
2G302	21	2N1889	35	BY126	16	OA5	39	1S021	11
2G303	21	2N1890	50	BY127	17	OA5SL	23	1S951	7
2G304	27	2N1893	41	BY128	17	OA10	39		
2G306	44	2N2147	79	BY130	18	OA47	8		

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Pack No.	Qty.	Description	Price
C 1	250	Resistors mixed values approx. count by weight	0·55
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C 3	50	Precision Resistors 1% mixed values	0·55
C 4	75	⅛th W Resistors mixed preferred values	0·55
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C 7	1	Pack Wire 50 metres assorted colours	0·55
C 8	10	Reed Switches	0·55
C 9	3	Micro Switches	0·55
C10	15	Assorted Pots & Pre-Sets	0·55
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C12	40	Paper Condensers preferred types mixed values	0·55
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C15	4	Mains Switches, 2 Amp plus	0·55
C16	20	Assorted Tag Strips & Panels	0·55
C17	10	Assorted Control Knobs	0·55
C18	4	Rotary Wave Change Switches	0·55
C19	3	Relays 6—24V Operating	0·55
C20	4	Sheets Copper Laminate approx. 10″ × 7″	0·55

Please add 10p post and packing on all component packs, plus a further 10p on pack Nos. C1, C2, C19 & C20.

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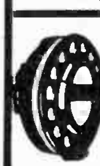

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SYSTEM 12 STEREO

Each Kit contains two Amplifier Modules, 3 watts RMS, two loudspeakers, 15 ohms, the pre-amplifier, transformer, power supply module, front panel and other accessories, as well as an illustrated stage-by-stage instruction booklet designed for the beginner.
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NEW LOW PRICED TESTED S.C.R.'s

PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·26	0·28	0·39	0·39	0·52	0·55	0·59	1·27
100	0·28	0·37	0·52	0·52	0·55	0·64	0·70	1·54
200	0·39	0·41	0·54	0·54	0 63	0·67	0·83	1·76
400	0·48	0·52	0·62	0·62	0·74	0·83	1·03	1·93
600	0·59	0·63	0·75	0·75	0·85	1·07	1·38	—
800	0·70	0·77	0·88	0·88	0·99	1·32	1·65	4·40

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1 5A	3A	10A	30A
50	0 04	0·06	0·06	0·08	0·16	0·23	0·66
100	0·04	0·07	0·06	0·15	0·18	0·26	0·83
200	0·06	0·10	0·07	0·16	0·22	0·27	1·10
400	0·07	0·15	0·08	0·22	0·30	0·41	1·38
600	0·08	0·18	0·11	0·26	0·38	0·50	2·05
800	0·11	0·19	0·12	0·28	0·41	0·61	2·20
1000	0·12	0·28	0·16	0·33	0·51	0·70	2·75
1200	—	0·37	—	0·42	0·63	0·83	—

TRIACS

VBOM	2A TO-5 £p	6A TO-66 £p	10A TO-48 £p
100	33	55	88
200	55	66	99
400	77	82½	1·21

DIACS

FOR USE WITH TRIACS
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One 50p Pak of your own choice free with orders valued £4 or over.

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Coded and Guaranteed

Pak No.		EQVT
T1	8 2G3713	OC71
T2	8 D1374	OC75
T3	8 D1216	OC81D
T4	8 2G381T	OC81
T5	8 2G382T	OC82
T6	8 2G344B	OC44
T7	8 2G345B	OC45
T8	8 2G378	OC78
T9	8 2G399A	2N1302
T10	8 2G417	AF117

All 55p each pak

D1699 NPN SILICON DUAL TRANSISTOR

(Similar to 2N2060)

1	25	100+
0·28	0·26	0·23

ND 120 NIXIE DRIVER TRANSISTOR.

Suitable replacement for BSX 21, C 407, 2N 1893 120veb.

1	25	100+
0·19	0·17	0·16

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 5½p each. Any Qty.

GP 100 TO3 METAL CASE GERMANIUM

Vebo=80V. Vceo=50V. I.C.=10 amps. Ptot=30W. hfe=30-170. Replaces the majority of Germanium power transistors in the OC, AD and NKT range.

1	25	100+
0·48	0·44	0·40

GP 300 TO3 METAL CASE SILICON

Vebo=100V. Vceo=60V I.C.=15 amps. Ptot=115W. hfe=20. 100fT.=1MHz. Suitable replacement for 2N 3055, BDY 11 or BDY 20.

1	25	100+
0·55	0·53	0·51

FULL RANGE OF ZENER DIODES

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2N3055

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UIC20=12×7420	0·55	UIC73=8×7473	0·55	UIC141=5×74141	0·55
UIC30=12×7430	0·55	UIC74=8×7474	0·55	UIC151=5×74151	0·55
UIC40=12×7440	0·55	UIC75=8×7475	0·55	UIC154=5×74154	0·55
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Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

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MODEL	CD66	GR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2·3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
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ONLY £3.58p each

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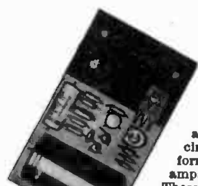

STABILISED POWER MODULE SPM80

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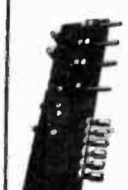
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.



SPECIFICATION

Frequency Response	20Hz – 20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs : 1. Tape Head	1·25 mV into 50K Ω
2. Radio, Tuner	35 mV into 50K Ω
3. Magnetic P.U.	1·5 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
Filters : Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than – 65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

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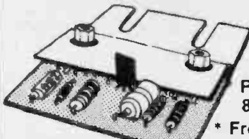

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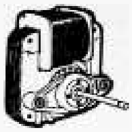

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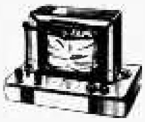

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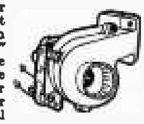
10% discount if 10 or more ordered.

CENTRIFUGAL BLOWER



Miniature mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quiet running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4½" × 4½" × 4". When mounted by flange, air is blown into the equipment but to suck air out, mount it from centre using clamp. Ideal for cooling electrical equipment or fitting into a cooker hood, film drying cabinet or for removing flux smoke when soldering etc., etc. A real bargain at £2·05.

GOOD COMPANION I.C. VERSION

We can now offer these again in I.C. version using Ferranti ZN414 and Mullard AF Module 1172. Cabinet size approx. 11in. wide × 8in. high × 3in. deep. Complete assembly instructions—Excellent tone wood cabinet £5·75 + 25p post & ins.

MIGHTY MIDGET

Probably the tiniest possible radio, as described in Practical Wireless, January '73. All electronic parts £2·20 post paid.

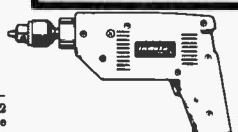
THIS MONTH'S SNIP

HORSTMAN 24 HOUR TIME SWITCH

With 6 position programmer. When fitted to hot water systems this could programme as follows:—

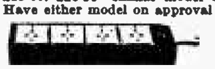
Programme	Hot Water	Central Heating
0	Off	Off
1	Twice daily	Off
2	All day	Off
3	Twice daily	Twice daily
4	All day	All day
5	Continuously	Continuously

Suitable of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped music and radio. In fact there is no limit to the versatility of this Programmer. Mains operated—Size 3" × 3" × 2" deep—Price £3·85 each. As illustrated but less case.



PORTABLE ELECTRIC DRILL

Very superior quality made by a famous Dutch Toolmaker. Model No. ASM 830. 300w – 2 speed 2200/3000. With ⅜" chuck and chuck key, also separate side handle and hammer facility for dealing with concrete, etc. An equivalent British made drill would cost £15·00. £10·90—similar model but without the hammer attachment £8·75. Have either model on approval for 7 days.

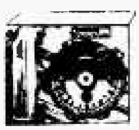


DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp. sockets in metal box to take standard 13 amp. fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, £2·50 plus 20p post and ins.

CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for an improved and even more efficient version (*Practical Wireless*, June). Price £6·55 plus 20p post. When ordering please state whether for positive or negative systems. De-luxe model including printed circuit board etc. £7·65.



24-HOUR TIME SWITCH

Made by Smiths, these are AC mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. Two completely adjustable time periods per 24 hours, 5A changeover contacts will switch circuit on or off during these periods. £2·75 post and ins. 25p. Additional time contacts 55p pair.

THYRISTOR LIGHT DIMMER

For any lamp up to 1kw. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price £2·95, plus 20p post and insurance. Industrial model 5A £3·30.

BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3½" × 6½" × 2" with leads and prods. Price £2·48 plus 20p postage.

SPIT MOTOR

200-250v Induction Motor, driving a carter gear box with 1½" of output drive shaft running at 5 revs per minute. Intended for roasting chickens, also suitable for driving models—windmills, coloured disc lighting effect, etc. etc. £2·04 plus 20p post and insurance.

DRILL CONTROLLER

NEW 1KW MODEL

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. £1·65. 13p post and p. Made up model also available. £2·75.

MAINS TRANSISTOR POWER PACK

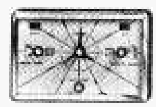
Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip only £1·10.

SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc.
24" × 18" £1·54
18" × 10" £1·10

PP3 BATTERY CHARGER

Almost 3 times the life can be obtained from PP3 battery if you re-charge it from the mains—this ready to use charger with instructions only 55p.



15A ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you awake switch on lights to ward off intruders — have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 15 amp. on/off switch. Switch on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £2·15 + 20p p. & p. or with glass front, chrome bezel, 83p extra.

BAKELITE INSTRUMENT CASE

Size approx. 6½" × 3¾" × 2" deep with brass inserts in four corners. This is a very strong case suitable to house instruments and special rigs, etc. Price 50p each. Fixolin lid 11p extra.

ROCKER SWITCH

13 amp self-fixing into an oblong hole. Size approximately 1" × ⅜" 9p each, 10 for 81p.

THERMAL CUTOUT

A miniature device ⅜" dia. on one screw fixing mount—can be used for motor overload protection —fire alarm—soldering iron—switch off, etc., etc. 15 amp contacts open with flame—radiant or conducted heat. 11p each or 10 for 99p.

HONEYWELL PUSH BUTTON MICRO SWITCHES

As used in some vending machines, etc. Each switch is a change-over type rated at 15 amps 250v A.C. Intended for panel mounting with fixing nuts and single black push knob. Single change-over switch 28p. Double switch 42p. Triple switch 61p.

KETTLE ELEMENTS

Made by the famous A.E.I. Co. Complete with washers and combined fixing ring and plug shroud. Normal 2 round pin and flat pin earth connection and overload reset push button. 2 Models—1¼" (approx.) suitable for Swan and other similar models—1⅜" (approx.) suitable for G.E.C., Hotpoint, etc. All quick boil 2¼Kw elements at 240v. Price £1·38 each.

MAINS TRANSFORMER BARGAIN

Standard mains 240v input Secondary 2·4v 9 amp intermittant 5 amp continuous. Price 55p.

BULGIN 4 PIN PLUG & SOCKET

Plug has shielded pin and flex entry and socket for panel mounting. 33p per pair.
Ditto—but 3 pin—22p per pair.

MACLAREN THERMOSTAT

Make and break 20 amp A.C. with the sensor probe coupled by 2 feet capillary covering range of 10—100oc—complete with large engraved control knob. Price 83p.

TERMS: 10% discount if ten of an item ordered, send postage where quoted—other items, post free if order for these items is £6·00 otherwise add 20p.

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Sinclair Project 60

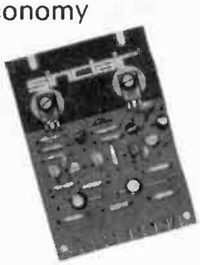
Now–the Z.50 Mk.2

with built-in automatic transient overload protection

When originally introduced, the Sinclair Z.50 proved how it was possible to design and produce a popularly priced modular power amplifier having characteristics to challenge the world's costliest amplifiers. Many thousands of Z.50's are now giving excellent service day in, day out. But we have also learned that constructors do not always use their Z.50's ideally. That is why we have introduced modifications whereby risk of damage through mis-use is greatly reduced and performance further enhanced. The Z.50 Mk.2 has improved thermal stability, more accurately regulated D.C. limiting to ensure more symetrical output voltage swing and clipping and still less distortion at lower power. Z.50 Mk.2 is compatible with all other Project 60 modules, and may be incorporated to advantage in existing systems. Eleven silicon epitaxial planar transistors are now used, two more than in the original Z.50; circuitry has been re-designed, making this versatile high performance amplifier better than ever.

with free manual
£5.48

Z.30 the power amplifier for quality and economy

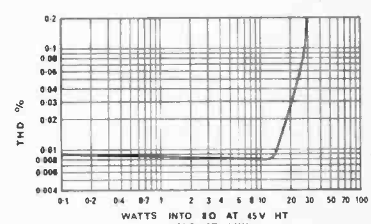


with free manual
£4.48

The Z.30 provides excellent facilities for the constructor requiring a high fidelity audio system of less power than that available from Z.50's. Using a power supply of 35 volts, Z.30 will deliver 15 watts RMS into 8 ohms, or 20 watts RMS into 3 ohms using 30 volts. Total harmonic distortion is a fantastically low 0.02% at 15 watts into 8 ohms with signal to noise ratio better than 70 dB unweighted. Input sensitivity 250mV into 100K ohms. Size 80 x 57 x 13 mm (3⅛ x 2¼ x ½) Z.30, Z.50 and Z.50 MK.2 modules are compatible and interchangeable.

Brilliant new technical specifications

Input impedance 100 KΩ
Input (for 30w into 8Ω) 400mV
Signal to noise ratio, referred to full o/p at 30v HT 80dB or better
Distortion 0.02% up to 20W at 8Ω. See curve
Frequency response 10Hz to more than 200 KHz ±1dB
Max. supply voltage 45v (4Ω to 8Ω speakers) (50v 15Ω speakers only)
Min. supply voltage 9v
Load impedance – minimum : 4Ω at 45v HT
Load impedance – maximum : safe on open circuit



Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control, etc.	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control, etc.	**£9.45**
12W. RMS continuous sine wave stereo amp. for average needs	**2 x Z.30s, Stereo 60; PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	**£23.90**
25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	**2 x Z.30s, Stereo 60; PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
80W. (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60W. RMS into 8 ohms)	**2 x Z.50s, Stereo 60; PZ.8, mains transformer**	As above	**£34.88**
Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**

F.M. Stereo Tuner **(£25)** & A.F.U. **(£5.98)** may be added as required.

Guarantee

If, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.

Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1.00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

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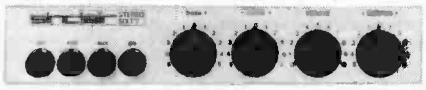
the world's most advanced high fidelity modules

Stereo 60 Pre-amp/control unit

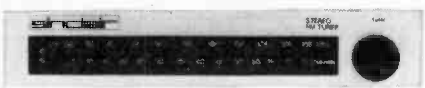


Designed specifically for use on Project 60 systems, the Stereo 60 is equally suitable for use with any high quality power amplifier. Since silicon epitaxial planar transistors are used throughout, a really high signal-to-noise ratio and excellent tracking between channels is achieved. Input selection is by means of press buttons, with accurate equalisation on all input channels. The Stereo 60 is particularly easy to mount.

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A. curve ±1dB :20 to 25,000 Hz. Ceramic p.u. – up to 3mV: Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE+12 to —12dB at 10KHz: BASS +12 to —12dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

Built, tested and guaranteed. **£9.98**

Project 60 Stereo F.M. Tuner



The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other advanced features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stero decoder and switchable squelch circuit for silent tuning between stations. In terms of high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108MHz. **Sensitivity:** 7µV for lock-in over full deviation. **Squelch level:** Typically 20µV. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10Hz – 15KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2µV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. maximum **Operating voltage:** 25–30VDC. **Indicators:** Stereo on; tuning. **Size:** 93 x 40 x 207mm.

Built and tested. Post free. **£25**

Super IC.12 Integrated circuit high fidelity amplifier

Having introduced Integrated Circuits to hi-fi constructors with the IC.10, the first time an IC had ever been made available for such purposes, we have followed it with an even more efficient version, the Super IC.12, a most exciting advance over our original unit. This needs very few external resistors and capacitors to make an astonishingly good high fidelity amplifier for use with pick-up, F.M. radio or small P.A. set up, etc. The free 40 page manual supplied, details many other applications which this remarkable IC. make possible. It is the equivalent of a 22 transistor circuit contained within a 16 lead DIL package, and the finned heat sink is sufficient for all requirements. The Super IC.12 is compatible with Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manual and printed circuit board.

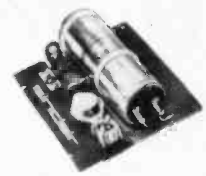
SPECIFICATIONS

Output power: 6 watts RMS continuous (12 watts peak). 6–8Ω. **Frequency Response:** 5Hz to 100KHz±1dB. **Total Harmonic Distortion:** Less than 1%. (Typical 0·1%) at all output powers and frequencies in the audio band (28V). **Load Impedance:** 3 to 15 ohms. **Input Impedance:** 250 Kohms nominal. **Power Gain:** 90dB (1,000,000,000 times) after feedback. **Supply Voltage:** 6 to 28V. **Quiescent current:** 8mA at 28V. **Size:** 22×45×28mm including pins and heat sink.

Manual available separately 15p post free.

With FREE printed circuit board and 40 page manual.
£2.98 Post free

Power Supply Units The new PZ.8 Mk.3



The most reliable power supply unit ever made available to constructors. Brilliant circuitry makes failure from over load and even direct shorting of the output impossible. This is due to an ingenious re-entrant current limiting principle which, as far as we know has never before been available in any comparable unit outside the most expensive laboratory equipment. Ripple and residual noise have been reduced to the point of almost total elimination. This is, of course, the perfect unit for Project 60 assemblies, particularly where the new Z.50 MK.2 amplifiers are used. Nominal working voltage – 45.

PZ.8 Mk.3—£7.98
(Mains transformer, if required) £5.98
PZ.5 30v. unstabilised
(not suitable for Project 60 tuner) £4.98
PZ.6 35v. stabilised
(not suitable for IC. 12) £7.98

Project 605

the easy way to buy and build Project 60 without soldering

Project 605 in one pack contains: one PZ.5, two Z.30's, one Stereo 60 and one Masterlink, which has input sockets and output components grouped on a single module and all necessary leads cut to length and fitted with clips to plug straight on to the modules thus eliminating all soldering.

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Order form

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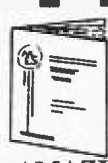

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ASY29	0.30
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BC118	0.20
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BC148	0.10
BC149	0.13
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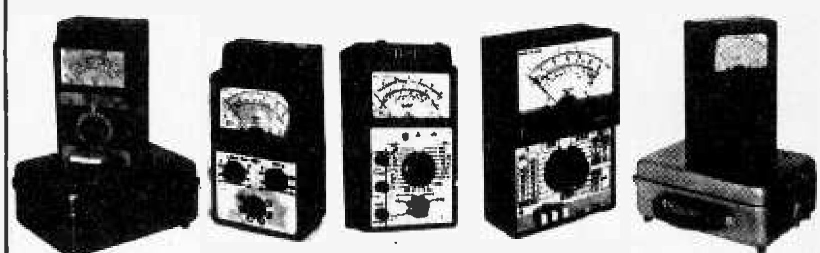
BC158	0.15
BC175	0.20
BC186	0.25
BCY30	0.25
BCY31	0.30
BCY33	0.25
BCY34	0.30
BCY72	0.15
BCZ10	0.30
BCZ11	0.40

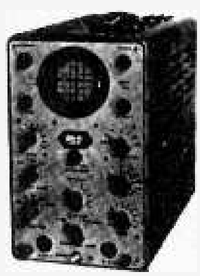
BD121	0.65
BD123	0.80
BD124	0.60
BD131	0.75
BD132	0.80
BF115	0.20
BF167	0.18
BF173	0.20
BF179	0.30
BF180	0.30
BF181	0.30
BF184	0.20
BF185	0.20
BF194	0.14
BF195	0.14
BF196	0.13
BF197	0.12
BF200	0.35
BFW87	0.25
BFW88	0.20
BFW89	0.20
BFW91	0.20
BFX88	0.20
BFY17	0.40
BFY19	0.25
BFY50	0.20
BFY51	0.20
BFY52	0.20
BSY26	0.17
BSY27	0.15
BSY28	0.17
BSY65	0.20
BSY95A	0.13
OC16	0.50
OC22	0.50
OC23	0.60
OC24	0.60
OC25	0.35
OC26	0.25
OC29	0.60
OC35	0.50
OC36	0.45
OC42	0.20
OC44	0.15
OC45	0.13
OC70	0.10
OC71	0.13
OC72	0.12
OC73	0.30
OC75	0.15
OC76	0.15
OC78	0.25
OC78D	0.20
OC81	0.20
OC81D	0.20
OC83	0.20
OC139	0.30
OC140	0.35
OC141	0.60
OC170	0.25
OC171	0.25
OC200	0.30
OC201	0.60
OC202	0.65
OC203	0.40
OC204	0.40



MULTIMETERS MADE IN USSR

Prices of these exceptionally well made instruments range from £4·95 to £10·50. Please write for illustrated catalogue.

SYNCHROSCOPE TYPE C1-5



Made in USSR

3-in tube fitted with telescopic viewing hood, giving bright display in full daylight. Sensitivity 10mV/mm (narrow band) to 30mV/mm (wide band).
Bandwidth 10 c/s—10 mc/s. Triggered sweep pre-set at 1·2·5·10·30·100·300·1000·3000 µsec per stroke. Free-running time base 20 c/s to 200kc/s with built-in crystal calibrator providing timing marks at ·05·.2·1·5·20·100 µ sec.
Amplitude calibrator directly calibrated in volts.
Input attenuator 1·10·100.
Power supplies 127/230v AC.
PRICE £39·00. Packing and carriage £1·50.

Series BZX61 1-watt ZENER Diodes
Available in: 7·5·8·2·11·15·16·24·27·30·33·36·62·68 volts. £0·20 each.

DIODES

OA5	0·25	OA81	0·07
OA6	0·12	OA85	0·07
OA7	0·15	OA86	0·15
OA10	0·20	OA90	0·07
OA47	0·08	OA91	0·07
OA70	0·07	OA95	0·07
OA79	0·07	OA200	0·07

MINIATURE SILICON HALF-WAVE WIRE-ENDED RECTIFIERS

IN4002	100 p.i.v.	1A	0·07
IN4004	400 p.i.v.	1A	0·08
IN4006	800 p.i.v.	1A	0·12
IN5399	1000 p.i.v.	1·5A	0·25
IN5408	1000 p.i.v.	3·0A	0·50
BY101	450 p.i.v.	1·1A	0·15
BY105	800 p.i.v.	1·1A	0·15
BY127	1250 p.i.v.	1A	0·12
DD000	50 p.i.v.	500mA	0·15
DD006	400 p.i.v.	500mA	0·25
DD058	800 p.i.v.	500mA	0·35

VALUE ADDED TAX

THE ABOVE PRICES DO NOT INCLUDE V.A.T. WHEN REMITTING CASH WITH ORDERS PLEASE ADD 10% OF THE VALUE OF GOODS INCLUDING POSTAGE AND HANDLING. AS SOME OF THE ITEMS STILL CONTAIN THE PROPORTION OF PURCHASE TAX, RESPECTIVE AMOUNT WILL BE REFUNDED.

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Constructional details Ref. No. 21 30p

P.W. Tricolour as per April/May June 1973. Parts list on request (52A).

★ SLIM DESIGN WITH SILVER TRIM

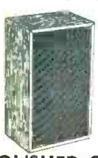
Overall chassis size 14½" × 6" × 2" high

SPECIAL KIT PRICE **£28·50** P & P 45p

COMPLETE WITH FREE TEAK CABINET

Designer approved kits distributed by Henrys!

LOW COST HI-FI SPEAKERS



E.M.I. Size 13½" × 8½". Large Ceramic Magnet.
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ASSEMBLED IN POLISHED CABINETS (8 ohms)
SERIES 6 (Assembled 150 T/C) per pair £16·50. Post 70p
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Uses Mullard Module. Slow motion tuning. Built in battery. Ferrite aerial. Overall size 7" × 2¾" × 3¼". TOTAL COST TO BUILD £4·85, Post 15p. All parts sold separately. Leaflet No. 6

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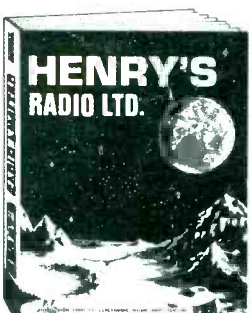
Printed circuit all transistor design using Mullard RF/IF Module. Medium and Long Wave bands plus Medium Wave Bandspread for extra selectivity. Also slow motion geared tuning, 600 mW push-pull output, fibre glass PVC covered cabinet, car aerial. Attractive appearance and performance.
TOTAL COST TO BUILD £7·98 p.p. 32p. (Battery 22p).

CATALOGUE



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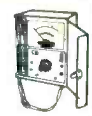
TEST EQUIPMENT Just a selection!



SE250B Pocket Pencil Signal Injector £1·90
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TE15 Grid Dip Meter 440 KHz–280 mHz £13·45
500 30 K/V Multimeter £9·25 With leather case £10·50
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TE20D RF Generator 120KHz–500MHz £16·50. Carr. 35p
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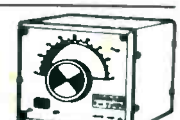
- CREDIT TERMS FOR CALLERS

BUILD THIS VHF FM TUNER



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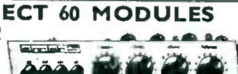

Z30 £3·57; Z50 £4·37
STEREO 60 £7·97; PZ5 £3·97
PZ6 £6·37; PZ8 £4·77
Transformer for PZ8 £2·95
Active Filter Unit £4·45
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IC12 £1·80; Q16's £15 pr.
Post etc. 20p per item

PACKAGE DEALS Post 25p
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See earlier page of this magazine for transistors, I.C.'s and Semi Conductor prices—latest list Ref. no. 36 on request.
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